Deanship of Graduate Studies
Al-Quds University

Justification of Urgent Brain Computed Tomography Scan Examinations in The Palestinian Government Hospitals

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M.Sc. Thesis

Jerusalem - Palestine

1443/2022

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This Thesis submitted in partial fulfillment of requirements for the degree of Master of Medical Imaging Technology Faculty of Graduate studies - Al-Quds University

1443 / 2022

Al-Quds University

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Faculty of Health Profession

Medical Imaging Technology

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Master thesis submitted and accepted 16.01.2022

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Dedication

My dear father, that has been fully supportive of my research since he was alive, and my beloved mother who for months has encouraged me, as well as my wife who looks after me with excellence and true attention, as I write this research paper.

Anas Nazzal

Declaration

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

Signed Anas . Y

Anas Yahya Issa Hamad Nazzal

Date: 01 / 01 / 2022

Acknowledgments

My gratitude and praise to ALLAH, the Almighty, the greatest of all, on whom ultimately, we depend for sustenance and guidance. I would like to thank Almighty Allah for giving me the opportunity, determination, and strength to do my research. His continuous grace and mercy were with me throughout my life and ever more during the tenure of my research.

I would like to express my sincere gratitude to my supervisor Dr. Mohammad Hjouj for the continuous support of my study and related research, for his patience, motivation, and immense knowledge. Thank you for supervising my thesis work and for supporting and encouraging me along the way, and for enthusiasm and inspiration, which was always there when I needed it. His guidance helped me in all the time of research and writing of this thesis. I could not have imagined having a better supervisor and mentor for my study.

Abstract

Emergency departments may need valuable imaging tools such as CT scans, especially in cases of minor head injury. However, they can cause unnecessary radiation risk to patients and can have a high-cost burden if used improperly. The purpose of this study is to assess the use of CT scans in Palestinian public hospitals. A multi-center descriptive cross-sectional analytical design was carefully chosen for achieving the study objectives. A questionnaire survey was also administered to physicians in government hospitals in order to know that to which extent physicians at the emergency departments have the basic knowledge for ordering CT scans. Data was collected by emergency physicians or residents in the hospitals. The study took place in Darwish Nazzal Hospital, Al Hussein Hospital, and Palestine Medical Complex that were in different areas of Palestine. SPSS v25 was used to list frequencies and analyze the collected data by the use of tests. 40% of doctors in the hospitals ordered CT scans with no guideline to depend on. Patients' complaints were compared with international guidelines; the unjustified value was about 41.8% of patients who came to the emergency department. As a result of that, many of the physicians need to be educated on international guidelines about CT scan requirements and the radiation dose from CT scans.

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List of Abbreviations

ACEP: American College of Emergency Physicians

ADM: Admission

CCHR: Canadian CT Head Rule

CCU: Critical Care Unit

CT: Computed Tomography

CVA: Cerebrovascular Accident

ED: Emergency Department

ER: Emergency Room

GCS: Glasgow Coma Scale

Hrs.: Hours

HIS: Health Information System

ICU: Intensive Care Unit

LOC: Loss of Consciousness

MHI: Minor Head Injury

MTBI: Minor Traumatic Brain Injury

TBI: Traumatic Brain Injury

USD: United States Dollar

PACS: Picture Archiving and Communication System

PTA: Post-Traumatic Amnesia

NSW: New South Wales

CHAPTER 1: Introduction

1.1 Background of the Study

Minor head injury (MHI) is one of the most common injuries seen in Emergency Departments (ED) (David Cassidy, 2004), which has typically been defined as patients with a history of blunt head trauma who present findings of a Glasgow Coma Scale (GCS) score of 13-15 on initial ED evaluation (Mack et al., 2003).

The brain computed tomography (CT) scan is s a valuable tool for many emergent conditions. However, overuse is a concern, due to financial costs and risks such as radiation exposure (Anumula, 2012). Other factors include a decrease in efficiency and a negative impact on hospital throughput (Morley, 2018). Moreover, unnecessary examinations can detect incidental findings that may require additional diagnostic studies, leading to increasing costs and patient anxiety and risk (Lumbreras, 2010).

Increasing referrals to hospitals and radiology departments complicate the procedures of imaging and treatment. Therefore, certain guidelines should be set with high sensitivity to assist physicians in distinguishing the patients who need emergency CT scans to reduce the economic burden of the health system and the radiation exposure as well as organize the priorities in this condition (Molaei-Langroudi, 2019).

The CT scan has relatively high radiation doses compared with the other ionizing radiation modalities. The average brain absorbed dose estimated from studies for adult CT scans was 60 mGy and the effective dose was 1.6 mSv. The CTDIw was 60 mGy, and the DLP was 1050 mGy/cm (Sheppard, 2018). Thus, the protection against the risk of radiation is an important issue. The principle of radiation protection related to the International Commission on Radiological Protection (ICRP) for ionizing radiation is justification, optimization of protection, and application of dose limits (Malone, 2012).

Among the most common CT scans performed in an emergency unit is the CT head. There are two types of CT head: post-traumatic and non-traumatic. The use of CT scans for minor purposes is not justified because each scan involves radiation. To lower hurdles and thresholds for testing and for an easy access to CT scans, CT scan misuse has to be avoided in medical practice (Parente, 2013). In the emergency department, a portion of CT scans is performed for medico-legal needs that require evidence-based treatment. There are clear advantages for using strategic imaging in the ED with reduced exposure to ionizing radiation. In children and young adults, radiation from medical imaging increases the risk of cancer for the long term. CT head scans did not detect acute clinically relevant abnormalities in the elderly or high-risk group with co-morbidities (Ip, 2013).

There are several requirements for ordering a CT scan of the head. It involves a thorough history and physical examination, as well as assessment of important symptoms connected to ordering a specific CT examination in accordance with the standardized worldwide standards for CT imaging in an emergency scenario. A multitude of guidelines and published criteria including recommendations from large multicenter trials and specialty societies—are available to help the emergency physician in determining if imaging is necessary. However, a definitive understanding of what constitutes appropriate imaging remains an enigma due to conflicting guidelines and variations in practice patterns (Hentel et al., 2011).

For example, there are at least six published guidelines available to assess the need for head CT in patients who have experienced minor head trauma. These are in addition to the guidelines from professional societies such as the American College of Emergency Physicians (ACEP) and the American College of Radiology (Hentel et al., 2011). The most reliable set of rules for mild head injury is the Canadian CT Head Rule (CCHR), which is more specific, thus offering a greater potential reduction in the overall number of scans needed (Stiell, 2001).

According to the guidelines mentioned in the previous paragraph, patients are classified into three groups: high-risk, moderate-risk and low risk. High-risk criteria include GCS less than 8 or 9 (2 H after injury), suspicious open or depressed fractures in the skull, symptoms of skull base fracture (hemotympanum, raccoon eye, cerebrospinal fluid rhinorrhea and otorrhea, Battle's sign), vomiting at least two times, and age over 65. The moderate-risk criteria include GCS=8 or (9-12), short-term Loss of Consciousness (LOC), amnesia after trauma, vomiting, headache, toxicity (Sultan, 2004) (J., 2005).

Moreover, low-risk criteria are characterized as being asymptomatic at the time, no other injuries and focal neurological deficit and change in LOC, normal pupils, normal memory, GCS>13, detailed history, mild injury mechanism, injury in less than 24 H, no headache or a mild headache, no vomiting and no high-risk factors (Sultan, 2004) (J., 2005).

1.2 **Problem Statement**

The problem is the lack of data reporting on the unnecessary use of head CT scanning or the practice of Palestinian physicians when ordering CT scans. There also seems to be a scarcity of information on how radiologists deal with doctors when interpreting scans. This would lead to increases patient dose radiation exposure that can lead to numerous types of cancer and costs.

Head CT scans can be a huge burden on the healthcare system of the government. There is a particular need for guidelines to control the ordering of brain CT exams.

1.3 **Study Objectives**

1. To assess the requested CT scan of brain, whether justified or unjustified, by the emergency department in the governmental hospitals.
2. To assess the collaboration between the emergency physician and the radiologist of the requested brain CT scan.

CHAPTER 2: Theory and Literature Review

2.1 Introduction

This chapter will delve into the previous and current literature available on head CT scans and how they are used by physicians in numerous countries. It also discusses how the quality of these practices can affect the safety of patients as well as the burdens and costs associated with performing them.

2.2 Literature Review

Radiation exposure from CT scans has been proven to cause leukemia and brain tumors in children, which has caused a stimulus in justification of every medical imaging procedure for both children and adults (Pearce, 2012).

Many studies have been published in the literature confirming higher than normal radiation doses from commonly performed CT scans and that they caused a variety of cancers depending on the specific type of CT examination (Smith-Bindman, 2009) (Shuryak, 2014).

However, several studies have shown that physicians often either lack awareness of the clinical decision rules for performing head CT scans or disregard them in clinical practice (Owen, 2015) (Tan, 2018).

A high consistency was found in high-quality clinical practice guidelines for minor traumatic brain injury assessment, imaging, and provision of patient information. However, the study didn't include CCHR and another problem was that minor traumatic brain injury (mTBI), or minor head injury, still does not have a specific definition that is agreed upon by the scientific community (Tavender, 2011).

For Medicare patients in the United States, the number of ED visits during which a CT examination was performed increased from 2.7 million to 15.2 million over 12 years from 1995 to 2007, with the percentage of ED visits in which CT was performed increasing from 2.8% to 13.9% (Larson, 2011).

A study published in 2018 estimated that around 105,802 CT scans were performed in people who are 21 years old or less in Spain in 2013 and that 168.6 cancer cases are projected to rise over life due to ionizing radiation exposure that they have received while getting scanned by the CT machine. It was also found that the biggest portion of these CTs was head and neck which in turn projected higher numbers of thyroid and oral/pharynx cancer cases (Bosch de Basea, 2018).

The available literature is scarce on the number of total CT scans performed locally, but in the Middle East region, the median traumatic brain injury (TBI) incidence rate per capita was 45 per 100,000. The overall median ED-based TBI mortality, which included all age groups and all injury severities, was 10%. It wasestimated the overall median mortality for head trauma studies based on emergency department admissions was 6% among all age groups and all injury severities. The overall TBI-related median mortality in the ICU-based studies was 25% (El-Menyar, 2017).

According to (Younis, 2011), the most significant causes of traumatic brain injuries in Palestine were impacts from heavy objects (3.2%), road traffic crashes (29.8%), falls (32.1%),

and assault (33%). It was also found that gunshot wounds and assault with firearms were two of the leading causes of head injuries in Palestine.

One study has demonstrated that the increased number of scans performed after installing a CT scanner in the ED has significantly outpaced the number of positive cases, resulting in a decreased positivity rate of neuroradiology exams primarily due to lower positive rates of facial CT scans (Oguz, 2002).

A systematic review and economic evaluation found that the CCHR was validated and cost-effective for use in adults, but needed more studying for further validation. As for hospital admissions, it was only cost-effective to admit patients with abnormal CT findings not normal CT brain scans (Pandor, 2011).

Cost-effectiveness analysis showed that performing CTs selectively for patients with MHI according to CCHR rules was the most cost-effective approach compared to other guidelines that were included in the study and predicted potential annual cost savings of around 120$ million USD provided that the sensitivity for identification of patients requiring neurosurgery is extremely high (Smits, 2010). In another study, the use of CT scanning based on a high sensitivity decision rule was also found to be effective and cost-saving and the CCHR rule appeared to be the best strategy for the use which supports the previous study's findings (Holmes, 2012).

Moreover, one study demonstrated that CTs obtained for MHI were non- compliant to guidelines in 10 to 35% of cases and that implementation of CCHR guidelines could reduce the use of head CTs in MHI by 35%. The study data also suggested that this can prevent 36 radiation-induced cancers per year and could result in savings that amount to 394 million USD annually (Melnick, 2012).

A study on 1,384 patients concluded that routine head CTs in patients with loss of consciousness (LOC) / amnesia without symptoms or signs of depressed skull fracture had minimal clinical value to physicians (Miller, 1996).

Another study indicated that patients with minor head trauma could be safely managed at primary or secondary-level units. This study suggested that patients who fit the criteria for MHI with a presentation GCS score of 15/15 could safely be managed at the referral hospital awaiting the next-day scan. This could have a significant positive impact on heavily burdened ambulance services and the trauma units at the major tertiary centers (Singata, 2018).

Other clinical predictors for abnormal CT findings after mild head trauma was found by a study to be correlated with older age, white race, signs of basilar skull fractures, and specific mechanisms of injury such as assault and pedestrians struck by a motor vehicle (eret, 1993). Additionally, there is a previous study that included adult and child patients in al makased hospital, where those studies obtained 30.4% of unjustification requests (Al-Tell, 2019).

CHAPTER 3: Materials and Methodology

3.1 Introduction

In this study, the main focus was to evaluate the use of head CT scanning in the emergency departments of government hospitals in Palestine. And to assess whether these CT scans were justified or unjustified by referring to the patient's files. A questionnaire was also administered for the physicians to explore their knowledge and attitudes regarding CT scanning risk and evaluate the justified and unjustified requests which can be found in Appendix A.

3.2 Study Duration

The study focused on the patients who underwent brain CT during the period from 1/1/ 2019 to 31/3/2019.

3.3 Study Design

A multi-center retrospective cross-sectional analytical design was carefully chosen for achieving the study's objectives.

3.4 Study Population

A total of 3379 patients from both genders who underwent brain CT scans have participated in this study. Patients were included and excluded based on criteria.

The number of physicians who participated in the questionnaire was 66, who distributed on 7 government hospitals which are; Darwish Nazzal Hospital, Martyr Yasser Arafat Governmental Hospital, Martyr Thabit Hospital, Palestine Medical Complex, Rafidia Hospital, Alya Hospital, and Hussein Hospital.

3.5 Study Sample

In this study, the process of data collection was conducted in three public hospitals (Dr. Darwish Nazzal Hospital in Qalqilya, Al-Hussein Hospital in Bethlehem, and Palestine Medical Complex in Ramallah).

3.6 Inclusion Criteria

The included participants were over 18 years of age who underwent a CT scan of the head in the mentioned hospitals, in the evening and night shift (from 15:00 to 08:00 in the morning).

3.7 Exclusion Criteria

Participants who were less than 18 years of age and all participants who underwent brain CT scan in the morning shift (urgent or not).

3.8 **Data Collection**

The process of data collection consisted of two steps: a data collection from public Hospitals PACS and a questionnaire preceded by informed consent for resident doctors. The participants for the questionnaire were 66 resident doctors from different governmental hospitals, which are, Darwish Nazzal Hospital, Martyr Yasser Arafat Governmental Hospital, Martyr Thabit Hospital, Palestine Medical Complex, Rafidia Hospital, Alya Hospital, and Hussein Hospital. For more details about the questionnaire, please see appendixes A

3.9 **Study Tools**

- Files contained demographic characteristics and questions in a survey targeting residents (Questionnaire).
- Files contained the number of head CT scans performed for each patient.
- Files also contained the place of admission to the hospital and the physician notes.

3.10 **Statistical Analysis**

SPSS V.25 has been used for statistical analysis. For categorical data, frequencies were used for descriptive analysis for quantitative data, the means were compared using an independent sample.

3.11 **Dependent / Independent variables**

Dependent Variable

i. Justified and unjustified brain CT examination.
ii. Patients complain

Independent Variables:

i. International guideline

3.12 **letter Approval**

- Approval was obtained from the Ministry of Health (Appendix B)
- Approvals were also obtained from the directors of government hospitals as well as the medical complex that was included in this study.

CHAPTER 4: Results and Discussion

4.1 Results of Data Collection

This chapter outlines the results of the study, the frequencies for the categorical variables, the means for the quantitative variables, and the tests conducted.

4.2 Background Information of the Study Populations

Patients were included and excluded based on criteria. A total of 1083 patients were included in this study while a total of 2296 patients were excluded. The total number of males was 595 (55%) and 488 (45%) were females.

4.3 Justified and unjustified brain CT examination

Based on the collected data from the three hospitals; it was found out that the number of CT scans done without justification according to diagnose (files patients empty) was 12.9% in Palestine medical complex, 24.1% were done in Hussein Hospital and 10.5% of CT scans were done in Darwish Nazzal Hospital were unjustified, so all government hospital according to note were justified as shown in Figure 1. Overall, the number of CT scans that were requested without justification in all three hospitals in this study was 157 out of 1083 CT scans, which are around 14.5%. An important point that has been founded is that no one of the patients in the evening and night shifts has a report of the CT scan from the radiologist.

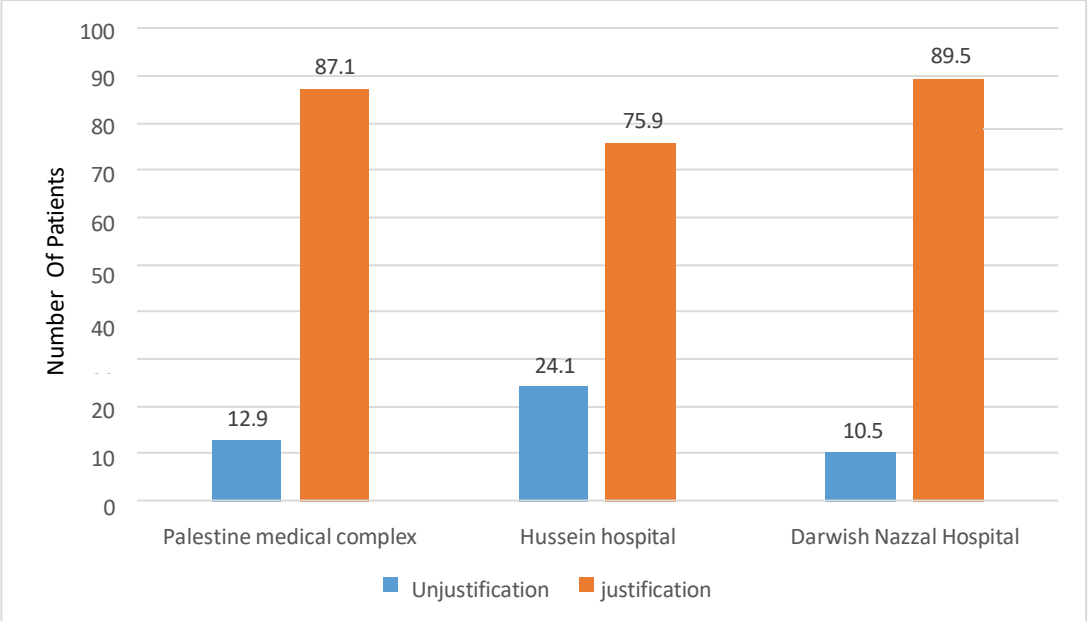

Figure 1 Justified and unjustified CT examination done in Palestine Medical Complex, Hussein, and Darwish Nazzal Hospitals according to diagnose (files patients empty)

4.4 Questionnaire

The participants for the questionnaire were 66 physicians from different hospitals that included Darwish Nazzal Hospital, Martyr Yasser Arafat Governmental Hospital, Martyr Thabit Hospital, Palestine Medical Complex, Rafidia Hospital, Alya Hospital, and Hussein Hospital that are distributed all over Palestine. Based on the questionnaire collection data, the number of physicians who order brain CT scans without national guidelines was 40 (60.6%) out of 66 resident doctors.

According to age of doctors the maximum percentage was from 22-30 was (56.1%) and the minimum age from 40-49 was (9.1%) as shown in the table 4.1.

Table 4 - 1 Doctors Age

AGE	**Frequency**	**Percent (%)**
22-30	37	56.1
31-39	23	34.8
40-49	6	9.1
Total	66	100

According to types of doctors and specialist were asked in questionnaire the resident was 45 (56.168.2%) and the specialist was 21 (31.8%) as shown in the table 4.2.

Table 4 - 2 Types of doctors and specialist were asked in questionnaire.

Type of Work		Frequency	Percent (%)
.Valid	Resident	45	68.2
	Specialist	21	31.8
	Total	66	100.0

According to experience of doctors in years, the maximum percentage was found in the range 1-4 years (51.5%) and the minimum percentage was found in the rage of less than one year (21.2%) as shown in the table 4.3.

Table 4 - 3 Experience of doctors in years.

Experience		Frequency	Percent (%)
Valid	Less than a year	14	21.2
	1-4 Years	34	51.5
	5+ Years	18	27.3
	Total	66	100.0

As for question one (When you order a CT scan of the brain especially in trauma patients, do you use any national or international guidelines?), 40 resident doctors answered that they don't use any guidelines. The other 26 resident doctors reveal that they use the global guideline. So, the majority responded that they did not use any global or local guidelines when ordering head CT scans. This implies that there is a need for educating doctors on international guidelines and standards for using CT scanners as shown in table 4.4.

Table 4 - 4 Percentage of doctors use a national or international guidelines?

		Frequency	Percent (%)
Valid	Yes	26	39.4
	No	40	60.6
	Total	66	100.0

Question 2 (When you request a CT scan of the brain, do you know the amount of radiation that the patient is exposed to in one image?) showed that 44 resident doctors lack the knowledge about the radiation dose which conclude that the majority of doctors ordered CT scans without knowing the radiation dose that comes from performing a CT scan as shown in table 4.5. This shows a need for further education for doctors on radiation doses, patient exposure percentages, and the maximum amount of radiation dose a patient can receive per year, which is. So, it is suggested to educate physicians about methods of lowering dose using international protocols.

Table 4 - 5 The percentage of the doctors' responses on whether they know the amount of radiation that the patient exposed to in one image or not.

		Frequency	Percent (%)
Valid	Yes	22	33.3
	No	44	66.7
	Total	66	100.0

Question 3 (Do you order brain CT image based on the request of the patient or his family?) showed that 59 of the resident doctors did not order a CT under influence of the patient's family which is a good sign. The results show that there is about 10% of the doctors who ordered CT scans for patients under pressure (patients or their family's pressures) as shown in table 4.6. This could be a problem because the doctors did not make their decisions based on medical rationale.

Table 4 - 6 Question about order brain CT based on patient or his/her family?

		Frequency	Percent (%)
Valid	Yes	7	10.6
	No	59	89.4
	Total	66	100.0

Question 4 (Can you read the CT image alone when you order them on the evening or night shift?) results displayed that about 38 resident doctors sometimes know how to read a CT scan alone, 9 resident doctors were not able to read it alone and 19 resident doctors can read it alone when there were no radiologists around, which again reinforces the need to educate these residents on CT scan reading and diagnosis as shown in table 4.7.

Table 4 - 7 The percentage of doctor's ability to read CT images.

		Frequency	Percent (%)
Valid	Yes	19	28.8
	No	9	13.6
	Sometimes	38	57.6
	Total	66	100.0

Question 5 (When do you call a radiologist on the evening or night shift?) as shown in table 4.8 revealed that many resident doctors are hesitant to call the radiologists in charge for reading a CT scan in the evening and night shift (from 66 doctors, the number of doctors who never call a radiologist to read the CT scan was 11, the doctors who sometimes call one were 44, and the doctors who always call one were 11), which should not be the case because patient safety always comes first and many did not know how to read a CT scan properly as was shown in question 4 results.

Table 4 - 8 Question about if doctors call a radiologist on evening or night shift?

		Frequency	Percent (%)
Valid	Never call	11	16.7
	Sometimes call	44	66.7
	Always call	11	16.7
	Total	66	100.0

Question 6 (What do you say to the patient if you request CT image on the evening or night shift and you need Radiologist to read it) showed that 17 resident doctors did not send the patients to any radiologist for diagnosis of the case (Wait till morning), 16 read the images alone, 33 were sent to a radiologist (outside) as shown in table 4.9. Most resident doctors referred to other radiologists in the evening and night shift if they needed to read the CT scan, which is a sign of good practice among these doctors. The majority of resident doctors (about 45) also took into account the expenses of CT scanning before performing them as was shown in question 7 results as shown in table 4.10.

Table 4 - 9 What did the doctors do about reading CT scans?

		Frequency	Percent (%)
Valid	Wait till morning	15	22.7
	Send to another doctor	33	50.0
	Read Alone	16	24.2
	Call Attending	2	3.0
	Total	66	100.0

Table 4 - 10 Question if doctors care about cost of image?

	Frequency	Percent (%)
Yes	45	68.2
No	21	31.8
Total	66	100.0

However, it was contradictory with the findings of the many unnecessary CT scans that were performed without doctor notes or any clinical significance or reasoning, which was estimated to be around 14.5%. Also, just 22 (33.3%) of the resident doctors know the amount of radiation that the patient is exposed to in one image. Moreover, most of the resident doctors 38 (57.6%) said that they can sometimes read the CT scan alone which sometimes leads them to call a radiologist. Most of the resident doctors in evening and night shifts send patients to radiologists outside of the hospital to write reports for them.

4.5 Patient Complain

In addition to what was previously mentioned that 14.5% of the total requested CT scans were unjustified, there are other medical diagnoses for which CT scan were requested without justification. In other words, there were no pre-diagnostic tests for the patient which led to ask a CT for him/her as shown in table 4.11.

Based on the patients' files, it has been found that some of the diagnoses mentioned in these files, such as (headache 12.5%), were not written any additional information before making a brain CT scan, especially that headache has many causes that could lead to it, such as high blood pressure, sinuses, etc., which do not need a brain CT scan to be diagnosed.

As for (chest pain 1.6%), no clear reasons have been written for requesting a brain CT scan, although it is possible to make a diagnosis for the patient without a brain CT scan because of the possibility that the patient may suffer from muscle pain, anxiety, etc.

In addition, there are other diagnoses such as (other, cut wound and assault 16.5%) for which a brain CT scan was requested, and the procedures that the doctor had taken before requesting the brain CT scan were not explained. For example, the doctors did not write in the patient's file whether the (cut wound) was superficial or deep or when diagnosing (other) such as Alzheimer, there is no need to request a brain CT scan.

Table 4 - 11 The diagnose patients in Palestine Medical Complex, Hussein Hospital and Darwish Nazzal Hospital.

	Palestine Medical Complex		***Hussein Hospital***		***Darwish Nazzal Hospital***	
Diagnose	Frequency	Percent (%)	Frequency	Percent (%)	Frequency	Percent (%)
Cerebrovascular Accident	**76**	**10.4**	**18**	**9.4**	**15**	**9.3**
Falling Down	**38**	**5.2**	**2**	**1.0**	**20**	**12.3**
Road Traffic Accident	**10**	**1.4**	**1**	**0.5**	**12**	**7.4**
Assault	**1**	**0.1**	**1**	**0.5**		
Stroke	**29**	**4.0**	**2**	**1**	**9**	**4.9**
Trauma	**53**	**7.3**	**27**	**14.1**		
Cut Wound	**5**	**0.7**	**1**	**0.5**		
Hemorrhage	**7**	**1.0**	**4**	**2.1**	**1**	**0.6**
Weakness	**43**	**5.9**	**12**	**6.3**	**2**	**1.2**
Chest Pain	**19**	**2.6**	**2**	**1**	**2**	**1.2**
Infraction	**1**	**0.1**				
Numbness	**17**	**2.3**	**12**	**6.3**		
Hypertension	**27**	**3.7**	**2**	**1**	**11**	**6.8**
Hypotension	**8**	**1.1**			**4**	**2.5**
Convulsion	**1**	**0.1**				
Mass	**1**	**0.1**				
Headache	**94**	**12.9**	**34**	**17.8**	**11**	**6.8**
Dizziness	**52**	**7.1**	**10**	**5.2**	**24**	**14.8**
Infection	**1**	**0.1**				
Other	**141**	**19.3**	**17**	**8.9**	**33**	**20.4**
Myocardial Infarction	**3**	**0.4**				
Fracture	**2**	**0.3**				
No Note	**94**	**12.9**	**46**	**24.1**	**17**	**10.5**
Tumor	**7**	**1.0**			**1**	**0.6**
Total	**730**	**100.0**	**191**	**100.0**	**162**	**100**

To conclude, it become clear that the reason for requesting a brain CT scan was not mentioned. Many of the diagnosed diseases and requested a brain CT scan, which are often accompanied by prior diagnoses that were not mentioned in the patients' files. Only the name of the diagnoses and that a brain CT scan requested were mentioned.

Based on what was mentioned, the percentage of the CT scans that were requested without justification is (27.3% (headache 12.5% + chest pain 1.6% + other, cut wound and assault 16.5%) + 14.5% = 41.8%), which expresses the sum of the previous percentages.

4.6 Discussion

The unjustified percentage of CT scans was 41.8 in government Hospitals. which correlates with other studies that suggest that around 20% of unnecessary radiation doses from CT scans could be reduced with proper guidelines (Brenner, 201It has been founded that in Palestine Medical Complex the highest percentage of the patients who have been asked to make a CT scan due to no reason was (19.3%) which is unjustified. It has been reached to this result since the reason for asking for CT scans was "others". The same result has been found in Darwish Nazzal Hospital, (20.4%) of the requested CT scans were without reason (unjustified). However, in Hussein Hospital, the percentage of unjustified CT scans was less (8.9%) of the total CT scan requested there.

According to the questionnaire, the majority of physicians are lack knowledge about the guidelines (either local or global) used when requesting a CT scan. Moreover, a high percentage of physicians who request CT scans do not have enough information about the radiation dose. According to O'Sullivan et al., 2010 limited radiation knowledge was not compensated by using guidelines. Only 20% of physicians and 72% of non-physicians used referral guidelines. Also, according to Krille et al., systemic review which showed moderate to low knowledge among physicians concerning radiation doses and the involved health risks. This was not compensated by using a guideline as mentioned before. The explanation might be the lack of initial training during medical studies and the absence of regular structured education in Hospitals on radiation protection (Al-Tell, 2019).

The majority of referring physicians do not have enough knowledge in reading CT scan images accurately. This led to another delusion that is the hesitation of asking the radiologist in charge to give them a hand in dealing with those images. Additionally, the physicians working in the ED must know the guidelines of CT order, and the clinical examined to the patients to collect data as much as possible about the present cases to dissipate the CT exam as possible (Nishtar et al., 2019). A previous study showed that there were a lot of patients who have been ordered to do a CT scan while the clinical examination was enough to diagnose them (Lumbreras B. D.-A., 2010) This implies that there is a need for educating doctors on international guidelines and standards for using CT scanners.

A study in Iran, which has similar results, shows that the CT scan is not necessary for patients suffering from a seizure, especially in the first time coming in the ED, where the seizure is considered from the indications of brain CT (Zarmehri, 2020).

By comparing the current study with a previous study by Al Tell et al., the results were as follows: Both studies focused in their research on patients in the emergency department, while they differed in the criteria for excluding patients, as the current study excluded patients in the morning shift and those under the age of 16, while the study of Al Tell et al., excluded patients from the morning shift only. Another difference between the two studies is that the current study included government hospitals only, while Al Tell et al., study was limited to Al-Makassed Hospital, which is not considered a government hospital. The most important point to mention here is the percentage of the unjustified CT scans, they were, in this research, about (41.8), which is far from the percentage of the other research, which were (30.4), where the difference (which maybe higher or lower) is attributed to the exclusion of children under the age of 16 from this research and numbers of study sample.

The NSW Health algorithm guideline has been used in this research in order to find out whether the CT scans ordered justified or unjustified. This is an international guideline which may use in Palestinian Government Hospitals when ordering CT scans.

CHAPTER 5: Conclusion and Recommendations

5.1 **Conclusion**

This study shows that there is a possibility to reduce the unjustified CT scans by educating physicians about the radiation dose values and optional risk. Also, training sessions about lasted guidelines to be used when requesting a CT scan.

5.2 **Recommendations**

- It is critical to design local guidelines and a checklist that organizes and assists in ordering justified CT scans.
- Physicians should also be well informed about radiation doses from imaging techniques and the maximum permissible doses through educational seminars to reduce unjustified CT scans.
- It is recommended to hire a radiologist in all public hospitals who works in the evening and night shifts. This would improve patient's files and reduces expenditures on patients.

5.3 **Limitations**

Many of the patients' files were not completed. Also at the same time, there were many patients who didn't have a written note in their files after their diagnoses which might affect the accuracy of the data.

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Appendix A

كلية الدراسات العليا / جامعة القدس

استبانة بحث علمي

تحية طيبة وبعد.....

يقوم الباحث بإجراء دراسة بعنوان مبررات اجراء فحوصات الاشعة المقطعية المستعجلة في النظام الصحي الفلسطيني : دراسة لضبط الجودة والتكلفة وجعة الاشعاع في اقسام التصوير الطبقي الحكومية.

سيكون الباحث ممتنا لك /ي إذا أجبت على أسئلة هذا الاستبيان، مع الاحتفاظ بحقك في عدم الإجابة على أي سؤال لا تريد الإجابة عليه، علما انه لا يجوز للباحث استخدام هذه البيانات إلا لأغراض البحث العلمي.

يرجى قراءة الأسئلة بتمعن، سيتم التعامل مع ردودك على الأسئلة المطلوبة في هذا الاستبيان بسرية تامة ومطلقة، ولن تكون ردودك معروفة لأي شخص خارج فريق البحث، ولن يتم الكشف عنها لأي شخص داخل مؤسستك الصحية، ولن يتم طلب أي معلومة في الاستبيان تحدد هويتك وهي لغرض البحث العلمي فقط.

إذا كان لديك أي استفسار آخر حول الاستبيان يرجى التواصل مع الطالب حسب المعلومات أدناه:

الطالب: انس يحيى نزال

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المشرف: د. محمد الحجوج

شاكرين لكم حسن تعاونكم

القسم الاول: البيانات الشخصية

1. الجنس □ ذكر □ انثى
2. العمر □ 30-22 □ 39-31 □ 49-40 □ ≤ 50
3. طبيعة العمل □ مقيم □ اخصائي
غير ذلك□
4. الخبرة □ اقل من سنة □من سنة الى 4 سنوات □اكثر من خمس سنوات

القسم الثاني: قياس مدى معرفة دكتور الطوارئ بجرعة الاشعة والحالات التي يجب طلب صورة طبقية فيها

السؤال الأول : عندما تطلب فحصًا بالأشعة المقطعية للدماغ خاصة في مرضى الصدمات ، فهل تستخدم أي إرشادات محلية أو دولية.

أ. نعم
ب. لا

السؤال الثاني: عندما تطلب فحصًا بالأشعة المقطعية للدماغ خاصة هل تعلم كمية الأشعة التي يتعرض لها المريض في الصورة الواحدة

أ. نعم
ب. لا

السؤال الثالث : هل تطلب صورة طبقية بناء على طلب المريض أو اهله

أ. نعم
ب. لا

السؤال الرابع : هل تسطيع قراءة صور الأشعة الطبقية لوحدك عند طلبها على الورديه المسائيه

أ. نعم
ب. لا
ت. أحيانا

السؤال الخامس : متى تستدعي دكتور الأشعة على الوردية المسائيه

أ. لا استدعيه أبدا
ب. استدعيه أحيانا
ت. اطلبه دائما

السؤال السادس : ماذا تقول للمريض في حال طلبك لصورة أشعة طبقية على الوردية المسائيه وتحتاج دكتور لقراءتها

أ. انتظر حتى صباح الغد

ب. اذهب الى دكتور خارجي خاص

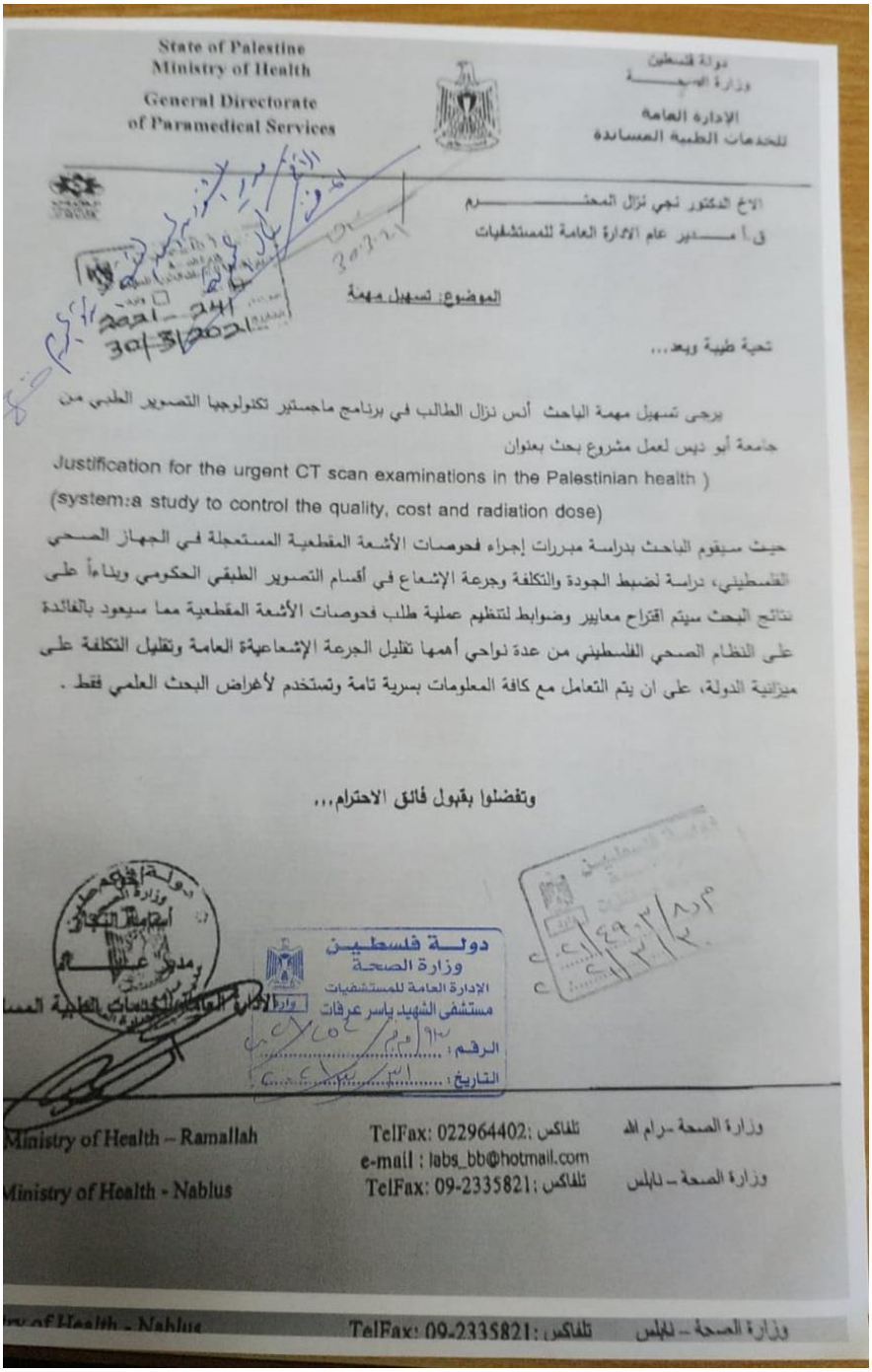
ت. تقرأها لوحدك

السؤال السابع: هل تأخذ بعين الإعتبار تكلفة القيمة المالية الفردية والعامة لفحص الطبقية عند طلبه

ا. نعم
ب. لا

=

Appendix B



State of Palestine
Ministry of Health
General Directorate
of Paramedical Services

دولة فلسطين
وزارة الصحة
الإدارة العامة
للخدمات الطبية المساندة

الاخ الدكتور نجي نزال المحتـــــــــــرم
ق.أ مـــــدير عام الادارة العامة للمستشفيات

الموضوع: تسهيل مهمة

تحية طيبة وبعد...

يرجى تسهيل مهمة الباحث أنس نزال الطالب في برنامج ماجستير تكنولوجيا التصوير الطبي من جامعة أبو ديس لعمل مشروع بحث بعنوان

Justification for the urgent CT scan examinations in the Palestinian health)
(system:a study to control the quality, cost and radiation dose)

حيث سيقوم الباحث بدراسة مبررات إجراء فحوصات الأشعة المقطعية المستعجلة في الجهاز الصحي الفلسطيني، دراسة لضبط الجودة والتكلفة وجرعة الإشعاع في أقسام التصوير الطبقي الحكومي وبناءاً على نتائج البحث سيتم اقتراح معايير وضوابط لتنظيم عملية طلب فحوصات الأشعة المقطعية مما سيعود بالفائدة على النظام الصحي الفلسطيني من عدة نواحي أهمها تقليل الجرعة الإشعاعية العامة وتقليل التكلفة على ميزانية الدولة، على ان يتم التعامل مع كافة المعلومات بسرية تامة وتستخدم لأغراض البحث العلمي فقط .

وتفضلوا بقبول فائق الاحترام...

دولة فلسطين
وزارة الصحة
الإدارة العامة للمستشفيات
مستشفى الشهيد ياسر عرفات
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وزارة الصحة –رام الله
وزارة الصحة – نابلس

Appendix C

Table C: Initial management of adult closed head injury (NSW Health algorithm).

No.	A-WPTAS.Abbreviated Westmead PTA Scale, GCS.Glasgow Coma Scale.
1	Glasgow Coma Scale (GCS) < 15 at 2 h after injury
2	Deterioration in GCS
3	Focal neurological deficit
4	Clinical suspicion of skull fracture
5	Vomiting (especially if recurrent)
6	Known coagulopathy or bleeding disorder
7	Age >65 years
8	Post-traumatic seizure
9	Prolonged loss of consciousness (>5 min)
10	Persistent post-traumatic amnesia (A-WPTAS <18/18 at 4 h after injury
11	Persistent abnormal alertness/behavior/cognition
12	Persistent severe headache
13	Large scalp hematoma or laceration
14	Multi-system trauma
15	Dangerous mechanism
16	Known neurosurgery/neurological impairment
17	Delayed presentation or representation

ملخص الدراسة

قد تحتاج أقسام الطوارئ إلى أدوات تصوير قيّمة مثل التصوير المقطعي المحوسب ، خاصة في حالات إصابة الرأس الطفيفة. ومع ذلك ، يمكن أن تسبب مخاطر إشعاعية غير ضرورية للمرضى لها عبء باهظ التكلفة إذا تم استخدامها بشكل غير صحيح. الغرض من هذه الدراسة ويمكن أن يكون هو تقييم استخدام الأشعة المقطعية في المستشفيات العامة الفلسطينية وتقييم مخاطرها وتكاليفها وآثارها على سلامة المرضى. تم اختيار تصميم تحليلي وصفي متعدد المراكز بعناية لتحقيق أهداف الدراسة. كما تم إجراء استبيان استقصائي للأطباء في المستشفيات الحكومية من أجل معرفة مدى امتلاك الأطباء في أقسام الطوارئ للمعرفة الأساسية لطلب الأشعة المقطعية. تم جمع البيانات من قبل أطباء الطوارئ أو المقيمين في المستشفيات. تمت الدراسة في مستشفى درويش نزال ومستشفى لسرد SPSS v25 الحسين ومجمع فلسطين الطبي في مناطق مختلفة من فلسطين. تم استخدام الترددات وتحليل البيانات المجمعة باستخدام الاختبارات. 40٪ من الأطباء في المستشفيات أجروا للمرضى أشعة مقطعية غير مبررة على الرأس. تمت مقارنة شكاوى المرضى بالإرشادات الدولية ، وبلغت القيمة غير المبررة حوالي 41.8٪ من المرضى الذين قدموا إلى قسم الطوارئ. يحتاج العديد من الأطباء إلى التثقيف حول الإرشادات الدولية لمتطلبات الفحص بالأشعة المقطعية ، وجرعات الإشعاع من الأشعة المقطعية.