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The Relationship between Emergency Department Average Length Of Stay (LOS) and Laboratory Testing at Governmental Hospitals in West Bank

Samia Mousa Mahmoud Al-Sabbah

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The Relationship between Emergency Department Average Length Of Stay (LOS) and Laboratory Testing at Governmental Hospitals in West Bank

Prepared By:
Samia Mousa Mahmoud Al-Sabbah
B.Sc. Medical Technology, Al-Quds University – Palestine

Supervisor: Asma Imam, PhD

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Thesis Approval

"The Relationship between Emergency Department Average Length Of Stay (LOS) and Laboratory Testing at Governmental Hospitals in West Bank"

Prepared By: Samia Mousa Al-Sabbah
Student ID No: 21511702

Supervisor: Asam Imam, PhD

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The names and signatures of examining committee members were as follow:

1-Head of committee: Dr. Asma Imam   Signature
2-Internal Examiner: Dr. Motasem Hamdan   Signature
3-External Examiner: Dr. Yaser Issa   Signature

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Dedication

To my parents who gave me the road of success.

To my brothers, my sisters and my family,

To my friends and colleagues who encouraged me to complete this work

Thank you and may Allah bless you

Samia Mousa Mahmoud Al-Sabbah

Declaration

I certify that this thesis submitted for the degree of Master is the result of my own research, except where otherwise acknowledged, and that this thesis (or any of its parts) has not been submitted for higher degree to any other university or institution.

Signed ....

Samia Mousa Mahmoud Al-Sabbah

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Abstract

Background: Waiting time in emergency departments (ED) is an issue in many countries that causes considerable delays in receiving medical care and negatively influences patient satisfaction. ED length of stay (LOS) which is defined as" the interval between the time of arrival to the ED and the time of ED departure (either admission or discharge) " (Rathlev*et al*., 2012). It is associated with ED crowding are affected by many factors. ED-LOS is an important indicator of the quality of care in ED.

Aim: To assess the duration of patient visits to the ED and to explore the relationship between laboratory testing and ED-LOS.

Methods: Medical records of 597 patient visits to the ED of Palestinian Medical Complex (PMC), Rafedia, BeitJala and Hebron governmental hospitals, between the period of January 1st 2017 to December 31st 2017, were retrospectively retrieved. Data was collected from the hospitals' computerized health information system. The visits' information in terms of the arrival time, the discharge time, the number of laboratory tests done, the laboratory sample acceptance time and results' approval time, the patient end point and patient's characteristic were collected. Regression, T-test, one way analysis of variance (ANOVA), and the Tukey test were used to evaluate the validity of the association between variables.

Results: A total of 597 patient visits were included for analysis with an overall mean ED LOS 125.70 minutes. The study selected three factors (patients' characteristics, day arrival time and patients end point from ED) the laboratory testing to assess their relationship with ED LOD**.**

Study results indicate that there is a significant statistical positive correlation between the emergency department length of stay, number of laboratory tests done and turnaround time of laboratory tests beta value (0.092 P=0.028) and (0.095 P=0.023), respectively. In relation to the hospital, the LOS was the highest in Hebron Hospital (M= 195.67, SD= 103.3). According to the day arrival time, the night shift had the highest LOS (M= 142.47, SD= 109.20).The mean LOS of ED for patients admitted, discharged home and patients discharged against medical advice was 155.14 , 120.53 and 38.22 minutes, respectively.

Conclusion: The study results show that gender does not have significant influence ED LOS. On the other hand, it was found that the patients' age, day arrival time (shift), the patient end point from ED, the number of laboratory tests and the laboratory tests turnaround time were significantly influence emergency department LOS.

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List of Abbreviations

(ED)   Emergency Department

(EM)   Emergency Medicine

(EQA)   External Quality Assessment

(FDA)   Food and Drug Administration

(LOS)   Length of Stay

(MOH)   Ministry of Health

(PMD)   Palestine Medical Complex

(PT)   Proficiency Testing

(AACC)   The American Association for Clinical Chemistry

(CLSI)   The Clinical Laboratory Standard Institute

(ISO)   The International Organization for Standardization

(NCCLS)   The National Committee for Clinical Laboratory Standards

(RQA)   The Research Quality Association

(WHO)   The World Health Organization

(TAT)   Turnaround Time

(EL)   Emergency Laboratory

(PMMS)   Palestinian Medical Military Services

(UNRWA)   United Nations Relief and Works Agency

(NGOs)   Non-Government Organizations

(POCT)   point-of-care testing

(HIS)   Health Information System

Chapter one

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Introduction

1.1 Background

Emergency Medicine (EM) is an remarkably central issue of healthcare systems (Bashkin, 2015), and   is a relatively new specialty that is expanding worldwide (Al-Agappan, 2014). EM is concerned with the care and treatment of patients who suffer an unexpected illness or injury, and who require immediate medical attention. Therefore, it must be available around the clock and at all times (Bashkin, 2015).

Moreover, key measurement of the Emergency Department (ED) throughput is Patient Length of Stay (LOS) and it has been considered as a major cause of ED overcrowding (Bashkin, 2015). Crowding and high patient LOS have become a daily challenges to providing high-quality care in ED worldwide (Johnson, 2011). Both of which are directly associated with other quality of care measures such as patient satisfaction , morbidity of ventilated patients, mortality among critical patients and also increase in ED-LOS have been associated with inpatient LOS. (Herring, 2009; Holland,2006).   Previous studies have expressed the presence of relationships between increased LOS with independent variables such as triage level, arrival time, the patients' end point from emergency department, radiology studies, laboratory tests, special procedures, sedation, consultations, and waiting time for inpatient room availability (Chaou*et al.,* 2016; Gardner *et al*., 2007; Forster *et al*., 2003; Yoon *et al*., 2003).

Lehto (2016)reported that the Turnaround Time (TAT) of laboratory tests has a direct influence on the duration of stay of patients in the ED: the reduction of laboratory TAT shortens ED stay and enhances the safety and satisfaction of patients. TAT a key indicator of laboratory performance which is one of the most noticeable quality indicators, a reliable indicator of laboratory effectiveness and it indicates the timeliness with which laboratory personnel deliver test results.

1.2 Problem Statement:

The patient's average LOS in the emergency department is one of the performance measures of ED, which is affected by many factors. There are several studies conducted in Western countries analyzing the factors that influence Emergency department LOS. However in Palestine up to our knowledge there are no studies about both ED-LOS and TAT in MOH laboratories according to the Quality and Planning Department in the Ministry of Health (MOH). This study is the first Palestinian study according to the researcher knowledge which focuses on analyzing the factors that influence ED-LOS, evaluating the analytical performance of MOH medical laboratories by measuring the TAT of laboratory tests that requested by ED. Therefore, the aim of this study was to assess the relationship between laboratory testing and patients LOS at the Emergency Departments in Palestinian Governmental hospitals.

1.2 Justification of the study:

A large number of patient visits to the ED may lead to overcrowding, as reflected by longer patient waiting times. This may place patients at a greater risk of poor health-related outcomes (Miro*et al.,* 2003; Ducharme*et al*., 2008).

ED performance measures that were identified in the literature include, but are not limited to, ED time intervals such as LOS, ambulance off-loading time, arrival-hospitalization and patient centeredness and safety performance measures (Sørup, Jacobsen and Forberg, 2013). Length of stay (LOS) is one of the important quality factors in the ED, whereby prolonged waiting time can increase the likelihood of patient dissatisfaction (Bourdeaux and Hea, 2004; Hedges *et al*., 2002). One of the simplest definitions of ED-LOS is the arrival time to departure time. The departure process may be one of the three potential destinations. The patient might be discharged (home or to an outpatient facility), transferred to another in-patient facility or admitted at the same facility (Jennifer *et al*., 2015).

Several factors influence the LOS of adult patients. Those include patient characteristics, the requirement for further evaluation such as radiology studies and laboratory tests, the need for sedation or special procedures, and the waiting time for hospitalization (Gardner *et al*., 2007; Forster *et al*., 2003; Yoon *et al*., 2003).

As yet, no study in Palestine has published data concerning factors associated with LOS in the Palestinian hospitals' EDs . This cross-sectional retrospective study might lay the foundation for a good basis to assess the ED performance of Palestinian MOH hospitals by evaluating the average LOS for emergency department patients, identifying the factors associated with it and assessing the relationship between LOS and laboratory testing.

The results of the current study may provide useful information for policy makers to understand the factors that affect patients' length of stay (LOS) in emergency departments (ED) in MOH hospitals as well as to improving the quality of care.

1.4 Aim and objectives

1.4.1 Aim of the study

The study aims to assess the relationship between emergency department (ED) length of Stay (LOS) and laboratory testing at Palestinian governmental hospitals ED's.

1.4.2 Specific objectives:

- To assess the relationship between ED-LOS and laboratory testing (TAT and number of laboratory tests).

- To assess the relationship between ED-LOS and the presence of a separate emergency laboratory.

- To assess the relationship between ED-LOS and the patients end point from emergency Department.

- To assess the relationship between ED-LOS and patients arrival time (shifts A, B or C) to the emergency department.

- To assess the relationship between ED-LOS and ED patients characteristics.

1.5 Research Questions :

Based on the reviewed literature, the set objectives and variables of the study, the following

Questions are proposed:

1. Are there differences in the emergency department length of stay in the Palestinian governmental hospitals according to gender?
2. Are there differences in the emergency department length of stay and patients' age ?
3. Are there differences in the emergency department length of stay in the Palestinian governmental hospitals according to the hospital?
4. Are there differences in the emergency department length of stay in the Palestinian governmental hospitals according to the patient's day arrive time (shift)?
5. Are there differences in the emergency department length of stay in the Palestinian governmental hospitals according to the patient's end point from ED?
6. Are there differences in the turnaround time of laboratory tests in the Palestinian governmental hospitals according to the hospital?
7. Are there correlation between the emergency department length of stay and laboratory testing (TAT and number of the laboratory tests)?

1.6 Context of the study:

1.6.1 Health System in Palestine

The Palestinian Territories are comprised of two small areas: the West Bank and the Gaza Strip (Ministry of Health, PHIC, Health Status in Palestine 2016, July 2017). These areas have been under the Israeli Occupation since 1967.

The five main health providers of health services in Palestine are, the Ministry of health (MOH), United Nations Relief and Works Agency (UNRWA), Non-Government Organizations (NGOs), Palestinian Military Medical Services (PMMS) and Private for profit. MOH bears the heaviest burden. In the Gaza Strip and West bank, there are 466 primary health care centers (Ministry of Health, PHIC, Health Status in Palestine 2016, July 2017).

The health services are distributed throughout Palestine. In addition, MOH provides a number of specific health programs as: health education community involvement, school health, immunization, human resources development, and referral of patients to non – MOH facilities (when services are not available in governmental facilities). UNRWA operates 23 primary health care centers scattered in eight refugee camps in the Gaza Strip and 41 centers in the West Bank. The NGOs sector operates 189 primary health care centers and general clinics where Palestinian Medical Military Services (PMMS) operate 20 primary health care centers and clinics. The number of hospitals in the Ministry of Health is 27 hospitals, with a capacity of 3,325 beds, or 54.1% of the total number of beds in Palestine, there are 14 MoH hospitals in West Bank, with a capacity of 1,661 beds, equivalent to 50% of the total hospital beds of MOH, while there are 13 MoH hospitals in Gaza Strip. 1,664 beds or 50% of the total MoH hospital beds in Palestine. From 2012 to 2016, the number of beds increase from 2979 to 3325 beds in MOH hospitals while the occupancy rate also increased from 82.7 to 92.2 within the same time period. Moreover, in 2016, the total number of follow-up visits of out-patient clinics reached 581,713 visits, while the number of visits to emergency services reached 804,613 visits in MOH hospitals in the West Bank.(Ministry of Health, PHIC, Health Status in Palestine 2016, July 2017).

The hospitals included in the study are:Rafedia , Hebron Governmental Hospital (Alia) , Bait-Jala Governmental Hospital and Palestinian Medical Complex (PMC).

1.6.1.1 Palestine Medical Complex (PMC):

On August 8th , 2010, President Mahmoud Abbas inaugurated the Palestinian Medical Complex in Ramallah. The complex was established by a presidential decree issued in 2009 with the aim of developing the management of the governmental hospitals in the city of Ramallah and upgrading the quality of health services provided to the Palestinian citizens. Promoting social participation and rationalizing spending by reducing outpatient referrals abroad.

The Palestine Medical Complex consists of four wings in addition to the central blood bank: 1. Ramallah's Son's Wing includes 135 beds, with an occupancy rate of 99.3%. 2. The pediatrics Wing includes 57 beds and an occupancy rate of 103.8%. 3. The Heart specialized Surgeries Wing includes 46 beds, with an occupancy rate of 98.6%. 4. The Emergency Wing: In 2016, 105,489 patients were treated in the emergency wing.

5. The National Blood Bank: The National Blood Bank was established following a decision of His Excellency the Minister of Health to work on providing a national stockpile of safe blood, which is provided when needed by establishing the concept of voluntary blood donation. The National Blood Bank donated 23,334 blood units in 2016, of which 7,494 units were donated through voluntary donations and 15,840 donated by relatives to relatives in need of blood. (Ministry of Health, PHIC, Health Status in Palestine 2016, July 2017).

1.6.1.2 Rafedia Hospital:

Rafidia Hospital was established in 1976 in Nablus to provide medical services to about half a million citizens from different governorates. The hospital is one of the largest health institutions in the country for its comprehensive treatment services. It includes general and orthopedic surgery departments, neurology department, women section, obstetrics and gynecology, in addition to the intensive care department and the ENT department. And medical services from radiation and treatment, where the hospital offers various therapeutic and surgical services such as eye surgery, jaw, burns, bacteriotherapy, neurosurgery, vascular surgery, plastic surgery and pediatric surgery.

During 2016, the emergency department in the hospital received more than 63 thousand citizens from different governorates, and the outpatient clinics received more than 68 thousand citizens. The number of patients who stayed for a night or more in the hospital was about 26 thousand patients. A total of 12756 surgeries were performed as of early December last year, including various types of surgery performed by the hospital departments, which ended with success and accuracy. (Ministry of Health, PHIC, Health Status in Palestine 2016, July 2017).

1.6.1.3 Hebron Governmental Hospital:

Sixty years of work, the highest occupancy rate among government hospitals and a center for treating burns in Palestine. Hebron Governmental Hospital conducted 8769 operations during the last year. The number of entries in the hospital during this period was 46124 patients. The emergency department received 99148 cases. The number of outpatients in the hospital was 94,349, and there were 5831 births in the hospital.

The occupancy rate of the hospital until the beginning of December 2016, was 134%, which is the highest occupancy rate among governmental hospitals. The hospital offers its services for more than 700 thousand people since 1957 in the largest governorates of the country by providing necessary treatment for patients in various departments and disciplines. The departments includes general surgery, urology, orthopedics, otolaryngology, neurosurgery, pediatric surgery, the Internal Medicine Department, the Children Department, the Intensive Care Department, the Emergency Section and the Eye Section, Surgery department, sterilization department, outpatient clinics, laboratory, blood bank, radiography department, CT imaging, Physiotherapy, anatomy, and various administrative and service departments (Ministry of Health, PHIC, Health Status in Palestine 2016, July 2017).

1.6.1.4 BeitJala Governmental Hospital

A center for the treatment of pediatric tumors in Palestine with, a 97% occupancy rate, further expansion and development. Operations department at BeitJala Governmental Hospital (Al Hussein) carried 2,867 operations during the last year, and the emergency department received 40439 cases, and the number of entries to the hospital during this period was 14989 cases, and the number of births were 1844 births. The kidney department conducted 9419 kidney dialysis cases for 938 patients.The occupancy rate of the hospital until the beginning of December 2016 was 96.7%. The hospital provides its services to the residents of the city of Bethlehem and the patients that are transferred for treatment. The hospital has served more than 200,000 people since it was founded in 1955.

The hospital is considered a center for the treatment of pediatric tumors at home, through the provision of competitive treatment between neighboring countries in terms of quality and care of patients.The hospital includes women, obstetrics and gynecology departments, surgery, children and Pediatric tumors and emergency, department of ENT and Intensive care unit, operations, Outpatient clinics, tumors and kidneys (Ministry of Health, PHIC, Health Status in Palestine 2016, July 2017).

1.6.2 Laboratories:

The General Directorate of Medical Support Services is the official body for the care of Laboratories and blood banks. This service is provided in Palestine, whereby the laboratory is Equipped with the latest laboratory equipment and the necessary manpower.

Laboratories in the Ministry of Health:

Laboratories in the Ministry of Health are classified into three categories: central, intermediate and Peripheral. Central Laboratories: are advanced laboratories to which the samples are transferred from different governorates of the West Bank for examination. The following laboratories fall under the following classification:

1.6.2.1 Central Public Health Laboratory in Ramallah:

In this laboratory, food, medicine and drinking water are tested for safe human consumption. Neonatal screening samples are also screened for phenylketonuria (PKU) and thyroid stimulating hormone (N-TSH). Serological tests are also carried out for some viral diseases and DNA.

1.6.2.2 Histopathology Laboratories:

In West Bank, histopathology tests are conducted in Rafidia Surgical Hospital in Nablus, in Beit-Jala Hospital andPalestine Medical Complex. There are 6 histopathologists and 8 laboratory technicians workingin this field. A total of 13,592 samples have been examined, the average cost of the sample examination is 25 NIS.

1.6.2.3 Intermediate Labs:

It is developed in MOH hospitals, in which samples of inpatients, outpatient clinics and samples transferred from clinics of health directorates are examined in each governorate. The average number of labs in West Bank was 14, with 232 technicians and specialists, and 4,714,807 laboratory tests were carried out. The average number of annual examinations per lab technician was 21,944, and the average direct cost pre-examination was 2.7 NIS.(Ministry of Health, PHIC, Health Status in Palestine 2016, July 2017).

1.6.2.4 Description of the Palestinian laboratories which are included in the study:
The center laboratory in Rafedia Hospital has performed 560354 laboratory tests for around

63993 patient visits, 22000 of them are coming from Emergency department. There is no point of care satellite laboratory within emergency department. The workload unit during year 2017 is 24,363 test/technician.

BeitJala hospital does not have point of care satellite laboratory within the emergency department and the center laboratory received 12677 patient visits from the emergency department during 2017, and also received 28219 patient visits from the inpatient and outpatients clinics. The total number of tests performed for all patients are 537172 tests, the workload unit during the study period is 17380 test/technician.

Hebron Hospital contains a center laboratory for inpatients and outpatients and the emergency department contains a point of care satellite laboratory. The total number of tests is 704654; the workload unit is 21181 test/ technician. The number of patients' visits is 66632 while 39600 of them are for Emergency laboratory.

In PMC, the total number of tests performed in both the center and emergency laboratories during year 2017 was 1054581 which were done for 82561 patients 44725 of them are coming from ED, In PMC the number of lab technicians is 30 and the workload unit is 22484 test/technician .(Ministry of Health, PHIC, Health Status in Palestine 2016, July 2017).table 1.1.

Table (1.1): Description of the Palestinian laboratories which are included in this study

Hospital	No. of tests	No of patients for lab. Test	No of patient for lab test from ED	No. of lab technicians	Test/technician
Rafedia	560354	63993	22000	23	24363
BeitJala	537172	40896	12677	21	17380
Hebron	704654	66632	39600	28	21181
PMC	1054581	82561	44725	30	22484

(Ministry of Health, PHIC, Health Status in Palestine 2016, July 2017).

Chapter Two

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Literature review

This chapter includes the literature related to ED throughput measures, evaluating the medical laboratories performance depending on the turnaround time (TAT), and factors affect ED-LOS including patients characteristic , end point from ED, day arrival time and laboratory testing (TAT and no. of laboratory tests)

2.1 Emergency Department throughput measures:-

Emergency medicine since its founding 40 years ago has developed rapidly as an essential part of public health science. With the increase in the demand of providing services by the ED and the complicated management process, patients' LOS in ED increased and ED become more crowded (Herring *et al*., 2009). ED overcrowding, waiting time and length of stay are important measures of the timeliness, efficiency, safety and patient centeredness of emergency care (Hurwitz, 2010).

"The emergency department length of stay is measured in minutes as a continuous variable from the time of registration to the time of departure from the ED "(Rathlev*et al*., 2012), whether they were discharged, transferred to another facility, or admitted to an inpatient ward. Overcrowding and long time to get treatment in ED are health system problems across the world that also make a challenge to delivering high quality and timely care for ED visits (Elder, 2015).

Various researchers have attempted to define ED overcrowding. One of simple definition is "that the overcrowding exists when there is no space in ED left to take more patients who need emergency care"(Salway, 2017). ED overcrowding, prolonged waiting time and patient LOS cause a decrease in patient satisfaction, an increase in the number of patients who leave ED without being seen by the physician (Horwitz, 2010), as well as a reduction in the quality of care , an increase in medical errors , an increase in medication errors (Salway, 2017. Horwitz, 2010).

Prolonged ED-LOS have an impact on ED overcrowding (Pines*et al*., 2010). Not only prolonged LOS cause of ED crowding but also it is a result of ED crowding which produces a vicious cycle (McCarthy et al., 2009) .

With regards to predictive factors for longer LOS in ED, researchers found that increased testing, consultation, provision of less substantial treatment and radiology studies cause a significant increase in ED-LOS (Casalino *et al*., 2014). Moreover, disease and acuity factors such as higher triage level, certain presenting symptoms and delayed pain alleviation are also associated with prolonged ED-LOS (Capuano, 2015).

Moreover, according to a study done by Derlet and Richards (2000), shortage of beds for admitted patients, intensive therapy in ED, delays of laboratory and ancillary services, shortage of medical staff, lack of availability or shortage of on call consultation, shortage of beds in ED, problem with language, increased medical record documentation requirements, amongst other factors, cause overcrowding and prolonged LOS in ED. However, Schiff (2011) in her study about system dynamics and dysfunctionalities, reports that the lack of inpatient bed arranging follow-up care and other factors are generally out of the control of the ED. He also states that a great majority of ED have worked on throughput competences with the aim to enhance their process for assessing, testing and handling patients for discharge.

A study on the "effect of testing and treatment on ED-LOS using national database "done by Kocher, *et al.* in 2012reported that blood tests and advanced imaging have larger effect on ED-LOS than treatment. Assessing the quality of medical laboratories test results has become increasingly important because test results are used as evidence for the therapeutic decisions, and this will reflect positively on the quality of patient care. Mainz (2003) reported in his research entitled "Defining and classifying clinical indicators for quality improvement" that the quality of medical laboratories test results help to make correct judgments and set correct priorities of the health care system.

While currently there is no accepted ED length of stay target in the world, Graff *et al*. (2002) in their study about measuring and improving quality in emergency medicine suggested that two hours is "best practice". It is worthy to note that ED throughput targets of four to eight hours are

currently being tested in Canada, New Zealand, and Australia (New Zealand Ministry of Health, 2011; Australian Government, 2010; and Ontario Ministry of Health, 2011).

2.2 Evaluating the medical laboratories performance depending on the turnaround time (TAT):

Laboratory testing is an integral part of modern medicine as it impacts patient management regarding both screening, early diagnosis, prognosis, appropriate treatment and monitoring (Saliki, 2000). Clinical laboratory tests are medical procedures that involve testing specimens of blood, urine, or other tissues or substances in the body (FDA, 2009). The American Association for Clinical Chemistry Clinical say that laboratory tests are essential for providing high-quality healthcare (AACC, 2015). But most researchers claim that those clinical laboratories test results can be misinterpreted and can accordingly affect the care that patients need; unless gulatory measures are taken to make sure that test results are reliable, accurate and consistent, regardless of where or when they are performed.

According to the importance of laboratory test results accuracy, the International Healthcare Regulatory Agencies also provide standards for monitoring and evaluating the accuracy of clinical laboratories test results. (AACC) in (2015) reported that "accurate laboratory tests give healthcare professionals vital insights so patients get the care they need" (p.3). Shahangian and Snyder (2009) reported in their review about *Laboratory Medicine Quality Indicators* that " laboratory testing and services have an important role in the provision of health care and in utilization and reimbursement" (p.418). These data indicate that laboratories should use reference measurement procedures as standards and regulations to ensure that clinical laboratory test results for a given specimen are accurate. This, in turn enhances the quality of healthcare, standardize clinical approaches to various diseases and conditions, and reduce healthcare costs. Along with accuracy and reliability of international standards of clinical laboratory test results, Desai *et al.* (2013) emphasized that timely reporting of laboratory test results is now considered an important aspect of the services provided by the clinical laboratory. Steindel and Novis (1999) reaffirmed that "one of the most visible and talked about areas of laboratory service is how fast a test result is returned to a caregiver" (p.194). This data indicates that appropriate and timely clinical decisions depend on test results' timely reporting, which in turn affects patient outcome.

The literature review reveals a variety of different approaches to defining the turnaround time (TAT). Westbrook *et al*. (2008) define the term TAT as "the time from receipt of the specimen until the time of availability of the result" (p.3), as well as Georgiou *et al*. (2007) defined it as "the time from the physician´s request until the time the physician views the result"(p.4). Fermann and Suyama (2002), Seamonds (1996), Hicks *et al.* (2001) defined the term therapeutic TAT "is sometimes used to describe the interval between when a test is requested to the time a treatment decision is made". Kaur*et al.* (2015) confirmed that the definition of Turnaround time (TAT) is commonly defined as "the time from when a test is ordered until the result is reported which includes the pre- analytical, analytical and post-analytical time" (p.9).

Hawkins (2007) defined intra-laboratory turnaround time as the period of time from test ordering to the time the results are made to the emergency department (ED) and it is a combination of nine steps namely ordering, collection, identification, transport, preparation, analysis, reporting, interpretation and action, and has also been classified as pre-analytical, analytical and post-analytical based on the different phases of sample processing.

In general, the turnaround time (TAT) can be defined as the time from when a test is ordered until the result is reported and it can also vary in its definition with possible start points of sample receipt time, registration time, or analytical sampling time and end points of analytical completion time, result verification time, result transfer to electronic medical record time and report printing time.

Hawkins (2007) reported that "the turnaround time (TAT) for laboratory results is frequently used as a key performance indicator of laboratory service performance" (p.39). His study "Laboratory Turnaround Time; The Clinical Biochemist Reviews" focused on the different definitions, measures, expectations, published data, and associations with clinical outcomes and approaches to improve the Laboratory turnaround time (TAT). Carraro and Plebani (2002) also reported that the "TAT is a useful marker of laboratory efficiency, and that process control reduces the laboratory TAT" (p.243). In their study "Process control reduces the laboratory turnaround time", they have implemented a process control system to reduce the Laboratory turnaround time (TAT) in particular for Stat tests, as well as a measure of service.

Using the turnaround time (TAT) as a quantitative quality indicator to determine the timeliness of medical laboratories test results have a positive impact on medical laboratories test results. Wankar (2014) reaffirmed in his study of determination of laboratory turnaround time in tertiary care hospital in India that the "TAT is often considered the most significant measure of a laboratory's service and is used by many clinicians to judge its quality" and "faster turnaround time can make any medical difference, patients and their physicians want reports as rapidly as possible" (p.1396).

2.3 Factors affecting ED-LOS

2.3.1 Laboratory testing TAT and number of laboratory tests

Holland, Smith, and Blick (2005) in their study "Reducing laboratory turnaround time outliers can reduce emergency department patient length of stay–an 11-hosiptal study" which focused on examining the relationship between laboratory testing (including test volume and turnaround time (TAT)) and emergency department (ED) length of stay (LOS), using linked patient-level data from four hospitals across 4 years, found that a reduction in tests with extremely long TATs was associated with a reduction in average emergency department (ED) length of stay (LOS). The authors also observed that the workflow improvement in one community hospital improved the TAT cause decrease in the ED LOS, the research showed that the ED LOS was reduced from 4.1 to 3.2 hours as the laboratory TAT decreased from 14.4% to 4.9% and this indicates that the relationship between the ED LOS and laboratory TAT is a dynamic relationship.

Francis, Ray, and Marshall (2009) in their study "The impact of computerized physician order entry systems on pathology services" stated that redesigning of pathology processes, including indicators of sample priority could reduce patient length of stay (LOS) in an emergency department (ED).The authors further assessed the long-term impact of two indicators of sample priority on pathology clinical performance indicators for ED samples. They affirmed that there is a relationship between laboratory work process design and LOS in ED.

A simulation study by Storrow *et al*. (2008) declared that decreased TAT could improve ED efficiency and reduce ED LOS.Gill *et al*. (2012) there study findings reveal that the mean time for hematology results to become available was 1 hour 6 minutes (95% CI: 29 minutes to 2 hours 13 minutes), while biochemistry samples took 1 hour 42 minutes (95% CI: 1 hour 1 minute to 4

hours 21 minutes), with some positive correlation noted with the patient LOS, but no significant variation between different days or shifts.

In their study, Singer *et al.* (2005) showed that incorporating more point-of-care testing (POCT) shortens patients' ED LOS. In an attempt to compare troponin levels being tested by a central laboratory and by a POCT, the study found that using a POCT decreased LOS by an average of 1.9 hours. While, Australian study done by Stuart *et al.* (2002), found there was a 40% reduction in laboratory test requests after the hospital established protocols for laboratory test requesting from emergency department.

2.3.2 Patients' characteristics

In New Zealand, the study by Prisk, Godfrey and Lawrence in 2016 indicated that females have prolonged time in emergency departments than males due to the difference in their life expectancy being longer. Pines*et al*. (2009) and Bekmezian*et al*. (2011) suggested that demographic characteristics such as age and ethnicity or even the presence of junior residents or medical students are associated with longer ED LOS.

According to literature, older patients presenting to the ED differ from younger patients in several important ways. Elderly patients are often more acutely ill than younger patients, in their study Casalino*et al.* (2014) found that ED-LOS differed significantly with the age group, increasing progressively from younger to older patients. Various studies have some up with similar findings such as that of Latham*et al.* (2014) which showed that 69% of older adults remained in ED for more than four hours compared with 39% of younger adults in 2008/2009.

Also, Chaou*et al*. (2016) in their study entitled "Analyzing Factors Affecting Emergency Department Length of Stay Using a Competing Risk-accelerated Failure Time Model in 2016" found that age is one of the factors related to increased ED LOS. They state that it is due to the fact that the elderly present with less specific symptoms and poor communication skills as well as more underlying conditions and presence of one or more additional diseases or disorders.

Moreover, Latham (2014) reported that ED length of stay increased with older age, by that older patients have more acute conditions. While McCusker*et al.*(2003) found that the Older adults are

often more acutely ill than younger patients and also Tabas and Hsia,(2011) andGruneir*et al*.(2011) found that the older patient's require more emergency resources and more biological and x-ray tests than younger patients. While, Brendan and Marco **(**2014)in there study found there are no differences in emergency department patients LOS based on these age and gender.

2.3.2 Patients end point from ED

The disposition decision is one of the most important decisions made during a patient's visits to emergency department (ED), while the physicians decided to admit or discharge a patient, (Calder *et al,.*2013).

Departure process may be one of the three potential destinations, the patient might be discharged (home or to an outpatient facility), transferred to another in-patient facility or admitted at the same facility (Jennifer *et al,.* 2015).

Every year in Canada, there is an estimated 15.8 million visits to EDs, of these, 80% of patients are discharged home or to assisted living, the discharge decision occurs in an environment of time pressure and ED crowding, if a discharge decision error is made, it could place patients at risk for adverse outcomes (Canadian Institute for Health Information, 2012).

Rathlev, Obendofer and Laura (2012) found in their research about time series analysis of emergency department length of stay 8-hour shift that the association between ED-LOS and hospital occupancy rate that an increase in hospital occupancy and high level of demand for inpatient beds can lead to delays in admitting patients to the hospital (increased LOS), and that LOS decreased as the number of ED discharges increased, discharging patients leads to increased ED capacity and beds become available for new patients.

The study done by Chaou *et al.* (2016) showed that some patients stayed in the ED for more than 10 hours. These patients were with special medical and socioeconomic conditions. The authors reported that a high presence of patients waiting to be admitted was a significant factor in ED crowding and posed a heavy burden on the ED staff.

Studying the effect of in-room registration on emergency department length of stay,Gorelick*et al.* (2005) state that the LOS for admitted patients is determined by hospital determinants such as hospital occupancy and admission – discharged ratio.

2.3.4 Day arrival time (shift)

EDs operate 24 hours a day, 7 days a week. Patient arrivals can be variable, with disparity in volume from hour to hour, diverse types of patients arriving during different times of the day, different patterns depending on the day of the week, and even seasonal changes associated with flu, school calendars, and local demographics (Møller*et al.,* 2017).

The study of Rathlev*et al*. (2012) reports that patient flow during night shifts is inherently different than both morning and evening shifts. Moreover, the mean LOS decreased as the number of ED discharges increased on morning shifts. Discharged patients will serve to increase ED capacity and decrease the time of arrival to ED bed for new patients.

 Moreover, early discharge of inpatients or transferring them to another facility will increase the supply of inpatient beds and reduce the variability in hospital occupancy rate that occurs during a 24-hour period. This, in turn, will reduce LOS and relieve crowding during hours of peak demand in the ED (Powell *et al*., 2010).

Welch and Jones (2007) state that despite the ED being open 24 hours a day, 7 days a week, not all services are available at night. Consequently, the phenomenon of "holding over" patients until morning for cardiac stress testing, consultations, ultrasound or other diagnostic tests, is prevalent in many EDs. On the same note, Nelson *et al.* (2009) reported that night shift arrival is associated with prolonged LOS which is more than 10 hours compared to other shifts. This was also parallel with the study of Chang *et al*. (2016) on analyzing factors affecting emergency department length of stay using a competing risk-accelerated failure time model

Chapter Three

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Conceptual framework

This chapter includes the conceptual framework of the study, conceptual definitions and operational definitions of the dependent and independent variables.

3.1 Conceptual framework of the study:

As shown in figure 3.1, the dependent variable is the Emergency department length of stay. The factors attributed to this dependent variable in this study are patient's characteristics (age and gender), patients end points from the emergency department (treatment and discharge to home, improved and discharge for follow up outpatient clinic, discharge against medical advice, admitted to the same hospital, transfer to another hospital and died in ED), patient's arrival day and time to the ED (shifts A,B,C), and the laboratory testing (TAT and number of laboratory tests).

3.2 Conceptual definitions

- Emergency Medicine is an exceedingly important issue to the healthcare system, which is a medical specialty concerned with the care and treatment of patients who have unexpected illness or injury and who need immediate medical care. Hence, it must be available 24 hours a day (Bashkin, 2015).

- Emergency department Length Of Stay :"the interval between the time of arrival to the ED and the time of ED departure (either admission or discharge)" (Rathlev*et al*., 2012).

- Laboratory test Turnaround Time : "the time from receipt of the specimen until the time of availability of the result" (Westbrook, *et al.,* 2008)

3.3 Operational definitions

3.3.1 Dependent variable: is the Emergency department Length of Stay which is calculated as the time period between registration of patients and the time of their physically leaving the ED, whether admitted or discharged.

3.3.2 Independent variables:

- **Patient's characteristics:**

    - Gender (Male / Female)

    - Age (< 15 year, 15-29 , 30-49, 50-64, > 65).

- **Patient's end point from ED**:

    - Admitted to the same hospital

    - Discharged home

    - Improved and discharge for follow up inoutpatient clinic

    - Transfer to another hospital

    - Self- discharged against medical advice

    - Died in the emergency room

- **Day arrival time (shift)** :

    - Morning (A) shift (8:00 AM - 3:00 PM)

    - Evening (B) shift (3:00 PM – 10:00 PM)

    - Night (C) shift (10:00 PM – 8:00 AM)

- **Laboratory testing** :

    - Laboratory test TAT: time by minutes starting from the receipt of the specimen to the release of the last result for the ED's physicians.

    - Number of laboratory test (1 , 2-3 , 4-6 , >7 tests)

Figure 3.1 Conceptual framework for the factors effecting ED LOS.

Chapter Four

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Methodology

This chapter covers study setting, study design, population of the study, study sample and sample technique, data collection, and ethical consideration.

4.1 Study setting

This study covered the four Palestinian governmental hospitals:

- Rafedia governmental hospital
- BeitJala governmental hospital
- Hebron governmental hospital
- Palestine Medical Complex (PMC)

These hospitals are located in different Palestinian Provinces (Nablus, Bethlehem, Ramallah, and Hebron) respectively. These governmental hospitals have Computerized Health Information System (HIS)that contains primary database for all hospitalized patients and their visits.

4.2 Study design

Retrospective quantitative design was selected for the current study. The primary database of the Palestinian governmental hospitalswere used. The quantitative methodology is appropriate to the exploratory nature of this research, which allows for examining the relationship between the emergency department length of stay in the Palestinian governmental hospitals and the variables that may affect it.

The study design is straight forward, relatively inexpensive and is conducted relatively fast. Thus, this type of design facilitated the completion of this study within the allotted time.

4.3 Study population:

The target population consists of 119,002 emergency department visits, which had laboratory tests performed at the Palestinian governmental hospitals belong to current study during the year 2017 as shown in Table 4.1

Table (4.1). Distribution of the study population (ED patients' visits) by each hospital:

Hospital	Population	Percent %
PMC	44725	37.5
Alia	39600	33.3
Rafedia	22000	18.4
BeitJala	12677	10.7
Total	**119002**	**100**

4.4 Sample and sampling technique:

The overall sample is composed of 597 patients (311 males and 286 females). The sample population was drawn from four Palestinian governmental hospitals in the West Bank: PMC hospital represented 37.5% (N=224) of the sample, 33.3% (N=199) were from Alia Hospital, 18.4% (N=110) were from Rafedia Hospital and 10.7% (N=64) were from BeitJala Hospitals (Table 4.2).

Table (4.2). Distribution of the study sample by each hospital:

Hospital	Sample	Percent %
PMC	224	37.5
Alia	199	33.3
Rafedia	110	18.4
BeitJala	64	10.7
Total	597	100

The sample size was calculated using the sampling website ofhttp://www.surveysystem.com/sscalc.htm and a sample size calculator, with a margin error of 0.04.as indicated in Appendix no. (4.1).

The formulas used in sample size calculator is: sample size= $Z^2 * (p) * (1-p)/c^2$ .Where, $Z = Z$ value (e.g. 1.96 for 95% confidence level), p = percentage picking a choice, expressed as decimal, (.5 used for sample size needed), and c = confidence interval, expressed as decimal

A Random stratified sampling method was used to select the patient's profile from the health information system in each hospital. The researcher was randomly chosen with an equal number of patient's profile from each month of 2017according to the sample size from each hospital.

4.5 Pilot study:

A Pilot study for the data collection form was conducted. Ten patient visits were obtained from the BeitJala hospital. After ensured that most of the needed information is available and the form is suitable for data collection, the researcher started data collection.

4.6 Data collection:

From the patient profile available at the HIS, the patients' characteristics were obtained from the patient's details page. The visit's information in terms of the arrival time, the discharge time, the number of laboratory tests, the laboratory sample acceptance time and the result's approval time, and the patient end point was abstracted from the patient's medical record page by the researcher herself.

During the month of February 2018, all information was recorded in the data collection form shown in Annex (4.2).

4.7 Data analysis

The data were coded, entered, and analyzed using Statistical Package for Social Sciences, Descriptive statistics including frequencies and Percentage of the study variables were calculated. All variables of interest were included to illustrate their impact on ED LOS whether or not it was significant.

Regression, t.test andOne way analysis of variance (ANOVA) were used to answer the study questions. Simple regression was used to examine the relationship between one dependent variable and one independent,linear regression was used to examine the relationship between dependent variable and more than one independents variables, while the t-test was used to determine whether there is a significant difference between the means of two groups, ANOVA used to determine whether there are any statistically significant differences between the means of two or more independent (unrelated group).(IBM SPSS Statistics 24 Brief Guide).

4.8 Ethical consideration

Al-Quds University research committee at the school of public health approved the study. Ethical approval from Ministry of Health through the General Directorate of Health Education and the General Directorate of Hospitals. A Permission letter was sent from school of public health at Al-Quds University and an approval letter was received from the General Directorate of Health Education in MOH through the General Directorate of Hospitals, a copy was sent to the general director of each hospital.

The researcher kept all patients information confidential and did not use the patients' names or any identification throughout the study.

Chapter Five

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Results

In this chapter, the demographic characteristics of the patients including gender and age, the patients' arrival time, patient end point from emergency department, TAT and number of laboratory tests are presented.

5.1 Descriptive analyses:

Table 5.1, illustrates that males represented 52.1% of participants, while the remaining 47.9% are females.

Table (5.1) Sample distribution by gender

Gender	Frequency	Percent %
Male	311	52.1
Female	286	47.9
Total	597	100

Table 5.2, shows that the patient's age were between three months and 96 years of age (M=33.53, SD= 24.17). Patients under 18 years of age represented 32.8% of the sample, and patients between 19-49 years of age represented 39.5% of the sample and the remaining 27.6% of patients aged more than 50 years.

Table (5.2) Sample distribution by age

Age group	Frequency	Percent %
Less than 18	196	32.8
19-49	236	39.5
More than 50	165	27.6

Total	597	100.0

Half (44.7%) of the selected Patients visits came from emergency department A shifts, 29% from B shifts, while the remaining 26.3% from C shifts, as indicated in table (5.3)

Table (5.3). Sample distribution by arrival time

Emergency department shift	Frequency	Percent %
Morning (A)	267	44.7
Evening (B)	173	29
Night (C)	157	26.3
Total	597	100

With regards to the patients' end point from emergency department, the results show that 33.7% of patients improved and were discharged for follow up the outpatient clinic, 32.2% of them were given the treatment and went home. The end point for 18 patients was not documanted in their profiles, as indicated in table (5.4).

Table (5.4). Sample distribution by end point from ED

Discharge type	Frequency	Percent %
Was given the treatment and send back home	192	32.2
Admitted to the hospital	129	21.6
Self- discharge against medical advice	18	3.0
Transfer to another hospital	11	1.8
Improved and discharge for follow up in-outpatient clinic	225	33.7
Died	4	0.7
Missing end point	18	3.0
Total	597	100

The number of laboratory tests was between 1 and 16 tests (M= 3.38, SD= 2.88). The findings show that 26.6% of these patients have one test only, 39.7% have 2-3 tests, 18.9% of them had 4-6 tests done, and the remaining (14.7%) had more than 7 tests done, as indicated in table (5.5).

Table no. (5.5). Sample distribution by number of laboratory test

No. of laboratory test	Frequency	Percent %
1	159	26.6
2-3	237	39.7
4-6	113	18.9
More than 7 tests	88	14.7
Total	597	100

5.2Emergency department length of stay:

The mean score of emergency department length of stay as experienced by the sample of five hundred and ninety seven patients was 125.70 (SD= 91.50) with a minimum time of four minutes and a maximum time of 428 minutes.

5.3 Results:

Question no. 1: Are there differences in the emergency department length of stay in the Palestinian governmental hospitalsaccording to gender?

The study findings accept this hypothesis and show that gender does not indicate any significant difference, as indicated in table (5.6)

Table (5.6). Association between length of stayat emergency department and participants gender

Gender	Frequency	Mean	Std. Deviation	df	T-value	Sig.
Male	304	129.08	95.09			
Female	275	122.32	87.91			
Total	579	125.70	91.50	577	0.923	0.356

Question no 2: Are there differences in the emergency department length of stay and patients' age?

As for the patients' age, the differences in favor of patients age group who more than 50 years (M= 142.51.14, SD= 103.92) compared to those who less than 18 years (M= 113.39, SD= 79.59) F-value was (4.435P=0.012), as indicated in tables(5.7)-(5.8).This mean that the LOS of the patients age group who more than 50 years old is the higher than those age less than 18 years old (P<0.05)

Table (5.7). One way ANOVA for the differences in the emergency department length of stayscore according to the participant's age

Source	df	Sum of squares	Mean square	F-value	Sig.
Between groups	2	73390.095	36695.047		
Within groups	576	4766030.810	8274.359	4.435	0.012
Total	578	4839420.905	-----		

Table (5.8). The differences in the emergency department length of stay (minutes) according to the participant's age

Age group	N	Mean	Std. Deviation
Less than 18	194	113.39	79.595
19-49	230	124.76	90.607
More than 50	155	142.51	103.926
Total	579	125.70	91.502

Question no. 3:.Are there differences in the emergency department length of stay in the Palestinian governmental hospitals according to the hospital?

The results reveal that in relation to the hospital, the differences in favor of Hebron Hospital ED-patients (M= 195.67, SD= 103.03) compared toBeitJala Hospital (M= 42.07, SD= 59.04) : F-value was (125.358 P=0.0001), as indicated in tables (5.9) ,(5.10): this mean that LOS in emergency department in Hebron hospital was higher than BeitJala hospital.

Table (5.9). One way ANOVA for the differences in the emergency department length of stayscore according to hospitals.

Source	df	Sum of squares	Mean square	F-value	Sig.
Between groups	3	1868628.714	622876.238		
Within groups	575	2970792.191	5166.595	120.55	0.0001
Total	578	4839420.905	-----		

Table (5.10).The differences in the emergency department length of stayscore (minutes) according to the hospital.

Hospital name	N	Mean	Std. Deviation
PMC	216	106.31	59.912
Hebron	199	195.67	103.039
Rafedia	110	78.27	30.328
BeitJala	54	42.07	59.041
Total	579	125.70	91.502

Question no. 4: Are there differences in the emergency department length of stay in the Palestinian governmental hospitals according to the patients day arrive time (shift)?

Are there correlation between the emergency department length of stay and laboratory testing (TAT and number of the laboratory tests)?In terms of emergency department arrival time (shift), the differences were in favor of night (C) shift patients (M= 142.47, SD= 109.20) compared to evening (B) shift (M= 118.98, SD= 81.73): F-value was (3.551 P=0.029), as indicated in tables. (5.11)-(5.12). This mean that the patients LOS in night shift is significantly higher than evening shift($p<0.05$)

Table (5.11). One way ANOVA for the differences in the emergency department length of stayscore according to the day arrival time (shift)

Source	Df	Sum of squares	Mean square	F-value	Sig.
Between groups	2	59079.089	29539.544		
Within groups	576	4780341.816	8299.205	3.551	.029
Total	578	4839420.905	-----		

Table (5.12). The differences in the emergency department length of stay (minutes) according to the day arrival time (shift)

Day arrive time (shift)	N	Mean	Std. Deviation
Morning (A)	259	120.04	84.75
Evening (B)	166	118.98	81.73
Night (C)	154	142.47	109.20
Total	579	127.70	91.50

Question no. 5 Are there differences in the emergency department length of stay in the Palestinian governmental hospitals according to the patient's end point from ED?

As for the patients' end point from ED, the differences in favor of patients who have been admitted to the same hospital (M= 155.14, SD= 101.06) compared to those self-discharged against medical advice (M= 38.22, SD= 42.94) F-value was (6.547 P=0.001), as indicated in tables(5.13)-(5.14).This mean that the LOS of the patients who have been admitted to the same hospital is the higher than those self-discharged against medical advice (P<0.05)

Table (5.13). One way ANOVA for the differences in the emergency department length of stayscore according to the patient end point from ED

Source	Df	Sum of squares	Mean square	F-value	Sig.
Between groups	5	Sum of Squares	52307.917		
Within groups	573	261539.584	7989.322	6.547	.0001
Total	578	4577881.321	-----		

Table (5.14).The differences in the emergency department length of stay(minutes) according to the patient end point from ED

Discharge type	N	Mean (minutes)	Std. Deviation
Was given the treatment and send back home	192	120.53	96.70
Admitted to the hospital	129	155.14	101.06
Self- discharge against medical advice	18	38.22	42.94
Transfer to another hospital	11	124.45	111.65
Improved	225	120.57	76.07
Died	4	110.50	103.35
Total	579	125.70	91.50

Missing=18

Question no 6: Are there differences in the turnaround time of laboratory tests in the Palestinian governmental hospitals according to the hospital?

The differences were found in the turnaround time of laboratory tests and the hospital, the differences in favor of the patients at BeitJala hospital (M 45.94 SD 42.10) compared to (M 32.14 SD 18.62) for patients at PMC hospital: F-value was (5.225 P=0.001), as indicated in tables' no. (5.15)-(5.16), this mean that the laboratory test TAT is higher in BeitJala hospital than PMC.

Table (5.15). One way ANOVA for the differences in the turnaround time of laboratory tests score according to the hospital

Source	Df	Sum of squares	Mean square	F-value	Sig.
Between groups	3	14827.634	4942.545		
Within groups	593	560935.646	945.929	5.225	0.001
Total	596	575763.280	-----		

Table (5.16).The differences in the turnaround time of laboratory tests score according to the hospital

Hospital	N	Mean (minutes)	Std. Deviation
PMC	224	32.14	18.62
Alia	199	38.76	36.57
Rafedia	110	43.22	31.33
BeitJala	64	45.94	42.10
Total	597	37.87	31.08

Question no 7: Are there correlation between the emergency department length of stay and laboratory testing (TAT and number of the laboratory tests)?

Study results indicate that there is a statistical significant positive correlation between the emergency department length of stay, number of laboratory tests and turnaround time of laboratory tests, Beta-value was (0.092 P=0.028) and (0.095 P=0.023), respectively, as indicated in table no. (5.17)

Table no. (5.17). Standardized regression between the emergency department length of stay and laboratory testing

Variables	N	Beta-value	Sig.
No. of laboratory tests	597	0.092	0.028
TAT of laboratory tests	597	0.095	0.023

Findings indicate that there is no significant difference with regards to gender. However, it was found that the age, the shift arrival time, the patient end point, and laboratory testing (TAT and number of requested laboratory tests) are significant variables.

Table 5.18 shows the linear regression between all independent variables (Patient's gender, age, arrival time, patient's end point from ED, no. of laboratory test, laboratory test TAT, hospitals) andemergency department length of stay, the findings from this test indicatedthere was significant value between ED-LOS andage of participants, hospitals,TAT of laboratory tests and arrival time . However, there was no significant value between ED-LOS and gender of participants, no. of laboratory tests and patients end point from ED. The most significant ranked according to Beta value is: hospital, age, TAT of laboratory tests and day arrival time (P = 0.0001, 0.0001, 0.001 and 0.032) respectively.

Table no. (5.18). Standardized regression between: Patient's gender, age, arrival time, patient's end point from ED, no. of laboratory test, laboratory test TAT, hospitals and the emergency department length of stay

Variables	Beta-value	Sig.
Age	0.169	0.0001
No.Lab	-0.085	0.056
Turn Around Time	0.147	0.001
Arrival time	0.087	0.032
End point from ED	-0.059	0.140
Hospital	-0.239	0.0001
Gender	-0.026	0.516

Chapter Six

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Discussion

This chapter presents the discussion of the findings of this study; It discusses the relationship between the ED-LOS and the independent variables that influence it in the Palestinian governmental hospitals. The study reinforces some previous findings about ED-LOS as in recent literature.

A recent systematic review of ED-LOS studies by report that admission, older age and diagnostic testing were factors related to longer LOS.(Rathlev*et al*., 2012. Chaou*et al*.,2016. Kocher, *et al*.,2012Casalino *et al*., 2014) . The outcomes of this study illustrate that laboratory testing (laboratory tests TAT and the number of requested laboratory tests), patient end point from ED, patients' arrival time during the day and patients' age have an effect on the ED-LOS. However, gender does not affect the ED-LOS.

While currently there is no accepted ED length of stay target in healthcare facilities worldwide, Graff*et al*. (2002) suggested that two hours is "best practice". The findings of this study show that the ED-LOS in Palestinian hospitals is around 125.7 minutes, which less than the minimum suggested target for other countries such as New Zealand and Australia as reviewed in the literature.

This study analyzed 597 ED patients' visits. The age group of under 18years represented 32.8% of the total ED visits in this study while the older adult (>50years of age) represented the lowest percent, which was contrary with previous studies in the literature which showed that older patients presenting to the ED differed from younger patients in several ways. This is due to the fact that the age structure of the Palestinian population is heavily skewed towards younger people who are under 18 years of age accounting for more than 45% of the population (PCBS, 2017).

The study findings showed that patients age group who have more than 50 years had highest ED-LOS (M= 142.51.14, SD= 103.92) compared to those who have less than 18 years (M= 113.39, SD= 79.59).This may be due to the elderly present with less specific symptoms and poor communication skills as well as more underlying condition and presence of one or more additional disease or disorders .This was parallel with the previous studies whereby age is a factor

related to prolonged ED-LOS across different nations (Casalino*et al*., 2014). ED-LOS differs significantly with the age group, increasing progressively from younger to older patients. Other studies by Latham (2014) found that ED length of stay increased with older age, by that older patients have more acute conditions (McCusker, et al 2003), Biber et al, (2013) found that the Older adults are often more acutely ill than younger patients and also (Tabas& Hsia,2011, Gruneir*et al*., 2011). found that the older patient's require more emergency resources and more biological and x-ray tests than younger patients.

In contrast of these studies Brendan and Marco (2014)in their study found there are no differences in emergency department patients LOS based on these age and gender. While this study did not find an association between the gender of emergency department patients and LOS in the department ,Prisk et al, (2016) found that the gender of patients did effect on the ED-LOS and they found that female have longer time than male.

As per the database of the four hospitals included in this study, there were 409,109 ED visits during the study period between the periods of January to end of December 2017. In the linked ED-laboratory data set, there were 119,002 ED patients with at least one laboratory test. While 26.6% of these patients had one test only, 39.7% had 2-3 tests, 18.9% of them had 4-6 tests done and the remaining samples had done more than 7 tests, there was positive correlation with the number of laboratory tests.

 The study findings indicated that there was a statistical significant positive correlation between the emergency department length of stay and TAT of the laboratory tests. This may be due to the fact that clinical laboratory test results is integral partof clinical medicine and used indiagnostic and treatment decision making by physicians , so the patient don't discharge without laboratory test result seen if required.

In keeping with study findings, and similar to findings of the study by Holand*et al*. (2005) there is a significant relationship between TAT of laboratory tests and ED-LOS. Holland's study suggested that for each 1- point increase in the laboratory tests TAT the additional patient waiting time in the ED, and that the relationship between the ED-LOS and laboratory TAT is dynamic.

Along the same lines, a simulation model study by Storrow*et al.* (2008) suggested that a decreased TAT could improve ED efficiency and reduce ED-LOS. This was also advocated by

Lehto (2016) who reported that the TAT of laboratory tests has a direct influence on the duration of stay of patients in the emergency department (ED), the reduction of laboratory test TAT which shortens ED-LOS, and on enhancing the safety and satisfaction of patients.

Gill *et al.* (2012) found that the average TAT for hematology results was 66 minutes while the biochemistry tests take 102 minutes with some positive correlation with the patient LOS, but no significant variation between different days or shifts.

The mean of laboratory tests TAT in included hospital was 37.87 minutes, the results favor Beit-Jala Hospital laboratory (M= 45.94, SD= 31.08) followed by Rafedia Hospital laboratory (M= 43.22, SD= 31.33. Both Beit-Jala and Rafedia have only a center laboratory and do not have a point of care satellite laboratory within their emergency department, while PMC and Alia Hospital which show low TAT have a satellite laboratory in their hospital. This mean that the specimens from the emergency department that do not contain a satellite laboratory are sent to a center laboratory within the hospital, which also receive the inpatients samples along the 24 hour-shift, and they also receive the outpatients' samples in the morning shift. So the high load in the central laboratory causes a delay in the ED- specimen results.

Also, in BeitJala Hospital there are no protocols for requesting laboratory tests from the emergency department and no common laboratory tests list that ED physicians can request. Accordingly, there is a need to improve protocols for test requests from ED in MOH hospitals. In an Australian study by Stuart *et al.* (2002), there was a 40% reduction in laboratory test requests after the hospital established protocols for laboratory test requesting.Another study done by Fracis*et al.*(2009) reported a relationship between ED-LOS and the design of work process in the laboratory, but they found no direct relationship between TAT and ED-LOS.

The Study results showed that patients who were admitted to the same hospital had the highest LOS (M=155.14,SD= 101.06) compared to patients discharged against medical advice (M= 38.22, SD= 42.94). Also, patients who were admitted to the same hospital had a longer LOS than those who were given treatment and discharged home, or referred to an outpatient clinic, respectively (M= 120.53, SD= 96.70 and M= 120.57, SD= 76.07). This is due to high occupancy rate in Palestinian MOH hospitals. According to the Palestinian MOH reports, the mean of the occupancy rate during 2017 for the hospitals of this study was 108.3%, Hebron Hospital showed the

highest occupancy rate (134%) whereas the lowest rate was that of BeitJala hospital (96.7%). with a high level of demand for inpatient beds, admitted patients need to wait longer time in the ED to find beds for them in the hospital, and if there are no free beds available, the hospital transfers the patients to another hospital. The study results were similar to Rathlev and his colleagues (2012) who suggested that even a mere 1% increase in occupancy can result in delays in the ED-LOS for admitted patients.

This result is also parallel to the study done by Chaou*et al*. (2016) which found that the median LOS was much longer for admitted patients than for discharged patients.

According to the outcomes of this study Hebron hospital had the longest ED LOS (M= 195.67, SD= 103.03) while BeitJala Hospital showed the shortest patients ED LOS (M= 42.07, SD= 59.04) and this was due to differences in the overall workload in each hospital, Hebron ED received around 99,148 patients while BeitJala ED received 40,439 patients during 2017, and also to difference in occupancy rate, Hebron Hospital shows the highest occupancy rate (134%) among the governmental hospitals whereas the lowest occupancy rate was in BeitJala hospital (96.7%). This explained by the fact that BeitJala hospital is the center for oncology in the West Bank and not all internal and surgical medical services are available at other hospitals. Therefore, some cases such as the myocardial infraction referral to another hospital and not waiting in ED; While the oncology patients who registered in ED did not get any treatment, most of whom were admitted directly to the inpatient departments or the day care unit in the hospital.

The study shows that half (44.7%) of the emergency department patients came from ED Morning A shift which starts from 8:00 AM to 3:00 PM, 29% from evening shift which starts from 3:00 PM to 10:00 PM, while the remaining 26.3% came from the night C shift.It was evident that the differences were in favor of C shifts patients (M= 142.56, SD= 109.48) compared to B shift patients (M= 118.85, SD= 82.48) . This may be due to the fact that patients who come during the night shift are acute cases when compared to those who come during the morning shift. Moreover, this is probably due not only to the shortage of emergency physicians at evening and night shifts but also to the shortage in resident physicians who tend to cover both inpatient and emergency departments at the same time. Some cases need follow-up from the resident physician after evaluation by ED physicians. These patients usually wait more time until a resident physician is available. Another shortage that significantly contributes to increasing LOS during night shifts

is the lack of or unavailability of on-call specialty consultants such as neurologists and cardiologists.

Some patients prefer to come to the emergency department rather than to primary healthcare centers to receive a rapid service; this is clear from the lowest ED LOS patients who have noted in their profile needing laboratory tests or imaging tests, which is considered a misuse for ED by both patients and medical staff alike. To add, the high load in outpatient clinics which close its registration when the target number is reached, patients turn to registering in the ED to receive the service they need. This misunderstanding of ED services causes crowding and increases the LOS and delays the acute emergency cases. In the end, these patients improve and are discharged to the outpatient clinics, and that is evident from the high present of improved patients in Palestinian hospitals. In a study done by Change *et al.* (2016) and Nelson *et al.* (2009), the authors reported similar findings. Night shift arrivals have a prolonged LOS which is more than 10 hours than the other shifts.

Chapter Seven

Conclusion and recommendation

7.1 Conclusion:

It is rather evident that emergency departments face significant challenges in delivering high quality and timely care, within the increasing patient numbers and limited hospital resources.

Emergency department prolonged patients LOS has been considered as a major cause of ED overcrowding which affects the quality of care. Many factors may be the cause of this prolonged time such as acuity of the case, type of hospital , the patient end point from ED and thereof

This is the first study, up to date, to examine the factors influencing the Emergency department LOS according to the researcher's knowledge. The study results show that gender does not have significant influence ED LOS. On the other hand, it was found that the patients' age, day arrival time (shift), the patient end point from ED, the number of laboratory tests and the laboratory tests turnaround time were significantly influence emergency department LOS.

These findings could be used for EDs to develop approaches to minimize ED LOS, in order to minimize ED crowding status, to increase patients' satisfaction levels and the Emergency department quality of care.

7.2 Recommendation:

The researcher recommends establishing a point of care satellite laboratory in all emergency departments in Palestinian governmental hospitals, which will decrease the load on the central laboratory and decrease the TAT of laboratory tests which will in turn decrease the ED patients' LOS. Moreover, it is essential to improve protocols for requesting tests from the emergency department, with a list of common tests that ED- physicians can request.

There is a noted misuse of the emergency department on the part of patients and staff alike, the high workload in the emergency department in the morning shift a result of the fact that people prefer to go to hospitals than the primary health care, which leads to crowding and prolonging the waiting time for urgent cases. So the MOH could also focus its work more on emergency de-

partment protocols, and enhance the people knowledge about the work of emergency department thereby allowing for urgent and acute cases to take the care they need in the shortest timeframe possible, more training on triage system and to invest in the triage on all ED in the country.

More training is needed for the staff on the Health Information System (HIS) that is currently used in MOH hospitals to make sure that all staff correctly fills all patients' information on their medical profile. This information must be complete and clear for others should they need to use it.

The quality of care in Palestinian hospitals and their ED's are very important, this study recommends determining a list of ED quality measures to evaluate ED work and with continuous measurement and monitoring to improve the quality of care and patient safety in the emergency department.

7.3 Limitations:

The study had some limitations. Due to its retrospective design, it cannot be used to demonstrate causality, but merely to measure association.

There were no previous studies in Palestine about the emergency department work flow, and there was no quality measure to evaluate ED LOS, patient-nurse ratio and thereof.

The factors investigated in this study were limited to a few. Many previous researches studied many other factors such as triage severity level, patient diagnostic and presentation of medical students, which are missing in in MOH hospitals' patient medical records. Accordingly, these factors were not included in the study because the MOH database does not contain these information.

The study only considered four hospitals in MOH, which used the computerized health information system (HIS).

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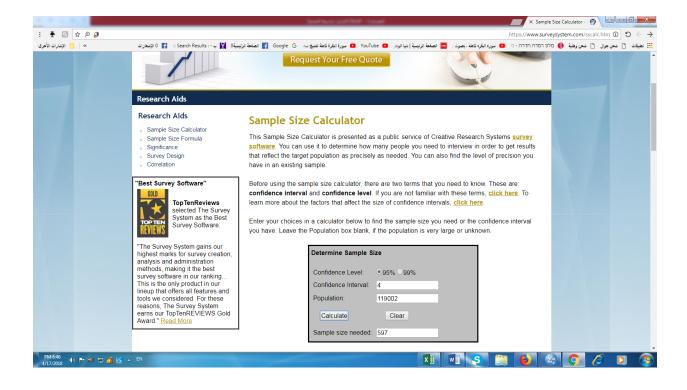
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Annex (4.1) data collection form

- **Patient** Gender

    1- Male   2- Female

- **Patient   Age**

    1- <15   2- 15-29   3- 30-49   4- 50-64   5- >65

- **ED LOS :**(patient registration time …….. , Patient discharged time ……..)

- **Patient's end point from ED**:

    - Admitted to same hospital

    - Discharge to home

    - Discharge for follow up in outpatient clinic

    - Transfer to another hospital

    - Self- discharged against medical advice

    - Expiring in the emergency room

- **Day arrival time** :

    1- Morning shift (8:00 AM - 3:00 PM)

    2- Evening shift (3:00 PM – 10:00 PM)

    3- Night shift (10:00 PM – 8:00 AM)

- **Laboratory testing**:

    - Number of laboratory test

        1- 1   2- 2-3   3- 4-6   4- >7

    - TAT (result approve time : …….. , specimen acceptance time:…….)

Annex (4.2). Sample size calculator

Annex 4.3 Permission latter

Al-Quds University

Jerusalem

School of Public Health

جامعة القدس

القدس

كلية الصحة العامة

التاريخ: 2018/1/30

حضرة الدكتورة أمل أبو عوض المحترمة

مدير عام التعليم الصحي/ وزارة الصحة الفلسطينية

الموضوع: تسهيل مهمة الطالبة سامية موسى الصباح

تحية طيبة وبعد،،

تقوم الطالبة سامية موسى الصباح برنامج ماجستير السياسات والإدارة الصحية/ كلية الصحة العامة/ جامعة القدس بإجراء

بحث الرسالة بعنوان:

"The relationship between Emergency Department Average - LOS and laboratory turnaround
time (TAT) at MOH hospitals in west Bank. "

وتهدف الدراسة إلى تحديد العلاقة بين مدة المكوث في قسم الطوارئ والمدة اللازمة لانجاز الفحوصات المخبرية، وهي

بحاجة لبيانات تبين مدة الفحوصات المخبرية ومدة مكوث المريض في قسم الطوارئ في المستشفيات التالية: مستشفى

رفيديا/ نابلس، مستشفى بيت جالا/ بيت لحم، مستشفى عالية/ الخليل، والمجمع الطبي/ رام الله. نرجو من حضرتكم

الموافقة والسماح لها بالحصول على البيانات المطلوبة لاستكمال بحث الرسالة. علما بان الدراسة ستكون لأغراض البحث

العلمي فقط.

وتفضلوا بقبول فائق الاحترام،،

كلية الصحة العامة
Faculty of Public Health
عميد كلية الصحة العامة

نسخة: الملف

فرع القدس / تلفاكس 02-2799234
ص.ب، 51000 القدس

Annex 4.4 Mohapproval latter

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

دولة فلسطين
وزارة الصحة– نابلس
الإدارة العامة للتعليم الصحي

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

رقم: .عم/٢٢٦/١١٤/ C.١٨
تاريخ: ...١٢.١٢/A.١٨/C

الأخ مدير عام الادارة العامة للمستشفيات المحترم،،،

الأخ مدير مجمع فلسطين الطبي المحترم،،،

تحية واحتراماً...

الموضوع: تسهيل مهمة طلاب.

يرجى تسهيل مهمة الطالبة: سامية موسى الصباح– ماجستير السياسات والادارة الصحية– جامعة

القدس، في عمل مشروع بحثي بعنوان: ' The Relationship between Emergency

Department Average –LOS and Laboratory Turnaround time (TAT) at

MOH Hospitals in West Bank'، لذا يرجى تسهيل مهمتها في الحصول على معلومات تبين

مدة الفحوصات المخبرية ومدة مكوث المريض في قسم الطوارئ، وذلك في:

– مستشفى رفيديا   – مستشفى بيت جالا   – مستشفى عاليه   – مجمع فلسطين الطبي

علماً بأنه سيتم الالتزام بمعايير البحث العلمي والحفاظ على سرية المعلومات. كما يرجى العلم ان

مشرف البحث: د. معتصم حمدان.

مع الاحترام...

مدير عام التعليم الصحي

نسخة: عميد كلية الصحة العامة المحترم/ جامعة القدس

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

ص.ب. 14
تلفاكس: 09-2333901

الملخص

العلاقة ما بين معدل مدة مكوث المرضى في قسم الطوارىء و الفحوصات المخبرية في مستشفيات وزارة الصحة الفلسطينية في الضفة الغربية.

اعداد الطالبة : سامية موسى الصباح

اسم المشرف : الدكتورة أسماء الامام

تهدف هذة الدراسة الى تقييم مدة مكوث المرضى فياقسام الطوارىء وايجادالعلاقة ما بين الفحوصات المخبرية و مدة المكوث في اقسام الطوارىء في مستشفيات وزارة الصحة الفلسطينية.

تكونت عينة الدراسة من 597 زيارة قام بها المرضى الي اقسام الطوارىء في كل من مجمع فلسطين الطبي و مستشفى الخليل الحكومي ومستشفى بيت جالا الحكومي ومستشفى رفيديا الحكومي خلال عام 2017. وقد جمع الباحث البيانات اللازمة من ملفات المرضى الطبية المتوفرة على نظام المعلومات الصحي المحوسب. وبعد جمع البيانات عولجت احصائيا باستخدام برنامج الرزم الاحصائية للعلوم الاجتماعية (SPSS).

وقد اظهرت النتائج أن معدل مكوث المرضى في قسم الطوارىء بلغ 125.7 دقيقة بحيث كان مستشفى الخليل الحكومي هو الاعلى من حيث مدة المكوث بينما كان مستشفى بيت جالا هو الاقل, وقد اثبتت الدراسة ان هناك علاقة ما بين مدة مكوث المرضى في قسم الطوارىء والفحوصات المخبرية من حيث عدد الفحوصات المعمولة ومدتها الزمنية, كما اثبتت الدراسة وجود علاقة ذات دلالة احصائية بين مدة مكوث المريض في قسم الطوارئ وقرار طبيب الطوارئ حول وجهة المريض بعد انتهاء تلقيه الخدمة من قسم الطوارىء .

ووجدت الدراسة كذلك وجود علاقة ذات دلالة احصائية بين مدة المكوث و كل من الوردية التي وصل خلالها المريض الي قسم الطوارىء و عمر المريض . ولا توجد علاقة ذات دلالة احصائية مع جنس المريض.