An-Najah National University

Faculty of Graduate Studies

Evaluation of Medication Dosing Errors in Outpatient Pediatrics in Primary Health Care Centers in Nablus City

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Dedication

Every challenging work needs self efforts as well as guidance of elders especially those who were close to our heart

My humble effort I dedicate to my sweet and loving

Father & Mother

Whose affection, love, encouragement and prayers of day and night make me able to get such success and honor

Husband

For your patience, love, friendship& making everything possible

Supervisors

Who are all hard working and have my utmost respect

My sister

Whom I believe embodies all things creative & beautiful

My children

Who I see the future in their eyes

My father &mother in law

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My special thanks to all my instructors in public health program at An Najah National University

Finally: My thanks to all my friends and my beloved family for their support and motivation

الإقرار

أنا الموقعة ادناه، مقدمة الرسالة التي تحمل العنوان:

Evaluation of Medication Dosing Errors in Outpatient Pediatrics in Primary Health Care Centers in Nablus City

تقييم أخطاء الجرعات الدوائية للاطفال المراجعين لمراكز الرعاية الصحية الاولية في مدينة نابلس

أقر بأن ما اشتملت عليه هذه الرسالة إنما هو نتاج جهدي الخاص، باستثناء ما تمت الاشارة اليه حيثما ورد، و أن هذه الرسالة كاملة، أو أي جزء منها لم يقدم من قبل لنيل أي درجة أو لقب علمي أو بحثي لدى أي مؤسسة تعليمية أو بحثية أخرى

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's Name: غدير تحسين عطا الله الشريف/عميرة اسم الطالب:

Signature: التوقيع:

Date: 20/9/2016 التاريخ:

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ADEs	**Adverse drug events**
ADR	**Adverse drug reaction**
CPOE	**Computerized physician order entry**
ED	**Emergency Departments**
IRB	**Institutional Review Board**
MEs	**Medication errors**
USA	**United States of America**
HIS	**Health Information System**
MCH	**Maternal and Child Health**
PID	**potential inappropriate dosing errors**
RSV	**Respiratory syncytial virus**
WHO	**World Health Organization**
OTC	**Over the Counter Medications**

Evaluation of Medication Dosing Errors in Outpatient Pediatrics in Primary Health Care Centers in Nablus City

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Abstract

Background: Pediatric patients are sensitive to medication errors including dosing errors and could be exposed to dangerous consequences if these errors occur. Medication dosing errors are probable to happen among outpatient pediatrics recurrently, and in commonly used medications. This is a public health issue that could be preventable by integrating strategies of different partners.

Objectives: To assess the prevalence of medication dosing errors in outpatient pediatrics aged (/1-144) months old in Primary Health Care centers in Nablus city and its possible associated factors.

Methods: The study was a prospective cross sectional study. A review of physicians' prescriptions was conducted. A sample of 400 pediatric prescriptions was reviewed and re-evaluated in terms of weight–adjusted dose. The prescriptions were obtained from all centers of Primary Health Care centers in Nablus City. The medication dosing errors were defined as over-dose, under-dose, inappropriate frequency or duration.

Results: The patients were prescribed a total of 782 medications, twenty nine different drugs were prescribed, the most common out of the total 782 prescribed medications were: Paracetamol (29.5%), Chlorpheniramine (17.0%) and Amoxicillin (16.1,%). The oral route was the most commonly prescribed as 702 out of 782 (89.8%) medications were oral medications. Most prescriptions included either one error in 31.8% of the total 400 patients or two errors in 30.8% of all patients. As percentages from the total prescribed 782 medications: 168 medications were potential over doses (21.5%), 200 were potential under doses (25.6%) and 51 were medications that should not be prescribed in similar conditions depending on the age. Regarding frequency and duration of the total prescribed medications: 37 medications were prescribed in a frequency that might be more than needed while 231 ones were potentially prescribed less frequent than needed، duration of 8 medications was potentially more than needed while 28 had potentially shorter duration. Weight, age, center and number of medications prescribed were found to be factors associated with potential inappropriate dosing errors.

Conclusion: Medication dosing errors among young outpatient children in Nablus city were common. Many variables were found to be significantly associated with such errors like weight, age, number of medications prescribed and the center; this provided us with better understanding of the way how these errors happen. Studies on the clinical impact of these potential errors and effective error prevention strategies are needed.

Chapter One

Introduction

Chapter One
Introduction

1.1 Background

Prescribing drugs is a very vital procedure in patient therapy that should not be accompanied with an error, especially medication dosing errors. Pediatric patients are sensitive to such errors and could be exposed to dangerous consequences if these errors occurred. Medication dosing errors are probable to happen among outpatient pediatrics recurrently, and in commonly used medications [1].

Quality amendment in children drug therapy requires a better recognition of the types of error in pediatric medication dosing [2]. However, adequate rational drug prescription is missing in developing countries, especially in pediatric drug therapy. Therefore, it is important to shed the light on such issue [2].

It should be noted that, pediatric medication errors represent a recurrently occurring public health issue. For example, the United States poison control centers reported more than 200,000 out-of-hospital medication errors annually, and pediatrics constitutes 30% of this harmed population [3]. In the meanwhile, a comprehensive study at the national level in the United States found that, through 2002–2012, every 8 minutes one child less than 6 years old is encountered an out-of-hospital medication errors and that the medication errors had an average annual rate of 26.42 per

10 000 population [3]. Furthermore, More than 70 000 children are admitted to Emergency Departments (ED) annually, because of inadvertently medication overdoses, and around 5% of these ED visits were an outcome of errors made by a caregiver and were associated with incorrect dosing [4].Two possible risks represent the outcome of medication dosing errors; either having adverse effects as a result of medication over-dosages, or treatment failure and insufficiency as a result of under-dosage. However, the outpatient children are at greater risks of having adverse effects due to the missing of sufficient Phamacovigilance in pediatric therapy particularly in developing countries [2].

1.2 The safety of pediatric drug therapy

Infants and children constitute a large proportion of the population in developing countries. They are especially vulnerable to contract illnesses and to the harmful effects of drugs due to differences in pharmacodynamics and pharmacokinetics [5]

The unique nature of children and pediatrics make them at higher risk of experiencing medication errors than adults because they have an immature physiology as well as developmental limitations that affect their ability to communicate and self-administer medications [6]. Another important factor is that the great majority of medications are developed in concentrations appropriate for adults; and pediatric indications and dosage guidelines are

often not included with a medication, so it needs many calculations based on many factors [7].

For example, in Germany, at least one adverse drug reaction (ADR) had been documented among 1.7% of pediatric population receiving medications in an outpatient basis, while 10% of inpatient pediatrics experienced at least one ADR. Overdoses and drug administration despite contraindications were reasons for such ADRs. According to reports headed from the Drug Commission of the German Medical Association in addition to inadequate monitoring of long-term treatment, communication, labeling, and drug administration also were accompanied with errors [8].

Amelioration of pediatric drug safety needs for more effective clinical analysis of pharmacovigilance information [9]. Pharmacovigilance as defined by the World Health Organization (WHO) is the science and activities related to detection, assessment, understanding and prevention of adverse effects or any other related drug problems. This newly developing issue has become one of the most important pillars, which concern most of national and international health organizations [10].

In adults, pharmacovigilance refers mainly to post marketing monitoring but in children population, the definition had been extended to involve other aspects [11]**.** Pediatric pharmacovigilance is the process of evaluating and progressing the safety of medicine prescribed for pediatric patients in all ages [12].

There is an instance to improve the evaluation of pediatric drug safety in the pre-market and post-market stages of drug evaluation. Including not only new drugs but also existing drugs that have been used in an off-label manner in children, for these drugs we need to improve pharmacovigilance procedures related to them [9].

This implies how medication issues are critical in pediatric population and explains the need for many studies to be conducted among such population.

Pediatrics are more liable to medication errors as it is needed to individualize the patient dose depending on different factors like age, gestational age, surface area and weight, using calculations and dilutions. Errors while calculating pediatric and neonatal doses are very likely to happen and considered as the most common sort of medication errors in this patient category, so efficient interventions are suggested such as computerized physician order entry (CPOE) or computerized provider order entry with clinical decision backing up, computer-aided prescribing, unit dose dispensing systems and educational/risk management programmes, using the Broselow pediatric emergency tape, color-coded materials and smart intravenous pumps to decrease infusion errors in pediatrics [13-16].

1.3 Significance of the study

Dosing errors are the most common type of medication errors among children. However, the majority of studies have assessed the medication dosing errors in adults and particularly inpatient adults [17]. Yet, few have concerned with outpatient pediatrics [1,2, 18] .

Pediatric patients are special and sensitive population who need special care. Therefore, it is important to evaluate the appropriateness of doses according to patients' weight to avoid the therapeutic failure or the increase in the side effects. To the best of our knowledge, this will be the first study of its kind in Palestine on which we rely to set up some recommendations and implement appropriate educational and interventional programs to decrease the dosing errors in Palestine.

1.4 Objectives

1.4.1 General objective

To assess the prevalence of medication dosing errors in outpatient pediatrics in Primary Health Care Centers in Nablus city and its possible associated factors.

1.4.2 Specific objectives

1- To estimate the prevalence of dosing errors among a group of outpatient pediatric patients aged (1-144) months old in Nablus city.

2- To identify the drug classes prescribed to the outpatient pediatrics in which dosing errors are predominant among those aged (1-144) months old.

3- To evaluate the major types of errors (over-dose, under-dose, inappropriate frequency and inappropriate duration).

4- To investigate the association between some factors (e.g., socio-demographic, number and class of medications, diagnosis, speciality of the prescribing physician and dosing errors.

Chapter Two

Literature Review

Chapter Two
Literature Review

Studies related to outpatient pediatric doses were limited. However, several studies about medication errors in general could be found and in most of them dosing errors were the most common type of errors in pediatrics. Examples of some related studies include the followings:

2.1 Studies related to medication errors in general or dosing errors in outpatient pediatrics:

In a study by McPhillips et al in 2005 to assess the prevalence of medication dosing errors in outpatient pediatrics for frequently used 22 medications: 15% of the studied population were probable to have dosing errors in their medications, sharing this percentage equally with either having probable overdoses or under-doses, 67% of the children (<35 KG) had their medication doses within the recommended range, but more than 1% had their medications with more than double the maximum recommended dose. Medications which were likely to be dispensed with probable overdoses were analgesics, while those dispensed with probable under-doses were antiepileptics and electronic prescription writer did not lower the rate of potential errors [1].

In a study by Oshikoya and Ojo (2007) to evaluate medication errors in pediatric outpatient prescriptions of a teaching hospital in Nigeria, they found that a total of 1944 prescriptions met the criteria for inclusion in the

study. Antimalarials (89.9%), analgesics (66.4%), vitamin B complex (61.5%) and antibiotics (41.4%) were the most prescribed drugs. Errors identified were inadequate medication dosing duration; omission of age, dosage, and duration of drug use; improper dosing and prescription of those drugs that could adversely interact. Errors of overdosing and under-dosing were common to most of the commonly prescribed drugs. Under dosing and overdosing were associated with 2518 (38.0%) and 1247 (18.8%) drugs respectively. Inadequate and omission of the duration of use of the drugs were observed in 1981(28.3%) and 61(0.9%) prescriptions respectively. They concluded that urgent formation of monitoring committees are needed to review pediatric prescriptions for correctness, sufficiency and accuracy of the dose by means of weight, age and other important data regarding the child [2].

In another study from the USA to investigate out-of-hospital medication errors among young children in the United States, they used data from the National Poison Database System, a retrospective analysis of out-of-hospital medication errors among children<6years old from 2002 through 2012 was conducted. They found that during 2002-2012, 696,937children<6yearsexperienced out-of-hospital medication errors, averaging 63,358 episodes per year, or 1 child every 8 minutes. The average annual rate of medication errors was 26.42 per 10,000 population. Cough and cold medication errors decreased significantly, whereas the number (42.9% increase) and rate (37.2% increase) of all other medication

errors rose significantly during the 11-year study period. The number and rate of medication error events decreased with increasing child age, with children<1 year accounting for 25.2% of episodes. Analgesics (25.2%) were most commonly involved in medication errors, followed by cough and cold preparations (24.6%). Ingestion accounted for 96.2% of events, and 27.0% of medication errors were attributed to inadvertently taking or being given medication twice. Most (93.5%) cases were managed outside of a health care facility; 4.4% were treated and released from a health care facility; 0.4% were admitted to a non-critical care unit; 0.3% were admitted to a critical care unit; and 25 children died. They concluded that they need to work hard in order to avoid medication errors among young children, particularly those involving non–cough and cold preparations [3].

Budnitz and Salis reported that during 2005 to 2009, a rise by 20% in ED visits due to medication overdoses among children < 5 years was noted, among 151 child, whose age is 2-year-olds, one was evaluated in an ED for a medication overdose in 2009. They recommended that recognizing the impact of blocking medication overdoses in pediatrics is an opportunity to exclude harm in such vulnerable group, and an important objective for many stakeholders by the coming years [4].

In a systematic review of medication errors (ME) in pediatric patients, dosing error was the predominant type among MEs types, often involving 10 times the actual dose required., MEs were commonly coupled with antibiotics and sedatives; which were frequently prescribed drugs, so they

concluded that there is an urgent need to detect the incidence plus the causes of MEs in pediatrics, and to adopt the most efficient interventions to reduce such MEs [17].

2.2. Studies related to medication errors in general or dosing errors in inpatient pediatrics:

In a study from Saudi Arabia, a five-week retrospective cohort study identified medication errors in the general pediatric ward and pediatric intensive care unit (PICU) at King Abdulaziz Medical City through the physical inspection of physician medication orders and reviews of patients' files. Out of the 2,380 orders examined, the overall error rate was 56 per 100 medication orders (95% CI: 54.2%, 57.8%). Dose errors were the most prevalent (22.1%). These were followed by route errors (12.0%), errors in clarity (11.4%) and frequency errors (5.4%). Other types of errors were incompatibility (1.9%), incorrect drug selection (1.7%) and duplicate therapy (1%). The majority of orders (81.8%) had one or more abbreviations. Error rates were highest in prescriptions for electrolytes (17.17%), antibiotics (13.72%) and bronchodilators (12.97%). Medication prescription errors occurred more frequently in males (64.5%), infants (44.5%) and for medications with an intravenous route of administration (50.2%). Approximately one third of the errors occurred in the PICU (33.9%) [19].

In a study by Slonim et al., the rate of hospital-reported medical errors in hospitalized children ranged from 1.81 to 2.96 per 100 discharges. These medical error rates were statistically lower in 1988, with the years 1991, 1994, and 1997 not being statistically different from each other. There were no consistent differences in the rates of medical errors when stratified by gender, race, pay or status, or median household income of the patient's zip code across years. There was, however, a statistically significant relationship between higher median household income and increasing medical error rates; this trend was consistent across all 4 years. Similarly, children with special medical needs or dependence on a medical technology also had significantly higher rates of hospital-reported medical errors. Although hospital size did not seem to be related to the rate of medical errors, private for-profit hospitals consistently reported lower rates, whereas urban teaching hospitals in all years except 1997 reported higher rates of medical errors [20].

Retrospective review of medication errors documented in standard reporting forms from April 1994 to August 1999 in pediatric teaching hospital in the UK showed that Medication errors occurred in 0.15% of admissions (195 errors; one per 662 admissions). While the highest rate occurred in neonatal intensive care (0.98%), most errors occurred in medical wards. Errors involving the intravenous route were commonest (56%), with antibiotics being the most frequent drug involved (44%) [21].

In another observational study (medication order review) from July 1, 2000, to January 4, 2002 in a teaching hospital located in northeastern New York State. Out of the 200 confirmed, the error rate in pediatric/neonate patient was 39 (19.5%).Tenfold-prescribing errors in pediatric patients were detected at a rate of 0.53 errors per 100 total admissions. Overdoses occurred in 20(51.3%) cases and under doses in 19(48.7%) cases. The mechanism by which the tenfold error was prescribed was a misplaced decimal point in 20 cases (51.3%), the addition of an extra zero in 9 cases, and the omission of a zero in 10 cases. For route error, injectable errors in 23 cases (59%), oral liquid 12(30.8%) and oral solid 2(5.1%). Error rates were highest in prescriptions for antimicrobial 15 case (38.5%), cardiovascular in 4 cases (10.3%), antiepileptic in 2 cases (5.1%), electrolyte in 1 (2.6%), NSAID in 1(2.6%) and antihistamine in 1(2.6%) [22].

In a study from Spain, a prospective, descriptive, multicentre epidemiological study on medical orders for inpatients aged 1 day to 18 years was conducted between July and October 2011 at eight hospitals treating pediatric patients. A total of 667 interventions related to quality of the prescription were recorded at eight sites. The interventions were performed on patients with a mean age of 5 years (standard deviation 5.43). In interventions concerning prescribing errors, 212 different drugs were involved, mainly belonging to the group of anti-infectives. The main factor triggering pharmacist's recommendations was dose errors of 1.5-10 times

the recommended dose. Therefore, the main prescription errors were dosing errors (49.3 %). With regard to the clinical severity of these prescribing errors, 51.9 % (306 cases) were considered significant, 26.3 % (155 cases) of minor significance, 19.8 (117 cases) were clinically serious and 2.0 % (12 cases) were potentially fatal [23].

A prospective cohort study was conducted of 1020 patients who were admitted to 2 academic medical centers during a 6-week period in April and May 1999. Of 10 778-medication orders reviewed, 616 contained errors. Of these, 120 (19.5%) were classified as potentially harmful, including 115 potential adverse drug events (18.7%) and 5 preventable adverse drug events (0.8%). Most errors occurred at the ordering stage (74%) and involved errors in dosing (28%), route (18%), or frequency (9%) [24].

A systematic review of the literature related to medication errors in Middle Eastern countries was conducted in October 2011. The search strategy included all ages and languages. Inclusion criteria were that the studies assessed or discussed the incidence of medication errors and contributory factors to medication errors during the medication treatment process in adults or in children in which Forty-five studies from 10 of the 15 Middle Eastern countries met the inclusion criteria. Nine (20 %) studies focused on medication errors in pediatric patients. Twenty-one focused on prescribing errors, 11 measured administration errors, 12 were interventional studies and one assessed transcribing errors. Dispensing and documentation errors

were inadequately evaluated. Error rates varied from 7.1 % to 90.5 % for prescribing and from 9.4 % to 80 % for administration. The most common types of prescribing errors reported were incorrect dose (with an incidence rate from 0.15 % to 34.8 % of prescriptions), wrong frequency and wrong strength. Computerized physician order entry and clinical pharmacist input were the main interventions evaluated. Poor knowledge of medicines was identified as a contributory factor for errors by both doctors (prescribers) and nurses (when administering drugs). Most studies did not assess the clinical severity of the medication errors [25].

In a study by Rauniar et al, drug prescription for pediatrics inpatients at a teaching hospital serving a developing community was investigated. A list of 695 patient record numbers was randomly generated from the 7637 children admitted over the period examined (9.1%). Prescribed drugs were computer-categorized and counted. Antibacterials (30.0%), vitamins, iron preparations and dietary supplements (20.0%), electrolytes (18.8%), analgesics (12.2%) and respiratory drugs (7.1%) comprised the most frequently-prescribed groups. The main (admitting) diagnoses of the sample were also classified. Infective diseases (42.0%), respiratory conditions (18.2%), perinatal disorders (14.9%) and nutritional deficiencies (9.9%) predominated. Data for individual drugs in the four dominant drug groups are presented. The margins between the top one or two drugs and the others in each therapeutic category were notable. Few drugs were

extensively used. They included ampicillin, paracetamol, multivitamin syrup and Darrow's preparations [26].

Chapter Three

Methodology

Chapter Three
Methodology

3.1 Study design

The study was a prospective_cross sectional study. A review of physicians' prescriptions was conducted in the Primary Heath Care centers and lasted for seven months.

3.2 Sample size, study population and settings

A sample of 400 pediatric prescriptions was reviewed and re-evaluated in terms of weight–adjusted dose, sample size was calculated using Raosoft sample size calculator. The prescriptions were collected from all centers of Primary Heath Care in Nablus city which are: AL Makhfieh center, Western center, Al Wasta center, Raselein center, Amman street center and Mother and Child Health MCH center. The researcher was in each center one day per week in a sequent pattern until the required sample was collected. The prescriptions were physicians' signed, for pediatric patients who aged between (1-144) months old. Pediatric patients whose age is >12 years may have a weight > 40 Kg and thus can have an adult dose. The medication dosing errors were defined as over-dose, under-dose, inappropriate frequency or duration.

Amman street center and Raselein are centers provide vaccination service in addition to other medical services, so the weight is measured for every child who comes for vaccination.MCH center have no pharmacy in it for

dispensing medicines hence the prescriptions were dispensed in the Middle center. In the other three centers, the weight was obtained using two types of scales: digital scale and the manual balance.

3.3 Operational definitions

A medication dosing error was defined as ≥10% deviation from the weight-appropriate dose. Drug frequency is the dosage regimen at which the drug doses are given per day. Drug duration is the period through which the drug is given and the route of administration is the way the dosage form is given.

The dose is defined as the quantity of drug taken at any one time. This can be articulated as the volume of drug solution (e.g. 10 mL , 2 drops), weight of drug (e.g. 250 mg),), the number of dosage forms (e.g. 1 capsule, 1 suppository) or some other quantity (e.g. 2 puffs) . The reference was the last updated edition of drug information hand book as this book is updated twice a year.

3.4 Inclusion criteria

All prescriptions for children aged (1-444) months where patient's weight could be obtained and were signed by the physician.

3.5 Exclusion criteria

All prescriptions for children aged >12years and all prescriptions where the weight cannot be obtained.

3.6 Data collection

Pediatric patients' prescriptions were reviewed. Patients' weight, age, medical conditions, all prescribed medications, their doses, frequency and duration were documented in a special data collection form (Appendix 1) based on the objectives of the study. Then the doses of medications were evaluated using the last updated edition of drug information hand book at that time [28].

3.7 Ethical and administrative procedures

The study proposal was approved by the Institutional Review Board (IRB) of An-Najah National University (Appendix 2), the scientific research committee of the Public Health Department and the faculty of graduate studies scientific research board council at An-Najah National University. An official request was submitted to the General Directorate of Primary Health Care in the Ministry of Health in Ramallah in order to conduct this study, this explained the aim, importance, confidentiality and anonymity of the information then an official permission was obtained (Appendix 3) and delivered to all centers of Primary Health Care in Nablus city.

3.8 Statistical methods

All data entry and analysis was performed using Statistical Package for Social Sciences Software (SPSS version 20) [29]. For continuous data, means ± standard deviations were computed. For categorical variables,

frequencies and percentages were calculated. ANOVA was used as appropriate. A p-value of less than 0.05 was considered to be statistically significant for analysis.

Chapter Four

Results

Chapter Four
Results

4.1 Socio-demographic characteristics of pediatric patients

During the study period, a total of 400 patients' prescriptions were reviewed in five governmental clinics in Nablus; 113 patients from Alwasta clinic, 81 from Balata clinic, 35 from Almakhfiya clinic, 74 from Westerrn clinic and 97 from Raselein clinic (Table 1).

Table 1: Clinics included in the study in Nablus

Clinic	Frequency (%)
Alwasta	113 (28.3)
Balata	81 (20.2)
Almakhfiya	35 (8.8)
Westerrn	74 (18.5)
Raselein	97 (24.2)
Total	400 (100)

The sample included 192(48.0%) males and 208 (52.0%) females (Figure 1).

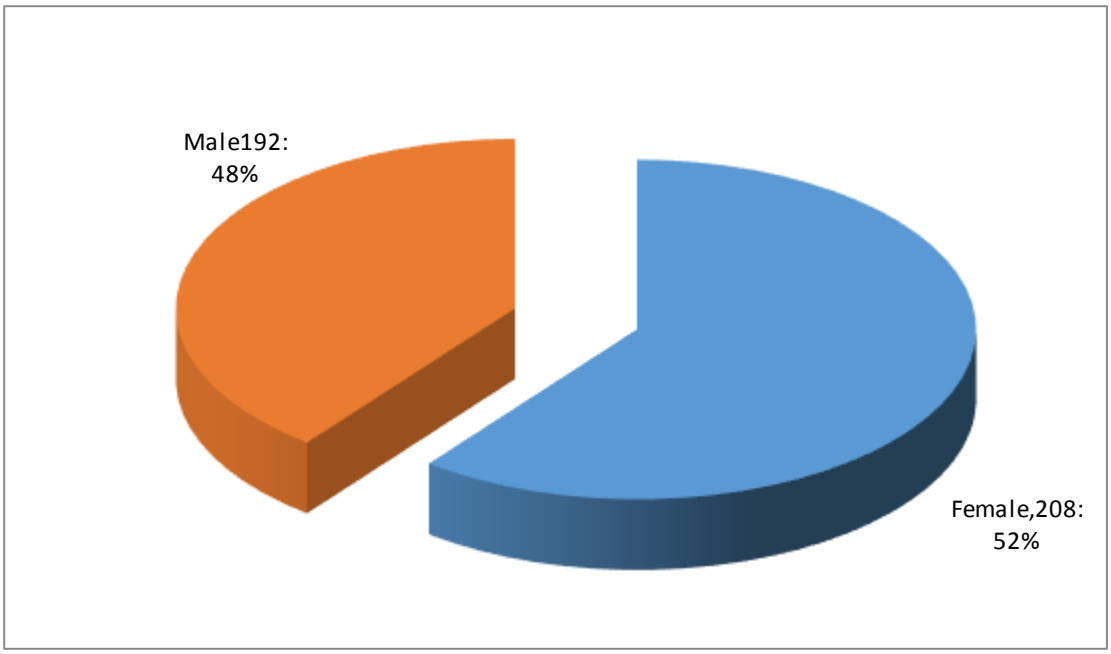


Figure 1: Gender distribution of pediatric patients in Nablus

The age of patients ranged from 1 to 144 months (around 12 years), the mean age ± SD was 45.85±31.68 months. Figure 2 shows the age distribution of the patients.

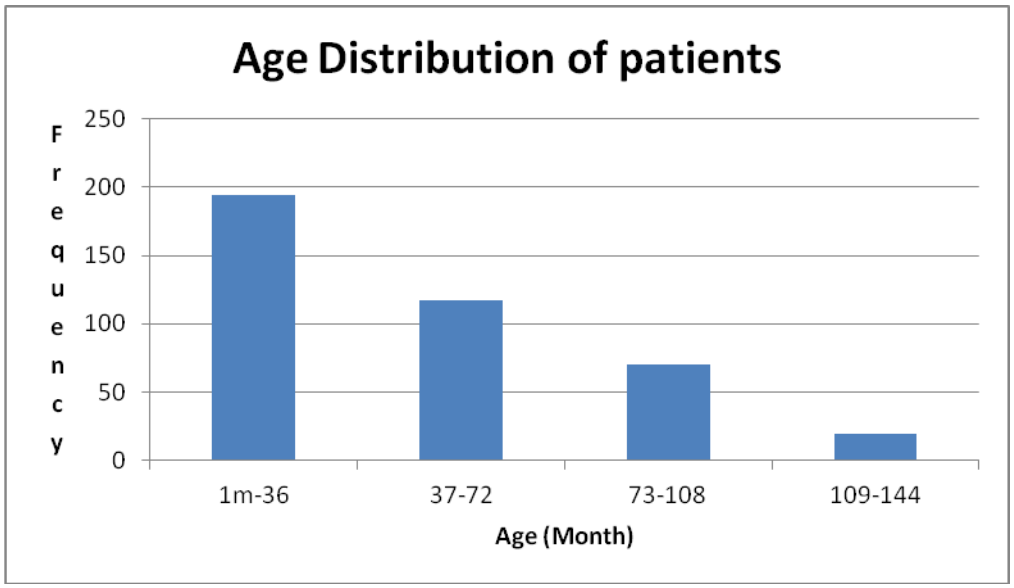


Figure 2: Age distribution of pediatric patients in Nablus

The weight was measured and documented for all patients, the mean weight ± SD was 16.55±8.07 kg (range: 2.6-55 kg).

4.2 Specialty distribution of prescribers in PHC in Nablus

The prescribers were mainly general physicians (Figure 3).

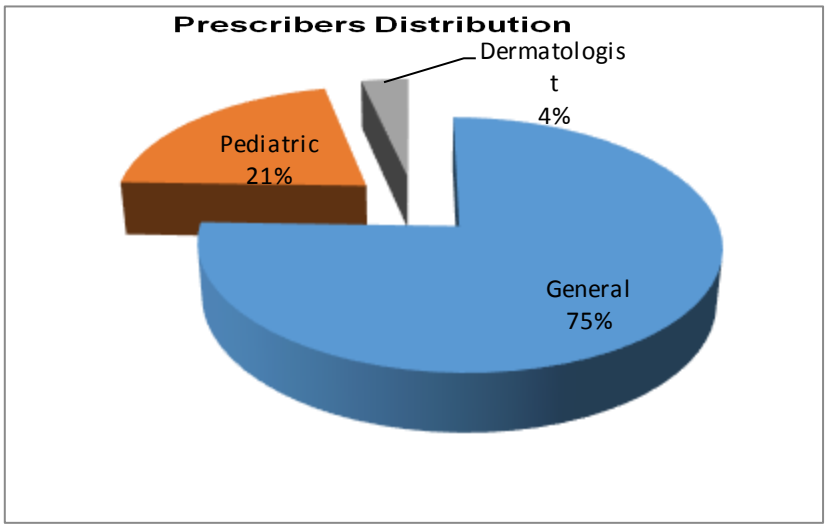


Figure 3: Specialty distribution of prescribers in PHC in Nablus

4.3 Distribution of medications prescribed for pediatric patients

The patients were prescribed 1 to 4 medications where most of them had been prescribed 3 medications (Figure 4)**.** The mean medications prescribed± SD was 1.96±0.59

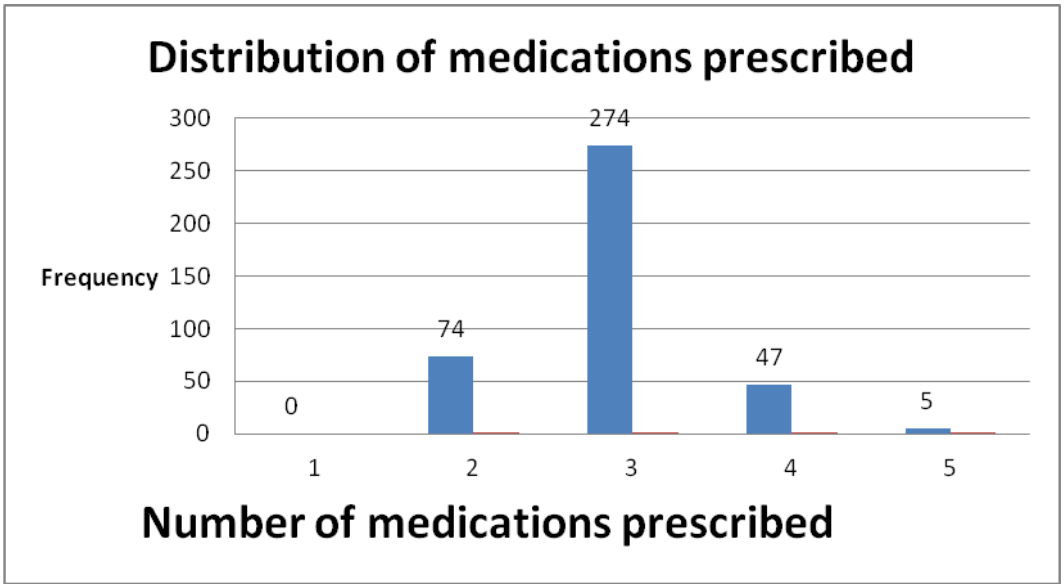


Figure 4: Number of medications prescribed for pediatrics in PHC in Nablus

4.4 Diagnosis for pediatric patients in PHC in Nablus

There were 50 different types of diagnosis in the study according to the documentation made by the physicians. The most common diagnosis was tonsillitis, which presented 25.3% of all cases, followed by common cold (13.0%) and pharyngitis (10.8%), the other reasons are shown in table 2.

Table 2: **Types of diagnoses and their frequencies for pediatric patients**

Diagnosis **Single diagnosis**	***Frequency (%)**
Tonsillitis	101 (25.3)
Common cold	52 (13.0)
Pharyngitis	43 (10.8)
Otitis media	33 (8.3)
Upper Respiratory Tract Infection	33 (8.3)
Bronchitis	24 (6.0)

Fever	11(2.8)
Dermatitis	10 (2.5)
Allergy	8 (2.0)
Cough	8 (2.0)
Urinary Tract Infection	8 (2.0)
Skin infection	6 (1.5)
Viral infection	6 (1.5)
Impetigo	4 (1.0)
Sore throat	4 (1.0)
Post vaccination	3 (0.75)
Skin allergy	3 (0.75)
Conjunctivitis	3 (0.75)
Diarrhea	2 (0.5)
Gastroenteritis	2 (0.5)
Urticaria	2 (0.5)
Oral candidiasis	2 (0.5)
Type1 diabetes	2 (0.5)
Chest infection	1 (0.25)
Chicken box	1 (0.25)
Amebiasis	1 (0.25)
Cut wound	1 (0.25)
Dental caries	1 (0.25)
Insect bite	1 (0.25)
Laryngitis	1 (0.25)
Unspecified pain	1 (0.25)
Scabies	1(0.25)
Sinusitis	1(0.25)

Toothache	1(0.25)
Ulcerated wound	1(0.25)
Combined diagnosis	
Common cold, sinusitis	2 (0.5)
Flu, fever	2 (0.5)
Cough, fever	2 (0.5)
Conjunctivitis, cough	1 (0.25)
Cough, wheezing	1 (0.25)
Cough, fungal infection	1 (0.25)
Gastroenteritis, candidiasis	1 (0.25)
Pharyngitis and candida oral	1 (0.25)
Pharyngitis and conjunctivitis	1 (0.25)
Post vaccination, wheezy chest	1 (0.25)
Tonsillitis, candidiasis	1 (0.25)
Tonsillitis, chest infection	1 (0.25)
Tonsillitis, toothache	1 (0.25)
Tonsillitis, otitis media	1 (0.25)
Upper Respiratory Tract Infection, otitis media	1(0.25)
Total	100

*Data is presented as frequency (percent).

4.5 Medications prescribed for pediatric patients and their frequencies

The patients were prescribed a total of 782 medications, twenty nine different drugs were prescribed, the most common were: Paracetamol (29.5%), Chlorpheniramine (17.0%, Amoxicillin) 16.1,%) , Ibuprofen

(8.8%) and Erythromycin (8.1%). Table 3 shows these medications, their frequency and percentage.

Table 3: Frequency of prescribed medications for pediatric patients

Name of medication	*Frequency (%)
Paracetamol	231 (29.5)
Chlorpheniramine	133 (17.0)
Amoxicillin	126 (16.1)
Ibuprofen	69 (8.8)
Erythromycin	63 (8.1)
Cephalexin	36 (4.6)
Amoxicillin+Clavulanate	17 (2.2)
Betamethasone	15 (1.9)
Azithromycin	14 (1.8)
Nystatin	10 (1.3)
Promethazine	10 (1.3)
Trimethobrim+Sulfamethoxazole	7 (0.9)
Gentamycin	6 (0.8)
Ampicillin	5 (0.6)
Iron Supplementation	5 (0.6)
Zinc oxid+Calamin	5 (0.6)
Salbutamol	5 (0.6)
Miconazole	4 (0.5)
Dexamethason Sodium Phosphate	3 (0.4)
Dimethindene	3 (0.4)
Metronidazole	3 (0.4)
Insulin NPH	2 (0.3)
Insulin Plain	2 (0.3)
Normal Saline	2 (0.3)
Oral rehydration salt	2 (0.3)
Clobetasol	1 (0.1)
Dexamethasone	1 (0.1)
Mebendazole	1 (0.1)
Tetrahydrazolin	1 (0.1)
Total	100

*Data is presented as frequency (percent).

4.6 Routes of administrations of prescribed medications for pediatric patients

Table 4 shows that the oral route was the most commonly prescribed as 702 out of 782(89.8%) medications were orally prescribed. medications, and intramuscular was the least (only one medication)

Table 4: Frequency of routes of administrations of prescribed medications for pediatric patients

Route	Frequency (%)
Oral	702 (89.8)
Rectal	26 (3.3)
Topical	24 (3.1)
Drops	27 (3.4)
Subcutaneous	2 (0.3)
Intramuscular	1 (0.1)
Total	782 (100)

* Data is presented as frequency (percent).

4.7 Number of total potential dosing errors regardless of error type

All types of potential errors were evaluated; they included inappropriate dose, frequency and duration. Most prescriptions included either one potential error in 31.8% patients or two errors in 30.8% patients (see table 5 for more details).

Table 5: **The number of total potential dosing errors regardless of error type**

Number of errors	Frequency (%)
0	50 (12.5)
1	127 (31.8)
2	123 (30.8)
3	69 (17.2)
4	26 (6.5)
5	4 (1)
6	1 (0.2)
Total	400 (100)

4.8 Frequencies and percentages of the types of errors among medications prescribed

Among 782 medications prescribed, 363 medications were correct doses (46.4%), 168 were over doses (21.5%), 200 were under doses (25.6%) and 51 were medications that should not be prescribed in similar conditions like Chlorpheniramine, Dimethindene (6.5%) depending on the age (Table 6).

Table 6: Frequencies and percentages of potential inappropriate doses among medications prescribed

Appropriateness of dose	Frequency (%)	Examples
Correct dose	363 (46.4)	
Over dose	168 (21.5)	Amoxicillin, Erythromycine
Under dose	200 (25.6)	Ibuprofen, Paracetamol
Should not be prescribed	51 (6.5)	Dimethindene, Chlorpheniramine
Total	782 (100)	

4.9 Frequencies and percentages of potential inappropriate frequency among medications prescribed

The 51medications that should not be prescribed were excluded from the analysis of frequency, this was because the reference used for dose calculation did not give any dose range or frequency or duration in these cases, from the remaining 731 medications, 37 were prescribed in potentially more than needed frequency and the frequency of 231 medications were potentially prescribed less frequently than needed as shown in table 7.

Table 7: Frequencies and percentages of potential inappropriate frequency among medications prescribed

Appropriateness of frequency	Frequency (%)	Examples
Correct frequency	395 (54)	
More frequency	37 (5.1)	Erythromycin, Cephalexin
Less frequency	231 (31.6)	Promethazine, chlorpheniramine
No available frequency	68 (9.3)	Paracetamol
Total	731 (100)	

4.10 Frequencies and percentages of potential inappropriate duration among medications prescribed

The 51 medications were also excluded from the analysis of duration, as it can be seen in table 8, the duration was correct for most medications for which it was documented; however, the duration for many medications was not available.

Table 8: Frequencies and percentages of potential inappropriate duration among medications prescribed

Appropriateness of duration	Frequency (%)	
Correct duration	466 (63.7)	
More duration	8 (1.1)	Azithromycin, Erythromycin
Less duration	20 (2.7)	Nystatin
Not available duration*	234 (32)	Chlorpheniramin, Amoxicillin
Missing **	3	
Total	731	

*Not available duration: dose and frequency of the medication were documented but duration was not **Missing: missing data

4.11 Factors associated with potential inappropriate dosing errors (PID)

ANOVA test was used because the number of errors variable was normally distributed. In analysis, the dependent variable was potential inappropriate dosing errors (PID) and independent variables were gender, age, weight, center, prescriber and number of medications as shown in table 9.

The mean ± SD and the (95%CI) for PID in male and female patients respectively were 1.68 ± 1.5 (95%CI=1.52-1.85) and 1.86 ± 1.15 (95%CI=1.70-2.02). There was no statistically significant difference in the prevalence of PID between male and female patients (*P*-value = 0.123).

Regarding the age, the mean of the age was 45 months which was used as a cut point in the analysis of the age, the mean ± SD of PID for the children aged between 1-45 months was 1.59 ± 1.12 (95% CI=1.44-1.74) while it was higher for the children aged between 46-144 months and equaled 2.00 ± 1.15 (95% CI=1.83-2.17) which means that as the child became older the PID increased. The age was significantly associated with PID (P-value < 0.001).

The mean of the weight was 16 Kg which was the cut point of weight analysis ,the mean ±SD of PID for the children whose weight was between 2.6-16 kg equaled 1.65 ± 1.15(95% CI=1.5-1.79) which was less than that for children whose weight was between 16-55 kg and it was 1.97 ± 1.13(95% CI=1.79-2.15). Therefore, as the weight of the child became

more, the PID increased. P-value for the age was 0.006 (statistically significant association).

The Western clinic had the highest proportion of PID with a mean ± SD equaled 2.34 ± 1.174 (95%CI= 2.07-2.61), while Almakhfiya clinic had the lowest one which was 0.91 ± 0.887(95%CI= 0.61-1.22). P-value for the centers was <0.001 (statistically significant association).

Regarding prescribers, pediatricians had the lowest incidence of PID: mean ± SD=1.71 ±1.147 (95%CI= 1.47-1.96) while it was the highest for dermatologists and equaled 2.14 ± 1.027(95%CI= 1.55-2.74).Prescribers subspecialty was not significantly associated with the incidence of PID (P-value=0.438).

Finally, children who were prescribed three or four medications had means of PID equaled 2.68 (95%CI= 2.28-3.08) and 2.60 (95%CI= 1.18-4.02) respectively, however ,those who were prescribed one or two medications, the means of PID were 0.93 and 1.83 respectively which means increasing the number of prescribed medications could lead to an increase in the prevalence of errors. P-value < 0.001 (statistically significant association)

Table 9: ANOVA analysis for the factors associated with potential inappropriate dosing errors (PID)

Characteristic	Frequency (%) N=400	*Number of PID Mean+-SD	95%CI**	P value***
Gender				
Male	192(48)	1.68±1.5	1.52-1.85	0.123
Female	208(52)	1.86±1.15	1.70-2.02	
Age (months)				
1-45	218(54.5)	1.59±1.12	1.44-1.74	<0.001
46-144	182(45.5)	2.00±1.15	1.83-2.17	
Weight (kg)				
2.6-16	241(60)	1.65±1.15	1.5-1.79	0.006
16.1-55	159(40)	1.97±1.13	1.79-2.15	
Center				
Alwosta Clinic		1.92±1.103	1.71-2.13	<0.001
Balata Clinic	113(28.3)	1.42±0.960	1.21-1.63	
Almakhfiya	81(20.2)	0.91±0.887	0.61-1.22	
Clinic	35(8.8)	2.34±1.174	2.07-2.61	
Western Clinic	74(18.5)	1.78±1.175	1.55-2.02	
Raselein Clinic	97(24.2)			
Prescriber				
General	302(75.5)	1.77±1.162	1.64-1.91	0.438
Pediatrician	84(21)	1.71±1.147	1.47-1.96	
Dermatologist	14(3.5)	2.14±1.027	1.55-2.74	
Number of Medications				
1	74(18.5)	0.93±0.709	0.77-1.1	<0.001
2	274(68.50	1.83±1.066	1.71-1.96	
3	47(11.8)	2.68±1.353	2.28-3.08	
4	5(1.2)	2.60±1.140	1.18-4.02	

*SD, Standard deviation. *PID, Potential inappropriate dosing errors. **CI, Confidence interval.*** Statistically significant (p <0.05)

Chapter Five

Discussion

Chapter Five
Discussion

The study aim, in general, was to assess the prevalence of medication dosing errors in outpatient pediatrics aged from 1-144 months, around 12 years in Primary Health Care Centers in Nablus city and its associated factors. But, in specific, to evaluate the major types of errors (over-dose, under-dose, inappropriate frequency or duration among the previously prescribed population.

Maternal and Child Health (MCH) center was not represented in the results but medications prescribed in it had been accounted during research period as this center had no pharmacy to dispense medications and the child got his medications from AL Wasta clinic, which was a center, included in the research.

A review of published research concerned in medication errors showed that dosing errors are possibly the major type of error in the pediatric population as eleven of sixteen studies discovered that the majority of medication errors were dosing errors [30].

The most common diagnoses in this study were: Tonsillitis (25.3%),Common cold (13.0%), Pharyngitis (10.8%), and Otitis media (8.3%), these infections are frequent to happen among pediatrics, so these results revealed the disease pattern in the studied pediatric population, this is concomitant with other studies which showed that most common causes

of illness in children are infections. One of the most prevalent introducing symptoms of pediatric illnesses is fever. Fever in children under age of five years indicates systemic inflammation, typically in response to a viral, bacterial, parasitic, or less commonly, a noninfectious etiology. Age and geographical settings plays an important role in diagnosis and treatment [31].

Infections associated with underlying causes like under-nutrition which can cause even death among children [32]. The most common cause of wheezing associated with respiratory infections in children under 5 years of age was RSV (Respiratory syncytial virus) where Mycoplasma pneumoniae was the most frequent isolate from school age children with wheezing illness. RSV, parainfluenza virus types 1 and 3, adenoviruses, and Mycoplasma pneumoniae accounted for 81% of the isolates [33].

Twenty nine different drugs were prescribed, the most common were: antipyretics like Paracetamol (29.5%), antihistamine as Chlorpheniramine (17.0%), antibiotics like Amoxicillin (16.1,%), and Erythromycin (8.1%), and the analgesic Ibuprofen (8.8%). This is in agreement with the most common reasons of visiting the centers, reflecting the irrational use of antibiotics to treat pediatrics where viruses are frequent potential causes of their illnesses and resulting in resistance to many strains of antibiotics plus wasting of money.

The prevalence of potential medication dosing errors among outpatient pediatrics was high: most prescriptions included either one error (31.8%) or two errors (30.8%).Medication dosing errors were defined as errors in dose, frequency or duration,168(21.5%) medications were prescribed with potential overdose like Amoxicillin and Erythromycine (antibiotics), while 200(25.6%) medications were prescribed with potential underdose like Ibuprofen,and paracetamol (analgesics),51 (6.5%) medications should not be prescribed like Dimethindene, Chlorpheniramine (antihistamines) ,these results presented the improper use of antihistamines plus overdoses of antibiotics and underdoses of analgesics, these high percentages are also concomitant with the high prevalence described before in McPhillips et al study which stated that15% of the studied population were probable to have dosing errors sharing this percentage equally either having overdose or under-dose [1], in addition to Oshikoya and Ojo study, under-dose and overdose were associated with (38.0%) and (18.8%) of prescriptions respectively which were near to results in this study . Inadequate and omission of the duration of use of the drugs were observed in 1981(28.3%) and 61(0.9%) prescriptions respectively [2].

Errors in frequencies contributed to high percent of medication dosing errors: medications with fewer frequencies than appropriate were 31.6 % like Promethazine and chloropheniramine (antihistamines) ,but those with frequencies more than appropriate were 5.1% like erythromycin and cephalexin(antibiotics), these results are concordant with the previous ones

which stated the improper use of antihistamines and the over use of antibiotics.68(9.3%). Medications were prescribed without mentioning their frequencies like paracetamol, this can be dangerous because although it is an OTC medication, it converts to a hepatotoxic one with improper frequency.

Durations of most medications were not available 32%, medications with durations less than needed were 2.7% like Nystatin , those with durations more than needed were 1.1% like Azithromycin, Erythromycin (antibiotics) The appropriate medication should be prescribed not only in a correct dose, the frequency and duration are important also. All these three points should be addressed.

No studies in Palestine and few in the world studied the PID in pediatric outpatients [1-3], most of the studies discussing this subject were in inpatient settings [19, 20] where children's weight is usually documented and a double or a triple check could be made or included adults not pediatrics who might be less sensitive to such errors than children. For example a. systematic review to review studies of the incidence and types of medication errors in Middle Eastern countries: only 20 % of the studies focused on medication errors in pediatric patients [34]. The majority of studies which were related to medication errors including dose calculation mistakes were conducted among adult population. However, latest proof assures that medication errors are also a real problem in the pediatric population [35].

In a study by Doherty and Mc Donnell, tenfold medication errors were examined in pediatric inpatient which represented a significant source of risk for this population; this was caused by wide variations in age, weight, dosing ranges and off-label practices, 252 10-fold medication errors were identified from 6643 medication reports of safety. Twenty-two reports documented patient harm. Errors of dose calculation were one of the frequent participating causes to 10-fold medication error [36].

No significant differences in the dependent variable (PID) were found between males and females; this was concomitant with other previous studies [1, 2].

Age is a socio demographic factor that showed a statistically significant association with the prevalence of PID, The age of the child and its association with errors was a remarkable finding because on the contrary of the results of a previous study which stated that the number and rate of medication error events decreased with increasing child age [3], this study found the opposite and the prevalence of PID increased with increased age, the mean ± SD of PID for the children aged between 46-144 month was 2.00 ±1.15 (P value <0.001) .

We could comment here that older children were prescribed doses the same as those for younger children and the dose 5 cc for syrup medications was frequent regardless of the age (under-dose =25.6%,overdose21.5%).

A chief finding of the study was that as the weight of the child increased, the potentiality of the errors increased, which is not highlighted by any other previous study. Weight is a very important determinant of the dose as it is the factor through which the dose is expressed for children. Number of factors were identified to understand the mechanism of pediatric medication errors. One of These factors was the lack of the available documented weights to calculate the precise weight-based doses for children [37]. A significant association was found between weight and potentiality of errors (P-value=0.006), the rate of PID increased when the weight of the child increased, this was a focal point of this study: the absence of children weighing process before calculating the dose was main cause for errors in the doses. The results were concomitant with each other as increasing the age is usually accompanied by increasing the weight of the child.

Getting the weight of the child was not an easy issue in this study: it was difficult to weigh every young child, or sometimes the child himself refused to be weighed, I had to weigh the children by myself without assistant of doctor or the nurse because there was no protocol to weigh the child before prescribing a medication, the weight of the child is not considered as an information that should be mentioned in the form of prescription adopted in MOH, the heavy load of work and huge number of patients in these centers in addition to this the scale mostly was not in the same room in which the doctor was.

This study investigated the association between the prevalence of PID and each outpatient clinic in which the study was conducted, The Western clinic had the highest prevalence of PID, this clinic had dermatological clinic and many of the 51medications which should not be prescribed were prescribed in this clinic for dermatological diseases, for examples: betamethasone should not be prescribed below the age of 12 years, chloropheniramine should not be prescribed below the age of two years old[28], and both of these drugs are used to treat dermatological diseases. Al Almakhfiya clinic had the lowest prevalence of PID and this may be due to the small contribution of this clinic to the sample as small numbers of children usually treated in this clinic. The association with this factor was significant.

Physicians who prescribed the medications played an important role in either existence or the absence of PID, dermatologists were the most to be associated with such errors followed by general physicians and the least to have errors were pediatrics, which is logical.

The fact that the western clinic was associated with the highest prevalence of errors was consistent with the association of PID with dermatologists who prescribed medications in this clinic; however, the association with this factor was not significant.

A significant association between the prevalence of PID and the number of medications prescribed was found, increasing the number of medications

led to an increase in the existence of PID as the patient need for a larger number of drugs usually represents complexity of the case and increases the load on the physician. For example, in a retrospective study that evaluated medication errors in community pharmacy settings, they found that 40% of errors were incorrect medications while 31% were due to incorrect doses ,one of the causing factors of errors was related to high prescription volumes[38].Routine violations of prescribing rules was a vital cause of prescription errors plus the fact that doctors reliance is on pharmacists and nurses to recognize and correct errors [39].

5.1 Strengths and limitations

5.1.1Strengths

1. To the best of our knowledge, this was the first study in this field in Palestine.
2. All the centers of Primary Health Care in Nablus City were included in this study.
3. The sample was large enough and representative

5.1.2 Limitations

1. The study was in Nablus city only and this may not be representative to the practice in other places.

2. Drug references may have different recommendations regarding pediatric doses, however, this study can give baseline data.

3. Cross sectional design of the study, where we can't generate causal relationships between the dependent and independent variables

4. Some centers like Al Almakhfiya clinic had very limited number of children to be treated there and it was visited more frequent times to collect the data.
5. Diagnosis of the case and duration of therapy was not documented in many cases, this required a manual documentation to them
6. Implementing HIS (Health Information System) was another limitation as it adopted a single frequency which is 1*1(the only available option for frequency), so doctors were asked to write frequencies on papers for each patient.
7. Getting the weight of the child was a limitation as there were no protocol of weighing children before prescribing medications

Despite these limitations we believe that this study provided a baseline data to assess the prevalence of medication dosing errors in outpatient pediatrics aged from 1-144 months years in Primary Health Care centers in Nablus city and its associated factors.

Chapter Six

Conclusions and Recommendations

Chapter Six
Conclusions and Recommendations

6.1 Conclusion

We could conclude that medication-dosing errors is an actual problem among outpatient pediatrics in Nablus city, adding to the importance of this problem two serious factors: the sensitivity of pediatric population to such errors plus the high prevalence of these errors, which was among the results of this study. Many variables were found to be significantly associated with such errors like weight, age, number of medications prescribed and the center; this provided us with better understanding of the way how these errors happen and forms the core on which any preventive strategy can depend. Moreover, further research is considered necessary to explain mechanism of these potential errors and to shed light on additional possible associated factors.

6.2 Recommendations

It is recommended to have good communication between all healthcare workers and to examine present system and its capacity in identifying serious errors that may cause harm to the patients and preventing adverse consequences. Furthermore, work to investigate the incidence and causes of medication errors in pediatrics is urgently required, plus studies on the

clinical impact of these potential errors and effective error prevention strategies are needed.

6.3 Specific recommendations

- As medication errors may lead to serious consequences, there is a demanding necessity to improve methods to reduce medication errors in pediatrics and considering dosing errors the first priority.
- Documenting weight and considering it as a basic data that must be included in any prescription according to which dose should be prescribed.
- Monitoring committee or having a clinical pharmacist is recommended to evaluate all pediatric prescriptions for correctness, adequacy and dosage accuracy using appropriate indicator(s) like weight and age.
- Junior doctors should be trained in the essentials of drug dosing and obligated on good practice in documentation with considering prescription writing as a significant issue.
- Communication in three domains could play an important preventative role to ensure pediatric mediation safety: doctor patient communication, interprofessional communication and researcher/professional discussion.
- Implementing provider order entry systems, especially computerized prescription; to implement bar-coding for medications with dosing alert system, this might prevent dosing errors from reaching patients.

- A recognized national standard for dosing that can be implemented so that evidence-based pediatric dosages can be calculated.
- Interventions to reduce medication dosing errors should be implemented intensively in the western clinic as this center had the highest percent of these errors.
- The role of pharmacist is essential in preventing medication dosing errors by re-evaluating the doses, frequencies or durations of medications before dispensing them based on updated standards for dosing and modifying them in coordination with doctors.

References

1. McPhillips, H.A., Stille, C.J., Smith, D., Hecht, J., Pearson, J., Stull, J., ….&., Gurwitz, J. (2005). **Potential medication dosing errors in outpatient pediatrics.** The Journal of Pediatrics.;147(6):761-767.
2. Oshikoya, K.A., Ojo, O.I. (.2007). **Medication errors in paediatric outpatient prescriptions of a teaching hospital in Nigeria.** Nigerian Quarterly Journal of Hospital Medicine .; 17(2):74-78.
3. Smith, M.D., Spiller, H.A., Casavant, M.J., Chounthirath, T., Brophy, T.J.,& Xiang, H.(2014). **Out-of-hospital medication errors among young children in the United States, 2002–2012**. Pediatrics; peds-2014.
4. Budnitz, D.S., Salis, S. (2011). **Preventing Medication Overdoses in Young Children: An Opportunity for Harm Elimination.** Pediatrics.; 127(6):e1597 -e1599.
5. Shankar, P.R., Upadhyay, D.K., Subish, P., Dubey, A.K., Mishra, P. (2006). **Prescribing patterns among paediatric inpatients in a teaching hospital in western Nepal**. Singapore Medical Journal.;47(4):261-265.
6. Kaushal, R, Jaggi ,T., Walsh, K., Fortescue, E.B., Bates, D.W. (2004). **Pediatric medication errors: what do we know? What gaps remain?** Ambulatory Pediatrics.;4(1):73-81.

7. Lim, C.A.E., Kaufman, B.J., O'Connor, J., Cunningham, S.J.(2013). **Accuracy of weight estimates in pediatric patients by prehospital Emergency Medical Services personnel**. The American Journal of Emergency Medicine,.;31(7):1108-1112

8. Wimmer, S., Neubert, A., & Rascher, W. (2015). **The Safety of Drug Therapy in Children**. Deutsches Ärzteblatt International, 112(46), 781-787**.**

9. Castro-Pastrana, L. I., & Carleton, B. C. (2010). **Improving pediatric drug safety: need for more efficient clinical translation of pharmacovigilance knowledge.** Journal of Population Therapeutics and Clinical Pharmacology= Journal de la Therapeutique des Populations et de la Pharamcologie Clinique,18, e76-88.

10. **http://www.who.int/medicines/areas/quality_safety/safety_efficacy/pv_nc_meeting/en ,**l ast access was in 30/4/2016

11. Neubert, A. (2012). **Pharmacovigilance in Pediatrics.** Pediatric Drugs, 14(1), 1-5.

12. Choonara, I**.(2006) Paediatric pharmacovigilance.** Paediatric and Perinatal Drug Therapy; 7(2):50–53

13. Conroy, S., Sweis, D., Planner, C., Yeung, V., Collier, J., Haines, L.&Wong, I.C. (2007) **Interventions to reduce dosing errors in children**. Drug Saf.;30(12), 1111-1125.

14. Rinke, M. L., Bundy, D. G., Velasquez, C. A., Rao, S., Zerhouni, Y., Lobner, K., ... & Miller, M. R. (2014). **Interventions to reduce**

pediatric medication errors: a systematic review. Pediatrics, peds-2013.

15. Shah, A. N., Frush, K., Luo, X., & Wears, R. L. (2003). **Effect of an intervention standardization system on pediatric dosing and equipment size determination: a crossover trial involving simulated resuscitation events.** Archives of Pediatrics & Adolescent Medicine, 157(3), 229-236
16. Kim, G. R., Chen, A. R., Arceci, R. J., Mitchell, S. H., Kokoszka, K. M., Daniel, D., & Lehmann, C. U. (2006). **Error reduction in pediatric chemotherapy: computerized order entry and failure modes and effects analysis**. Archives of Pediatrics & Adolescent Medicine, 160(5), 495-498.
17. Ghaleb MA, Barber N, Franklin BD, Yeung VW, Khaki ZF, Wong IC. **Systematic review of medication errors in pediatric patients.** Annals of Pharmacotherapy 2006; 40(10), 1766-1776.
18. Resar R.Will, **Ideas, and Execution: Their Role in Reducing Adverse Medication Events.** The Journal of Pediatrics 2005;147(6): 727–728.
19. Al Anazi, M., Al-Jeraisy, M., & Abolfotouh, M. A. (2015). **Medication prescribing errors in a pediatric inpatient tertiary care setting in Saudi Arabia.** Journal of Infection and Public Health, 8(4), 395.

20. Slonim, A. D., LaFleur, B. J., Ahmed, W., & Joseph, J. G. (2003). **Hospital-reported medical errors in children**. Pediatrics, 111(3), 617-621.

21. Ross, L. M., Wallace, J., & Paton, J. Y. (2000). **Medication errors in a paediatric teaching hospital in the UK: five years operational experience.** Archives of Disease in Childhood, 83(6), 492-497.

22. Lesar, T. S. (2002). **Tenfold medication dose prescribing errors.** Annals of Pharmacotherapy, 36(12), 1833-1839.

23. Fernández-Llamazares, C. M., Pozas, M., Feal, B., Cabañas, M. J., Villaronga, M., Hernández-Gago, Y., ... & Álvarez-del-Vayo, C. (2013). **Profile of prescribing errors detected by clinical pharmacists in paediatric hospitals in Spain**. International Journal of Clinical Pharmacy, 35(4), 638-646.

24. Fortescue, E. B., Kaushal, R., Landrigan, C. P., McKenna, K. J., Clapp, M. D., Federico, F., ... & Bates, D. W. (2003). **Prioritizing strategies for preventing medication errors and adverse drug events in pediatricinpatients**. Pediatrics, 111(4), 722-729.

25. Summers, R. S., & Summers, B. (1986). **Drug prescribing in paediatrics at a teaching hospital serving a developing community**. Annals of Tropical Paediatrics, 6(2), 129-133.

26. Rauniar, G. P., Naga Rani, M. A., & Das, B. P. (2000). **Prescribing pattern of antimicrobial agents in paediatric in-patients.** Journal of Nepalgunj Medical College, 3, 34-7.

27...http://www.drugs.com/dosage/ **More about dosage and administration** , last access in 28/4/2015.

28.. Corbett,A.H., Dana, W. J., Fuller, M. A.,Gallagher,J.C.,Golembiewski,J.A.,Gonzales,J.P.,……..&Young,S.. (2015). **Drug information handbook with international trade names index**. Lexicomp.

29..SPSS Inc. (2007): **SPSS 16 for windows- Statistical Package for the Social Sciences.** Chicago, USA. (www.spss.com).

30.Wong, I. C., Ghaleb, M. A., Franklin, B. D., & Barber, N. (2004). **Incidence and nature of dosing errors in paediatric medications.** Drug Safety, 27(9), 661-670.

31.Herlihy, J. M., D'Acremont, V., Burgess, D. C. H., & Hamer, D. H. (2016). **Diagnosis and Treatment of the Febrile Child.** Reproductive, Maternal, Newborn, and Child Health, 137.

32.Black, R. E., Morris, S. S., & Bryce, J. (2003). **Where and why are 10 million children dying every year?**. The Lancet, 361(9376), 2226-2234.

33.Henderson, F. W., Clyde, W. A., Collier, A. M., Denny, F. W., Senior, R. J., Sheaffer, C. I., ... & Christian, R. M. (1979). **The etiologic and epidemiologic spectrum of bronchiolitis in pediatric practice**. The Journal of Pediatrics,95(2), 35-39.]

34. Alsulami, Z., Conroy, S., & Choonara, I. (2013). **Medication errors in the Middle East countries: a systematic review of the**

literature. European Journal of Clinical Pharmacology, 69(4), 995-1008

35. Wong, I. C. K., Wong, L. Y., & Cranswick, N. E. (2009). **Minimising medication errors in children**. Archives of Disease in Childhood, 94(2), 161-164.

36. Doherty, C., & Mc Donnell, C. (2012). **Tenfold medication errors: 5 years'experience at a university- affiliated pediatric hospital**. Pediatrics, 129(5), 916-924.

37. .Henriksen, K., Battles, J. B., Marks, E. S., & Lewin, D. I. (2005). **Methodological Challenges in Describing Medication Dosing Errors in Children**--Advances in Patient Safety: From Research to Implementation (Volume 2: Concepts and Methodology).

38. Phillips, J., Beam, S., Brinker, A., Holquist, C., Honig, P., Lee, L. Y., & Pamer, C. (2001). **Retrospective analysis of mortalities associated with medication errors.** American Journal of Health-System Pharmacy, 58(19), 1835-1841.

39. Dornan, T., Ashcroft, D., Heathfield, H., Lewis, P., Miles, J., Taylor, D., ... & Wass, V. (2009). **An in-depth investigation into causes of prescribing errors by foundation trainees in relation to their medical education**: EQUIP study. London: General Medical Council, 1-215.

Appendices

Appendix 1: Data collection form

- ✓ **Section 1 : general information:**

Case number :	Date:
Primary Health Care Center name :	Prescriber : General, Pediatric, Others_____

- ✓ **Section 2 :patient information:**

Diagnosis:	
Weight of patient:	
Gender of patient : ☐ Male ☐ Female	
Age of patient:	

- ✓ **Section 3 : Prescribed medications:**

No.	Name of the drug	Route of administration	Dose	Frequency	Duration
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

- ✓ **Section 4 : Evaluation of prescribed medications:**

No.	Name of the drug	Appropriate dose	Appropriate frequency	Appropriate duration
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Appendix 2: IRB Approval

An - Najah
National University
Faculty of Medicine & Health Sciences
Department of Graduate Studies

بسم الله الرحمن الرحيم

جامعة النجاح
الوطنية
كلية الطب وعلوم الصحة
دائرة الدراسات العليا

IRB Approval letter

Study title:
Evaluation of Medication Dosing Errors in Outpatient Pediatrics in Primary Health Care Centers in Nablus City

Submitted by:
Ghadeer Al Shareef/Ameireh

Date Reviewed:
May 4,2015

Date approved:
May 19, 2015

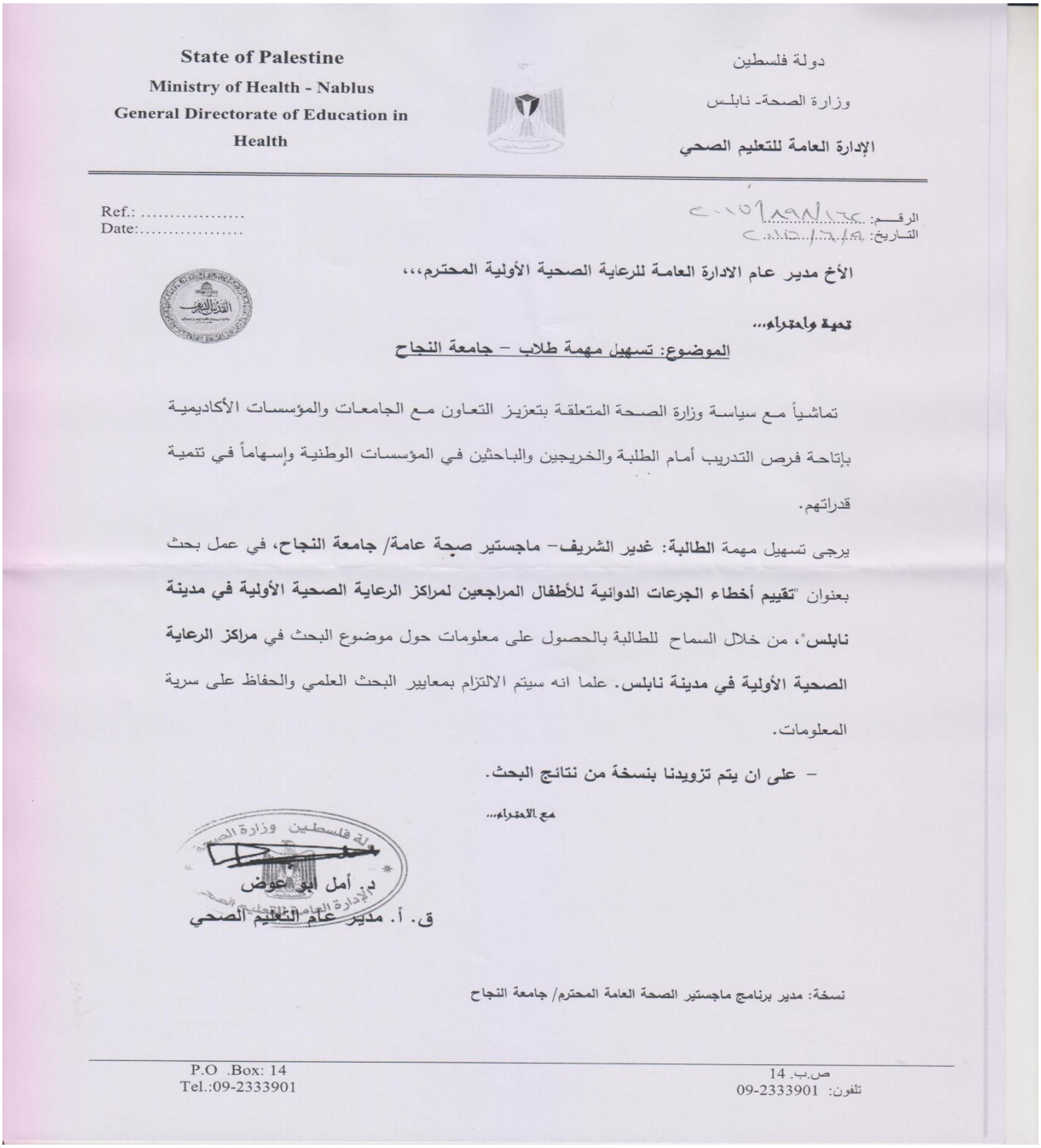
Your study titled: "Evaluation of Medication Dosing Errors in Outpatient Pediatrics in Primary Health Care Centers in Nablus City" with archived number 44/May/2015 , Was reviewed by An-Najah National University IRB committee & approved on May 19, 2015 .

Hasan Fitian , MD

IRB Committee Chairman,
An-Najah National University

نابلس – ص.ب 7 أو 707 هاتف 14/8/7/4/2342902(09)(970) ، فاكسميل 2342910 (09) (970)
Nablus – P.O.Box: 7 or 707 – Tel (970) (09) 2342902/4/7/8/14 – Faximile (970)(09)2342910
Email: hgs@najah.edu Web Site: www.najah.edu

Appendix 3: The letter of the General Directorate of Education in Health to the General Directorate of Primary Health Care facilitate the student's mission



State of Palestine
Ministry of Health - Nablus
General Directorate of Education in Health

دولة فلسطين
وزارة الصحة- نابلس
الإدارة العامة للتعليم الصحي

Ref.: .....
Date:.....

الرقم: ٢٠٥٦٨٩٨١٦٤-٢
التاريخ: ٢٠٢٠/٦/١٨

الأخ مدير عام الادارة العامة للرعاية الصحية الأولية المحترم،،،

تحية واحترام،،،

الموضوع: تسهيل مهمة طلاب – جامعة النجاح

تماشياً مع سياسة وزارة الصحة المتعلقة بتعزيز التعاون مع الجامعات والمؤسسات الأكاديمية بإتاحة فرص التدريب أمام الطلبة والخريجين والباحثين في المؤسسات الوطنية وإسهاماً في تنمية قدراتهم.

يرجى تسهيل مهمة **الطالبة: غدير الشريف– ماجستير صحة عامة/ جامعة النجاح**، في عمل بحث بعنوان "**تقييم أخطاء الجرعات الدوائية للأطفال المراجعين لمراكز الرعاية الصحية الأولية في مدينة نابلس**"، من خلال السماح للطالبة بالحصول على معلومات حول موضوع البحث في **مراكز الرعاية الصحية الأولية في مدينة نابلس**. علما انه سيتم الالتزام بمعايير البحث العلمي والحفاظ على سرية المعلومات.

- **على ان يتم تزويدنا بنسخة من نتائج البحث.**

مع الاحترام،،،

دولة فلسطين وزارة الصحة
الإدارة العامة للتعليم الصحي

د. أمل أبو عوض
ق. أ. مدير عام التعليم الصحي

نسخة: مدير برنامج ماجستير الصحة العامة المحترم/ جامعة النجاح

P.O .Box: 14
Tel.:09-2333901

ص.ب. 14
تلفون: 09-2333901

جامعة النجاح الوطنية

كلية الدراسات العليا

تقييم أخطاء الجرعات الدوائية للأطفال المراجعين لمراكز الرعاية الصحية الاولية في مدينة نابلس

إعداد

غدير تحسين الشريف عميرة

إشراف

د. رواء الرمحي

د. حمزة الزبدي

قدمت هذه الأطروحة استكمالاً لمتطلبات الحصول على درجة الماجستير في الصحة العامة بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس–فلسطين

2016

تقييم أخطاء الجرعات الدوائية للأطفال المراجعين لمراكز الرعاية الصحية الاولية في إعداد مدينة نابلس

غدير تحسين الشريف عميرة

إشراف

د. رواء الرمحي

د. حمزة الزبدي

الملخص

خلفية الدراسة: الأطفال المرضى حساسين أكثر من غيرهم من المرضى عند حصول الأخطاء الدوائية بما فيها الأخطاء في الجرعة الدوائية وبالتالي يمكن أن يكونوا عرضه لنتائج خطيره في حال حصول تلك الأخطاء بشكل متكرر وعند إستخدام أدوية شائعة الإستعمال لعلاج الأطفال، وبالتالي فإن هذا الأمر يعتبر قضية تخص الصحة العامة ويمكن الحيلولة دون وقوعها عند تطبيق إستراتيجيات متكاملة من قبل أطراف مختلفة.

الهدف: تقييم إنتشار الأخطاء في الجرعات الدوائية لدى الأطفال المرضى الذين تتراوح أعمارهم من صفر –12 سنه وذلك في العيادات الخارجية في مراكز الرعاية الصحية الاولية في مدينة نابلس والعوامل التي يمكن أن تؤدي إلى حصولها.

المنهجية: تم إجراء دراسه مقطعية و تم من خلالها مراجعه للوصفات المكتوبة من قبل الأطباء حيث وصل حجم العينه الى 400 وصفة طبية تخص الأطفال الذين تتراوح اعمارهم من صفر –12 سنه كما تمت المراجعه و إعادة التقييم للجرعه المكتوبة بناءا على وزن الطفل .

تم تعريف الأخطاء الطبية في الجرعه الدوائية على أنها إما جرعه زائده عن الحاجة أو انها جرعه أقل من الجرعه اللازمة أو عدم ملائمة كل من تكرارات إعطاء الدواء خلال 24 ساعة أو فترة إعطاء الدواء

النتائج: تم وصف 782 دواء للمرضى الأطفال ضمن العينة المأخوذة، وكان عدد أصناف الأدوية 29 صنف مختلف وأغلب الأدوية الموصوفة كانت كالآتي: باراسيتامول بنسبة 29.5% من العينة، كلورفينيرامين بنسبة 17% من العينة وأموكسيسيلن بنسبة 16.1% من العينة. كانت غالبية الأدوية الموصوفه عن طريق الفم بما يعادل 702 دواء من أصل 782 وبنسبة 89.8% كما كانت نسبة إنتشار الأخطاء الطبية للجرعات الدوائية كما يلي: 31.8% من الوصفات احتوت على خطأ واحد بينما 30.8% من الوصفات احتوت على خطأين، 168 دواء تم وصفها بجرعات أعلى من اللازم بنسبة 21.5% و200 دواء تم وصفها بجرعات أقل من اللازم بنسبة 25.6% بالإضافة الى 51 دواء كان يجب عدم وصفها في ظروف مماثلة بناءا على عمر المريض. فيما يخص تكرار إعطاء الدواء خلال 24 ساعة تم وصف 37 دواء بتكرار أكثر من اللازم و231 دواء تم وصفهم بتكرار أقل من اللازم. 8 أدوية تم وصفها لمده أطول من اللازم و28 دواء تم وصفها لمده أقصر من اللازم. لقد وجد أن العمر، الوزن، مركز الرعاية الصحية الأولية وعدد الأدوية الموصوفة جميعها عوامل لها علاقة باحتمالية حدوث أخطاء في الجرعات الدوائية.

الاستنتاج: أخطاء الجرعات الدوائيه بين الاطفال المرضى في العيادات الخارجيه كانت شائعه وكان هناك عدة عوامل متعلقة بحصول مثل هذه الأخطاء مثل وزن الطفل وعمره وعدد الأدوية الموصوفة ومركز الرعاية الصحية الأولية الذي تم علاج الطفل فيه الامر الذي أدى إلى خلق فهم أفضل لدينا عن كيفية حدوث مثل هذه الأخطاء، لكن لا زلنا بحاجه الى دراسات أخرى تتعلق بالأثر الطبي لمثل هذه الأخطاء وبالإضافه إلى إستراتيجيات فعاله لمنع حصول هذه الأخطاء.