Issues in Biological Sciences and Pharmaceutical Research Vol.9(2),pp.54-77, March 2021
Available online at https://www.journalissues.org/IBSPR/
https://doi.org/10.15739/ibspr.21.007

ISSN 2350-1588

Original Research Article

Effect of the pharmacy staff shortage on the medication safety

Received 19 May, 2019 | Revised 17 August, 2019 | Accepted 23 October, 2019 | Published 14 March, 2021

Aymen Khalid Al-Suwailem

Prince Sultan Cardiac Center

Author's Email: aymen_4120@hotmail.com

Tel.:+966505209837

This study intend to evaluate the relationship between sufficient well trained healthcare staff and the medication safety. Medication mishaps are the most common errors in healthcare, and as a result medication safety has become a top priority for healthcare organizations. The focus on medication safety underscores ongoing goals for risk managers; to reduce the frequency and severity of errors related to medication use and to help facilities medication error prevention strategies. Medication errors can involve many individuals, processes, and systems, risk managers need to help their facilities adopt a multidisciplinary and systems approach to medication safety. Common causes of medication errors include noncompliance with policies and procedures, competency and credentialing issues, and inadequate staff and/or inadequate orientation and training, education programs should be provided to heighten practitioner's awareness of medication policies and procedures and to educate them about medication safety procedures. These educational and training programs should be able to provide knowledge to pharmacy staff: Guidance on preparing medication safety, education programs to the heads of units and hence they could distribute the information to the remaining employees, a medication safety teaching plan, reproducible visuals to customize for use during training and as handouts, pre-training and post-training quizzes to identify areas in need of review or additional emphasis. Therefore we should have adequate staff initially then those staff should keep ongoing training and they should get several tips such as building a strong trusting relationships as these are fundamental to how well care is delivered, take time to communicate, update records, and share information, ensure regular and formal reviews of care plans and medication, prioritize safety by protecting the drugs round, improving systems and attention to detail, identify, capture and develop good practice and help disseminate this to all staff. Finally, from the analysis of the given data in this study medication errors increased significantly in the year 2017 where there is a shortage of pharmacists (16 to 20) with 21 and more medication errors, while few medication errors recorded in the year 2018 where there is no shortage of pharmacists (0 to 5) with (6 to 10) medication errors ($p < 0.01$).

Key word: Pharmaceutical medication safety, medication error, adverse drug reaction, patient safety

INTRODCUTION

Medication safety continues to be a priority for healthcare practitioners and the general public. Healthcare professionals and administrators are faced with the daily challenges of improving the medication use process to ensure patient safety and improving the tools currently used for this purpose (Philip, 2002).

Observation is one of the most important methods for data collection; with the others being self-reports (e.g. interviews, questionnaires, and physical evidence).

All these methods for data collection and evaluating of the medication safety in a medical organization should be performed by the pharmacy staff with the indirect help of other medical staff (Kenneth et al., 2002). Therefore any shortage in the pharmacy staff can result in several medical errors which could be arise from prescribing, manufacturing, dispensing, administering the treatment and monitoring the therapy.

In order to prove the importance of good pharmacy staff in both quantity and quality to minimize the medication errors, we have to enumerate the strategies to prevent medication errors (David and Lonser, 2003).

Report all medication error data to establish safe care practices, involve a multidisciplinary approach in considering medication errors, access for adequate levels and numbers of staff (since deficit was the most noteworthy cause of error) provide training and retraining in the agency's medication procedures, because medication administration is a skill with life-threatening consequences therefore all the medical staff not only pharmacy should respect and follow the five rights to medication; right dose; right client; right route; and time, continuously re-evaluate medication policies and procedures to ensure optimum efficiency and safety.

Furthermore, increase awareness of staff concerning medication errors, safe practice is primarily based on careful administration behavior.

Persons administering medication are human and make mistakes, but care decrease mistakes and may save a life.

The most common error-omission and improper dosage-are errors that can be avoided by carefulness which is only obtained by having enough and well-trained medical staff.

In addition, stress is considered as one of the most common cause of medication errors. At one institution the negative effect of the stress is managed by a program consisting of 12 two-hour sessions. Pre and Post test anxiety and medication error rates were collected. Results indicated that staff in the experimental group receiving the stress management techniques had 62.5% less error in the control group (David and Lonser, 2003). This data suggest that attention to the medication errors can decrease errors, but attention to the stress level of staff is also a significant deterrent.

In addressing medication safety, it is important to understand the relationship among medication errors, potential adverse drug events (ADEs), and preventable (ADEs). Medication errors are very common, with most having relatively little potential for harm.

However, a small proportion have that potential. Healthcare practitioners are most interested in preventable ADEs (although most ADEs are not preventable) Bates et al(1995) reported that, for 10070 drug orders administered, there were 530 medication errors (1.4 errors per admission), 35 potential ADEs, and 5 preventable ADEs. One in 100 medication errors caused an ADE, and 7 in 100 had the potential to do so. Extrapolating these numbers to a 700-bed hospital yields a conservative estimate of approximately 300,000 medication errors. 1900 ADEs (530 preventable ADEs plus 1370 non-preventable ADEs), and 1600 potential ADEs per year reference.

Although the number of medication errors is unacceptable high, many administrators are not aware of the problem; therefore safety needs to be viewed as a top priority by the health care community, particularly its leadership.

Consequently, self-reporting are needed because most organizations rely on self-reports as the primary mechanism for identifying medication safety issues, even though such reports identify only a small proportion of ADEs. It is typical for organizations to report only 1every 20 ADEs. One study found that one third of organizations report no errors at all. Failure to report errors in this study was more frequent in hospitals that might be expected to have higher rates (e.g., those serving indigent population) (David, 2002).

In Saudi Arabia, two recent studies estimated that the prevalence of prescribing errors in hospital inpatient ranges between 13 and 56 per 100 medication order (Al-Dhawailie, 2011; Al-Jaraisy, 2011). These data suggest that medication safety is an important international contributor to morbidity and costs of healthcare.

Different strategies are helpful to minimize the medication errors occurrence, for example the use of computerized physician order entry reduce the serious medication error rate by 55% (Bates et al., 1998) and the use of bar-code technology minimized the rate of dispensing error by 31% (Poon et al., 2006). One study suggested that having a medication safety officer in the hospital may be associated with a lower rate of ascertaining a patient's medication history at admission by a pharmacist decreases medication errors (Vira et al., 2006).

Though research has shown the value of these interventions in reducing medication error rates, the extent to which they are implemented in hospitals around the world is poorly understood. In 2005, the World Health Organization (WHO) launched the World Alliance for patient safety. In 2007, the Alliance recommended patient safety solutions to help prevent medication errors and adverse events. Adherence to the recommendations of the WHO regarding medication safety practices by hospitals is unknown.

Research Problem

What is the relationship between shortage of pharmacy staff as independent variable and medication safety as dependent variable? David bizar and Lonser (David and Lonser, 2003) prove that inadequate levels and numbers of staff could result in several incidence of medication errors. Not only shortage of staff, but also lack of well training of staff and uncontrollable stress faced the pharmacy and medical staff could produce the same result. Therefore this research will try to answer the following questions: What is

the major reason for these medication errors?, What can the pharmacy department do to minimize these medication errors?, by which way can the medication safety department educate both staff and patients? Do the promotion strategies attract the involved staff and increase their job satisfaction?, and What is the role of recent technologies to avoid or at least minimize such condition?.

The Research Importance

Medication safety is a crucial topic, however limited studies available to explain its relationship with the staff shortage and staff training. The importance of this study is to show the impact of staff shortage in the incidence of medication errors. Good quantity and quality of medical staff is very important issue that helps the hospital administration to properly improve patient safety and satisfaction.

Aim and Objectives of the Research

This research deals with the medication safety and its improvement through increasing both quantity and quality of medical staff involved to a required level. To achieve this aim, the following objectives have been identified, which guided the investigation of the research problem.

Objectives of the research

1- Provide guidance for improving medication safety in all the processes of the medication use system, both in hospital and ambulatory care settings, based on reporting, analyzing and active learning from the medication errors and on evidence-based strategies.
2- Study the relationship between both quality and quantity of the organization's employees and the medication safety.
3- Foster the development of a safe medication practices agenda.
4- Improve the staff job satisfaction to increase their retention.

Independent Variables: Measured by Employee shortage

1- Employee shortage (Spetz and Adams, 2006): Shortfall in the numbers of workers with the skill needed to fill the jobs currently available which may cause by lacks of educational and vocational training or does not met the met the ambition of workers.
2- Employee Satisfaction (Iilies et al., 2009): Is the terminology used to describe whether employees are happy, contented, and fulfilling their desires and needs at works.

Dependent Variables: Measured by Medication Safety

1- Medication Safety (Benjamin, 2003): Freedom from preventable harm with medication use.
2- Healthcare (Cramer et al., 2008): Is the diagnosis, treatment and prevention of disease, illness, injury and other physical and mental impairment in humans.
3- Patient safety (Hellier et al., 2006): Is a new healthcare discipline that emphasizes the reporting, analysis and prevention of medical errors that often lead to adverse healthcare events.
4- Incident Reports (Rissato et al., 2008): Is a form that is filled out in a healthcare facility, such as a hospital or nursing home in order to record details of an unusual event that occurs at the facility.
5- Medication Error (Valverde et al., 2003): Any incorrect or wrongful administration of a medication such as a mistake in dosage or route of administration, failure to prescribe or administer the correct drug or formulation for a particular disease or condition, use of outdated drug, failure to observe the correct time for administration of the drug, or lack of awareness of adverse effects of certain drug combination.

RESEARCH METHODOLOGY

This research aimed to investigate employee shortage and its impact on medication safety. The data collection method is based on analyzing the incident reports collected pre and post employees' shortage. This type of data collection method is considered as secondary method since it does not done by the researcher himself; however this type of data collection is not easily operated and performed since it required good analysis, evaluation and reasonable comparable parameters. The general hypothesis for this research is to estimate the possible positive relationship between employees' shortage and medication errors. The research population consisted of all the incidence reports reported in the year 2017 of noted pharmacy staff shortage in comparing to the next year which lacks any shortage of employees. These incidence reports have been reported from different words throughout the center, therefore, they should be versatile and lacks of any bias or reaping.

Theoretical framework

A medication safety incident is defined by the National Patient Safety Agency (NPSA) as:

"Any unintended or unexpected incident which could have or did lead to harm for one or more patients" (NPSA, 2007).

These incidents can occur at each stage of the process involved in the delivery of medicines to patients, i.e. prescribing, dispensing, preparation, administering and monitoring (NPSA, 2007).

Medication incidents have been reported as accounting for 10%-20% of all adverse effects (AE) as event that causes an unintended injury to a patient that either prolongs hospitalization or produces disability (Karson and Bates, 1999).

The impact of medication safety incidents on patient

outcomes includes increased length of stay, disability and mortality. Across the U.K., about two and a half million medicines are prescribed across hospitals and the community everyday (DoH, 2004) and an indicator for quality, adopted to demonstrate medication safety, is the incidence of medication errors. The government has committed to reducing the incidents of medication errors in prescribed drugs by 40%.

Training for non-medical prescribes involves 27 days in the classroom (although some programs have a distance learning element) and 12 days in practice with a Designated Medical Practitioner (DMP) responsible for the education and assessment for the prescribing student. A range of techniques are used to assess students prescribing knowledge (which includes assessment of numeracy and drug calculation skills), this expansion in the medicines prescribing may cause a serious and untolerated medication errors, therefore any health organization should has enough and well educated and trained staff dealing with drugs.

The NPSA have identified seven key actions to improve medication safety. These actions include:

- Increased reporting and learning from medication incidents.
- Implementation of safe medication practice recommendations.
- Improve staff skills and competence.
- Minimization of dosing errors.
- Insure that medicines are not omitted.
- Insurance that correct medicines are given to the correct patient.
- Documentation of patient's allergy status.

These actions apply to all healthcare professionals involved in delivering medicines to patients, including those on undergraduate programs. Additionally, given the recent legislative changes expanding prescribing powers to include other groups of healthcare professionals (in addition to doctors).

Safety in prescribing

The rationale for improving prescribing safety are namely the high rate of deaths, unnecessary hospital admissions and illness caused by unsafe prescribing; and what practical steps prescribes should take to reduce the risk of issuing an unsafe prescription. The tragedy in Northwick Park in 2006 when healthy volunteers suffered catastrophic consequences, albeit in the first test of a new drug, highlighted how pharmaceuticals need to be treated with caution and respect. However, it is not just new drugs which can be unsafe; drugs which have become established after many years of clinical use can also cause problems (Lasser et al., 2002). For example, after several years of use, a widely used non-steroidal anti-inflammatory drugs was found to be associated with an increased risk of myocardial infarction (Solomon et al., 2004).

Therefore, prescribing should be limited to clinical professionals. Clinical professionals have a duty to keep themselves updated as part of their requirements for registration by their professional body. The pace of change in pharmaceuticals and their guidelines for safe use are so great that it is essential to ensure appropriate support mechanisms are in place. For example, β-blockers once thought to be contraindicated in heart failure are now part of guidelines for best practice; anti-depressants once thought safe in adolescence are now known to be associated with an increased suicidal risk. Individuals and organizations need to implement appropriate knowledge management strategies (delusignan, 2002).

Safety in dispensing

When someone is prescribed a medicine, he expects the doctor to have made the right choice, and to receive what the doctor has ordered. Ensuring that these expectations are fulfilled is a fundamental part of the pharmacist job, but most people waiting for routines that are designed to keep them safe. Instead, they may watch staff at work and wonder why dispensing a few tablets can take as long.

Pharmacists have a professional responsibility to ensure the well-being and safety of their patients and the public. As part of this, they should assess every prescription presented for dispensing to determine its suitability for the patient, and should also make sure that the patient is given the information and advice needed to enable the safe and effective use of that medicine that has been ordered which consequently required enough and well-trained staff.

The basic prescription management process

When a prescription is presented for dispensing, pharmacist and their staff will have a set routine-or standard operating procedures-to follow. This should be set out in writing so that all staff, including locums, knows what is normal practice.

Worldwide therefore been many studies describing the hospital and community pharmacies role in checking for prescribing errors and adverse drug events.

Errors and harm

Hawkey et al. (1990) questioned whether the hospital ward pharmacy services were cost-effective; pointing out that the effectiveness of the prescription screening process could not be assessed without information on how many errors the pharmacists missed. This is almost impossible to measure in a natural setting, although reports of actual, or potential, harm caused by errors that were not detected during routine screening can provide a proxy measure.

Many papers present the serious errors that pharmacists detect. In Hawkey's study, 4% of all prescribing interventions concerned dose-related errors which the authors judged could have led to significant harm.

The vast majority of reports involving community pharmacy relate to dispensing, although harm resulting from failure to check drugs and doses has also occurred.

Official reports do not consider the failure of prescription screening as a contributing factor to prescribing errors (NPSA, 2007). In the hospital setting, pharmacy chart review is only mentioned in relation to omitted medicines, resulting from delays in the supply to wards.

However, wrong dose, strength or frequency errors from over a third (38%) of the 92 cases of serious harm or death reported to the National Reporting and Learning Scheme between January 2005 and June 2006. Misunderstandings resulting from unclear, ambiguous or illegible medication errors caused by staff shortage and/or involving new staff without well-training programs are cited as common contributing factors. This suggests that, in these cases, the pharmacist's clinical check was either not done, or the errors were missed.

The incident most likely to cause harm was a patient receiving a drug to which he was allergic. Checking allergy documentation is part of the hospital pharmacist's role, but they may expect the prescriber to make the actual record.

Roberts et al. 2002 analyzed 4380 dispensing error reports with outcome data from 89 hospital pharmacies between 1991 and 2001. Seven percent of incidents were judged to have had a serious detrimental effect and there was one fatality. However, in the majority of medication errors that reach the patient, harm happens at the administration stage (NPSA, 2007), of the 92 incidents resulting in sever harm or death reported between January 2005 and June 2006, only four could be attributed directly to the preparation of the medicines.

Perceived causes of errors

The main perceived causes of dispensing errors as reported in hospital (Spencer and Smith, 1993) are similar names, similar packs, stock in wrong place on shelf, scrolling down drug list, misreading prescription, hard to read handwriting, product or dose knowledge, short of staff and/or new staff, Busyness, interruptions, and tried/unwell/lack of focus.

Picking errors linked to "look-alike-sound-alike" product names and similar packs have been mentioned by most authors whose wrote about dispensing errors. In the hospital survey by Roberts et al. 2002 the ten drugs most commonly involved in dispensing errors accounted for 27% of serious or fatal outcomes. Most were because the wrong strength of the right drug had been picked.

It is widely held that checking by a second person is better than re-checking your own work, although experimental evidence to support this is limited. (Bower, 1990) analyzed reports of near misses and dispensing errors made over a 6-month period in five hospitals using different final check routines. He suggested that dispensing errors were more likely with self-checking. In (Spencer and Smith, 1993) study, 19 hospital pharmacies recorded data over 6-months; dispensing error rates were significantly higher in hospitals where the technicians were checked, but pharmacists were not.

Adverse drug reactions

The World Health Organization defines adverse drug reactions (ADRs) as a response to a drug which is noxious and unintended and which occurs at doses normally used in man for prophylaxis, diagnosis or therapy of diseases, or for modification of physiological function (WHO, 2002).

Not all side effects of medicines are detrimental. For example, a dry mouth is a side effect of anticholinergic medicines, if anticholinergic medicines such as Orphenadrine is prescribed for Parkinson's disease, drying of the mouth will help with the excess salivation that occurs in Parkinson's disease. Metformin can cause anorexia and nausea and lead to less food consumption, which can be helpful when prescribed for an overweight type 2 diabetic.

Side effects may be so significant that they can be used as an alternative indication. For example, codeine can be used as a pain-killer, but can give the patient constipation as an unwanted side effect, so codeine is also used to treat diarrhea. Similarly, the antibiotic erythromycin increase gastric motility and can cause diarrhea, so is sometimes used to stimulate gastrointestinal motility in the critical ill (unlicensed use).

Type A or Type B (ADRs):

In 1977 Rawlins and Thompson classified ADRs into two groups, i.e. those that are predictable from their pharmacology (Type A), and those that are unexpected and cannot be anticipated (Type B). Type A are "augmented" effects and Type B are "bizarre" effects.

Type A ADRs are the most common and are usually less serious. They can usually be anticipated from the medicine's pharmacology and it is often helpful to warn patients about their possible occurrence so that they will not worry about new sensations. Type A ADRs can often be managed by reducing the dose, altering the method of administration or by prescribing another medicine. They are normally well documented before a drug is licensed.

Type B ADRs are normally rare, and completely unexpected, but can be potentially serious or even fatal. It is unlikely that these ADRs will have been documented before the medicine is marketed. Should a type B ADRs occur, the medicine has to be stopped at this sort of ADR is not usually dose dependent. The following are examples of type A ADRs; hypoglycemia with sulfonylurea, diarrhea with Senna. While anaphylaxis on administration of penicillin, a plastic anemia with Chloroamphenical and agranulocytosis with Clozapine are examples of Type B ADRs.

It is easy to think of "typical" Type A or Type B ADRs, but some ADRs do not fall into "typical" categories as following:

- Type C (Chronic) ADRs example osteoporosis after long-term steroid use.
- Type D (delayed) examples drugs excreted in breast milk and carcinogens.
- Type E (end of use) i.e. withdrawal symptoms such as narcotic and scheduled drugs.

- Type F (treatment failure), e.g. developing malaria while taking malaria prophylaxis.

Which drugs are most often involved?

Research has been carried out to find out which medicines are likely to cause ADRs that result in hospital admission. One systematic review (Howard et al., 2007) identified that 51% of drug-related admission were caused by antiplatelet agents.

Drug interactions

Drug interactions occur when two or more drugs interact in such a way that the effectiveness or toxicity of one or more of the drugs is altered. Dietary supplements, herbal medications, alcohol, cigarettes and food are agents that can cause interaction.
Broadly speaking drug interaction fall within two groups: pharmacodynamics and pharmacokinetic.

Pharmacodynamics

This interaction occurs when a medicine modifies the effect of another medicine but without altering the blood level of that medicine (effect of the drug on the body). Examples include: Co-administration of beta-blocker (e.g. Propranolol or Atenolol) with a beta-agonist (e.g. Salbutamol either oral or inhaled). The beta blocker blocks the beta receptors in the lower respiratory tract potentially giving rise to bronchospasm and limiting the effectiveness of the beta agonists, drawness caused by alcohol exacerbates the drawness caused by sedating medicines (fatal respiratory failure).

Pharmacokinetic

These interactions involve one drug altering another drug's blood level, during absorption, distribution, metabolism or excretion (effect of body on drug).

Therefore, certain medicines require particular case where there are potential drug interaction such as drugs with a narrow therapeutic margins e.g. Warfarin, Digoxin, antiepileptic, Theophylline, cyclosporine and drugs that require careful dosage control e.g. antihypertensive and anti-diabetic drugs.

Controlled drugs and patient safety:

Opioid analgesics are frequently involved in a serious medication errors. Morphine is one of the most frequently involved drugs in medication errors through all over the world. Through (NPSA), opioids were highlighted as being most commonly implicated in medication incidents resulting in severe harm or patient death (NPSA, 2007). Opioids are widely used, in both primary and secondary care, for the management of moderate to severe pain. They are formulated to be administered by a wide range of different routes including by mouth or rectum, by the transdermal and parenteral routes. In addition, a wide range of opioid products are available and these have different potencies and release characteristics. This is worsened by the fact that opioids have a relatively narrow therapeutic margin with a fine line between providing adequate analgesia and producing side effects and toxicity. In overdose respiratory depression and hypotension may lead to patient death.

Reporting medication errors

In order to summarize the processes of reporting the medication errors we have firstly to recognize the medication processes in which the medication errors are happened commonly. The medication process is the term used to describe the process of delivering medications to patients. It consists of five stages.

Stage 1: Prescribing errors

Prescribing medicines is now no longer the sole responsibility of medical staff. A number of pharmacists, nurses being authorized to independently prescribe all the medications within their scope of clinical practice.

A prescribing error may be defined as the incorrect drug selection for a patient or errors involving wrong drug, dose, quantity, and indication for use or a contraindication (Williams, 2007). Prescribing errors also include illegible handwriting, misspelling of a drug within a similar name and use of abbreviations.

Stage 2: Dispensing errors

Dispensing is carried out in a variety of settings from hospital pharmacies, community pharmacies and some rural general practices. One common dispensing error is selection of the wrong product, usually where there are two drugs with similar proprietary names (e.g. Losec® and Lasix®), which may look similar when hand written. Other dispensing errors include wrong dose, wrong drug and wrong patients.

Stages 3 and 4: Administration and Preparation errors

There are very little documented data around preparation and administration errors. Drug administration and preparation has been considered as an area of "high risk" within nursing practice and the well-known six rights of the medication use process should be familiar to all: Right patient, Right drug, Right dose, Right route, Right time, and Right outcome.
Many drug administration errors of omission but also include failure to check patient identity, incorrect administration technique and administration of a wrong or

expired drug (Williams, 2007).

Stage 5: Errors in monitoring outcome

With an increasing elderly population, there is a subsequent rise in patients living with long-term, often complex chronic diseases. This gives rise to issues of medicines management and the need for careful monitoring of outcomes. Some patients take certain drugs, which require continuous monitoring to ensure they are taking the optimum dose for their condition at the time. Literature suggests that recommended ongoing monitoring of patients taking certain drugs is not being undertaken by healthcare professionals. The NASP (2007) cite one study where less than one-third of patients taking diuretics were having the electrolyte levels in their blood monitoring. This statement may be borne out by evidence stating diuretics as one of the medicines most commonly responsible for medicine-related admission to hospital (pirmohamed et al., 2004; Howard et al., 2007).

The nursing and midwifery council (NMC) has produced standards for medicines management (2007), which sets standards for safe practice for supplying administering and dispensing medicines to patients.

Reporting patient safety incidents

What to report

Patient safety incidents to be reported are defined by the NPSA as "any unintended or unexpected incident which could have or did lead to harm for one or more patients". The reports are anonymous; although it may be that the trust or Health Board may be identified. Names of patients and staff are removed prior to the information being stored in the database.

Reporting adverse drug reactions (ADRs)

A study by Pirmohamed (2004) determined that ADRs were related to 6.5% of adult hospital admission and that in 80% of those, the ADR was the direct cause of admission. The study was also found that ADRs accounted for 4% of all hospital admission.

Further findings showed that the mortality rate of patients admitted with ADRs was over 2%.

Reporting of ADRs began in 1964 following the thalidomide tragedy (fetus malformation). In 1958, Distaval was advertised as being an "outstandingly safe" medication which was "relatively free from side-effects". It was commonly given to women during the first three months of pregnancy to Combat nausea and sleeplessness. Following a huge rise in the number of babies being born which deformities ensuring-safety through evidence-based medicine.

To offer our patients high quality and safe care, we must be prepared to base our decisions on the best available evidences, continually evaluate our own practice and seek to improve it, learn from unexpected incidents and errors (whether these are our own or others'), and share uncertainty with our patients.

What is evidence?

In its broadest sense evidence is information that is used to support the truth of a recommendations or conclusions. Evidence is found in a wide variety of sources such as published research, expert opinion, patient experience and audit data.

What is evidence-based medicine?

Evidence-based medicine has been defined as the integration of best research evidence with clinical expertise and patient's value and circumstances (Straus et al., 2005).

Supporting evidence-based practice in the future

Despite the ever-increasing volume of evidence on which we can base the clinical decisions and the development of clinical guidelines that interpret and apply that evidence, the healthcare provided by clinicians too often falls short of optimum. One solution to address the problem of implementing evidence-based medicines in the development of information systems that provide patient-specific assessment and/or recommendations to improve decision making-computerized decision support systems. Such systems have been developed to support the making of a diagnosis, to alert the healthcare ordering and to provide evidence-based suggestions for patient management.

Despite the growing evidence to support the use of computerized decision support systems to improve the safety and quality of medication administrations, uptakes has been slow. With the widespread introduction of electronic health records and the improved performance and evaluations of such system, the introduction of these systems in the not-too-distance future.

As the result of all that complications in medication and their possible errors, none doubt about the importance of having a medication safety department and a medication safety officer.

The medication safety officer "MSO" is a clinical practitioner designated by an organization to serve as the authoritative expert in safe medication use. The MSO most commonly reports to one of four areas pharmacy, medication safety department, continuous quality improvement or senior administrator. Potential benefits of reporting within the pharmacy department include:

- Elevated attention to medication safety through MSO involvement in department leadership, operations, clinical services and business decisions.
- Enhanced understanding of pharmacy operations by MSO and ability to design safety systems and resolve identified risks.
- Close working relationships with pharmacy staff.

- Increase access by pharmacy department to MSO expertise.

Medication-Use Technology and Safety

The use of technology has had an incalculable impact on the evolution of human work. Considered among the greatest engineering achievements of the internet, imaging, and health technologies enhance our daily lives and the delivery of healthcare. The use of technology is a major tool in strategies to improve efficiency, patient care, processes, and safety. Technology interventions can result in significant medication safety improvements such as better adherence to clinical practice guidelines, reduction of medication turnaround time, and decreased medication errors (Klein, 2012).

There are several examples of technologies which used to improve the medication safety and avoid or minimize the medication errors. Only Bar Code Medication Administration and automated dispensing Cabinets have been selected to be discussed briefly due to their importance.

Bar Code Medication Administration

Bar code medication administration (BCMA) is a technological intervention recommended and widely accepted as a means to reduce medication errors. It is estimated that 35% of medication errors occur in the administration phase where there are few to no double-checks in the process before reaching the patient. Studies suggest that BCMA systems can reduce administration medication errors by up to 50% (Johnson et al., 2002). BCMA is often the last line of defense against administration errors, and if implemented carefully, can improve medication safety.

According to American Society of Health System Pharmacists (ASHP) at 2001, 50.2% of U.S hospitals use BCMA, a significant increase from 34.5% reported in the previous year. A multidisciplinary team including front line clinicians especially pharmacy, nursing, and respiratory therapy should be involved in the planning for BCMA implementation. The MSO is the key member of any BCMA team.

Automated Dispensing Cabinets

Automated dispensing Cabinets (ADCs) are "Computerized drug storage devices or Cabinets that allow medication to be stored and dispensed near the point of care, while controlling and tracking drug distribution". ADCs have evolved into the primary method of drug delivery in many hospitals. There use has positively impacted drug distribution by improving accessibility, security, and billing processes. ADC software capabilities range from simple to complex. More complex systems often integration with automated refilling systems as well as bar coding for restocking and administration. Most systems offer some type of alerts and/or basic decision support as well. It is interfaced with the pharmacy computer system and require pharmacist verification of the patient's medication orders prior to withdrawal from ADCs, provide optimal medication safety.

Medication errors can result from ADCs being restocked incorrectly due to look-alike/sound-alike medications next to each other. Such errors could be avoided by using the hyphenated technique, in which the BCMA and ADCs are connected together.

As a conclusion, there are several factors should be considered to minimize the medication errors, the most effective one is to have an enough and well-trained medical staff in both medical knowledge and technological experiences.

Literature reviews

Kathleen and Gregory conduct a study with title "implementation of patient safety initiatives in U.S hospitals" (Kathleen and Gregory, 2006). The purpose of this study is to explore the use of patient safety initiatives (PSIs) at the US hospitals. These PSIs include such approaches as open discussion of errors, education and training, and system redesign. The paper draws on the continuous quality improvement CQI and medication safety literatures to develop a conceptual framework for improving medication safety. Extensive survey data were gathered from 252 hospitals throughout the US to test the factors influencing successful medication safety.

Certain barriers (lack of top management support, lack of knowledge and lack of resources, lack of incentives and lack of knowledge and training) significantly impeded the improvement of medication safety which in turn cause an increase in the medication errors, therapy cost and loose of patient satisfaction.

Traditionally, when an error or adverse event occurred in a hospital setting, the most common reaction was to blame a person. In fact, one of the most commonly cited causes of medical errors and adverse events is human errors. Compelling evidence now suggests that the majority of errors and adverse events more accurately contribute to the cause. By tracing the chain of events that caused the error or adverse events and making system changes, hospital can prevent the same error from recurring.

A system design error generally refers to an error that occurs because of deficiency in the design of the system. In fact, there is an implicit relationship between system and human error. An organizational factor resulting from the design of the system may increase the likelihood that a person will make an error. Such organizational factors may also prevent a human error from being corrected before harm has been done to a patient. For example, reducing the nurse staffing levels (an organizational factor possibly resulting from pressures to reduce costs) has been shown to be associated with a higher level of medication errors.

The importance of enough and well training medical staff can be understood from the following tragedy which occurs

in one of the US hospitals which indicate the influence of the organizational factors. At that hospital staff indicted that work load and working short-staffed were primary stressors. In Unit B, the licensed practical nurses responsible for medication administration had a heavy work because staff went to help a short-staffed unit C. Work load lead to interruptions and destructions while completing the medication pass. Staff on units A and C mentioned it was difficult to try and remember everything that had to be done at once. On unit B, staff were frustrated by balancing their responsibilities as a team, which requires monitoring staff, while trying to focus on medication administration. Staff on units B and C reported being stressed and poor teamwork particularly because team members either do not know their jobs or are not familiar with a unit.

The explanation of that tragedy is related to insufficient staff (n = 50, 94.3%); overwork, stress or fatigue (n = 46, 86.8%); poor training (n = 41, 80.4%); and health professionals not working together or not communicating as a team (n = 40, 76.9%). Poor supervision was seen as an important issue leading to medication errors by slightly less than half the respondents (n = 22, 46.8%), while lacking computerized medical records was viewed as a somewhat important issue leading to errors (n = 24, 45.3%). Both increasing the number of medical staff and supporting them by a good training as well as providing them with an automated medication dispensation were indicated as an effective solution by most respondents.

Similarly, the traditional work scheduled of physicians and pharmacists requiring long hours on duty may contribute to medication errors. In additional to organizational factors, other causes of errors can be equipment failure, infrastructure breakdown, or system malfunction. Other factors that cause errors related to an internal demand. Internal demand relates to such things as unplanned shortage of capacity, errors in scheduling, fatigued staff, and unexpected demand for personnel in one specific area of the hospital. For example, sometimes nurses are taken from one unit to share up a short-staffed unit in another part of the hospital while it is possible for an error to be the result of willful misconduct by an employee, such as a prank gone awry, carelessness of duty, substance abuse, or sabotage, these incidents are extremely rare. The ultimate problem of errors in healthcare is not about bad or incompetent employees. Rather, it is about good caring individuals that make honest mistakes as they work in a very complex environment. Although human errors are inevitable, the work environment can be redesigned to prevent or detect medication errors and improve patient safety.

Another study has been done by Atiya and Habib with title “Long-term care physical environments-effect on medication errors” (Atiya and Habib, 2012). Only few studies examine physical environmental factors and their effects on staff health, effectiveness, work errors and job satisfaction. To address this gap, this study aims to examine environmental features and their role in medication and nursing errors in long-term care facilities.

A mixed methodological strategies were used. Data were collected via focus groups, observing medication preparation and administration, and nursing staff survey. The paper reveals that, during the medication preparation phase, physical design, medication room layout, is a major source of potential errors. During medication administration, social environment is more likely to contribute to errors, interruptions, noise, and staff shortage were particular problems.

Both Danielle and Sean conduct a study titled “The effect of work hours on adverse events and errors in healthcare”. In this study the authors tend to explain the negative effects of fatigue suffered by healthcare employees as the result of staff shortage. Overtime is time on job beyond the hours scheduled for the individual shift and/or work week. Overtime is frequently used in healthcare setting to meet staffing needs due to employee shortages. With a shortage of healthcare works documented for well over a decade, overtime has been a major management tool for ensuring coverage of patient needs (Danielle and Sean, 2010).

Using New York State administrative data from 1995 to 2000, researchers showed that an average of 4.5% of total paid hours worked by registered nurses were paid overtime. From 1995 to 2002, paid overtime increased from an average of 3.9% to 5.9% of total hours. Despite talk of a need to regulate mandatory overtime for health workers, considerably other studies have been conducted to examine the association between the length of employee’s shifts or work weeks and adverse events in patients. In this study both Danielle and Seam prove that working more than 40-hours a week significantly increased the risk of self-reported errors.

In terms of negative influence of overtime on workers, research findings have connected overtime with work-related errors across a variety of hospitals. Data from 1987 to 2000 revealed that every additional five hours worked per week (past 40 hours) was associated with an average increase of approximately 0.7 errors per 100 worker-hours.

In addition, the authors showed that working a job more than 60 hours per week was associated with or 23% higher errors rate, fatigue was more likely to be cited as a contributing factor for medication errors. From the above mentioned information everyone can conclude that overtime is not the best solution to compensate the staff shortage since it is associated with a significant decrease in medication safety.

Pamela et al., conduct a study which explain the main causes of employee’s turnover (Pamela et al., 2008). Taking nurses an ideal example of medical employees, and despite the increase in employment of nearly (185000) hospitals registered nurses since 2001, there is no empirical evidence that the nursing shortage has ended.

Job burnout and Dissatisfaction

There are several factors driving the current medical employees to leave the profession. The average registered

nurses turnover rate in the United States of America was 13.9% (Pamela et al., 2008), the average vacancy rate 16.1% and the average registered nurses cost-per-hire was 2821$.

It is apparent that nurse staffing in hospitals has an important relationship to patient safety and quality of care. Factors such as how staffing, fatigue, stress, sleep deprivation, organizational culture and shift work can lead to errors were supported because these factors have not been studied closely in healthcare settings.

Another study conducted by Alkawajah et al., with a title "The role of pharmacists in patient's education on medication".

The need to provide the patient with the clear and complete information on the name of a drug, frequency of administration, important side effects, the types of foods and activities to avoid while taking a drug and labeling have recently become a subject demanding awareness (Alkhawajah et al., 1992). Lack of proper and clear information on drugs to the patients may result on therapeutic failure, economic waste and detrimental effects to the patient. This study was carried out in the Eastern Province of Saudi Arabia. It showed that both physicians and pharmacists explained the use of medication to majority of patients. As to the clarity of explanation on drug usage, 69% of the patients agreed that pharmacists and physicians were equally clear, while 11% thought that physicians were much clearer than pharmacists. On the other hand, 20% felt pharmacists were much clearer than physician. The methods of explanation were: written (14%), verbal (1%) or both (85%). Patients felt that the pharmacists could counsel better if pharmacies were less crowded and availability of enough and well-trained pharmacists as well as technician (Alkawajah et al., 1992).

Therefore, patient counseling is an important role of the pharmacists; a pharmacy is no longer considered simply a place where a patient goes to get medicines to care his illness. Pharmacists are among the most easily accessible healthcare professionals, and since they are the last persons in the healthcare team to come into contact with patients on drug use. However, 90% of the cases studied in this study believe that they need more counseling about their medication. It is uncertain why the pharmacists did not provide complete information, lack of time and staff shortage might be one of the reasons. Additionally, lack of motivation or technical knowledge could have also contributed.

On the other hand, not only the number of healthcare employees affect the medical services and increase the possibility of medication errors but also the level of education and training is a significant factor. Both Mark and Stanton conduct a study which explain this factor (Mark and Stanton, 2013). The major factors contributing to lower staffing level include the needs of today's higher acuity patients for more care and a nationwide gap between the number of available positions and the number of registered nurses qualified and willing to fill them.

By employing a low staffing level we are not reducing the cost of healthcare. In the fact inadequate staffing level place heavy burdens and adverse events on the patients. Furthermore, there is also a considerable financial cost to be considered, several adverse events such as pneumonia, pressure ulcer, urinary tract infection, wound infection, patient injuries, sepsis, and adverse drug events were associated with increased cost and reducing staffing levels.

Moreover, several factors affecting the medication safety such as demographic factors (age, gender, values and beliefs), education (place of primary qualification, process of registration, years of experiences post qualification), workplace factors (working pattern, work environment, sector of practice) and mental and physical health such as (chronic illness, stress, depression, alcohol, drug and other addictions (Ellen et al., 2011).

The Research Population and Period of Research:

The research population consisted of all the incident reports reported in 2017 of noted pharmacy staff shortage in comparing to the next year which lacks any shortage of employees. These incident reports have been reported from different words throughout the center. Therefore, they are versatile and lacks of any bias or reaping.

The study population is composed of all employees authorized to write an incident report in a healthy organization institute (1834 employees) in seven main departments (Table 1).

Data Collection Method

The data collection method is based on analyzing the incident reports collected pre and post employees shortage in two years. This type of data collection method is considered as secondary method since it does not done by the researcher himself, however this type is not easily operated and performed since it required good analysis, evaluation and reasonable comparable parameters.

Research hypothesis:

The general hypothesis for this research is to prove the positive significant relationship between employees shortage and medication safety.

Statistical analysis:

The data entered, analyzed by using IBM SPSS statistics 20.0. Frequencies were described as percentages. Comparison of frequencies between the year 2017 and 2018 regarding frequency of medication errors was made using Pearson chi-square test (χ^2). Statistical significance was defined at a level of 0.05.

The chi-square is one of the most popular statistics because it is easy to calculate and interpret. There are two kinds of chi-square tests. The first is called a one-way analysis, and the second is called a two-way analysis. The purpose of both is to determine whether the observed

Table 1. Study Population

Sr.	Department	No. of employees
1	Administrators	365
2	Physicians	169
3	Nursing	578
4	Laboratories	252
5	Pharmacy	52
6	Supportive services	366
7	Trainees	52
Total		**1834**

frequencies (counts) markedly differ from the frequencies that we would expect by chance.

Description

The Frequency table and Chi-squared test procedure can be used for the following:

- To test the hypothesis that for one classification table (e.g. gender), all classification levels have the same frequency.
- To test the relationship between two classification factors (e.g. gender and profession).

Chi-squared test

When you want to test the hypothesis that for one single classification table (e.g. gender), all classification levels have the same frequency, then identify only one discrete variable in the dialog form. In this case the null hypothesis is that all classification levels have the same frequency. If the calculated P-value is low ($P<0.05$), then you reject the null hypothesis and the alternative hypothesis that there is a significant difference between the frequencies of the different classification levels must be accepted.

Chi-squared test for trend

If the table has two columns and three or more rows (or two rows and three or more columns), and the categories can be quantified, perform the Chi-squared test for trend. The Cochran-Armitage test for trend (Armitage, 1955) tests whether there is a linear trend between row (or column) number and the fraction of subjects in the left column (or top row). The Cochran-Armitage test for trend provides a more powerful test than the unordered independence test.

RESULTS AND DISCUSSIONS

One of the objectives of this study is to find out if there is a relationship between quantity or number of the organizational employees and the medication safety. So in the following section we investigate the frequency, type, and consequences of medication errors as reported in the period of 10 months in year 2017 where there is staff shortage and year 2018where there is no staff shortage.

Types and classification of medication errors

Medication errors classification can be contextual, modal, or psychological. Contextual classification deals with the specific time, place, medicines, and people involved. There are 23 medication errors (ME).There were 15 ME not occurred in the year 2017where there is staff shortage, nor in the years 2018where there is no staff shortage. (Figure 1 and Table 2).

Actual Medication Errors Occurs

As shown in (Figure 2 and Table 2), the actual medication errors were 8 ME, most of it were omission errors in addition to administration technique errors and dose errors:

1. Omission of date
2. Omission of dose
3. Omission of signature
4. Unordered dose
5. Unordered drug
6. Wrong administration technique (inj.)
7. Wrong delivery (dose not delivered directly to the patient)
8. Wrong dose

Analysis of Reported Medication Errors For 2017

As we mentioned before that there were 8 medication errors occurred in the years 2017and 2018 (Table 3). Wrong dose as a medication error represent the highest frequency of medication errors in the year 201731.2% (171 events were reported), followed by omission of date 29.0% (159 events were reported), then omission of signature 24.5%, 5.8% of the total medication errors reported in the year 2017were omission of dose (32 events were reported), 3.5% of the total medication errors reported in the year 2017were wrong delivery (dose not delivered directly to the patient) (19 events were reported). 2.2% of the total medication errors reported in the year 2017were unordered dose (12 events were reported). Similarly 2.2% of the total medication errors reported in the year 2017were wrong administration technique (inj.) (12 events

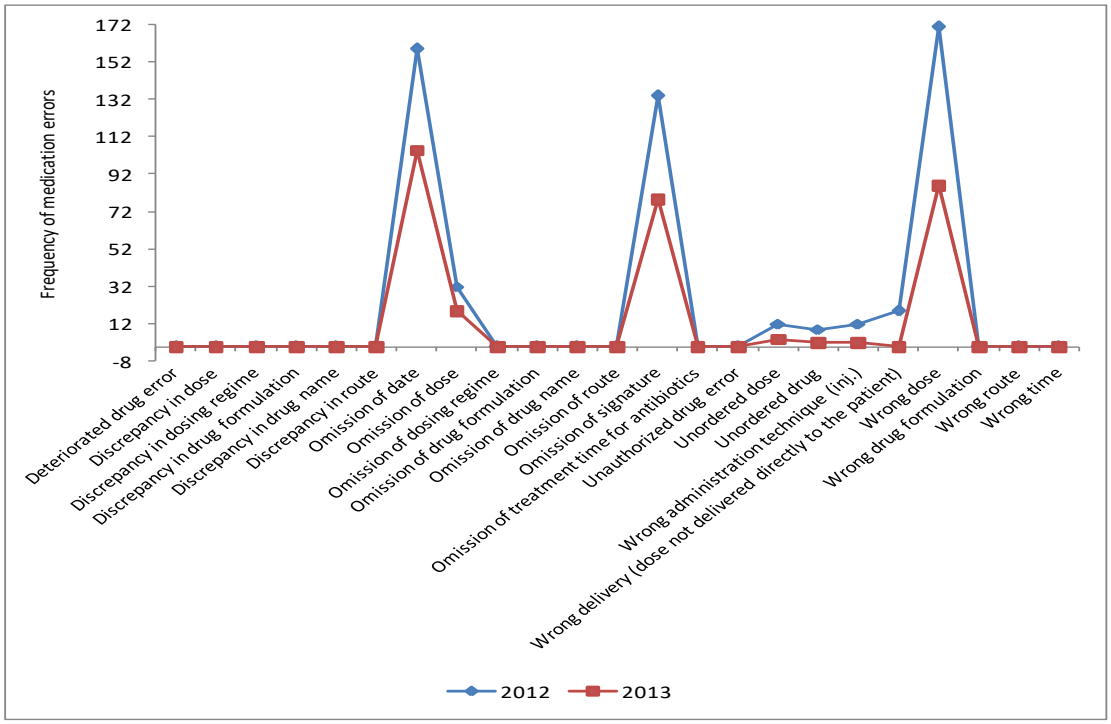

Figure 1: Types and frequencies of medication errors in 2017-2018 (Jan. to Oct.)

Table 2. Types and frequencies of medication errors in 2017-2018(Jan. to Oct.)

	2017		2018	
	No	**%**	**No**	**%**
Deteriorated drug error	0	0.0	0	0.0
Discrepancy in dose	0	0.0	0	0.0
Discrepancy in dosing regime	0	0.0	0	0.0
Discrepancy in drug formulation	0	0.0	0	0.0
Discrepancy in drug name	0	0.0	0	0.0
Discrepancy in route	0	0.0	0	0.0
Omission of date	159	29.0	105	35.4
Omission of dose	32	5.8	19	6.4
Omission of dosing regimen	0	0.0	0	0.0
Omission of drug formulation	0	0.0	0	0.0
Omission of drug name	0	0.0	0	0.0
Omission of route	0	0.0	0	0.0
Omission of signature	134	24.5	79	26.6
Omission of treatment time for antibiotics	0	0.0	0	0.0
Unauthorized drug error	0	0.0	0	0.0
Unordered dose	12	2.2	4	1.3
Unordered drug	9	1.6	2	0.7
Wrong administration technique (inj.)	12	2.2	2	0.7
Wrong delivery (dose not delivered directly to the patient)	19	3.5	0	0.0
Wrong dose	171	31.2	86	29.0
Wrong drug formulation	0	0.0	0	0.0
Wrong route	0	0.0	0	0.0
Wrong time	0	0.0	0	0.0
Total	**548**	**100**	**297**	**100**

were reported), while unordered drug as a medication error recorded the least frequency which was 9 events (1.6%).

Dispensing errors

Dispensing errors refers to medication errors linked to the

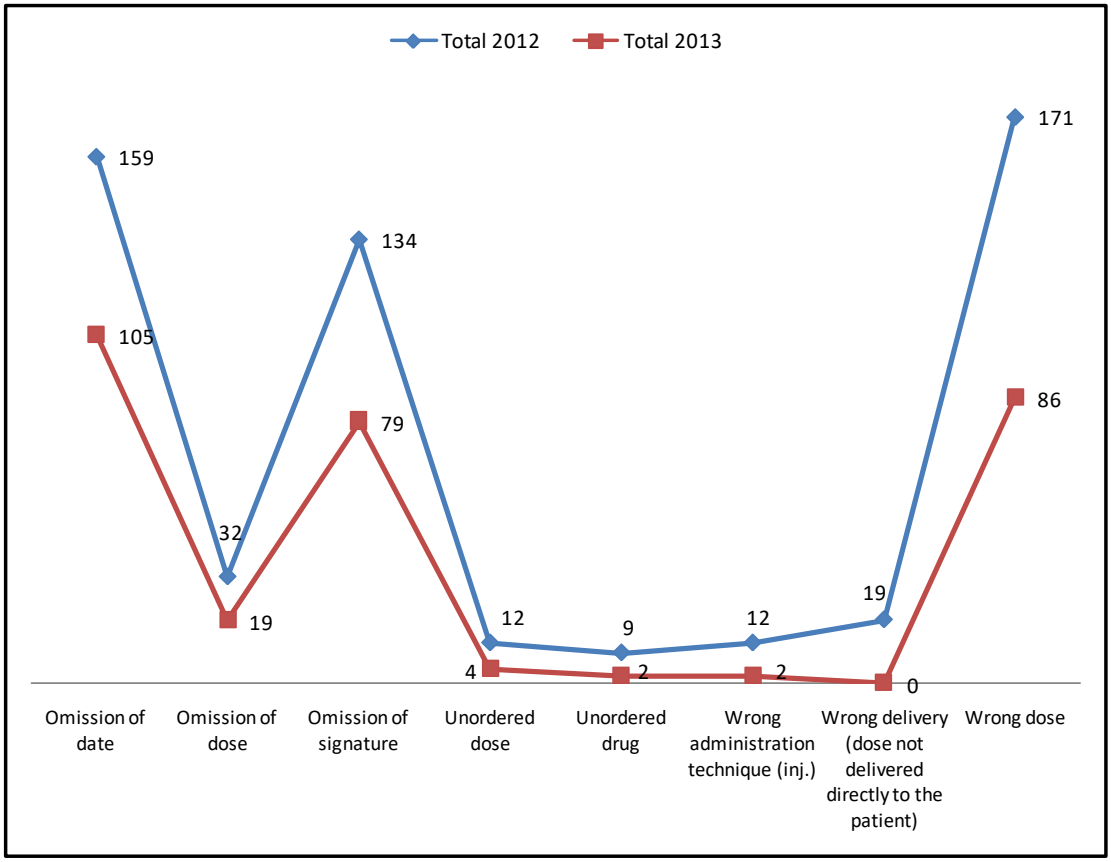

Figure 2: Actual medication errors reported in 2017-2018(Jan. to Oct.)

Table 3: Actual medication errors reported in 2017-2018(Jan. to Oct.)

	2017		2018	
	freq	**%**	**freq**	**%**
Omission of date	159	29.0	105	35.4
Omission of dose	32	5.8	19	6.4
Omission of signature	134	24.5	79	26.6
Unordered dose	12	2.2	4	1.3
Unordered drug	9	1.6	2	0.7
Wrong administration technique (inj.)	12	2.2	2	0.7
Wrong delivery (dose not delivered directly to the patient)	19	3.5	0	0.0
Wrong dose	171	31.2	86	29.0
Total	**548**	**100**	**297**	**100**

freq. = frequency

pharmacy or to whatever health care professional dispenses the medication. These include errors of commission (e.g. dispensing the wrong drug, wrong dose) and those of omission (e.g. omission of date, omission of dose and mission of signature).

Errors of omission

Such as the omission of date, omission of dose , mission of signature and failure to administer a drug that was prescribed or not administering a drug in a timely manner.

Despite the fact that they are greatly more difficult to discover in the course of systematic reporting tools, errors of omission ought to be addressed throughout process improvement efforts in order to actually improve patient safety in a wide-ranging manner.

Omission of date

As shown in the Figure 4 below, that omission of date as a medication error reported in the year 2017,reached its highest frequency in March (13.8%), while it decreased in

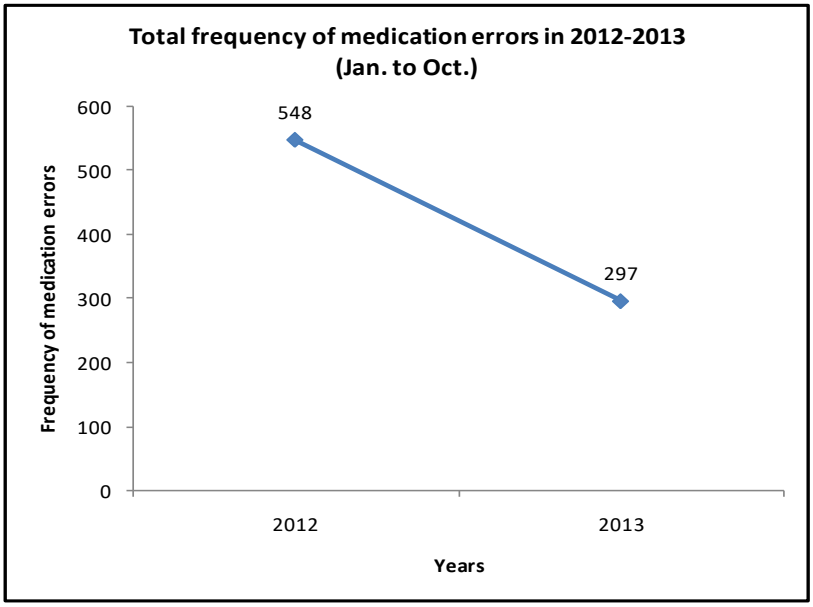

Figure 4: illustrate the frequency percentage of medication error (omission of date) as reported in the year 2017(from Jan. to Oct.)

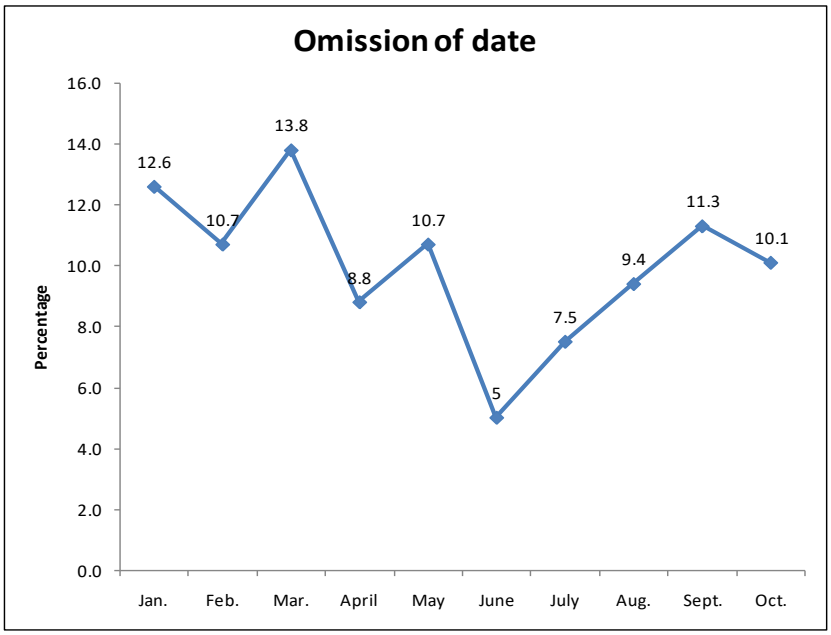

Figure 5: illustrate the frequency percentage of medication error (omission of dose) as reported in the year 2017(from Jan. to Oct.)

June (5%) and then its occurrence increases once more in the months (July (7.5%), August (9.4%) and Septembers (11.3%). But it was declined to 10.1% in October.

Omission of dose

Figure (5) shows the occurrence of the medication error (omission of dose) during ten months (January to October 2017) (Figures 4,5). As shown in the figure, this medication error recorded its highest frequency in September (28.1%) and no events reported regarding this medication error in the months (March and April). The sequence of the occurrence of this medication error was not stable, that in January the reported event regarding this ME was (12.5%) out of the total occurrence through the ten months. Then it decrease to 6.3% in February, while it disappeared in the months March and April, to rise again in May (15.6%). After that it decreases in the months June, July and August. To

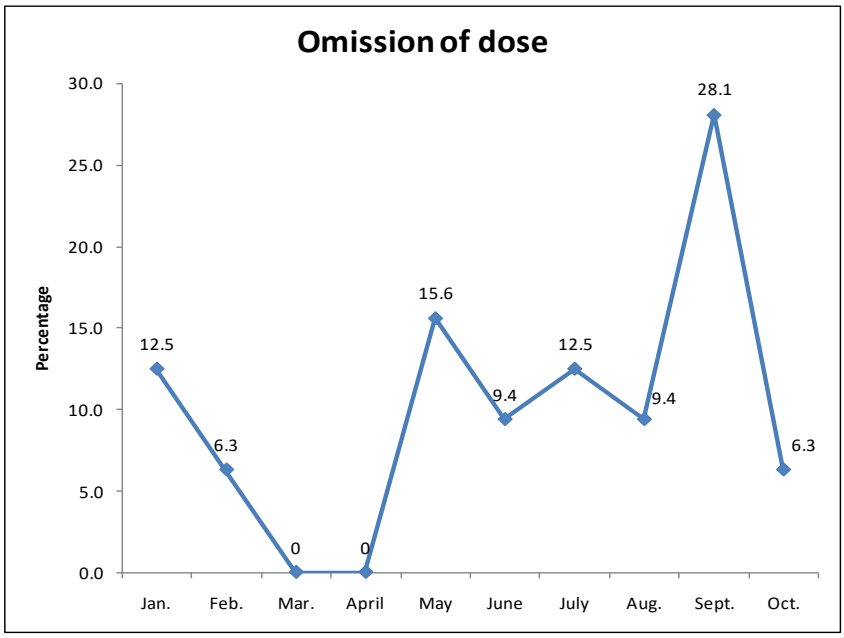

Figure 6: illustrate the frequency percentage of medication error (omission of signature) as reported in the year 2017(from Jan. to Oct.)

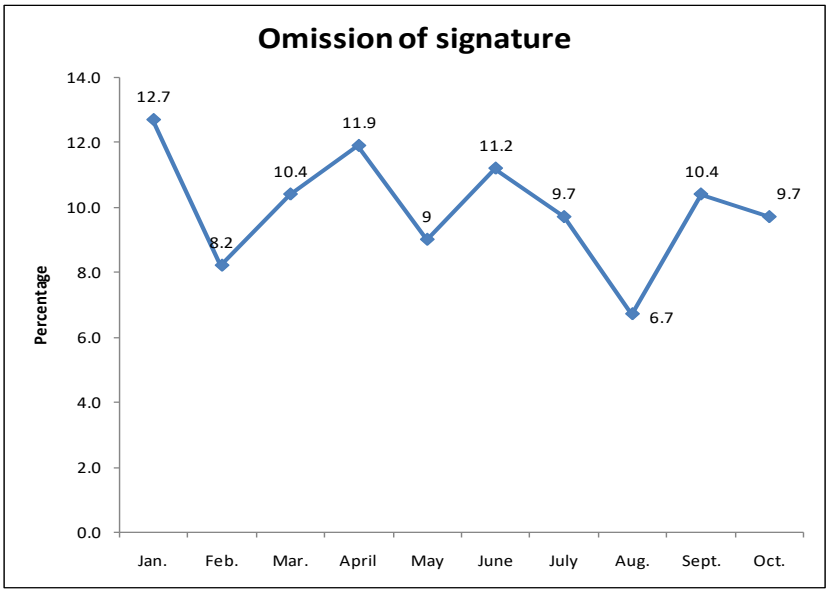

Figure 7: illustrate the frequency percentage of medication error (unordered dose) as reported in the year 2017 (from Jan. to Oct.)

rise again in September (28.1%). However, it was declined to 6.3% in October.

Omission of signature

As shown in the figure below, that omission of signature as a medication error reported in the year 2017 (Figure 6). during ten months (January to October) ,reached its highest frequency in the months January, April , June and September (12.7%, 11.9%,11.2% and 10.4%) respectively, while it lowest frequency occurred in the months February, May and August (8.2%, 9.0% and 6.7%) respectively.

Unordered dose

As shown in the figure below (Figure 7), that unordered dose as a medication error reported in the year 2017during ten months (January to October), recorded its highest

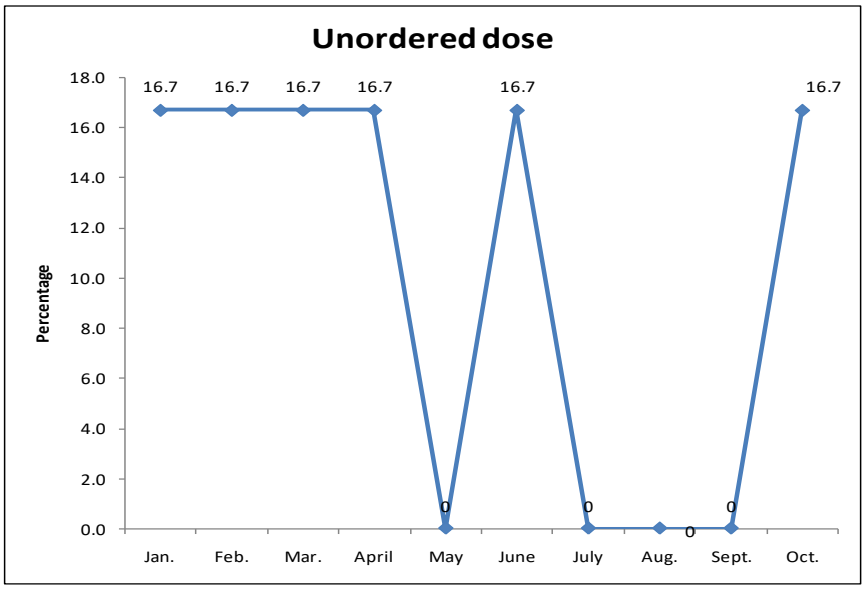

Figure 8: illustrate the frequency percentage of medication error (unordered drug) as reported in the year 2017(from Jan. to Oct.)

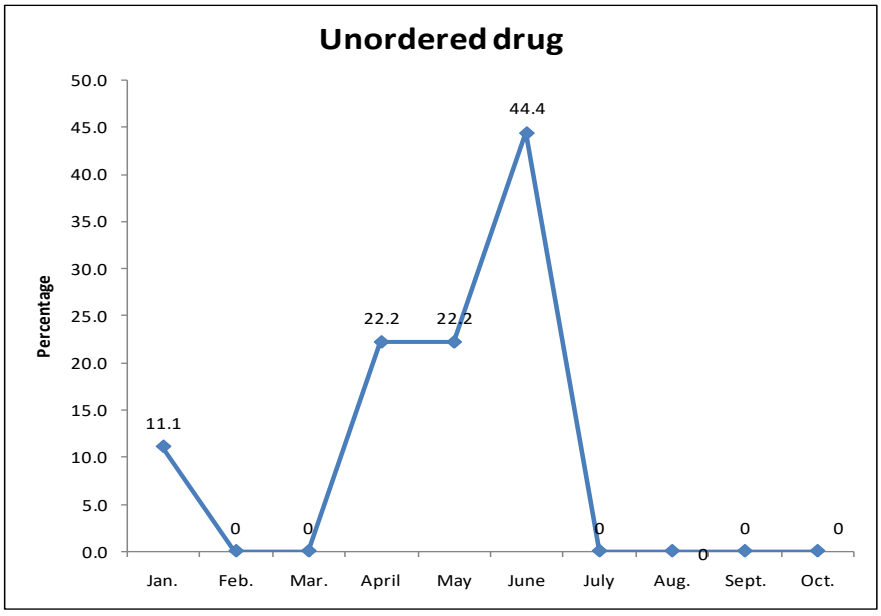

Figure 9: illustrate the frequency percentage of medication error (Wrong administration technique (inj.) as reported in the year 2017(from Jan. to Oct.)

frequency in the months January to April, June and October with an equal percentage (16.7%). But in the month of May, July to September no events regarding this ME was reported.

Unordered drug

As shown in the figure below (Figure 8), that unordered drug as a medication error reported in the year 2017during ten months (January to October), recorded its highest frequency in June (44.4%) , while in the months July to October no events regarding this ME was reported.

Wrong administration technique (inj.)

As shown in the figure below (Figure 9), that wrong administration technique (i.e. injection) as a medication error reported in the year 2017during ten months (January to October), recorded its highest frequency in May (33.3%), while in the months February to April, June and August no

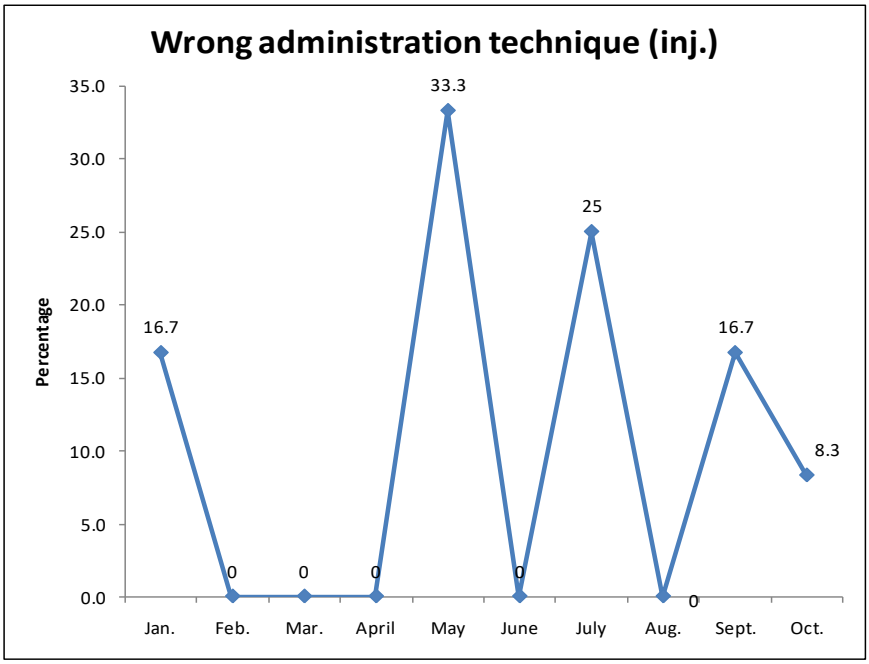

Figure 10: illustrate the frequency percentage of medication error (Wrong delivery (dose not delivered directly to the patient) as reported in the year 2017 (from Jan. to Oct.)

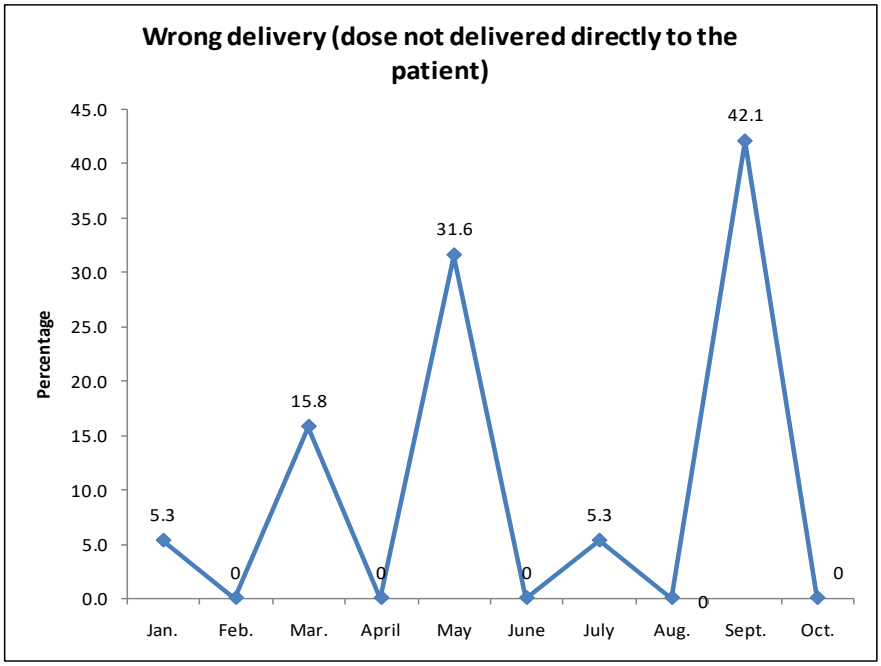

Figure 11: illustrate the frequency percentage of medication error (Wrong dose) as reported in the year 2017(from Jan. to Oct.)

events regarding this ME was reported. It is worth mentioning that in the month October, the occurrence of this ME was 8.3% which was lowest frequency when compared to the other months were medication errors reported.

Wrong delivery (dose not delivered directly to the patient)

As shown in the figure below (Figure 10), that wrong delivery (dose not delivered directly to the patient) as a

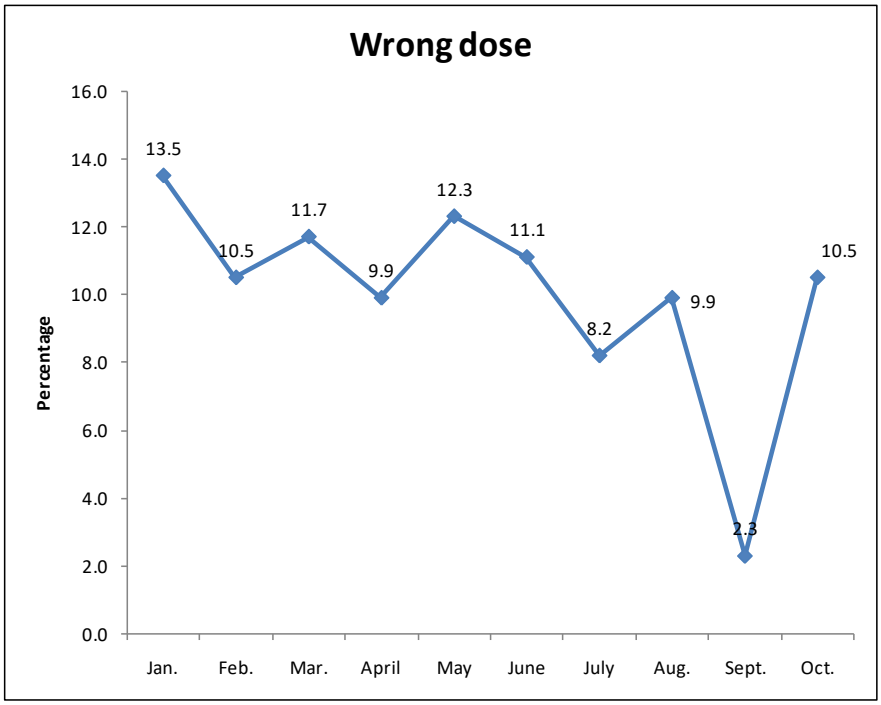

Figure 12: illustrate the frequency percentage of medication error (omission of date) as reported in the year 2017(from Jan. to Oct.)

medication error reported in the year 2017during ten months (January to October), recorded its highest frequency in September (42.1%), while in the months February, April, June, August and October no events regarding this ME was reported. It is important to mention that in October, the occurrence of this ME was 31.6% and in March was 15.8%, while the percentage was equal in January and July (5.3%).

Errors of commission:

Wrong dose

Referring to Table (2), that wrong dose as a medication error was the most highest medication error reported in the year 2017with the percentage of (31.2%) out of the total medication errors reported through ten months (January to October) (Figure 11). The figure below shows that this medication error follows the sequence of rising and declining. That in January the occurrence was (13.5%) declined to (10.5%) in February, then increases in March (11.7%) and declined to (9.9%) in April. Once again the occurrence of this ME increases to reach (12.3%) in May and declined to 11.1% in June and continue decreasing in July 8.2%. In the month of August the occurrence was increases again to reach 9.9% and then slows down to 2.3% which was lowest occurrence. But surprisingly, the occurrence of this medication error was rise in October 10.5% which was similar to the sequence of ME "Unordered dose" occurrence decreases in September (Null) and rise in October.

Medication errors report for 2018

As we mentioned before that there were 8 medication errors occurred in the years 2017and 2018. Omission of date as a medication error recorded the highest frequency of medication errors in the year 2018, 35.4% (105 events were reported), followed by wrong dose 29.0% (86 events were reported), then omission of signature 26.6%. 6.4% of the total medication errors reported in the year 2018were omission of dose (19 events were reported). 1.3% of the total medication errors reported in the year 2018were unordered dose, while unordered drug and wrong administration technique (inj.) as a medication errors recorded an equal percentage 0.7% (only 2 events were reported), whereas no events reported regarding the medication error (Wrong delivery (dose not delivered directly to the patient)).

Errors of omission
Omission of date

Referring to Table (2), that omission of date as a medication error was the most highest medication error reported in the year 2018with the percentage of (35.4%) out of the total medication errors reported through ten months (January to October) (Figure 12). As shown in the figure below, that omission of date as a medication error reported in the year 2018, reached its highest frequency in the

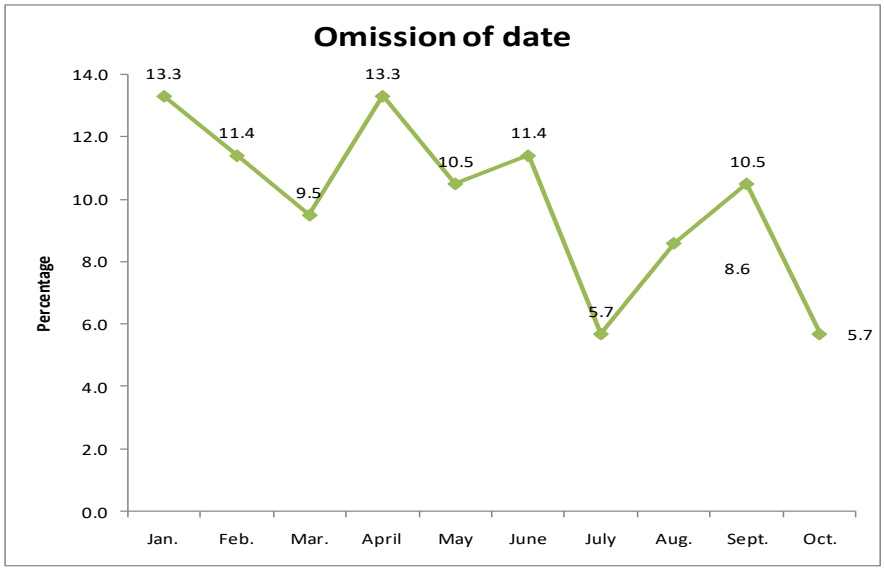

Figure 13: illustrate the frequency percentage of medication error (omission of dose) as reported in the year 2017 (from Jan. to Oct.)

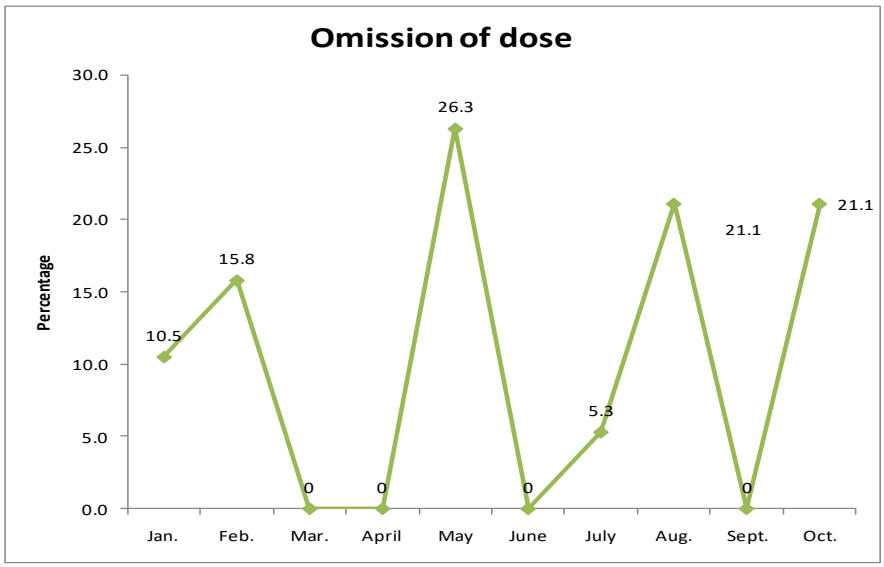

Figure 14: illustrate the frequency percentage of medication error (omission of signature) as reported in the year 2017(from Jan. to Oct.)

months January and April with an equal percentage (13.3%), while it lowest frequency occurred in the months July and October with an equal percentage (5.7%).

Omission of dose

Regarding the occurrence of the medication error (omission of dose) during ten months (January to October) in the year 2018, (Figure 13) shows that the occurrence of this ME has four peaks (February "15.8%", May "26.3%", August "21.1%" and October "21.1%). As shown in the figure, no events reported regarding this medication error in the months (March, April, June and September). We noticed that the occurrence of the medication error (omission of dose) rise again in July to the percentage of 5.3% keeping in mind that no events reported regarding this medication error in June.

Omission of signature

The figure below shows the omission of signature as a medication error reported in the year 2018in the period (January to October) (Figure 14). We can see that all the percentages of occurrence less than 20%. The highest was

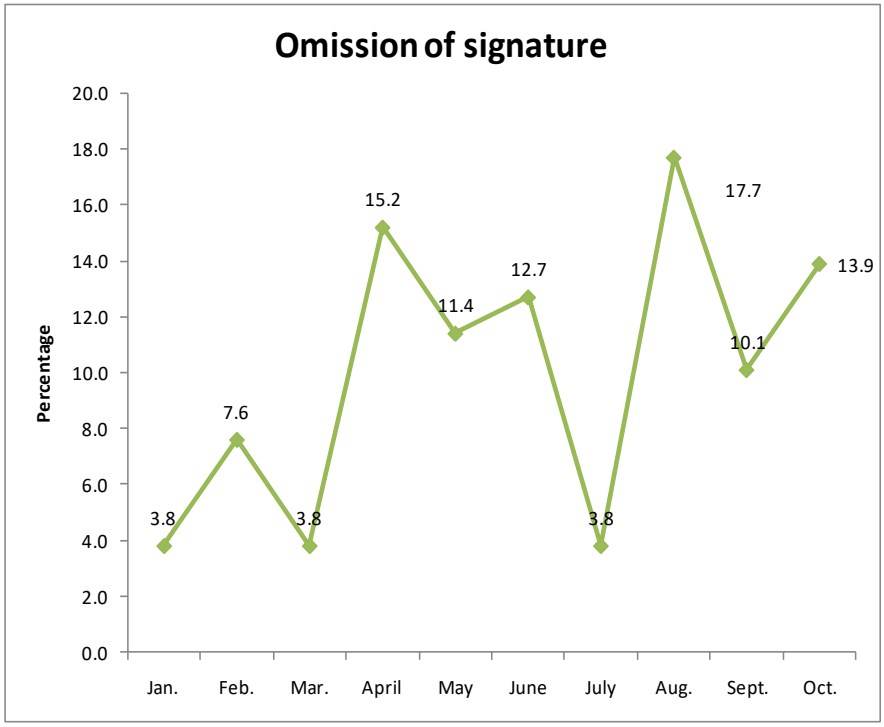

Figure 15: illustrate the frequency percentage of medication error (unordered dose) as reported in the year 2017(from Jan. to Oct.)

17.7% in August, followed by 15.2% in April, then 13.9% in October, followed by 12.7% in June and then 11.4% in May followed by 7.6% in February. However, the lowest frequency occurred in the months January, March and July with an equal percentage (3.8%).

Unordered dose

As shown in the figure below (Figure 15), that unordered dose as a medication error reported in the year 2018in the period of ten months (January to October), reported its highest frequency in the months January, June and August (50%, 25.0%, 25.0%) respectively. Nevertheless, in the months (February to May, July and September no events regarding this ME was reported.

Unordered drug

As shown in the figure below (Figure 16), that unordered drug as a medication error reported in the year 2018during ten months (January to October), has two peaks , one in January (50.0%) and the other in April (50.0%) and no events regarding this ME was reported in the rest of the months (February, March and May to October).

Wrong administration technique (inj.)

As shown in the figure below (Figure 17), that wrong administration technique (i.e. injection) as a medication error reported in the year 2018during ten months (January to October), was only occurred in February and no events regarding this ME was reported in the rest of the months (January, March and March to October).

Errors of commission

Wrong dose

The figure below (Figure 18) shows that this medication error follows the sequence of rising and declining almost the same its sequences in the year 2017. That in January the occurrence was (12.8%) declined to (8.1%) in February, then increases in March (11.6%) and declined to (9.3%) in April and continue decreasing in July 8.2%. Once again the occurrence of this ME increases to reach (12.3%) in May and declined to 11.1% in June and continue decreasing in July 7%. In the month of June the occurrence was increases again to reached 10.5% and then decreased to 9.3% in July to increases once more in August 12.8%. And then the occurrence was decreased to 8.1% in September which was lowest occurrence and rise again in October 10.5% (Figure 19).

Occurrence of medication errors by months (freq. / %) (2017):

The results of this study revealed that, the highest occurrence of medication errors in 2017was reported in January (n=70, 12.8%), while the lowest was reported in August (n=44, 8.0%).

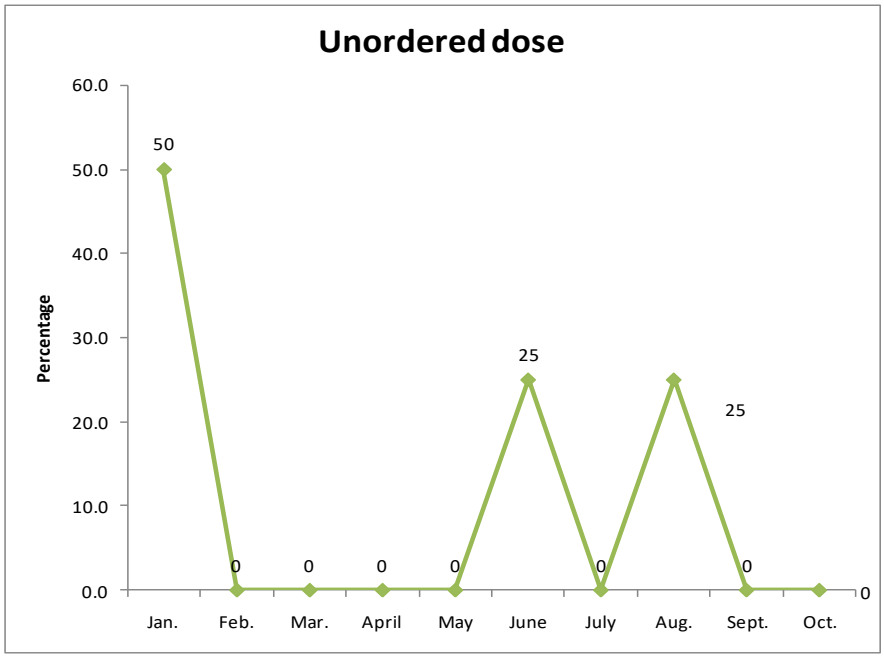

Figure 16: illustrate the frequency percentage of medication error (unordered drug) as reported in the year 2017(from Jan. to Oct.)

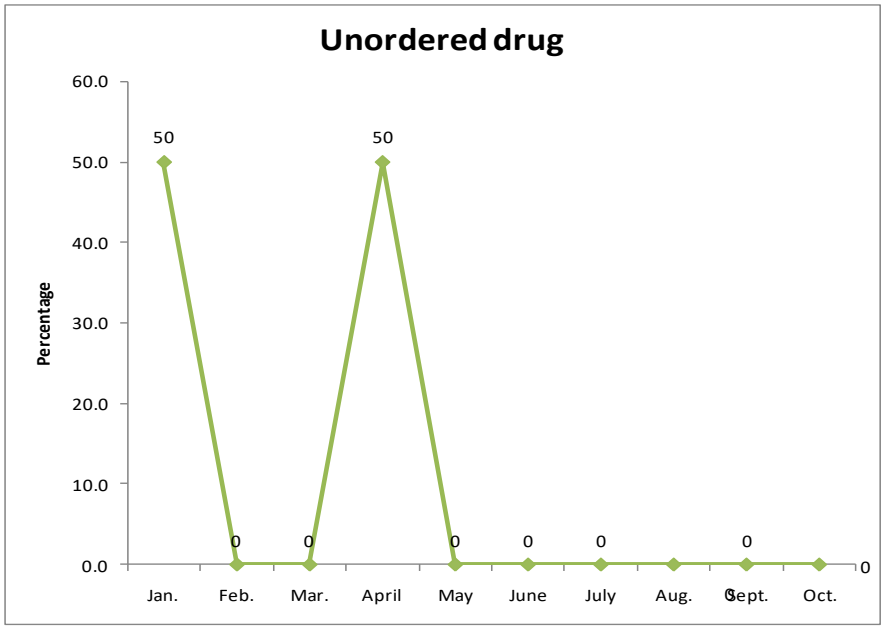

Figure 17: illustrate the frequency percentage of medication error (Wrong administration technique (inj.)) as reported in the year 2017(from Jan. to Oct.)

The highest occurrence of medication errors by months:

Wrong dose

Regarding the occurrence of medication errors by months, we found that wrong dose as a medication error have the highest frequency in the months (January, February, April, May, June, July, August and October) in the year 2017.

Omission of date

The highest frequency reported in the months (March and September) was for the medication error omission of date.

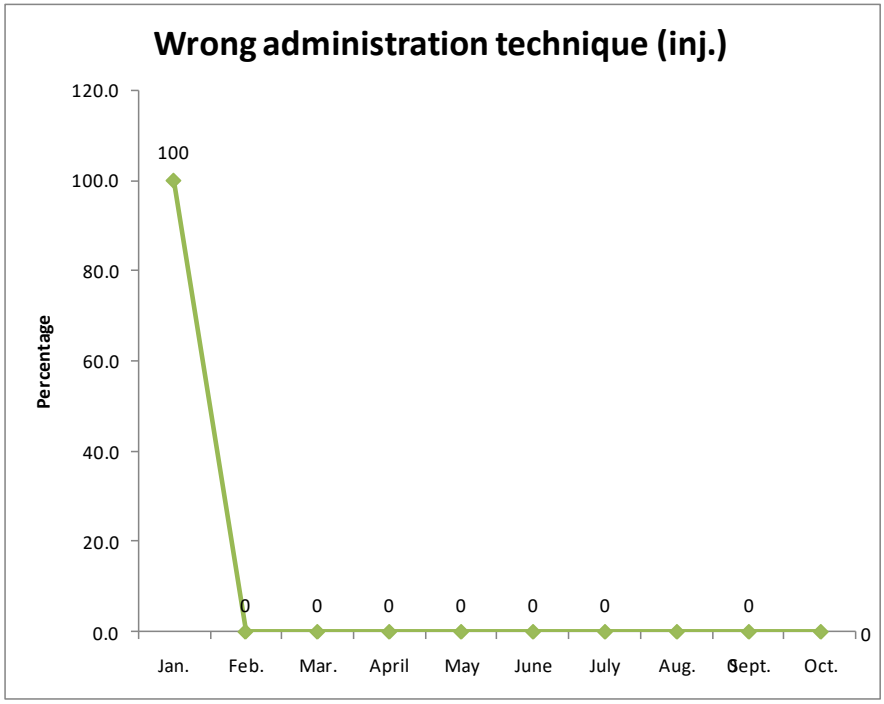

Figure (18) illustrate the frequency percentage of medication error (Wrong dose) as reported in the year 2017(from Jan. to Oct.)

Table 4. Comparison of reporting medication errors in (2017and 2018)

		Year		Total
		2017	2018	
Frequency of medication errors	0-5	48	53	101
	6-10	5	16	21
	11-15	11	11	22
	16-20	13	0	13
	21+	3	0	3
Total		80	80	160

Chi-square =22.009 p value =0.000

The lowest occurrence of medication errors by months:

The results of this study revealed that the lowest frequency of medication errors reported in January (Table 4) was for (Wrong delivery (dose not delivered directly to the patient) and (Unordered drug).

February: (wrong delivery (dose not delivered directly to the patient), (unordered drug), (wrong administration technique (inj.))

March: (wrong administration technique (inj.)), (unordered drug), omission of dose.

April: (wrong delivery (dose not delivered directly to the patient), (wrong administration technique (inj.) and omission of dose.

May: unordered dose.

June: wrong delivery (dose not delivered directly to the patient), (wrong administration technique (inj.)).

July: (unordered drug) and unordered dose

August: wrong delivery (dose not delivered directly to the patient), (wrong administration technique (inj.), (unordered drug) and unordered dose.

September: (unordered drug) and unordered dose.

October: wrong delivery (dose not delivered directly to the patient) and (unordered drug).

Effect of pharmacist's shortage on the medication safety:

Using data collected from routinely filed incident reports (2017) where there is a shortage of pharmacists and (2018) where the gap was filled.

The report in 2017was compared to the same parameters from 2018. To find out the effect of pharmacists shortage on the medication safety Chi square test was used, which showed that there are statistically significant differences in the frequencies of medication errors reported in the year

2017 where there is a shortage of pharmacists and the year 2018 where there is no shortage of pharmacists.

As shown in Table (4) that much medication errors increased in the year 2017where there is a shortage of pharmacists (16 to 20) and 21 and more medication errors, while few medication errors increased in the year 2018where there is no shortage of pharmacists (0 to 5) and (6 to 10) medication errors. ($P<0.01$).

SUMMARY, CONCLUSION, AND RECOMMENDATION:

Patients today are informed healthcare consumers who want to be educated regarding errors made. Hospital staff members, therefore, must be taught how to use incidence reports correctly. Periodic seminars and in service programs allow for free exchange of information and alert managers and staff members to overlooked risks, attitude problems, and opportunities for prevention and control.

The most important barrier to improving medication safety is lack of awareness of the extent to which errors occurs daily in all healthcare settings and organizations. This lack of awareness exist because the vast majority of errors are not reported and they are not reported because staff shortage, load of daily works, personal fear they will be punished.

Healthcare professionals should be alert for incomplete or incorrect incident reports and communicate to staff members the deficiencies noted so they are corrected. Education, quarterly updates in newsletters form, role playing, and case studies are examples of effective methods to trigger change. Compliance depends or proper training of staff members. If behavior and practices do not change, then accidents and litigation will continue to be a drain on healthcare resources.

Recommendations:

Many factors can lead to medication errors. The Institute for Safe Medication Practice (ISMP) has identified 10 key elements with the greatest influence on medication use, noting that weaknesses in these can lead to medication errors. They are:

- Patient information
- Drug information
- Adequate communication
- Drug packing, labeling and nomenclature.
- Medication storage, stock, standardization, and distribution.
- Drug device acquisition, use, and monitoring.
- Environmental factors.
- Staff adequacy, education and competency.
- Patient education and counseling.
- Quality processes and risk management.

Therefore, all the previous factors are recommended to be considered and based on. Finally, vigilance and the use of appropriate technology to help ensure proper procedures should be followed. Computerized physician order entry reduces errors by identifying and alerting physicians to patient allergies or drug interactions, eliminating poorly handwritten prescription, and giving decision support regarding standardized dosing regimens.

REFERENCES

Al-Dhawailie A (2011). Inpatient prescribing errors and pharmacist intervention at a teaching hospital in Saudi Arabia. Saudi Pharmaceutical J. (19): 193-196.

Al-Jaraisy M, Al-anazi M, Abolfotough M (2011). Medication prescribing errors in a pediatric inpatient tertiary care setting in Saudi Arabia. Res. Notes. (4): 4-29.

Alkhawajah AM, Yasser MO, Eferakeya MD (1992). The Role of Pharmacists in Patient's Education on Medication. Public Health. (106): 231-237.

Atiya M, Habib C (2012). Long-term care physical environments-effect on medication errors. International Journal of Healthcare Quality Assurance. (25): 431-441.

Bates D, Boyle D Vander M (1995). Relationship between medication errors and adverse drug events. J. Gen. Intern. Med. (274): 29-34.

Bates D, Leape L, Cullen D (1998). Effect of computerized physician order entry and a team intervention on preventing serious medication errors. JAMA. (280): 1311-1316.

Benjamin D (2003). Reducing medication errors and increasing patient safety: Case study in clinical pharmacology. J. Clin. Pharmacol. (43): 768-783.

Bower AC (1990). Dispensing error rates in hospital pharmacy. Pharma. J. 17 (244): R22-R23.

Cramer J, Burell C, Fairchild C, Fuldeore M, Olendorf D, Wongb (2008). Medication compliance and persistence: terminology and definitions. Value Health. (1): 44-47.

Danielle M, Seon P (2010). The effect of work hours on adverse events and errors in healthcare. Journal of Safety Research. (41): 153-162.

David BR, Lonser G (2003). Strategies to decrease Medication Errors. Health Care Manager. (22): 211-218.

Debra M (2003). Incident reports-correcting processes and reducing errors. AORN Journal. (78): 211-233.

Delusignan S, Pritchard K, Chan T (2002). Acknowledge-management model for clinical practice. J. Postgraduate Medicine. 48 (4): 297-303.

DoH (2004). Building a safer NHS for patients: improving medication safety: A report by the Chief Pharmaceutical Officer, London: Department of Health.

Ellen IS, Elizabeth MS, Karen H (2011). Factors influencing pharmacist's performance: A review of the peer-reviewed literature. Health Policy. (102): 178-192.

Hawkey C, Hodgson S, Norman A, Daneshmend T, Garner S (1990). Effect of reactive pharmacy intervention on quality of hospital prescribing. British Medical Journal, 300 (5): 986-990.

Hellier E, Derbyshire J, Costello A (2006). Considering the impact of medicine label design characteristics on patient safety. Ergonomics. (49): 617-630.

Howard RL, Avery AJ, Slavenburg S, Royal S, Pipe G, Lucassen P, Primohamed M (2007). Which drugs cause preventable admissions to hospital? A systematic review. British Journal of Clinical Pharmacology. 63 (2): 136-147.

Ilies R, Fulmer I, Spitzmuller M, Johnson M (2009). Personality and Citizenship behavioure: the mediating role of job satisfaction. J. App. Psychol. (4): 945-959.

Johnson C, Carlson R, Tucker C (2002). Using BCMA software to improve patient's safety in veterans Administration medical centers. J. Health C. Infor. Manag. 16 (1): 46-51.

Karson AS and Bates DW (1999). Screening for adverse effects. Journal of Evaluation in Clinical Practice. (5): 23-32.

Kathleen L, Gregory N (2006). Implementation of patient safety initiatives in US hospitals. International Journal of Operations & Production Management. (26): 326-347.

Kenneth N, Elizabeth A, Ginette A (2002). Observation method of detecting medication errors. Am. J. Health Syst. Pharm. (59): 2314-2316.

Klein M (2012). The technological revolution. The newsletters of FBRI's Watchman Center. (13): 18-23.

Lasser KE, Allen PD, Wollhandler SJ, Himmelstein DU, Wolfe SM, Bor DH (2002). Timing of new black box warnings and withdrawals for prescription medications, J. the American Medical Association. 287 (17): 2215-2220.

Mark W, Stanton MA (2013). Hospital Nurse Staffing and quality of care. (301): 427-435.

NPSA, (2007). Safety in doses: medication safety incident in the NHS: the fourth report from the medication safety observation. London. NPSA.

Pamela E, Windle MS, Rawn C (2008). Addressing the nurse staffing shortage, J. anesthesia Nursing. (23): 209-214.

Philip J (2002). Measuring Medication Safety in Hospitals, Am. J. Health-Syst-Pharm. (59): 2313-2314.

Pirmohamed M, James S, Meakin S (2004). Adverse drug reactions as cause of admission to hospital: prospective analysis of 18820 patients. British Medical J. (329): 15-19.

Poon E, Cina J, Churchill W, Ghandhi T (2017). Medication dispensing error and potential adverse drug event before and after implementing Bar Code Technology in the pharmacy. Ann. Intern. Med. (145): 426-434.

Rawlins MD, Thompson JW (1977), Pathogenesis of adverse drug reactions, In Davies D.M. (ed.) Textbooks of Adverse Drug Reactions, Oxford: Oxford University Press.

Rissato A, Romano N, Lieber L (2008). Terminology for drug incidents in the hospital context. Cad. Saude Publica. (24): 1965-1975.

Roberts DE, Spencer MG, Burfield R, Bowden S (2002). An analysis of dispensing errors in a pediatric teaching hospital: five years operational experience. Archives of Disease in childhood. 83 (4): 492-497.

Solomon DH, Schneeweiss S, Glynn RJ (2004). Relationship between selective Cyclooxygenase-2 inhibitors and acute myocardial infarction in older adults. Circulation. 109 (17): 2068-2073.

Spencer MG, Smith AP (1993). A multi-center study of dispensing errors in British hospitals. International Journal of Pharmacy Practice. 2 (6): 142-146.

Spetz S, Adams S (2006). How can employment-based benefits help the nurse shortage. Health Aff. (1): 212-218.

Stratus SE, Richardson WS, Glasziou P, Haynes RB, (2005). Evidence-base Medicine: How to practice and Teach EBM, 3rd edition, Edinburgh: Elsevier Churchill Livingstone.

Valverade M, Martin R, Dominguez A (2003). Drug Safety and Preventing medication errors. Farm. Hosp. (27): 396-400.

Vira T, Colquhoun M, Etchells E (2006). Reconcilable differences: correcting medication errors at hospital admission and discharge. Qual. Saf. Healthcare. (15): 122-126.

WHO (2002) The importance of pharmacovigilance p40. Accessed at http://www.who.int/medicinedocs/collect/edmweb/pdf/s4893e/s4893e.pdf July 2008.

Williams DJ (2007). Medication errors. Journal of the Royal College of Physicians Edinburgh. (37): 343-346.