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Optimizing oncological services quality in Palestinian governmental hospitals: A Six Sigma approach from the Perspective of hospital administration

By

Dua'a Hussein Hamed Alhamed

Supervisor

Dr. Yahya Salahat

This thesis was submitted in partial fulfillment of the requirements for the Master's degree in quality management in health institutions

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Thesis Approval

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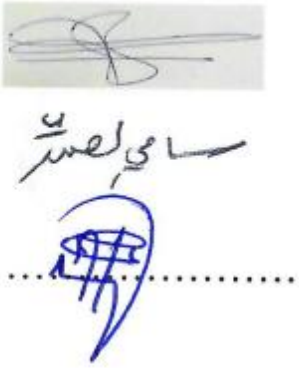
This thesis was defended successfully on 1/3/2025 and approved by:

Committee members

Signature

1. Dr. Yahya Salahat : Supervisor
2. Dr. Sami Sader : Internal Examiner
3. Dr. Atef Rimawi : External Examiner



Declaration

I declare that all the work in this thesis titled “Optimizing Oncological Services Quality in Palestinian Governmental Hospitals: A Six Sigma Approach from the Perspective of Hospital Administration” has been done to fulfill the requirements for the degree of Master’s in Quality Management in Healthcare and submitted to Arab American University, Palestine. All work is original and it has been written by me. I have duly acknowledged all the sources of information that have been used in this thesis.

This thesis has also not been submitted to any other degree or university.

Name: Dua’a Hussein Hamed Alhamed

ID: 202216615

Signature: 

Date: 14.4.2025

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Abstract

The current study aims to assess the quality of the oncological services applied by the oncological departments in the governmental hospitals in Palestine and to utilize Six Sigma tools to improve the quality of such services. To this end, the study used descriptive and analytical approaches that are appropriate for the aim of the study. More specifically, the quantitative and qualitative methods have been used to collect the needed comprehensive data from the administrators of governmental hospitals' perspectives via a questionnaire. The study utilized primary and secondary data; the primary data included five governmental hospitals in three districts (north, middle, and south) that apply oncological management. On the other hand, the secondary data was based on reviewing the medical referral reports of all Cancer patients who have been referred outside the Ministry of Health (MoH) facilities as a result of drug shortage between the period of 1st of January 2023, and 31st of December 2023. A random sampling technique was adopted to gather the needed information from the cancer patients at the Service Purchase Unit of the MoH. In total, 379 medical reports were chosen to be reviewed.

The analysis of the gathered data was conducted by SPSS 26. The results revealed that some of the Six Sigma tools have been applied in governmental hospitals. More specifically, concerning the define-measure-analyze-improve and control (DMAIC) components, definition, analysis, and improvement dimensions were found to be applied very well, while the measurement and control elements of DMAIC came out in a moderate appliance.

Keywords: Six Sigma, DMAIC, Cancer, oncological services, Palestinian Governmental Hospitals

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List of Abbreviations

AVH	Augusta Victoria Hospital
C&E	Cause and Effect Investigation
CBC	Complete Blood Count
CCU	Cancer Coordination Unit
CSF	Critical Success Factors
CTQ	Critical to Quality
DMAIC	Definition, Measurement, Analysis, Improvement, and Control.
EDC	Early Detection Clinics
EDL	Essential Drug List
GBCI	Global Breast Cancer Initiative
GS	Gaza Stripe
HBCR	Hospital-Based Cancer Registries
HBCR	Hospital-Based Cancer Registries
LSS	Lean Six Sigma

MoH	Ministry of Health
PALCO	Palestine Against Lung Cancer Day
PDSA	Plan-Do-Study-Act
PMoH	Palestinian Ministry of Health
QA	Quality Assurance
QC	Quality Control
RTDP	Palestine Radiotherapy Development Plan
SGPT	Serum Glutamic Pyruvic Transaminase
SPU	Service Purchase Unit
TPS	Toyota Production System
VSM	Value Stream Mapping
WB	West Bank

Chapter One: Introduction

1.1 Overview

According to the World Health Organization (WHO), Cancer is defined as *"a large group of diseases that can start in almost any organ or tissue of the body when abnormal cells grow uncontrollably, go beyond their usual boundaries to invade adjoining parts of the body and/or spread to other organs"*. Breast, lung bronchus, prostate, and colorectal cancers account for almost 50% of all new cancer cases in the United States. While, Lung and bronchus, colorectal, pancreatic, and breast cancers are causing death for about 50% of all deaths. (National Cancer Institute [NIH], 2024).

According to "The GLOBOCAN 2022 cancer estimates ", which included 185 countries and 36 cancer types; lung cancer was the most frequent among males worldwide about 1.57 million, followed by prostate cancer with a number of 1.47 million. However, in females, the most common cancer incidence rate was breast cancer followed by lung cancer and cervical cancer with a number of (2.3,0.91 and 0.66 million), respectively (Filho, A. M., et al. 2025).

Globally, Cancer is considered the second leading cause of death, after heart disease with about 9.6 million deaths in 2018 (WHO, 2018). Regarding this notable increase in the incidence and mortality rate of Cancer, several efforts must be applied to improve the quality of cancer services, especially in low and middle-income countries where the health systems are unable to manage this burden, which many of the people did not have a chance for early detection, diagnosis, and quality targeted treatments. A comparison between the United

States and Palestine in the number of newly diagnosed cases of Cancer and the number of deaths regarding Cancer in 2023, are shown in Table 1, and Table 2, respectively.

Table 1 : A comparison between the United States and Palestine in the number of new Cancer cases in 2023

	New Cancer Cases, 2023 in the United States	New Cancer Cases, 2023 in West Bank
Breast	300,590 (15%)	546 (15.2%) WB
Prostate	288,300 (15%)	171 (4.8%)
Lung & Bronchus	238,340 (12%)	316(8.9%)
Colorectal	153,020 (8%)	468 (13%)
Other	978,060 (50%)	2048 (58.1%)

Table 2 : A comparison between the United States and Palestine in the number of Cancer deaths in 2023

	Cancer Deaths, 2023 in the United States	Cancer Deaths, 2023 in Palestine
Lung & Bronchus	127,070 (21%)	203 (15%)
Colorectal	52,550 (9%)	198 (14.6%)
Pancreas	50,550 (8%)	75(5.6%)
Breast	43,700 (7%)	175 (13%)
Other	335,950 (55%)	699 (51.8%)

Regarding the available data from the Palestinian Health Information Center/ Cancer Registry at the MoH, about 3590 people were newly diagnosed with cancer in West Bank,

however, the provided data about Gaza was inaccurate regarding the war and it is estimated by 2200 case. Breast cancer is the most common cancer diagnosis, with an estimated number of 546 people. On the other hand, colorectal and lung cancer are the second and third most common types of cancer diagnosis, with a total number of newly diagnosed cases of 486 and 316, respectively.

1.2 Problem Statement

In the Palestinian healthcare system, which faces many challenges, and operates within a complex socio-political context, assessing the quality of the oncological services among the governmental hospitals while understanding the main factors that influence it; is considered of paramount importance.

According to the Palestinian MoH Annual Reports of the past two years (2021 -2022), it was documented that there is a significant increase in the total number of cancer patient referrals from Palestinian Ministry of Health Hospitals (PMOH) to non-PMOH, by which it reflects a direct and indirect impact on the high referrals' financial bills /costs regarding such Referrals at Service Purchase Unit of MoH. On the other hand, there is a shortage of studies to assess the rational use of oncological drugs in Palestine where none of the studies assessed the quality of the oncological services among the governmental hospitals in Palestine. Therefore, this retrospective cohort study aims to examine the quality of the oncological services among the Palestinian governmental facilities and how could implementation of Six Sigma improve it. By identifying the key constraints on the extent of providing good quality oncological services and analyzing their correlations with different aspects of healthcare

quality, this research can contribute to the existing body of knowledge on healthcare quality improvement, offering valuable knowledge for policymakers and healthcare administrators by providing evidence-based recommendations that can guide policy changes and interventions aimed at enhancing the overall quality strategies within conflict-affected regions.

1.3 Significance of the study

The significance of this study arises from the importance of the Care given to patients with Cancer. More specifically, given the unique attributes of the Palestinian context, having efficient and effective systems in healthcare in Palestine is critical, as the services fulfill and satisfy the needs of patients whilst also reducing the costs hospitals bear as a consequence of referral to other Private hospitals regarding the lack of services and shortage of cancer drugs among the governmental hospitals.

According to the Annual Health Report, Palestine -2022 MoH, there were 110,810 referrals outside MoH facilities, an 11.8% increase from 99,064 in 2021. Oncology management had the highest number of referrals, accounting for 26.3% of the total. It also represented the largest share of spending on outsourced healthcare services. The MoH spent approximately 1.08 billion NIS (approximately 310,000 $) on purchasing services, making up 41.2% of total health expenditures for the year. As a result; the MoH should take action and create a strategic plan to manage the referral processes and service purchasing systems while ensuring high-quality services to cancer patients at the governmental oncological departments, also providing high levels of transparency by both beneficiaries and referral facilities by which

decrease the expenditure; one of the main cornerstones of such plan is the implementation of Six sigma tools.

Also, Chemotherapy medications are considered cytotoxic with a narrow therapeutic index. Any related medication errors have to be considered critical ones. Understanding and preventing such errors is imperative because they could lead to severe consequences even by increasing toxicity or leading to organ dysfunctions and impairing disease control. Since medication errors can occur in all cancer regimens and at every point of the medication use system including prescription, preparation, administration, and dispensing, in addition to that it may not always be prevented, health organizations have to create and implement risk reduction strategies and quality improvement tools, by which six sigma is considered a valuable one. This study will describe quality tools to ensure patient safety which is considered an important dimension of quality science. Clinical pharmacists play an important role as healthcare providers who have the responsibility and experience to participate in multidisciplinary committees to assess and improve strategies in such departments.

In 2023, the MoH added some new oncological drugs to the essential drug list (EDL) to decrease such referrals. In this study, an analysis will be studied to assess the quality of the oncological services among the governmental hospitals in Palestine, in addition, to assess the referral situation before and after adding such drugs, also to give other recommendations using Six Sigma by which will improve the oncological services' quality; by which it will decrease the cancer referral number and cost, and decrease chemotherapy-related problems to ensure patient safety. Eventually, the implementation of Six Sigma processes in hospitals would enhance its service and patients' overall wellness and satisfaction (Niñerola, A., et al

. 2020). Moreover, this study is significant due to the best of our knowledge; it is the first of its type in Palestine to investigate the impact of using Six Sigma management practices in Oncological departments among MoH facilities. The research findings could be useful to the healthcare sector in Palestine in general, and Cancer departments in hospitals in particular. It may also be of interest to other researchers to continue on thus such, also other researchers in developing countries who are interested in undertaking comparable studies in the healthcare sector in their circumstances.

1.4 Objectives of the Study

As mentioned previously, the main goal of this research is to assess the quality of the oncological departments' services at governmental hospitals in Palestine and determine how the implementation of Six Sigma tools could improve the services that are applied. For this goal, the following objectives were derived:

1. To describe the DMAIC model phases applied toward the Oncology /Hematology departments among the Governmental Hospitals.
2. To define the root causes that prevent the oncological departments at the governmental hospitals from applying treatment and good services for cancer patients, so refer the patients out the MoH facilities.
3. To describe improvement frameworks and strategies at the oncological departments of MoH that can improve quality.

1.5 Question of the Study

This study seeks to answer the main question ‘‘To what extent can the implementation of Six Sigma tools improve the quality of oncological services in MoH hospitals?"

1.6 Hypothesis of the Study

Based on the research question and objectives, the following hypothesis is formulated:

H1: The implementation of Six Sigma will not result in a statistically significant improvement in the quality of oncological services at governmental hospitals within the MoH

1.7 Conceptual Model

The conceptual framework of this study represents the hypothesis, and relationships within variables studied in this study is depicted in Figure 1.

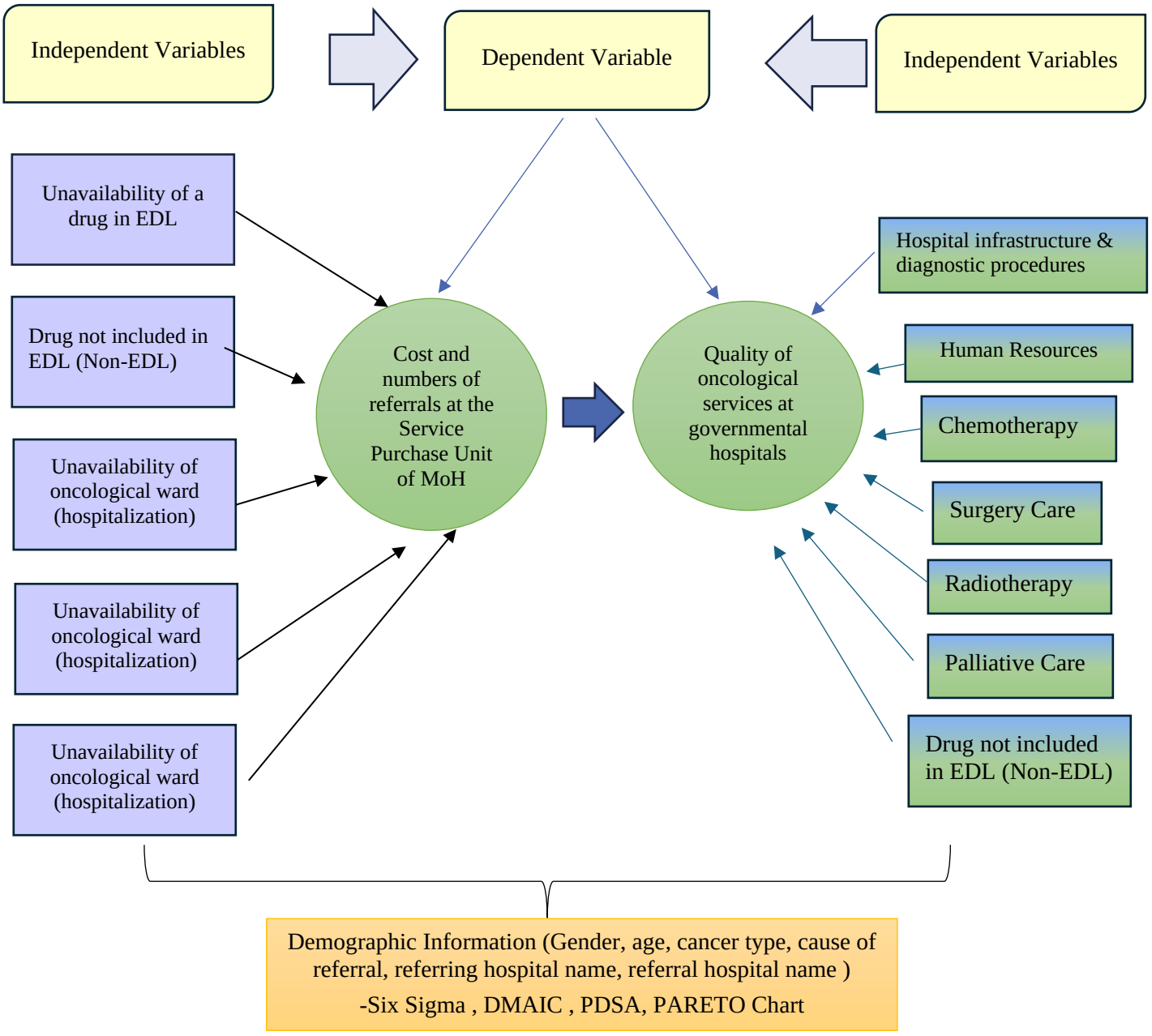

Figure 1: The conceptual model

1.8 Thesis Structure

This thesis consists of five main chapters as follows:

- Chapter One: Introduction; this chapter initially introduces an introduction to cancer incidence rate and mortality globally, then more specifically in Palestine. An overview of Six Sigma and its tools related to oncology's quality improvement will be discussed. The Problem Statement, Significance of the Study, Objectives, Questions, and Hypothesis of the Study will then be explained.
- Chapter Two: Literature Review study topic. This chapter will review the current applicable literature. A number of sources, including Google Scholar, Medline, and PubMed, were utilized as a search strategy.
- Chapter Three: Methodology: This chapter presents a description of the research design that was followed by the researcher, toward answering the questions and achieving the objectives of the study as well as a review of the employed methodology including the definition of the population, sample size, inclusion /exclusion criteria subjects, instrumentation, and techniques that had been used. It also includes a presentation on the design of the data collection tools (interviews and questionnaires). Finally, further explanation of the chosen model (DMAIC) will be provided
- Chapter Four: Results and Analysis, which includes presentation of the results of the statistical analysis, supported with inferential statistics needed to test the hypotheses, and answers the questions of the study.

- Chapter Five: Conclusion and Recommendations; this chapter summarizes the research by presenting the conclusions of the results as well as the recommendations to the different stakeholders in the hospitals: oncologists, pharmacists, nurses, and hospital administration

2 Chapter Two: Literature Review

2.1 Overview

This chapter presents a review of the current applicable literature regarding previously published articles that serve the main concept of the research, which is about optimizing oncological services using the Six Sigma approach. Several sources, including Google Scholar, Medline, and PubMed, were utilized as a search strategy. MeSH keywords were used to study these literature databases, such as " Quality Improvement and Cancer " Six Sigma ", Cancer in Palestine", DMAIC, and Oncology improvement

2.2 Overview of Six Sigma

Six Sigma is defined as *" an organized and systematic method for strategic process improvement and new product and service development that relies on statistical methods and the scientific method to make dramatic reductions in customer-defined defect rates." (*Linderman et al. 2003). It is a set of techniques and improvement methodologies to reduce defects (to about 3.4 defects per million) and process variations. The implementation of Six Sigma was pioneered by Motorola Company in the 1980s. This business improvement strategy evolved to eliminate waste, also to improve profitability and efficiency in the process, product, or applied service (Antony, 2002). DMAIC (Define, measure, analyze, improve, and control)is the main approach in Six Sigma for problem-solving and improvement (McAdam and Lafferty, 2004)

Six Sigma has expanded beyond industry into the service sector, notably healthcare, where it improves efficiency and reduces errors in hospitals and medical procedures. Leveraging digital technologies, it helps optimize resource use and service processes (Niñerola, A., et al .2020).

Six Sigma has been applied in various inpatient care areas, focusing mostly on error rates (42.1%), process time (38%), and productivity (18.9%). While 67% of applications showed initial improvements, only 10% sustained them. Cost savings (28%) and revenue enhancement (8%) were minimal, questioning Six Sigma's overall effectiveness in healthcare. Future research should directly survey healthcare organizations for better assessment(J. Liberatore, M., 2013).

Six Sigma in healthcare focuses on reducing patient harm, enhancing safety, and improving satisfaction by minimizing defects. Key challenges include the high cost of hiring experts and the need for sustained stakeholder buy-in, especially for long-term projects. While Six Sigma certifications provide structured training, they are not mandatory for process improvement. Concerns exist that Six Sigma is not being fully utilized in healthcare (Barr, E., & Brannan, G. D. 2024).

2.3 Cancer Incidence in Palestine (2017 - 2023)

According to the Palestinian Health Information Center / National Cancer Registry and Reporting System at MoH, it is notable that there has been a significant increase in the incidence rate of cancer in Palestine over the last 10 years. The incidence rate of newly diagnosed cancer cases in 2022 increased by 2.5%, compared to that of 2021; however, it increased by 5.3 % in 2023 compared to that in 2022.

The most frequent registered Cancer types in 2023 were Breast Cancer with 546, followed by Colorectal Cancer and Lung Cancer, with a number of 468, 316, respectively, and it is in the same order for the years between 2017 and 2022. Table 3 summarizes the number of cancer cases in Palestine in 2023 compared to the years between 2017-2021.

Table 3: Distribution of Top Ten Reported Cancer**, West Bank, Palestine (2017-2023)

Site	ICDO 3	Total No. of Cases	% Out of Grand Total of Cancer Cases /2023	Incidence Rate per 100,000 of Pop.*/2023	Incidence Rate per 100,000 of Pop.*/2022	% Out of Grand Total of Cancer Cases / (2017-2021)
Breast	C50	546	15.2%	18.6	18.8	15.9%
Colorectum	C18-C20	468	13.0%	15.9	15.3	12.6%
Bronchus & Lung	C34	316	8.8%	10.8	9.1	7.7%
Thyroid	C73	198	5.5%	6.7	7.2	5.2%
Leukemia	C91-C95	193	5.4%	6.6	7.1	5.6%
Prostate	C61	171	4.8%	5.8	4.6	3.6%
Bladder	C67	171	4.8%	5.8	5.4	4.9%
Non-Hodgkin's Lymphoma	C82-C85, C96	147	4.1%	5.0	5.4	4.7%
Pancreas	C25	125	3.5%	4.3	3.3	-

Brain & Nervous system	C70-C72	106	3.0%	3.6	-	3.1%
***Jerusalem J2**						
****Non-melanoma skin cancers are excluded from top ten cancers**						

In a comparison between the Cancer incidence rate in 2010 and 2021, the results were 53.7 and 119.2 per 100,000 population, respectively, which indicates a double increase. This increase can be attributed to lifestyles and environmental changes, e.g., sedentary lifestyle, increased smoking, fatty and fast foods, and rapid growth of the elderly. However, there has been no decrease in the mortality rate. Figure 2 shows the results.

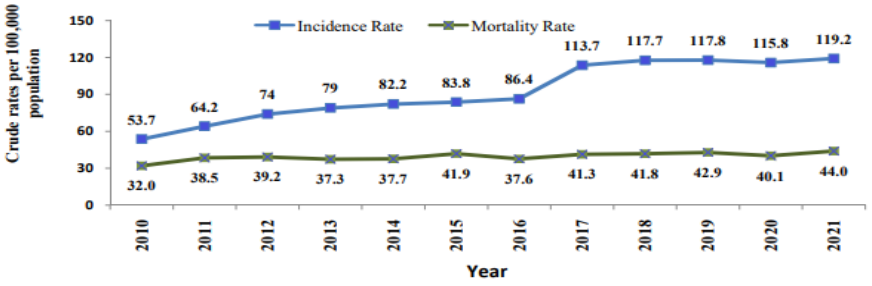

Figure 2: Crude incidence and mortality rates per 100,000 populations of all cancer types, West Bank, Palestine, 2010-2021

Despite the worldwide incidence rate of Cancer, which is higher in males than females, the number of diagnosed females is higher than in males in Palestine. these include all types of cancer, including female sex-specific cancer (such as breast and thyroid cancers). Regarding the data of the National Registry Cancer, 8099 females were diagnosed with cancer in the period between 2017-2021, however, the number of males was 7658, as shown in Table 4.

Also in 2022, females occupied the highest percentage of all cases, with 2876 of all cases, about 52.7% compared to 47.3% of males.

Table 4 : Numbers, Crude and Age-Standardized Incidence Rates (world) of notified Cancer cases (all types) by sex, West Bank, Palestine, 2017-2021

Sex	Number	%	CIR	ASIR
Males	7,658	48.6	111.0	202.1
Females	8,099	51.4	122.4	189.3
Total	15,757	100.0	116.7	193.4

Regarding age, there is a positive correlation between cancer and age; the highest incidence rate was seen in the age group of 15-64 years old, with a median age of 57 years old, however, it differs according to the type of cancer. A significant correlation was found with the older age group (>74 years old), with an increase of about 14.5 % from 2017 to 2021, as shown in Figure 3.

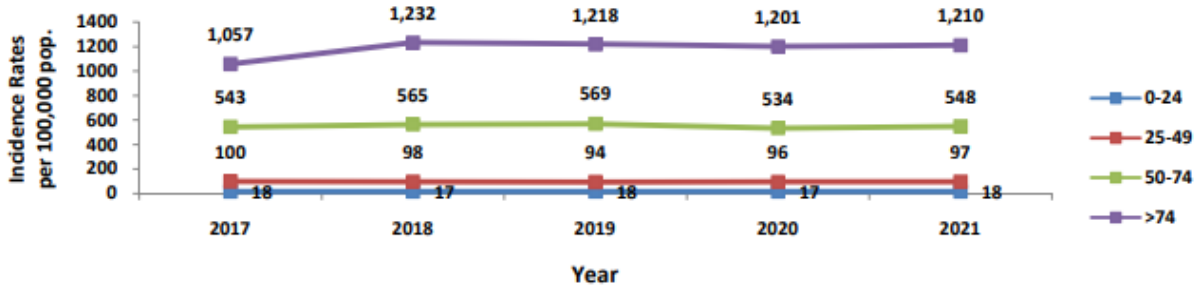

Figure 3: Incidence rates of cancer (all types) per 100,000 population by age groups and year, West Bank, Palestine, 2017-2021

According to the governorate; the top three governorates regarding CIR (2017-2021) were Ramallah and Al Bireh districts with a rate of 143.8, Tulkarem (134), and Bethlehem (132.3), respectively. in each governorate, the CIR for females was higher than that of males, except in Jenin and Tubas. The distribution of Cancer CIR of Cancer according to governorate is shown in Figure 4.

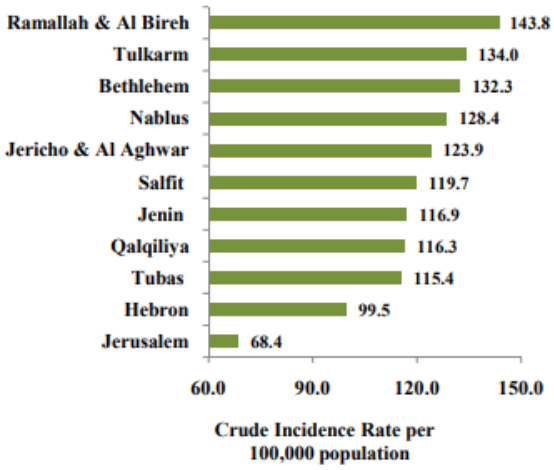

Figure 4: Distribution of Cancer Crude Incidence rates by government, West Bank, Palestine, 2017-2021

More specifically, the most common types of cancer in females were breast, Colorectal, and thyroid, 30.4%, 11.6 %, and 8.1 %, respectively. However, Colorectal cancer was the most common type among males which accounts for 13.6% of the total cases, followed by lung

cancer (13.2 %) and bladder cancer (9%), respectively. Figure 5 shows the percentages of the most common types of cancer distributed by gender.

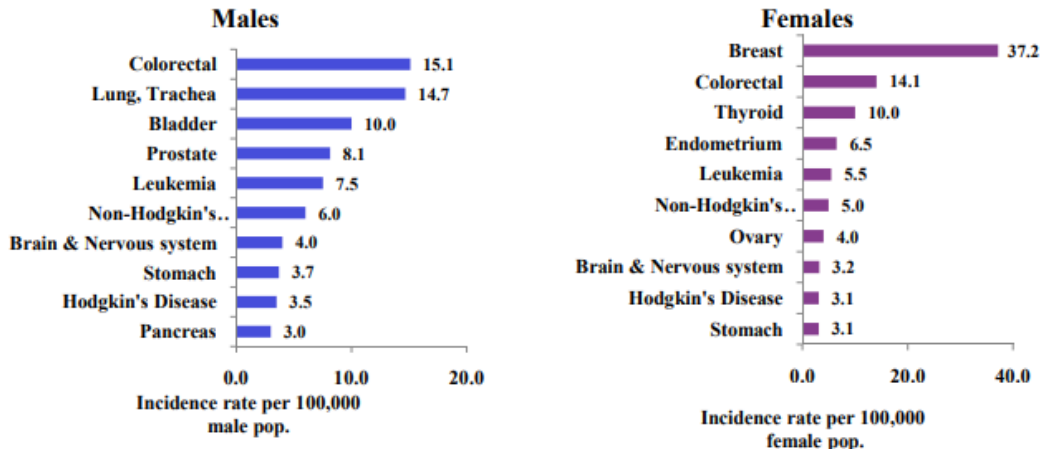

Figure 5: Distribution of Crude Incidence rates of the ten most common cancers, by gender, west Bank, Palestine, 2017-2021

2.4 Cancer Mortality in Palestine (2017 – 2021) & 2022

Cancer is considered the 2nd most common cause of death in Palestine, after ischemic heart disease. The total number of deaths in 2022 was 2147, 1243 in WB and 914 in GS. Lung, Colorectal, and breast cancers were the most common causes of death. However, the highest percentage of deaths was among males (55% of all deaths).

In the West Bank, within the period of 2017 – 2021, 5778 deaths were documented as a result of Cancer, which accounts for about 14.5% of the total number of deaths in the same period (39848 deaths). Of those, about 3,167 were male deaths, however, 2,611 deaths were among females. The Cancer Mortality Rate (CMR) increased significantly by 12% in the five years (2017-2021). mainly in males (19%) over females (4.2%). More details are shown in Figure

6

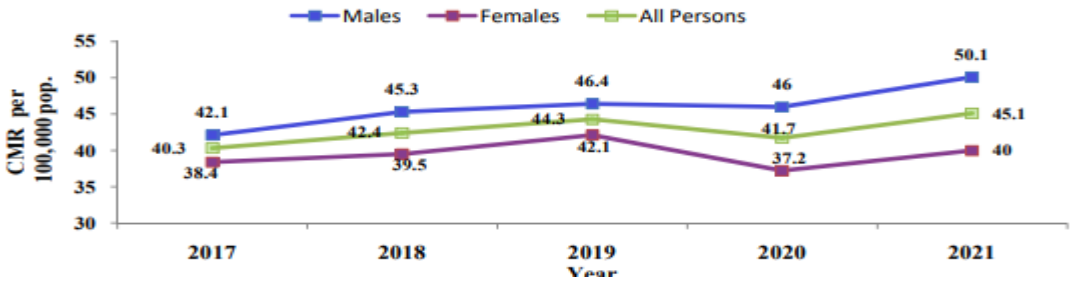

Figure 6 : Trends in crude Cancer mortality rates for Cancer in the West Bank, Palestine, 2017-2021

2.5 Cancer drugs that are included in the Essential Drug List among the Palestinian MoH

Essential drugs are the drugs that cover the priority of health care needs and manage the most prevalent diseases. The selection criteria take into consideration national disease burden and prevalence, safety and efficacy evidence, and cost-effectiveness. The essential drugs must be chosen in appropriate dosage forms, and prices, with quality specifications, and have to be available all the time. (WHO,2023)

The MoH EDL includes 653 drugs, of which about 463 have active ingredients. The oncological medications occupied about 14.7% of the list with a total number of 97 medications, which are mentioned in (Appendix A). This reflects the paramount importance that the MoH attaches to cancer patients.

By the end of 2022, and based on the recommendations of the relevant medical and pharmaceutical committees, there was a trend towards adding 9 new medications for patients

with Cancer in order to work to improve the quality of services provided and improve treatment opportunities for patients with a better quality of life.

As a result in Jan 2023, The MoH submitted a tender for oncology medicines at a cost of approximately 80 million shekels, which also includes the price of the new medicines that have been added to the essential list; which: Pertuzumab 420 mg vial, Pembrolizumab 100 mg vial, Brentuximab vial, Ribociclib 200 mg tab, Nivolumab 40 mg vial, Nivolumab 100 mg vial, Roxulutinib (5 mg tab, 15 mg tab, 20 mg tab), Eltrombobag (25 mg tab, 50 mg tab), Sunitinib 50 mg tab.

2.6 Shortage of Cancer Medications & Its Impact on Service Quality

Oncological drug shortage is considered a serious complex problem that affects patients' safety, treatment quality, healthcare sector management, and other factors. A prospective observational study in the oncological departments of Moroccan hospitals showed that about 67.3 % of 101 interviewed patients suffered from drug shortage, Non-Hodgkin lymphoma was the most interrupted disease (55.85, and Vincristine shortage was the most one of about 34 $, and about half of the patients buy their drugs from a nonlocal pharmacy in case of shortage which result in care delay and anxious patient (45.6 %). *(*Chefchaouni A , 2022)

Drug shortage crises led to significant increases in cost and toxicity, and may lead to a change to an alternative medication with lower efficacy. A comparison study was conducted at New York University Hospital between April – September 2010 and the same period of 2011, to assess the drug shortage by reviewing the pharmacy records and conducting a survey of oncological physicians. further discussion and development steps are required to manage drug shortage (Becker, 2013)

In a survey to assess the experience of oncologists with cancer drug shortages, 74% of the reported cases faced a shortage in at least one drug. Also, the shortage led to a change to another alternative regimen with less effectiveness, which affects patient safety (Kehl,2015)

Drug shortage in the United States caused a significant increase in costs, medication errors, and delays in chemotherapy sessions, which affect patient safety and medication efficacy (McBride, 2013)

Table 5 : Drugs in shortage vs new drugs that had been added to Palestinian EDL, 2023

Drugs are currently in short supply as of 2023	New Drugs that have been added to EDL
Bevacizumab	Pembrolizumab 100 mg/vial
Goserelin 3.6 mg prefilled syringe	Nivolumab 10 mg / 10 ml vial
Capecitabine 500 mg tab	Nivolumab 4mg/ 10 ml vial
Abiraterone tab	Ibrutinib tab
BCG	Ribociclib 200 mg tab
Nivolumab vial	Roxulutinib 5 mg , 10 mg tab

2.7 Six Sigma Tools, DMAIC, and Oncological Services' Quality Improvement

Many tools and techniques for continuous improvement are included in Six Sigma, including the Cause-and-Effect investigation (C&E), Value Stream Mapping (VSM), and many others (Albliwi &Antony, 2015; Drohomereski, et al., 2013). The six tools that are most frequently used in Six Sigma applications, according to literature, are "Control Charts," "Value Stream Mapping," "DMAIC," "Kaizen," "Ishikawa Diagram," and "Histogram;" Control graph is the

highest-level tool (Walter &Paladini, 2019). DMAIC is a five-stage process for advancing current cycle difficulties with hazy causes. DMAIC describes and assesses the problems; identifies the causes of the problems; and carries out, confirms, and maintains the problems. All Six Sigma and Lean tools are located in the DMAIC or Define, Measure, Analyze, Design, Verify (DMADV) tool compartment (Mustapha et al., 2019).

Roesler, K., & Dydyk, D. (2007) utilized the Six Sigma strategy namely DMAIC at an outpatient oncology care; The Cowdery Patient Care Center (CPCC) , to improve any delay in the treatment's starting time. In their study, a Patient Flow Project was initiated by The Cancer Service Line. DMAIC was conducted to define and analyze the root causes that result in delays in the start time of treatment which leads to decreased patient satisfaction. As a result, many improvement strategies were implemented and resulted in an increase in the percentage of treatments started within 22 minutes from 29% in 2004 to 78% in 2006. Other change plans include a change in the scheduling process, the short appointments were separating out, altering the check-in process, and changing the role of the charge RN to monitor flow and triage.

O'Sullivan, B.,(2020) aimed to develop a framework for improving the quality of oncological services and maintaining outreached services for Australian Rural regions. The study was done over 12 months (2016-2017) and published in 2020,. In this study, DMAIC was used as a Six Sigma improvement tool. A protocol of referral eligibility criteria was developed based on many criteria such as stakeholder skills, patient characteristics, treatment options, and considerations e.g. complexity, complication risk, hypersensitivity, cancer type, and

treatment availability), also if higher-risk regimens have to be used in medical oncologist visits, and need of earlier access to treatment.

Freeman, S. (2022). Used Six Sigma to find out the root causes behind increasing the delays between the first appointment and diagnosis with starting treatment for breast cancer patients . The data revealed a comparison between (March and December) of 2019 and 2020; with a result in 2020 only 31% of the patients were assessed completely in one day, however, the percentage was 100% in 2019 before COVID Many frameworks were used to decline such delays by using DMAIC, PDSA, process map and other quality improvement methods.

Failure mode and effects analysis (FMEA) has been applied through many studies to identify proactively potential failure, errors, and preventive strategies, especially in oncological departments As a Six Sigma quality tool. Implementation of Failure Mode and Effects Analysis (FMEA*)* for medication use risk analysis in lung cancer patients has resulted in the medication administration process focusing on the evaluation and monitoring of patient medication and post-medication (Lin, 2022)

Similarly, Weber, (2022) implemented FMEA as a quality tool in the strategic work plan at the University Hospital of Bonn as well as at the University Hospital of Cologne to increase Cancer patient safety, which resulted in a total of 52 potential identified failure modes, according to the RPNs the most critical processes were related to the prescription specifically, incorrect patient parameter information; non-standard applied chemotherapy protocols; and supportive therapy's problems. A significant risk reduction was evaluated by implementing suitable improvement actions that resulted in decreased chemotherapy medication errors and increased patient safety.

In addition to the previously mentioned articles, FMEA analysis was to define the rate of medication errors specific to the compounding chemotherapy process to analyze the effect of Phocus Rx® which is an image-based workflow new software system, on the safety of cancer patients. The results were a 46% reduction in material preparation, a 76 % decrease in drug production, and a 48 % decrease in quality control subprocesses.

So After the implementation of Phocus Rx®, the relative risk decrease of the compounding error rate was 63% which is considered an effective one (Marzal-Alfaro Mb, 2020)

A one-stop fast-track outpatient clinic for gastrointestinal GI cancer was initiated to decrease long waiting times. Lean Six Sigma tools such as DMAIC were used to increase patients' number to ≥ 85% of five days or less admission time and to ensure that ≥ 90% of referring specialists received the decisions within one day, formulated at the Multidisciplinary Team Meeting (MDTM) . as a result of implementing LSS; the major causes for long AT, as well as for sending the decisions include patient delay, official holidays, incomplete referral, and absences because of medical conferences. After successfully addressing improving processes, the percentage of patients with AT ≤ 5 days was increased from 48% to 70. After LSS 99% of referring physicians receive the decision formulated in ≤ 1 day. which is a substantial improvement (from 2% to 99%) (Basta, 2014).

In another prospective study that was carried out at a pediatric oncological treatment center, more than 10,000 chemotherapy prescriptions were examined during the duration of 2008 - 2011. Error rates were reduced by 50% after the implementation of quality improvement frameworks (6/1,000 patient encounters to 3/1,000 patient encounters. The most common medication error was related to dosing or prescribing errors with a percentage of 42%,

followed by 26 % of treatment protocol errors, supportive care errors (15%), (12%) errors in time, and finally 4% pharmacy dispensing errors. 92 % of errors were intercepted before reaching the patient. No critical patient harm was caused by a medication error. Efforts to lower rates were effective and successful but have not been able to prevent all errors. (Watts, 2013)

Since there is a lack of previous studies in such fields in Palestine; related to optimizing the quality of health services among Cancer departments in the MoH hospitals, using the Six Sigma improving tool, this study will add a value to the existing knowledge, and will make an improvement in the healthcare sector.

3 Chapter Three: Methodology

3.1 Overview

This chapter presents a description of the research design that was followed by the researcher, as well as a review of the employed methodology including the definition of the population, sample size, inclusion /exclusion criteria subjects, instrumentation, and techniques that had been used. It also includes a presentation on the design of the data collection tools (interviews and questionnaires). Finally, further explanation of the chosen model (DMAIC) will be provided.

3.2 Research Approach

Mainly, the study aimed to optimize the quality of the oncological services among governmental hospitals.

In any research work, there is a specific methodology followed by the researcher to gather, analyze, and interpret data. These research methods can be classified into three domains: quantitative, qualitative, and mixed. In qualitative research, the researcher relies on data collection and analysis to understand and interpret a particular phenomenon by using inductive reasoning (Williams, 2007). In contrast, the quantitative method relies on numerical data gathering and analysis. However, many studies integrate both types of data; the qualitative and quantitative in one study which in turn strengthens and integrates the comprehensive of the specific study's topic (Sekaran & Bougie, 2016)

In this study, the researcher followed a combined methodology that includes both quantitative and qualitative ones.

A retrospective cohort, observational study was obtained to assess the quality of oncological services among the governmental hospitals and the referral status to other private and non-governmental hospitals (2022 - 2023) and to utilize Six Sigma methodology namely "DMAIC" to improve the quality.

According to the main objective of the study, the qualitative method approach has been used to collect the needed and comprehensive data from the hospitals' administrators' perspectives. Through conducting a questionnaire with interviews for the governmental oncologists and hematologists, also with the public hospitals' administrators that consists of primary data variables in order to assess the quality of oncological services in 2022, and to discuss any improvement strategies that had been utilized in 2023.

3.3 Population of the Study

Based on the aim of this study, the population was divided into two groups; the first was the governmental hospitals among the MoH, which provide oncology/ hematology services, and these are as follows: Palestinian Medical Complex (PMC) in Ramallah and Albireh constrict, The National (Alwatani) hospital in Nablus city, Beit-Jala Hospital (Harmalah)at Bethlehem city, Thabet-Thabet hospital in Tulkarem, and finally, Jenin governmental hospital in Jenin.

The data obtained provides us with a detailed assessment of the applied oncological services in 2022, through a questionnaire with in-person interviews.

On the other hand, another population was tested to obtain essential data for analysis, It consisted of all the patients with solid and hematological cancers, of both sexes male and female with an age of one or more years old, who were referred to other than public hospital for getting a service or Treatment /medication that not found at the public one. The referral hospitals were as follows: Augusta Victoria Hospital (AVH), An-Najah National Hospital and Istishari Hospital.

3.4 Sample of the Study

The author used the random sampling technique to gather the needed information from the referral reports at the service Purchase Unit of the MoH. Thus, 379 medical report files were reviewed randomly. The sample size has been calculated based on the following equation (Thompson, 2012):

$$n = \frac{N \times p(1-p)}{([N-1 \times (d^2 \div z^2)] + p(1-p))}$$

Where:

n:	Sample size.
N:	Population size (28332 oncology/hematology referral reports in the year of 2023).
z:	Confidence level at 95% (1.96).
d:	Error proportion (5%).
p:	the proportion of property offers and neutral (P=0.5)

Accordingly, by Substituting the aforementioned parameter values in the above equation, it is obvious that the representative sample size equals n=379, who are needed to participate in the study. Based on that, the researcher reviewed and assessed 379 medical referral reports, and all of them were valid to be statistically analyzed. This means that the response rate was of 100%

A review of a sample of medical referral reports for patients with solid and hematological cancers, male and female, > 1 year old, referrals for Treatment /medication in 2023, was done. The data was collected randomly from the Service Purchase Unit of the Palestinian MoH. The Dependent variable was defined as the main oncology referral cause; which includes (Unavailability of drug that is included in the Essential drug list (EDL) at MoH, referral for drug non-EDL, referral to medication regimen needs hospitalization (oncology ward not found), head and neck management, sarcoma management, chemo-radiotherapy treatment plan.

However, the independent variables included in the electronic referral report were patient demographic information: Patient name and ID, Gender, address, Name of referring hospital, and name of a referral hospital.

3.5 Data Collection

After developing the study's hypotheses, data must be gathered for each variable included in the hypotheses. In general, surveys, interviews, and observations can be used to gather primary data. There are three primary categories of questionnaires: (1) those given out in person, (2) those sent by mail, and (3) those given online (Sekaran and Bougie, 2016).

In this study, the researcher collected data about the assessment of oncology departments among five governmental hospitals; The National (Al Watani Hospital), Beit-Jala Hospital, Palestinian Medical Complex (PMC), Jenin Governmental Hospital, and Thabet-Thabet Hospital for the year 2022. By conducting in-person interviews with the administrators, oncologists, pharmacists, Cancer registry unit at MoH. The researcher asks the questions and writes the answers by himself. the data collection takes a period of one month (May-June /2024)

On the other hand, the researcher also collected other needed data personally, by reviewing the medical referral reports for a Cancer drug from (Jan- Dec / 2023), at the service Purchase Unit through the E-Referral Electronic healthcare system, in which a total of 379 were conducted also they were valid to be analyzed. Moreover, the time duration of collecting the data was 4 weeks from 10/5/2024 to 9/6/2024. This process reflects a response rate of 100 % of the total sample size.

3.6 Instrument of the Study

The study depended mainly on the questionnaire as the main tool of data gathering, which has been designed according to the main objective of the study since the main objective is to present the perspectives of the administrators and the head of the oncological departments, by short in person interviews, among five Governmental Hospitals that provide oncological/hematological services, which are: Beit Jala Hospital in Bethlehem, The National (Al-Watani) Hospital in Nablus, Palestinian Medical Complex in Ramallah and al Bireh District, Jenin Governmental Hospital and Thabet-Thabet governmental Hospital in Tulkarem. on the application of Six Sigma management tools used by the hospital

management toward improving the quality of the oncological services. The questionnaire has been developed based on the questionnaires used in the studies of (Nwachukwu, et al., 2019) / (Appendix B) . The questionnaire consists of seven sections, in which:

- The first section: consists of health facility information and infrastructure that includes 24 sub-questions:
- The second section: includes categories to assess the human resources
- The third Section: is divided into two categories; adult and pediatric
- The fourth Section: Radiotherapy and Nuclear Medicine
- The fifth Section: Patient follow-up and palliative care
- The sixth Section: Data System
- The seventh Section: Chemotherapy Stock Management

After data collection and analysis, DMAIC, FMEA, and many various techniques, Six Sigma quality tools and methods, e.g. fishbone diagram, and SIPOC were employed to define the main root causes that lead to increased referral from MoH to other Non-governmental facilities, also to create improving strategies through the medical team using six sigma that can decrease and manage such oncological referrals to private hospitals

Moreover, the study used descriptive and analytical approaches that are appropriate for the aim of the study, in which the descriptive approach is used to describe the perspectives of hospital administrators toward Six Sigma tools to improve the oncological services at public hospitals. However, the analytical one was used to assess the relationships between the variables of the study

3.7 Six Sigma Methodology :

Six Sigma is a data-driven methodology used to improve processes and eliminate defects, which can be particularly beneficial in healthcare settings such as oncology services (Carrigan et al, .2006). It was developed by the Motorola company in 1987, to achieve a goal of declining defects to 3.4 per million (Barney, 2002)

Six Sigma can be applied to improve the quality of oncology services using the DMAIC tool, which refers to (Define, Measure, Analyze, Improve, Control) (Selvi, K., & Majumdar, R., 2014).

In this study , the researcher used Six Sigma to optimize the oncological services among the governmental hospitals.

3.8 DMAIC

DMAIC is a core tool used in Six Sigma for process improvement, and it stands for Define, Measure, Analyze, Improve, and Control. In the context of our study, it can be applied in the following fields:

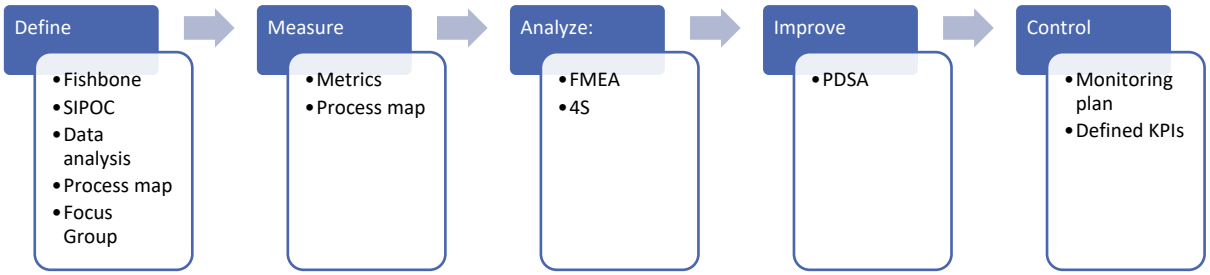

Figure 7 : DMAIC MODEL

3.8.1 **Define Phase**:

In this crucial project, the researcher met the administrators and the heads of oncology departments at the specified governmental hospitals, explaining the main goals and objectives, discussing the medical team roles in applying cancer care, Identifying specific problems in oncology services that need improvement and defining the major obstacles that prevent them from providing high-quality care services.

A Focus-Group was established to find out the main problems that faces the oncological departments among the MoH facilities, also to establish a SMART (Specific, Measurable, Achievable, Relevant and time-bound) goals they have to achieved within the improvement project, This Focus group consists of the head of the oncology department as a chairman of the committee, also clinical pharmacists, pharmacists, nurses, pathologists, oncological surgeries

A clear overview of SIPOC analysis was developed to understand the main components, key stakeholders, and boundaries of this quality-improving project (Table 6).

Providing oncology care to cancer patients was defined as a set of activities that started with patient registration and admission and ended with patient discharge.

Table 6 : SIPOC for providing Oncological Services at the Palestinian Governmental Hospitals

Supplier	Input	Process	Output	Customer
Registration employee	ID Governmental insurance	The registration team registers the patient through the HIS to schedule an appointment to visit the physician at the oncology clinic	Scheduled visit appointment	Registry team Patient
Doctor	Admission report Diagnostic order Medical prescription Discharge order	The doctor admits the patient,, writes the medical report, orders any required diagnostic procedures, writes the treatment plan, and medication prescription, orders discharge note	Filled medical report on Health electronic System (HIS) Filled diagnostic order Filled medical prescription Best treatment plan Filled discharge order	Patient Nurse Pharmacist
Nurse	Diagnostic order Prescription order	The nurse gives the prepared drugs to the patient	Treated patient with the required	Patient

	Discharge order		therapeutic dose of medication	
Pharmacy / clinical pharmacist	Medication prescription Patient Patient family	The pharmacist sends the ordered drugs to the oncology unit in the hospital to be prepared by the clinical pharmacists and nurses and then given to the patient	Medications Informed patient on the right route and dosage of taking the drug Informed the patient and the family on the possible side effects and interactions of drugs	Nurse Patient Patient's family
Referral unit	Medical report Referral form Insurance ID Doctor Pharmacist Electronic referral system (E-Referral)	The doctor orders any diagnostic procedures or treatment plan that is unavailable at the hospital to be referred to other private hospitals through an application to the SPU on the E-Referral	Filled referral application Informed medical providers in SPU	Patient
Service Purchase Unit at MOH	Electronic referral form ID	The coordinators at the service purchasing unit present the file to the oncology committee to make the correct	The patient was transferred to another entity from the private health sector to	Patient SPU

	Governmental Insurance Oncology committee	medical decision to refer the patient and specify the destination	provide the intended service to him	

As shown in Figure 8, a fishbone diagram was used to define the major barriers that decrease the quality of the applied cancer services. Shortage of drugs and the Unavailability of a consistent manner, lack of oncological departments and beds, insufficient number of health care providers especially oncologists, hematologists, pharmacists, surgeons, and nurses, lack of diagnostic procedures and equipment such as PET scans, MRI, endoscopy procedure, and the limited IT technology and slow information system; were considered all the main obstacles affecting the services' quality. A fishbone – Ishikawa diagram was used to identify the root causes behind the inability to apply good quality cancer services, which leads to an increased referral to other facilities outside the MoH

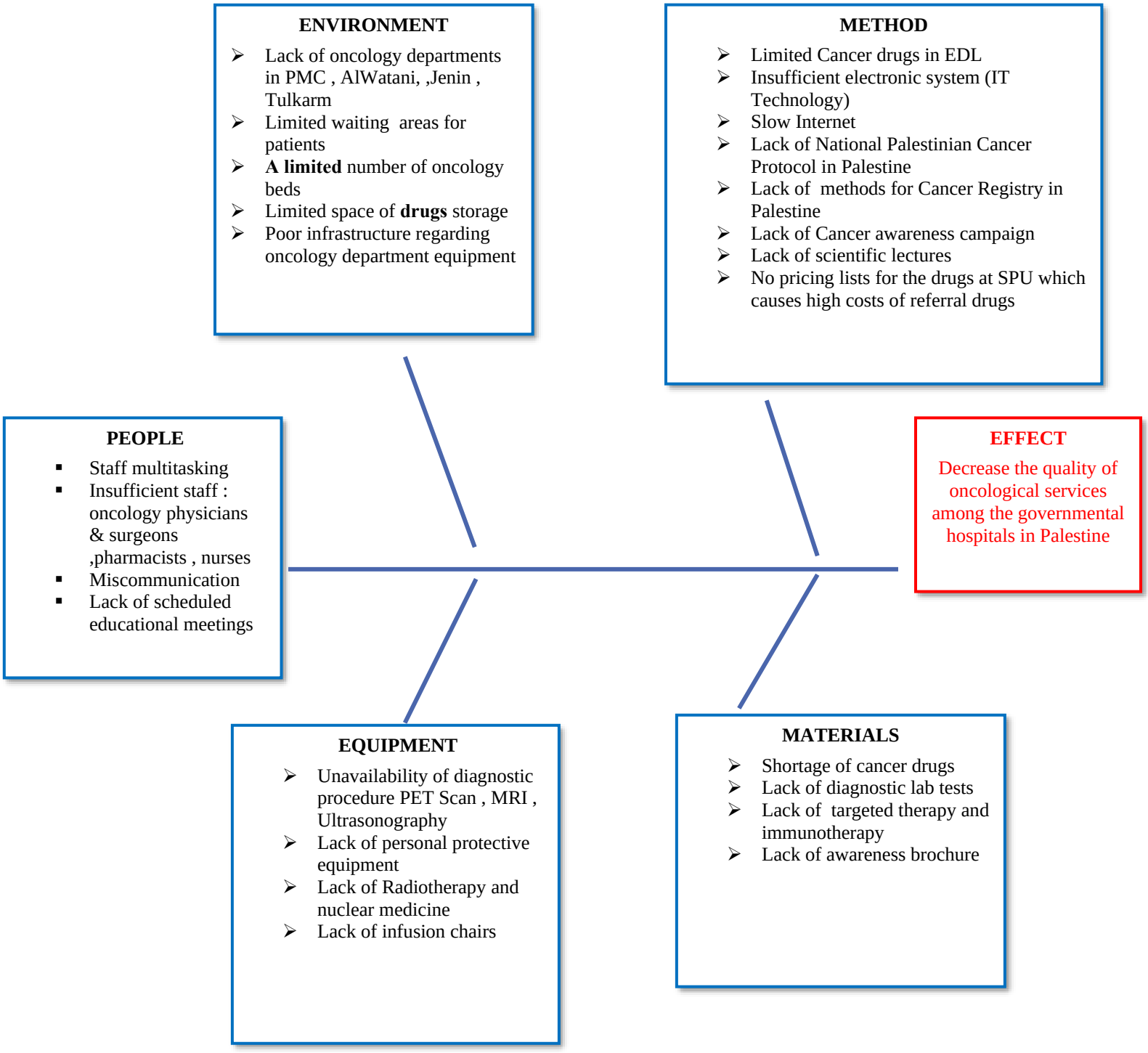

Figure 8 : Fishbone Diagram: barriers in providing high-quality services in oncology

A detailed process map (Figure 9) was designed to investigate the possible pinpoint bottlenecks and other areas of variation. The process starts with the registration department, where the patient has to supply the employee with the identification documents and governmental insurance, then after registration to the oncology/hematology clinic, an appointment is booked by the medical secretaries to visit the oncologist clinic when possible. On the appointment date, the healthcare provider inspects the patient to collect the needed medical information. If the medical information is not sufficient, further tests can be ordered internally or externally by applying a referral application form which includes a signed medical report and referral form, ID copy, and insurance copy, and sending these attachments through the referral coordination unit in the hospital to the service purchase unit in MoH, which in turn receive the application and signed it through a specific oncology committee in order to refer the patient to other facilities to do the required diagnostic procedure or test.

If the cancer diagnosis is confirmed, the patient must go to the governmental hospital again / oncology clinic to decide the treatment plan and set an appointment to initiate the treatment plan The treatment may include Surgery, chemotherapy/immunotherapy, or radiotherapy. If any of these choices are not found at the governmental hospitals such as radiotherapy or other medications or complicated surgeries, a referral form is applied as we mentioned previously to be taken in other private hospitals.

However, if the treatment plan is available at the governmental facilities, the doctor will order it on the HIS, then the order reach the specified required unit; surgical departments, or pharmacy units, to prepare the ordered regimen according to the international guidelines, and

then given to the patient in the oncology unit or in other sections in case of overcrowded patients.

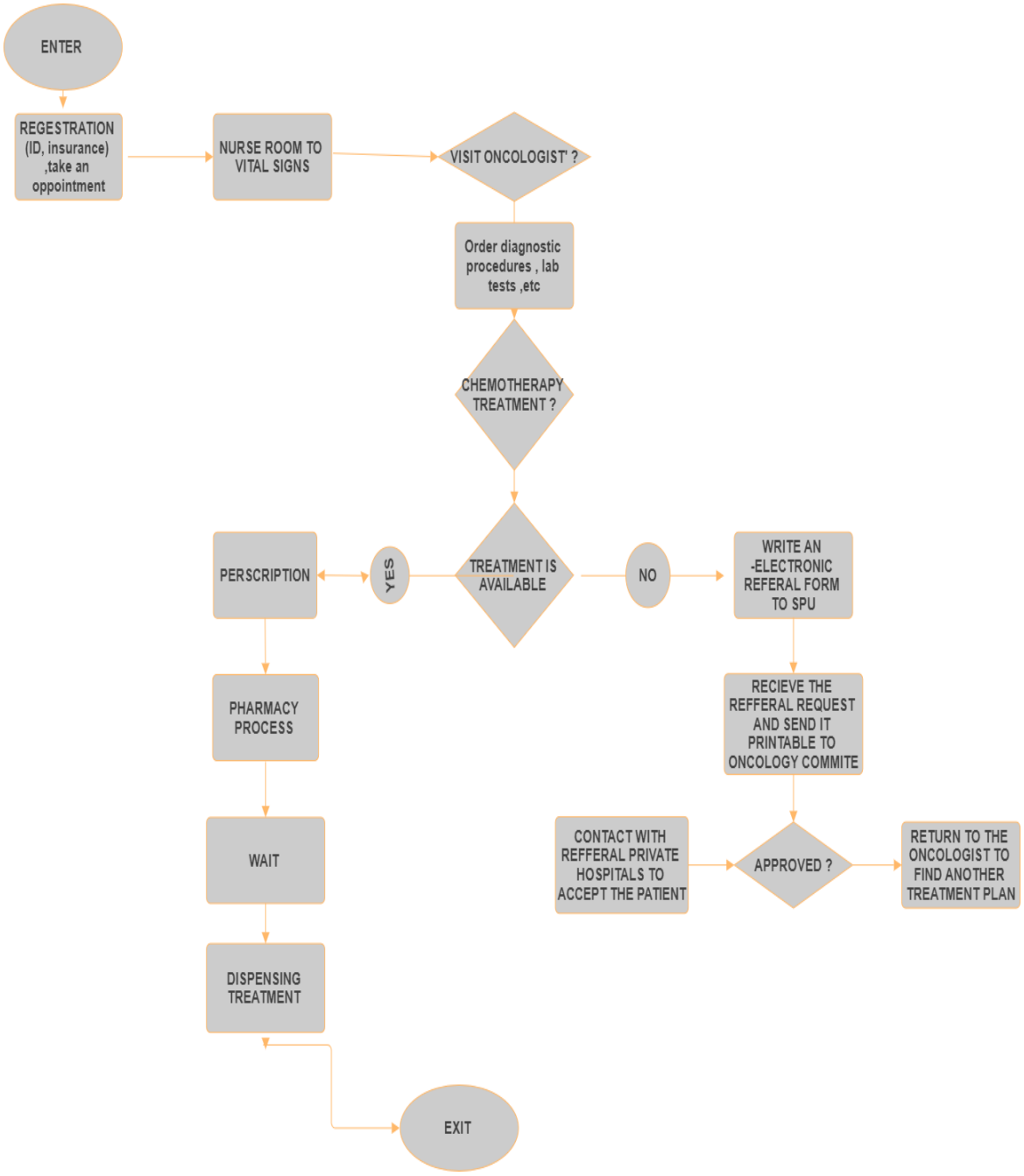

Figure 9 : Process map/ Flow Chart for a Cancer Treatment Governmental Center

Also, to investigate the main problems and barriers, a data analysis was done for the seven sections of the used questionnaire to evaluate the oncological services among these governmental hospitals; the results were shown in section 4.4

3.8.2 **Measure Phase**:

This phase began with data collection and analysis of the current status performance of the quality of the oncological services among MoH hospitals. Albert, J. M., & Das, P. (2012) found that developing quality indicators in oncology is challenging due to delayed treatment effects and the multidisciplinary nature of care. Emerging comparative effectiveness data are improving evidence-based practice and enabling the identification of key quality measures. As the focus on quality and efficiency grows, it is crucial to develop rigorous quality metrics to guide improvement, accreditation, and reimbursement. This study reviews the current state of quality assessment in oncology, highlights the best-supported existing indicators, and proposes a framework for refining measures that truly reflect quality care.

Some measurable metrics and Key Performance Indicators were obtained in this study, to track progress and identify areas for improvement, such as :

- Patient Outcomes & Survival Rates
- Cancer Incidence Rate (CIR **)** :

  CIR in Palestine, 2022 was 108.2 per 100,000 population

The total number of newly diagnosed patients with cancer in Palestine, 2022 was 5,455

The total number of newly diagnosed patients with cancer in Palestine, 2021 was 5,320

The total number of newly diagnosed patients with cancer in Palestine, 2023 was 5790 (3590 in WB, and an estimated number regarding the war in GS of 2200)

- Mortality rates by cancer type :
- Tracks death rates to assess treatment effectiveness.

In 2022, according to the Cancer Registry at MoH, the mortality rate was 42.6 per 100,000 population, with a total number of deaths of 2,147 (1,233 in WB and 914 in GS)

- Early Detection & Diagnosis

- Time to diagnosis: Measures how quickly patients receive a confirmed cancer diagnosis after symptoms appear. After asking the head of oncology departments and administrators, they answered that it takes about one to three months to confirm diagnosis, due to the unavailability of diagnostic procedures and lab tests, PET scan, also due to the long waiting list.

- Treatment Effectiveness & Access

- Time from diagnosis to treatment initiation: Ensures timely care to improve outcomes.

After asking the oncologists, it takes about one to two weeks to start treatment and may extend to one month in the case of unavailability of medications

- Adherence to evidence-based treatment guidelines: Assess whether hospitals follow standardized oncology protocols. Regarding the analysis of the reviewed medical reports from SPU at MoH, a percentage of 98.7 % of all the reviewed medical referrals' protocols, which were prescribed by the oncologists and hematologists at MoH, were according to the National Palestinian protocols.
- Number of treated patients with each Cancer medication (Appendix G)
- Number of all consumed chemotherapy medications among governmental hospitals (Appendix G)

 Infrastructure & Resource Utilization

- Availability of oncology specialists per patient ratio: Assesses workforce sufficiency; Description of Health facility information and Infrastructure indicators (number of Human resources, e.g., oncologists, pharmacists, pathologists, number of oncological beds at the hospitals, etc) were explained in section 4.4, Appendix 3
- Radiotherapy and chemotherapy wait times – Ensures timely access to critical treatments. In this study, after asking the head of oncology departments, it takes about one to two weeks as waiting time to start treatments, either chemotherapy or radiotherapy.

 Financial & Policy Indicators

- Coverage of oncology services under health insurance: Measures financial accessibility.

Regarding the Palestinian MoH insurance's coverage, all Cancer patients were covered 100% for their treatment costs, diagnostic procedures, surgeries, and otherwise admissions in hospitals, either governmental or private.

- Government funding allocated to cancer care :

- Evaluates national commitment to oncology services, referral numbers, and costs outside MoH facilities.
- The Oncology Referral number and cost indicator were obtained in section 4.4
- The PET scan number and cost indicator were measured in section 4.4
- The radiotherapy number and cost indicator were shown in section 4.4

3.8.3 **Analyze phase**:

This phase determines the most critical factors that were causing the most obstacles to providing high–quality care for cancer patients; through the analysis of the main variables in the questionnaire that was distributed among the five specific governmental hospitals.

A content-analysis method was used to code the notes, revealing the questionnaire after conducting several interviews with the administrators and oncologists among the five participating governmental hospitals. The results obtained were classified into a framework of four sections (Pre-identified themes), regarding the used methodologies (Nwachukwu et al, 2018). These four themes are defined as 4S (Table 7).

Table 7 : Definitions of the 4 S

Pre-identified theme	Definition
Staff	the employees or workforce of an organization. Staff members can hold various roles and responsibilities, ranging from entry-level positions to executive roles.
Stuff	All equipment, machines, materials, and supplies which are required to operate the unit
System	a set of interacting or interdependent components forming an integrated whole. In a business context, this often refers to the processes, procedures, and technology used to achieve organizational goals.
Space	The physical or virtual environment where staff and systems operate. This could include office spaces, remote work environments, or digital platforms.

Failure Mode and Effects Analysis (FMEA) is a proactive risk assessment tool to determine failure modes and possible actions to reduce it regarding the Risk Priority Number (RPN) score. FMEA is a systematic method for evaluating processes to identify where and how

they might fail and assessing the relative impact of different failures (Bluvband, Z., & Grabov, P. 2009). In oncology, FMEA can be particularly valuable for improving quality and safety in patient care. Many steps in FMEA can be applied to oncology quality improvements (Anjalee, J. L. et al. 2021). which are as follows:

Step 1 : Assemble the Team: Include multidisciplinary members such as oncologists, nurses, pharmacists, radiologists, and quality improvement specialists.

Step 2: Define the Process: Clearly map out the oncology care process. This can include diagnosis, treatment planning, chemotherapy administration, radiation therapy, follow-up, and palliative care.

Step 3: Identify Failure Modes; Determine potential points of failure within each step of the process. Examples include incorrect diagnosis, medication errors, treatment delays, equipment failures, and communication breakdowns.

Step 4: . Determine Effects: For each failure mode, identify the potential effects on patient safety and treatment outcomes. Consider both direct effects (e.g., incorrect dosage leading to adverse reactions) and indirect effects (e.g., delayed treatment reducing survival rates).

Step 5: Assign Severity, Occurrence, and Detection Ratings:

- Severity (S): Rate the seriousness of the effects of each failure mode.

- Occurrence (O): Estimate the frequency with which each failure mode is likely to occur.

- Detection (D): Assess the likelihood that the failure will be detected before it causes harm.

Step 6: Giving a numerical value (scoring) by calculating Risk Priority Number (RPN): Multiply the severity, occurrence, and detection ratings for each failure mode (RPN = S × O × D). This helps to quantify the values and prioritize which failure modes need the most attention. It includes a numeric ranging from (1(lowest) -10 (highest) ,

Step 7: Develop Action Plans: Create strategies to reduce or eliminate the high-priority failure modes. This can include process redesign, additional training, new protocols, or technology upgrades.

Step 8: Implement and Monitor: Put the action plans into practice and continuously monitor the process to ensure that improvements are effective and sustainable.

All of these steps were included in the FMEA Analysis that is attached in Appendix C (Table 21).

Regarding the calculated -results of RPN scores; the most urgent interventions should be started with the following process, respectively; infrastructure and Human Resources Capacity and communications with a score of 628, followed by Providing treatment to patients with a score of 392, Drug-related Problems (DRP) with a score of 320, followed by oncology and staff programs training with a score of 294, radiation therapy concerns with an RPN score of 225, Assess the patient 268, etc.

Also, the root causes of variation and poor performance were identified using a Pareto chart to prioritize action plans. The Pareto Principle (80-20 rule) suggests that 80% of outcomes come from 20% of causes. It highlights that a small proportion of efforts often leads to the majority of results. This idea is widely applied in business and productivity (Dunford, R., et al. .2014). The Pareto principle. *The Plymouth Student Scientist*, *7*(1), 140-148. The existing

chart was mapped to track the sequence of steps, understand the challenges, and review for potential areas of improvement. The results were that about lack of cancer drugs that are included in EDL, Drugs not included in EDL, and lack of oncological wards and unavailability of beds because of scheduling issues, as shown in Section 4.2 , Figure 15

3.8.4 **Improve Phase:**

The fourth phase of the DMAIC methodology is “Improve”. After the investigation of the obtained data from the “Analyze Phase”, applying improvements is challenging, however, it is considered crucial to develop and implement solutions to address the identified problems. This included PDSA (Plan, Do, Study, Act), streamlining processes, enhancing staff training programs, or adopting new technologies to improve accuracy and efficiency.

During the improvement phase, potential solutions were identified through brainstorming with key stakeholders. These solutions were then tested and refined using multiple PDSA cycles over few months period (Mamballikalam, G., et al. 2024) ; that included the mentioned steps :

Identify Improvement Opportunities – Review root causes, analyze best practices from leading oncology centers.

- **Develop Solutions** – Enhance processes, upgrade technology, train staff, and implement patient-centered care initiatives.
- **Pilot Testing** – Conduct small-scale trials, monitor key performance indicators (KPIs), and assess impact.

- **Evaluate Results** – Analyze data and gather stakeholder feedback to measure effectiveness.
- **Refine Solutions** – Adjust and standardize best practices based on findings.
- **Full-Scale Implementation** – Expand successful initiatives across the department, ensuring staff training and clear communication.
- **Sustain Improvements** – Maintain documentation, monitor performance, and foster a culture of continuous improvement.

In this study, the researcher focuses on the improvement strategies that were added in 2023, which were :

- The first improvement strategy was through the modification of the essential drug list (EDL)of MoH by the addition of nine Cancer drugs and targeting medications, which improve the quality of life of patients, also serve as a cost-effective manner to apply further treatment choices among the governmental facilities, by which reducing referral numbers and costs.

- The second improvement strategy was the implementation of the National Palestinian Cancer Protocol

- The third improvement Strategy was to establish a unified price list for oncology drugs for private hospitals to which they are referred, which reduces the diversity in prices offered by supplying pharmaceutical companies, which reduces the variation in the input and output of the referral cost, which achieves the efficiency quality dimension.

- The fourth improvement strategy is the establishment of a PET scan unit at the Palestinian Medical Complex, which plays an important role in the diagnostic procedures

- The fifth improvement strategy is opening a daycare department for oncology patients in Dura city, Hebron, which serves the oncology/hematology patients from Hebron city, and decreases the load of patient admissions at Beit-Jala Governmental hospital

- The sixth improvement strategy is to apply Staff Training and Development through the establishment of Training and Communication-focusing groups and committees; to ensure that all staff members are adequately trained on new procedures and technologies, also, to achieve regularly updated training programs and oncology protocols to include the latest advancements in oncology care, and discuss complicated cases that require treatment outside the MoH health basket.

- However, many other improvement strategies were shown in detail in Chapter 5 later.

3.8.5 PDSA

PDSA, which stands for (Plan, Do, Study, Act), is a cyclic key component of the quality improvement model, which was discovered by Deming in 1986 (Taylor MJ et al. 2014). It consists of four steps :

- Plan: identification of the main goals of the project

- Do: Pilot Testing (Small-Scale Implementation) by testing the proposed improvements in a controlled setting, such as a single department or unit. Then, track key performance indicators (KPIs) to assess the impact of changes, with a focus on metrics like patient satisfaction, treatment success rates, and process efficiency.
- Study: A comparison between the achieved and predicted outcomes
- Act: Execution of the plan on a large scale of population (Implement Full-Scale Rollout). Also, ensure that all staff members are adequately trained on new procedures and technologies. Communicate changes clearly to avoid resistance.

Effective PDSA (Plan-Do-Study-Act) implementation relies on small-scale tests before scaling up. However, a review found that fewer than 20% of studies used iterative cycles, suggesting larger tests may be ineffective. Challenges include setting overly ambitious goals beyond PDSA's scope and oversimplifying the process, leading to improper execution. In healthcare, successful PDSA application requires adequate resources, including staff, technology, inventory, and funding, to ensure integration into workflows (Barr, E., & Brannan, G. D. 2024).

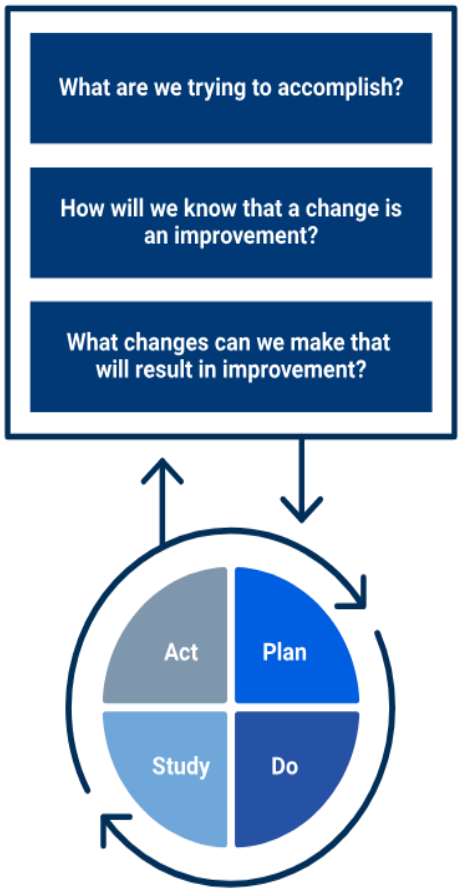

Figure 10 : PDSA MODEL

3.8.6 **Control Phase**:

The Control phase in the DMAIC framework focuses on maintaining the improvements sustained during the improvement phase by keeping up with them regularly (Momani et al., 2017). This involved ongoing data collection and analysis, regular audits, and feedback mechanisms to ensure continuous improvement, with a comparison between some Key Performance Indicators (KPI).

In the context of oncology quality improvements, the Control phase ensures that the process changes are sustained over time, leading to consistent and reliable patient care. In this study, the control phase was not carried out, however, a detailed approach to the Control phase in oncology quality improvements that could be applied will be discussed in this section.

1. Develop Control Plans:

- Create detailed control plans that outline how the improved processes will be monitored and maintained.

- Specify the key performance indicators (KPIs) that will be tracked to ensure the process remains stable, such as oncology referral number, oncology referral cost, number of succussed oncological surgeries that are carried out at the governmental hospitals

- Define roles and responsibilities for team members involved in monitoring and controlling the process.

2. Standardize Processes:

- Document the new processes and procedures in standard operating procedures (SOPs) such as SOPs of chemotherapy preparation, SOPs of oncological drugs pricing, SOPs for referral system for Cancer patients

- Ensure that all staff members are trained on the updated SOPs and understand their roles in maintaining the improvements by providing comprehensive training for all staff on the new SOPs and the use of the HIS system.

- Use checklists and guidelines to standardize critical tasks, such as chemotherapy administration, radiation therapy, and patient identification.

3. Implement Monitoring Systems:

- Use real-time monitoring tools, such as electronic health records (EHR) and clinical decision support systems (CDSS), to track patient care processes and outcomes, and to track each step of the chemotherapy administration process.

- Establish automated alerts and reminders for critical steps in the oncology care process to prevent deviations.

- Conduct regular audits and inspections to verify compliance with the new processes.

- Automated Alerts: Set up alerts for any deviations from the prescribed dosage or protocol, for example, automated alerts when the cancer drug supply is running low

4. Use Statistical Process Control (SPC):

- Apply SPC tools, such as control charts, to monitor the performance of key processes over time. For example, control charts to monitor dosage accuracy rates over time

- Identify any variations or trends that could indicate potential issues, and take corrective actions as needed.

- Regularly review control charts with the oncology team to ensure everyone is aware of process performance.

- Review Meetings: Hold weekly meetings to review control charts and discuss any deviations

5. Create Response Plans:

- Develop response plans for when process performance falls outside of acceptable limits, and ensure that response plans are readily accessible to all team members.

- Define specific actions to be taken, who will be responsible, and how issues will be documented and resolved. For example, if a dosage error is detected, the response plan involves immediate notification of the oncology pharmacist, review of the error, and corrective action documentation.

- Responsibility: Assign specific team members to oversee the implementation of the response plan.

6. Engage and Train Staff:

- Conduct regular training sessions to reinforce the importance of the new processes and how to maintain them.

- Encourage staff feedback and involvement in continuous improvement efforts.

- Recognize and reward staff contributions to maintaining high-quality care.

- Ongoing Training: Conduct monthly training refreshers and include new staff in the training program.

- Feedback Mechanisms: Implement a system for staff to provide feedback on the process and suggest improvements.

7. Conduct Regular Reviews:

- Schedule periodic reviews of the control plans and process performance with the oncology quality improvement team.

- Analyze the data collected from monitoring systems and SPC tools to identify any areas needing further improvement.

- Adjust control plans and SOPs as necessary based on review findings.

- Quarterly Reviews: Perform quarterly reviews of the number of oncological referrals and costs, chemotherapy administration processes, and analyzing data from the control charts.

- Adjustments: Make necessary adjustments to the SOPs and control plans based on review outcomes.

8. Sustain Improvements:

- Foster a culture of continuous improvement by encouraging ongoing evaluation and optimization of oncology care processes. Also, encourage staff to participate in quality improvement projects and share best practices.

- Implement quality improvement cycles (e.g., Plan-Do-Check-Act) to ensure that the processes remain effective and efficient.

- Maintain open communication channels to address any emerging issues promptly.

- Recognition: Acknowledge and reward staff for their efforts in maintaining high-quality chemotherapy administration practices.

The benefits of the Control Phase in Oncology could be summarized by ensuring that the improvements made during the improvement phase are consistently applied, leading to stable

and reliable oncology care. Also, early Detection of Issues by monitoring with the use of SPC tools helps detect potential problems early, allowing for timely corrective actions. On the other hand, by maintaining high-quality processes, patient outcomes are improved, and adverse events are minimized. Finally, ongoing training and involvement in continuous improvement efforts keep staff engaged and committed to quality care.

In conclusion, The Control phase is crucial for sustaining the gains achieved in oncology quality improvements. By implementing robust monitoring systems, standardizing processes, and fostering a culture of continuous improvement, healthcare teams can ensure that high standards of oncology care are maintained over time (Monday LM, 2022).

In this study, a comparison between some KPIs was done between 2022 and 2023, as shown in Tables 8 and 9, respectively.

Table 8 : A comparison of the Oncological Referral Costs between 2022 & 2023, SPU, MoH

REFERRAL HOSPITAL	COST OF ONCOLOGY BILLS, 2022	COST OF ONCOLOGY BILLS,2023
An-Najah National Hospital	77,728,716.92	63,608,623.97
Augusta Victoria Hospital	205,900,932.42	191,155,900.18
Istishari Hospital	107,551,654.83	88,752,457.37
Al-Hayat Hospital/Gaza	10,849,016.19	6,727,499.20
Al-Helo Hospital / Gaza	526,219.30	949,015.43
Totals Referral Bills Costs	402,556,539.66	351,193,496.15

Table 9 : The Difference of the Referral Drugs' Costs between 2022 & 2023, SPU, MoH

Referral Hospital Name	Drug costs /2022	Drugs Costs /2023	S/D
Istishari Hospital	72,009,415.09	62,332,869.67	-13%
An-Najah National Hospital	50,669,041.61	8,910,032.53	-82%
Augusta Victoria Hospital	56,392,691.06	44,793,212.28	-21%
Total bills Costs	179,071,147.76	116,036,114.48	-35%

3.9 Analysis & the Statistical Tests Use

SPSS version 26 was used for statistical analysis. The chi-squared test and the independent t-test were used to test the correlation between variables. Also means, standard deviation, percentages, and frequencies were computed for the numerical data as a descriptive analysis. In statistical tests, P-values < 0.05 were considered significant. In addition, the thematic extraction method was used for the qualitative approach.

3.10 Ethical Concern

With this study, four ethical concerns were raised. First, respondents were informed of the study's goal on the questionnaire's cover page. Also, responders' information is held under the strictest confidence. Furthermore, the data that were amassed during the study are not

being reported in a way that intentionally misrepresents or distorts them. Finally, there is no financial conflict between this research on the one hand and any other party on the other.

Data collection approval was taken from the Palestinian MoH at the service Purchase Unit, General Administration of Hospitals and Emergencies, and Health Information Department / Cancer Registry.

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4 Chapter Four: Data Analysis and Discussion

4.1 Introduction

This chapter presents the results of the study through the respondents' responses to the paragraphs included in the study tool (questionnaire) that relate to Optimizing Oncological Services Quality in Palestinian Governmental Hospitals: A Six Sigma Approach from the Perspective of Hospital Administration. The chapter presents the answers to study questions and the results of examining the hypotheses that emerged from them related to the variables.

4.2 Results of Analysis

An analysis was done using IBM SPSS version 26. Table 4.2.1 shows that the sample has been examined among 52.8% females and 47.2% males, according to gender. However, the age of the sample as shown in (Figure 11) fluctuated between 21.4 % aged between (60-69) years old, 20.3% aged between (40-49) years old, 18.7% between (50-59) years old, 11.9% between (70-79) years old,11.6 % in the age group of (30-39) years old, 6.3 % in the pediatric group whose ages between (1-9) years old, 4.2 % (20-29) years old, 2.9% between (10-19) years old and finally the older age group between 80-89) years old with the lowest percentage of 2.6 %.

Table 10 : Distribution of patients according to gender

Gender	Frequency	Percent	Cumulative Percent
Male	179	47.2	47.2

Female	200	52.8	100.0
Total	379	100.0	

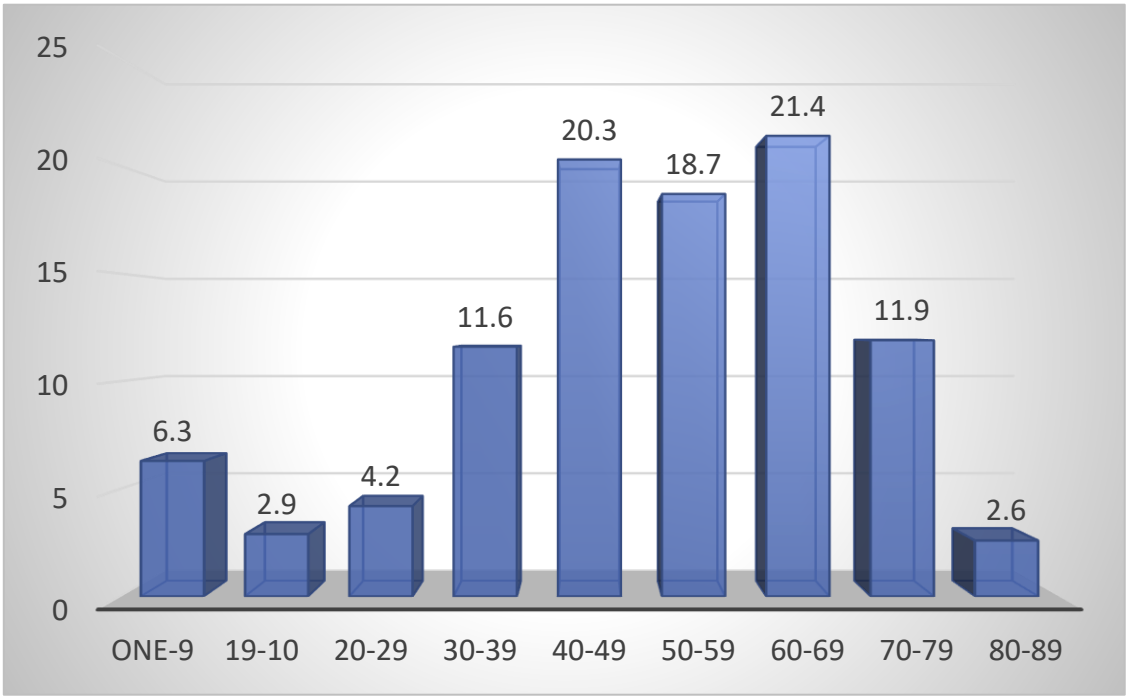

Figure 11 : Distribution of patients according to their age group

According to the address of the chosen patients, the highest percentage, about 39.8%, was from the North district of the West Bank, which includes Nablus, Jenin, Tulkarm, and Qalqilya. However, about 24.3 % were from the South district of WB, which includes Bethlehem and Hebron, and 18.5% were from the intermediate district, which includes

Ramallah and Al-Bireh city, Jericho, and Tubas. Also, about 14.2% were from Gaza and 3.2% from Jerusalem, as shown in Figure 12.

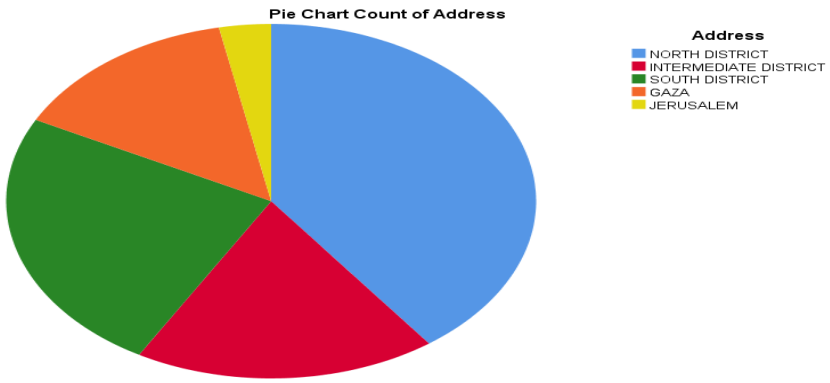

Figure 12 : Pie Chart for the distribution of patients regarding address, SPU 2023

Most referral requests were from The National Hospital (Al-Watani) in Nablus, with a percentage of 29%, followed by 24.3% from Beit-Jala Hospital, 18.7% from PMC,14.2% from Gaza,7.4% from Jenin, and with equal proportions for Thabet-Thabet and Jerusalem city with a percentage of 3.2%. As shown in Figure 13.

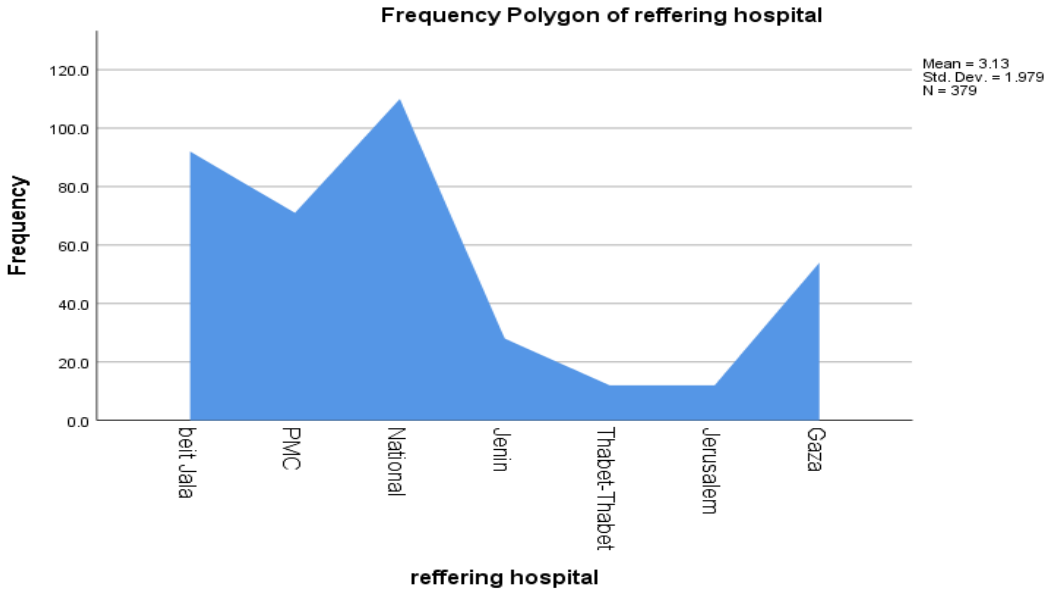

Figure 13 : Distribution of patients related to the referring hospitals

Regarding the Cancer group; more than two-thirds of the patients with a percentage of 76.8% (291 patients) were diagnosed with a solid cancer type group, however, 23.2% (88 patients)were diagnosed with hematological cancer type; as shown in Table 11 .

Table 11 : Distribution of patients related to their Cancer Group

Cancer Group	Frequency	Percent	Valid Percent	Cumulative Percent
Hematology	88	23.2	23.2	23.2

Solid Cancer	291	76.8	76.8	100.0
Total	379	100.0	100.0	

In more detail; the most frequent types of cancer among the patients with solid cancer type were breast cancer 22.4%, colorectal 16.4 %, prostate cancer 10.3 %, lung cancer 9.8%, hepatocellular -pancreatic cancer 5.5%, sarcoma 3.7 %, and brain tumor 3.2%, Renal cell carcinoma 1.8 %, respectively. On the other hand, regarding the hematology cancer group, 6.3 % of the patients were diagnosed with Acute Lymphoblastic Leukemia (ALL), 4.7 % multiple myeloma, 4.2% Hodgkin- Non-Hodgkin Hodgkin lymphoma, Acute Myeloid Leukemia 4.2%, CML with a percentage of 1.8 % and 0.5% were diagnosed with CLL. As shown in Figure 11.

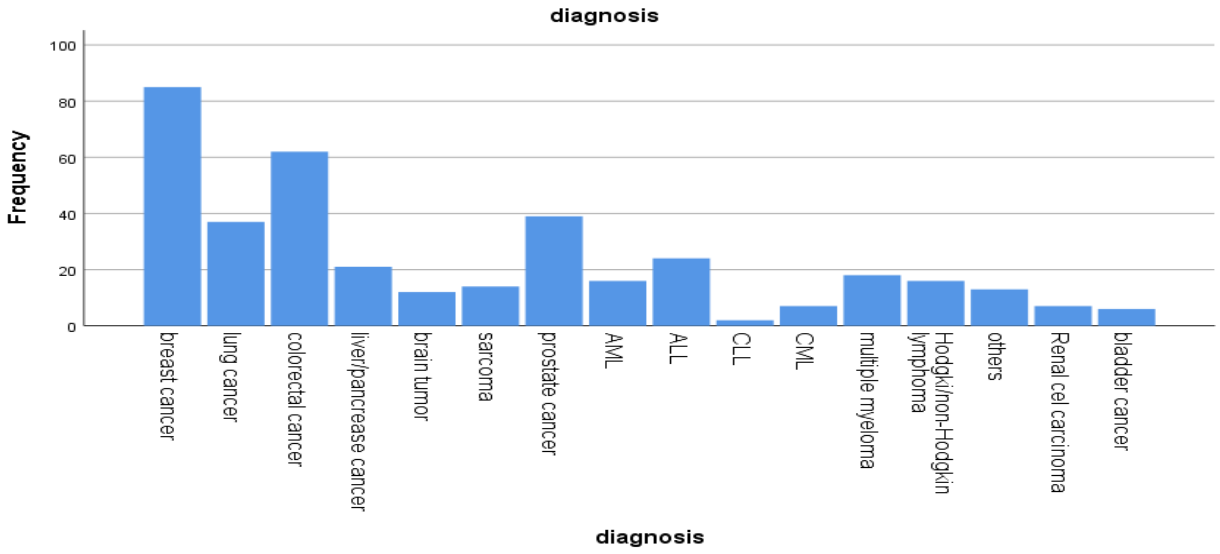

Figure 14 : Distribution of patients regarding diagnosis

When we investigate the main causes behind referrals; the results show that the highest percentage was due to the unavailability of the drugs with a percentage of 47.5 % in WB, and 4.7% in Gaza, followed by 16.6 % for referral for medication that was not included within the EDL, and referral for a regimen that requires admission /hospitalization with a percentage of 16.4%, 7.7% of the sample was for pediatric patients, 3.7% for Sarcoma, 3.4 % Chemo-radiotherapy, Head and neck 1.3 %, Jerusalem 0.8%, as was shown in Table 12.

Table 12 : Description of the main causes for Cancer referral outside the Palestinian MoH

Main referral cause	Frequency	Percent	Valid Percent	Cumulative Percent
EDL NA	172	45.4	45.4	45.4
NON-EDL	63	16.6	16.6	62.0
HOSPITALIZATION	62	16.4	16.4	78.4
WARD INPATIENT ADMISSION PEDIATRIC	29	7.7	7.7	86.0
EDL NA GAZA	18	4.7	4.7	90.8
CHEMORADIOTHERAPY	13	3.4	3.4	94.2
SARCOMA	14	3.7	3.7	97.9
HEAD & NECK	5	1.3	1.3	99.2
QUDS	3	.8	.8	100.0
Total	379	100.0	100.0	

A Pareto Analysis was done regarding the main causes of oncology referral outside the MoH facilities and the results revealed that shortage of drugs that are included in EDL with a percentage of 45.4%, a lack of drugs that are not added to EDL with a percentage of 16.6%,

and Lack of oncology wards among the governmental hospitals; occupy the first three ranks, The top three ranks, if worked on improving, will lead to solving 80% of the problems, Figure 15.

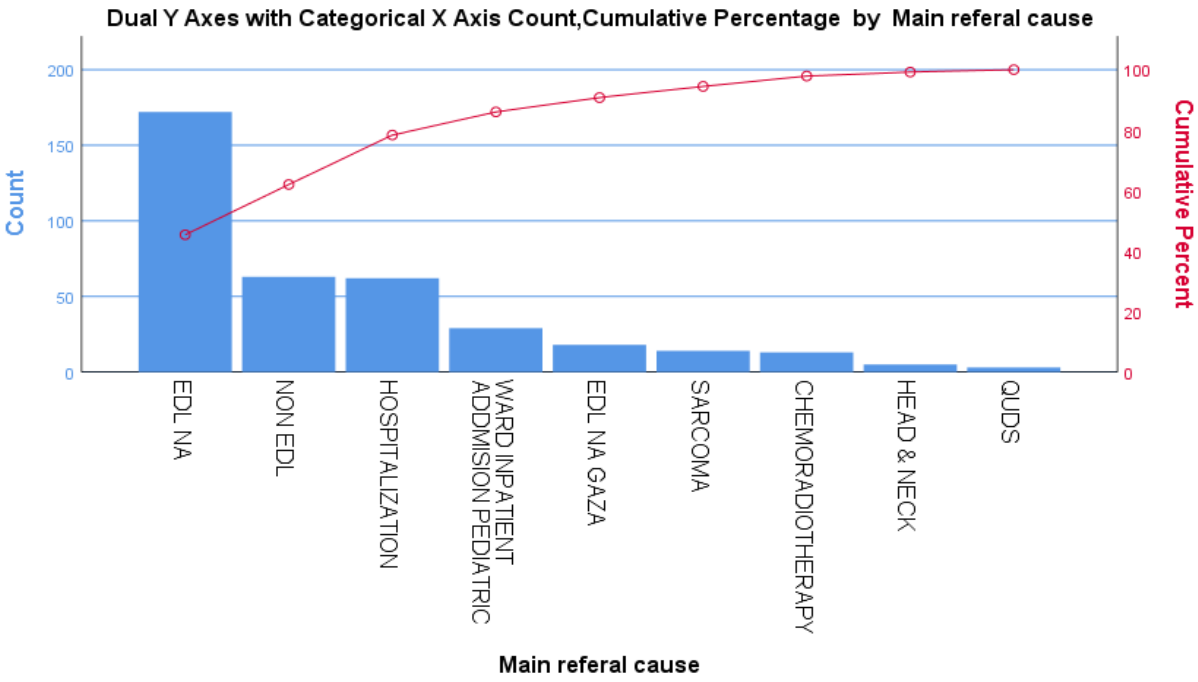

Figure 15 : Pareto Analysis of the main referral causes outside the governmental facilities

Regarding the referral hospitals, the results show that about one-half of the patients were referred to AVH, with a percentage of 50.7%, followed by 27.7 % referred to An-Najah National Hospital and about 21.6% of the patients referred to Istishari Hospital, shown in

Table 13. Also, Table 14 (Appendix H) shows a crosstabulation of the distribution of patients between the referring and referral hospitals.

Table 13 : Distribution of patients related to referral hospital

Referral Hospital					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
	Najah Hospital	105	27.7	27.7	27.7
	Istishari Hospital	82	21.6	21.6	49.3
	Augusta Victoria Hospital	192	50.7	50.7	100.0
	Total	379	100.0	100.0	

Regarding the results in Table 15 (Appendix H), most referrals from almost all five hospitals were related to the unavailability of drugs included in the EDL at the main stores of MoH,

followed by referrals for drugs that are not included in the EDL. On the other hand, a regimen that requires hospitalization was a second reason for a referral from the facilities that do not have an oncology/hematology department, specifically; PMC of about 15 patients, The National Hospital with a number of 20 patients, Jenin Governmental Hospital with 5 patient referrals and 6 cases from Thabet-Thabet Hospital in Thabet- Thabet hospital. The results show that about 29 referral forms were related to the unavailability of pediatric oncology departments, as in the case of the National Hospital, Jenin, Tulkarm, and PMC, also Beit Jala Hospital, even though it has a special pediatric unit, but referrals were made as a result of long waiting times.

4.3 Answering the Questions of the Study

To test the hypothesis, a descriptive analysis was used to compare the means of the financial oncology bills and the number of cancer referrals at SPU of MoH between 2022 and 2023 for the three related - private hospitals; Istishari Hospital, An-Najah National Hospital, and AVH, the results are shown in Table 16, Figure 16 .

Table 14 : Descriptive Analysis among Istishari Hospital , An-Najah Hospital and AVH for the total oncology bills 2022 vs 2023 , SPU, MoH

Hospital Name		Total Oncology Costs 2022	Total Oncology Costs 2023
Istishari Hospital	Mean	107551654.8300	88752457.3700
	N	1	1

	Std. Deviation	.	.
An-Najah hospital	Mean	77728716.9200	63608623.9700
	N	1	1
	Std. Deviation	.	.
AVH	Mean	205900932.4200	191155900.1800
	N	1	1
	Std. Deviation	.	.
Total	Mean	130393768.0567	114505660.5067
	N	3	3
	Std. Deviation	67069745.85489	67561065.12627

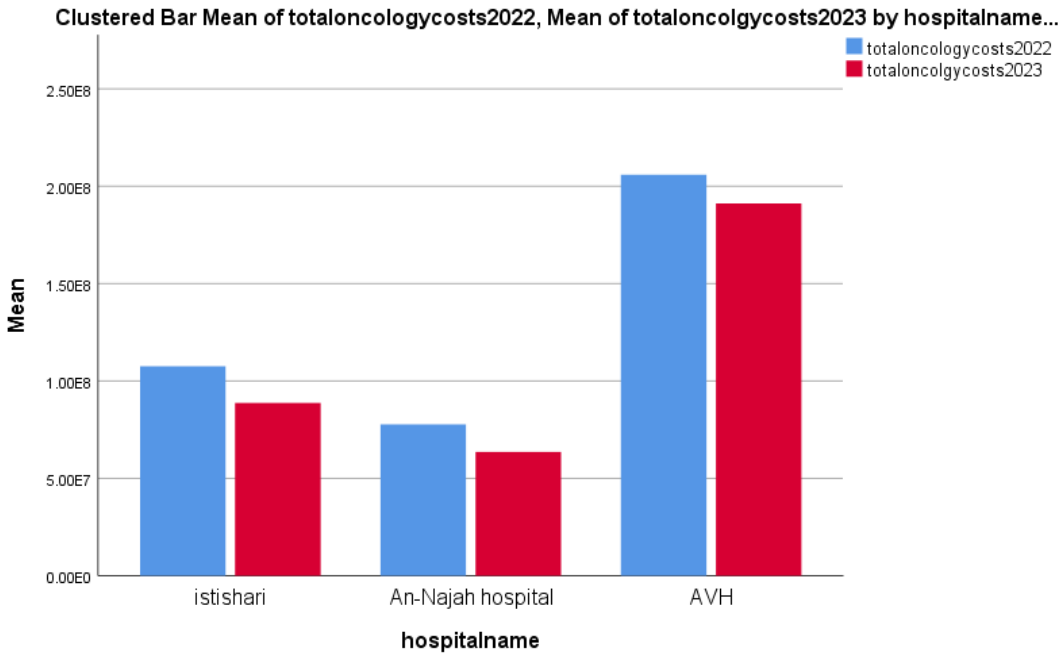

Figure 16 : A Bar Chart shows a comparison between the years 2022 & 2023, among the three Cancer Private Hospitals regarding the total oncology bills costs at SPU, MoH

Also, the Paired Sample T-test was used to test the hypothesis. The results show that there is a significant correlation with a notable decrease in the total oncology costs and referral numbers between the two years (2022 and 2023), related to the three private hospitals. The

p-value was 0.024 for the pair of total oncology costs of referrals related to SPU, between 2022 and 2023. While the p-value was 0.046 for the second pair, which is related to the total number of oncology referrals for the same two years, as shown in Tables 17 and 18.

On the other hand, decreasing the oncological referrals while increasing the total number of newly diagnosed patients by about 3590 cases in 2023, with an incidence rate of 122.1 per 100,000 population. It turns out that there is a 5.3% increase of cancer cases comparing to number in 2022, according to the data from the Cancer Registry, this will encourage the hypothesis of that "The implementation of Six Sigma will result in a statistically significant improvement in the quality of oncological services at governmental hospitals within the MoH ", with no increase in the referrals' numbers and costs. This is shown in Table 17, Table 18, and Figure 17.

Table 15 : Paired Sample Statistics of the total oncology bills,2022 vs 2023

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Total oncology costs 2022	130393768.0567	3	67069745.85489	38722735.82380
	Total oncology costs 2023	114505660.5067	3	67561065.12627	39006399.13739
Pair 2	Total number of oncology referrals 2022	10163.0000	3	6552.66503	3783.18292
	Total number of oncology referral 2023	9016.6667	3	5973.91884	3449.04365

Table 16 : Paired Sample Correlations of the total oncology referral costs & numbers, 2022 vs 2023

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Total oncology costs 2022 & total oncology costs 2023	3	.999	.024
Pair 2	Total number of oncology referrals 2022 & total number of oncology referrals 2023	3	.995	.046

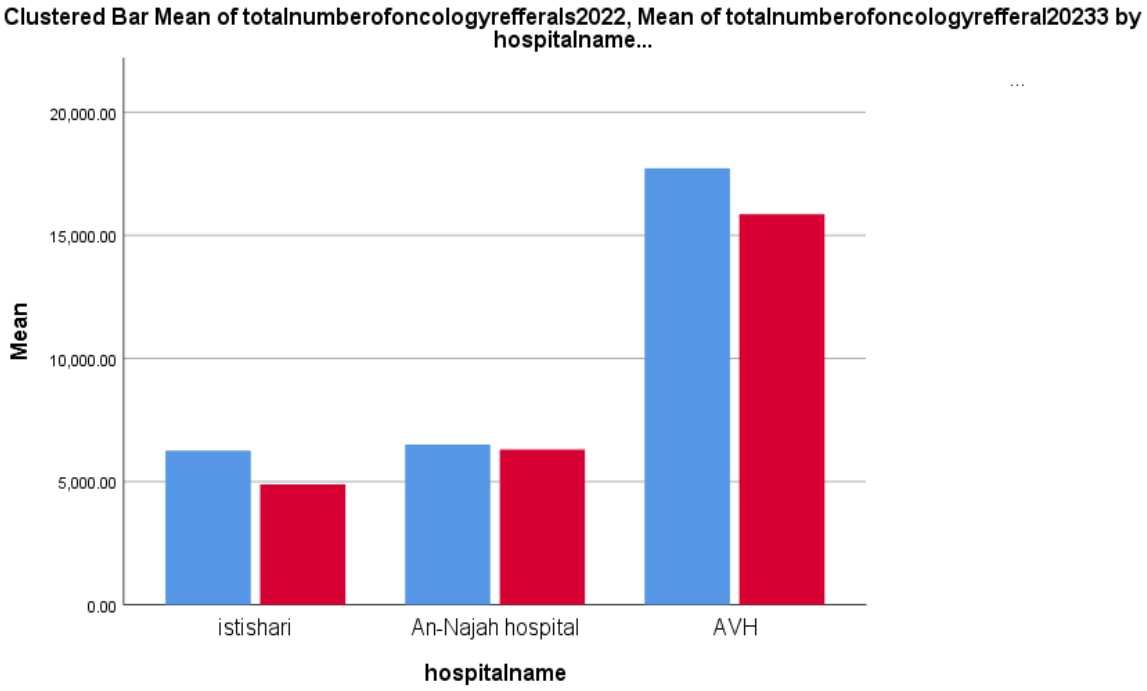

Figure 17 : A comparison between the years 2022 & 2023, among Istishari, An-Najah National Hospital, and AVH; regarding the total referrals number at SPU, MoH

4.4 Results of the analysis of the questionnaire

This section investigates the results that were obtained from the questionnaire (Appendix B) analysis. It consists of the analysis of the seven sections.

4.4.1 Analysis of Section One: Health facility information and infrastructure :

Regarding the results, the five hospitals were established to cover the needs of cancer patients throughout the West Bank; divided into three districts:

1. The northern district is served by the National (Al Watani) Hospital in Nablus which is considered a central one that receives patients from Nablus, Tulkarem Jenin, Qalqiliya, and Thabet–Thabet governmental hospital in Tulkarem as a second category hospital which contains only a daycare oncology unit with no department for patient's admission.
2. The intermediate district served by the Medical Palestinian Complex (PMC) to receive patients from Ramallah and Al-Bireh city, Jericho, and Salfit City.
3. The Southern district is served by Beit-Jala Governmental Hospital, which includes a day-care oncology unit and Harmalah Hospital for residence and admissions.

After analysis, we found that all five governmental hospitals provide adult chemotherapy, palliative care, and surgery. Beit Jala Hospital is the only facility that provides a pediatric oncological care unit, which treats pediatric patients with low-risk stages of different cancer types; however, PMC in Ramallah and Albireh City and Rafedia Hospital in Nablus City have daycare units for diagnostic purposes only. Regarding the health facility information

and infrastructure section, we found that the only hospital with hospitalization beds for the oncology department is in Beit Jala City, which receives patients from the southern area; both Hebron and Bethlehem cities. It has about 24 adult oncology beds and 14 beds for pediatric oncology. However, All other remaining hospitals have only oncology/hematology daycare units with no specified beds for oncology hospitalization, so they have to refer all cancer patients who need an in-patient regimen with hospitalization, to other private hospitals which are Al-Istishari Hospital in Ramallah, An-Najah National Hospital in Nablus, and AVH in Jerusalem. Table 4.4.6 shows in detail the most common regimens that have to be referred to other private hospitals because of the unavailability of oncology hospitalization departments. In addition, when we ask about other infrastructure and availability of oncology equipment, none of the hospitals provided porta-catheter insertion procedures for chemotherapy, also none has a pump infusion tool. Regarding the availability of infusion chairs, The national hospital has 25 infusion chairs, however, each PMC and Beit-Jala Hospital have only 12.

The average waiting time for cancer patients, from the registration process to taking the medications, ranges from hours as in the case of Beit-Jala Hospital to (one- to two) weeks as in each of PMC and the National Hospital, Thabet-Thabet, and Jenin governmental Hospitals. This disparity in the length of waiting time is due to several reasons, including the availability of oncology departments, in addition to the number of specialists and relevant medical and registry staff. More details about the infrastructure are shown in Appendix D .

Regarding the diagnostic imaging procedures that are applicable in the hospitals, the results show that Ultrasonography, MRI, Mammography, and C-arms were efficient at Beit Jala

Hospital with a total number of procedures per year of 3540, 500, 11176, and 17124, respectively. In more detail regarding MRI, it is available in the PMC, Jenin, Alia Hospital in Hebron, and Rafedia Hospital in Nablus, but has remained dysfunctional for a long time and needs constant maintenance. On the other hand, the total number of mammography machines in the West Bank is 43, 14 were found in the public sector, 7 of them were functioning, 2 were non-functional, and the 5 remaining machines were with old systems that required constant maintenance with no spare parts. About 8000 procedures were done by these mammography machines per year, which target 9000 for early diagnosis and more than 50000 for screening programs.

The endoscopy diagnostic technique is found in Tulkarm, Jenin, and Hebron governmental hospitals only, but they also have to refer a number of patients to other private facilities due to long waiting times. The total number of endoscopy referrals in 2022 was 3436 with an estimated total cost of 8,894,061 NIS.

PET scan is an important imaging diagnostic procedure to find any disease and to test the progression and improvement after therapy, but unfortunately in 2022, it was unavailable at governmental hospitals in 2022, so the oncologists have to refer the patients to other private clinics where it is found; which are AVH in Jerusalem, Al-Rahma clinic in Nablus, Al-Ahli Hospital in Hebron. Every PET scan costs the MoH between 2000 – 2500 NIS, with a total cost of 2022 according to referral financial bills of 9,648,200 NIS for a number of 4378. However, the total PET scan cost decreased in 2023, as shown in Table 17 below.

Table 17 : Number & Costs of PET scan referral in 2023, SPU, MoH

Referral clinic	Number of PET Referrals 2023	Cost of PET referrals
Patient's Friends Association - Al-Rahma Clinic	1,430.00	2,064,000.00
Al-Ahly Hospital – Hebron	1,562.00	3,119,800.00
Augusta Victoria Hospital	2,598.00	3,125,300.00
Grand Total	**5,590.00**	**8,309,100.00**

4.4.2 Analysis of Section Two: Human Resources

In the second section of the questionnaire, the gathered data talk about the human resource factor; in more detail, it was seen that there is a lack of staff, which is considered a main constraint for providing high-quality services. The total number of oncologists in the five hospitals is 13 adult oncologists/ hematologists and 3 pediatric oncologists. Table 18 shows the number of human resources by specialty for each hospital.

Table 18 : Number of Human Resources in Cancer Management, MoH, Palestine,2022

2.1 Number of healthcare workers involved in cancer care & treatment (management)

	Specialty	Beit-Jala Hospital	PMC	The National Hospital	Jenin Hospital	Thabet - Thabet Hospital
Medical oncology	Medical oncologist	18 (7 specialists)	2	4 (2 oncologists + 2 hematologists) + 6 medical resident	3(2 specialists)	1

	Pediatric oncologist	6 (2 specialists)	2	-	-	-
	Radiotherapist	1	-	-	-	-
	Pharmacist (Oncology)	3 (2 specialists)	2	3	-	1
	Nurse (Oncology)	32 (5 specialists)	4	10	3 (2 specialists)	2
Surgical oncology	Gynecologist/surgeon	2 (2 specialist)	-	-	-	-
	GI Surgeon (Oncology)	2 (1 specialist)	-	-	-	-
	Breast Surgeon (Oncology)	1	1	-	-	-
	Thoracic Surgeon (Oncology)	0	-	-	-	-
	Neurosurgeon (Oncology)	0	-	-	6(non of them is a specialist)	2 (general Surgeon)
Pathology	Pathologist	2	1		-	-
	Biomedical laboratory scientist	3	5		-	-
	Psychosocial agent	-	-		-	-
	Other – specify					

4.4.3 Analysis of Section Three: Chemotherapy

The third section of the questionnaire was divided into two parts: adults and pediatrics. It investigates the oncology/hematology treatment protocols that require hospitalization, in which it is considered to refer the patient to other facilities outside the governmental hospitals that have only a day-care department, such as PMC, The National Hospital (Al Watani), Thabet Thabet Governmental Hospital, Henin Governmental Hospital. These Cancer types and regimens are distributed in Table 19 below.

Table 19 : Classification of Referral Cancer Regimens that required hospitalizations

Cancer Category	**Cancer Type**	**Drug regimen**
Adult (Oncology /Solid Tumor)	Colorectal Cancer	5-FU PROTOCOLS *
	Liver Cancer	5-FU PROTOCOLS *
	Pancreatic Cancer	5-FU PROTOCOLS *
	Advanced Testicular Cancer	-VIP Protocol (Etoposide , Ifosfamide , Cisplatin)
	Soft Tissue Sarcoma	Anthracycline-based regimens: Doxorubicin, Epirubicin, Liposomal Doxorubicin, AD (Doxorubicin, Dacarbazine), AIM (Doxorubicin, Ifosfamide, Mesna), Ifosfamide, Epirubicin, Mesna.
Adult (Hematology)	Advanced Stage Hodgkin Lymphoma	Escalated BEACOPP (Bleomycin, Etoposide ,Doxorubicin, Cyclophosphamide, Vincristine , Procarbazine, and Prednisone)
	Acute Myeloid Leukemia (AML)	Azacitidine + Venetoclax
	Diffuse Large B Cell Lymphoma (DLBCL) ,2nd line	ICE (Ifosfamide ,Carboplatine ,Etoposide)
	Mantel Cell Lymphoma	R-DHAP (
	Myelodysplastic Syndrome (MDS)	Azacitidine +/- Venetoclax
Pediatric Cancer	Acute Lymphocytic Leukemia (ALL)	Vincristine ,Peg Asparginase, Daunorubicin ,Cytarabine , High dose Methotrexate , Etoposide

Acute Lymphocytic Leukemia (ALL)	(Arsenic Trioxide, Tretinoin (ATRA), Cytarabine, Etoposide, Mitoxantrone, Idarubicin, L-Asparaginase)
Hepatoblastoma	(Cisplatin, Vincristine,5FU, cyclophosphamide)
Medulloblastoma/ Brain Tumor	(Vincristine, Lomustine, cisplatin, cyclophosphamide, etoposide, carboplatin, thioguanine)
Soft Tissue Sarcoma –Non Rhabdoid	(Ifosfamide, doxorubicin, Vincristine)
Soft Tissue Sarcoma Rhabdoid	(Vincristine, actinomycin Cyclophosphamide)
Ewing Sarcoma	(Vincristine, cyclophosphamide, etoposide, dactinomycin)
Osteosarcoma	(High-dose methotrexate (HDMTX), Ifosfamide, etoposide, doxorubicin)
Retinoblastoma	(Carboplatin, Vincristine, Etoposide, Cyclophosphamide)
Neuroblastoma	**-Low Risk /Intermediate Risk** (Vincristine, Carboplatin, Etoposide, Cyclophosphamide, Doxorubicin) **-High Risk** (Vincristine, Etoposide, Cyclophosphamide, Carboplatin, Cisplatin, Doxorubicin, Dinutuximab, Topotecan)

Non-Hodgkin Lymphoma	(Cyclophosphamide, Vincristine, Doxorubicin, High-dose methotrexate (HDMTX), Cytarabine, Rituximab, Etoposide (VP16) **ICE:** Ifosfamide**,** Carboplatin**,** Etoposide

*5-FU PROTOCOLS: FOLFIRI (5-Fluorouracil, Calcium Folinate, Irinotecan, FOLFOX (5-Flurouraci, Calcium Folinate, Oxaliplatin), Folforinox (5-Fluorouracil, Calcium Folinate, Oxaliplatin, Irinotecan), FLOT (5-Fluorouracil, Calcium Folinate, Oxaliplatin, Docetaxel)

More specifically, when we asked about the availability of pre-treatment workups for pediatric/adult cancer patients; all of the following were available in the five hospitals participating in the research: Complete Blood Count (CBC), serum glutamic pyruvic transaminase (SGPT), SGOT, Creatinine, Glycemia, Electrolytes, Ultrasounds, X-ray. A list of the diagnostic and genetic lab tests that are done in MoH facilities is attached in Appendix E

4.4.4 Analysis of Section Four: Radiotherapy and Nuclear Medicine

In Section Four, which asks about radiotherapy services; the results show that in 2022 none of the participating governmental hospitals has a radiotherapy unit or nuclear medicine, so they have to refer all the patients who require such management to Augusta Victoria Hospital (AVH) in Jerusalem which is considered the only private one in Palestine that provides radiotherapy, the main cause behind the absence of radiotherapy unit is the absence of equipment, however, there is 3 trained radiotherapist, but no one of either GP (General practitioner) or Radio physicist, Technical support staff have been trained for radiotherapy treatment. The total number of clients who were eligible for radiotherapy in 2022 is about

2000, however, about __1046_____ effectively received it with a total number of radiation sessions of about 1992 sessions; regarding the data from the Service Purchase Unit (SPU), with a total cost of 103,563,728 NIS.

On the other hand, in 2022, none of the five hospitals had a nuclear medicine unit. There is only one nuclear medicine specialist, and there is a plan to localize nuclear medicine, which may require an estimated time of more than 5 years. When we asked SPU about the cost of one session of radiotherapy, the answer was about 400 NIS, however, every patient on average requires about 30- 35 sessions, and it is a matter related to each patient's condition individually (case by case), according to his diagnosis and the treatment plan that this doctor decides for him.

And when we asked about the applied surgeries at the five participating hospitals, they answered that surgery offers the greatest survival benefit (10-50%) to the greatest percentage of people diagnosed with cancer (50-70%), including for the most common cancers in Palestine.

Regarding the five- hospitals, in general, the most common types of oncological surgeries are for Breast cancer, Gastrointestinal, Thyroid cancer, and Gynecological ones; all of them can be executed in PMC, Beit-Jala, and Rafedia hospitals, except for complicated cases that require extensive care and combined efforts of several medical teams, such as bone tumor surgeries and brain tumors; so they have to be referred to other high qualified centers outside MoH such as; Al-Makassed Hospital in Jerusalem, Istishari Hospital in Ramallah and Al bireh, An-Najah Hospital and other private hospitals. Unfortunately, there is no data available about the surgery deaths or complications in the participating hospitals in 2022. Table 20

below describes cancer surgery that includes the number and types of surgeries, and the number of staff included by each hospital. In more detail, variations in surgical quality are well established and have been linked to differences in survival.

Table 20 : Description of Oncology Surgery Services, MoH, 2022

	Beit-Jala Hospital	PMC	The National Hospital	Thabet-Thabet Hospital	Jenin Hospital
The most commonly executed types of surgeries	Breast, Gastrointestinal, Gynecological	Breast surgeon	No	Breast, Gastrointestinal, Gynecological	Neurosurgery
Number of staff working in the Surgical department	Surgeons: 2-GI 2-Gynecologists 1-breast Surgeon			5 General Surgeons	6 Neurosurgeon (No one is a specialist)
Number of complications or deaths	Unknown	Unknown	Unknown	-	Unknown

Interventions to improve surgical quality are not well defined, though generally related to sub-specialty training and accreditation standards for treating facilities, based on volume or treatment capacities

4.4.5 Analysis of Section Five: Patient follow-up and palliative care

In this section, we revealed that the chemotherapy pharmacy is separated from the hospital's main pharmacy in the five hospitals. Also, we examined the number of personnel involved

in chemotherapy preparation sessions, and it was as the following: 2 pharmacists at each of The National Hospital, Beit Jala, Thabet-Thabet Hospital, Jenin Hospital, and PMC. All of them were trained in the preparation of chemotherapy, and all of the departments provided protective materials, which are gloves, gowns, goggles, facemasks, and laminar flow cabinets.

About patients and their caregivers' education on the disease, symptoms, treatment plan, and the way of drug administration, all of the medical team participate in such education, with more responsibility falling on the oncologists, nurses, and pharmacists. Many types of materials are used to educate patients and their relatives, such as brochures and written documents about how to take their medications and to manage any related side effects. However, no training programs are taken into place for such fields of education. Many organized meetings and forums took place to educate patients and their relatives about cancer and early diagnosis, not in the hospitals due to overcrowding and the large number of patients present, but with the support of many institutions and civil organizations. Other scientific seminars are organized to raise community awareness about malignant cancer and the importance of early detection. While scientific seminars in government hospitals are limited to the participation of oncologists and other medical staff, and are organized by the hospital administration to keep pace with the latest developments in the field of oncology treatment, and to discuss some of the rare complex cases that have been discovered.

Palliative care services for cancer patients are needed throughout the country and should be made available to them and their families in the most effective manner. Furthermore, community-oriented regional palliative care programs have proven cost-effective elsewhere.

Palliative care for cancer patients is applied through the daycare units among the five governmental hospitals for adults and pediatrics with cancer, however, none of the aforementioned hospitals has a separate department for palliative care, but services are provided through daycare departments and other medical wards. A proposed referral pathway of palliative care is shown in an algorithm in Figure 18. The aim of the national palliative care program for cancer patients is to make high-quality palliative care services accessible to all patients and families who need these services anywhere in Palestine.

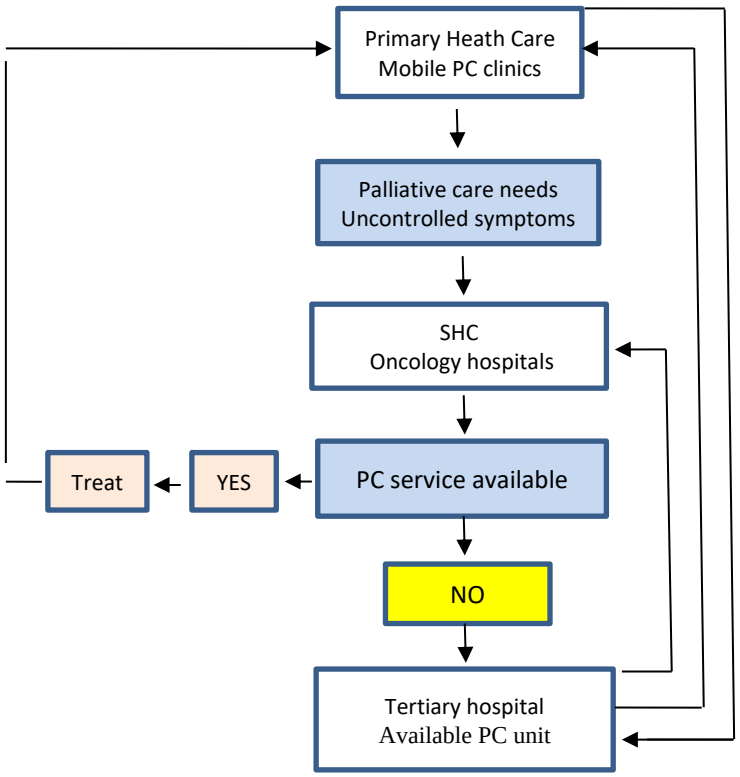

Figure 18 : Describes algorithmically the proposed system for the palliative program in Palestine

The most common controlled drugs that have been used in hospitals are Morphine, Oxycodone, Fentanyl, and Pethidine Patches. The palliative care Drug Formulary is attached in Appendix F.

4.4.6 Analysis of Section Six: Data systems

Regarding the data systems that have been used for cancer data collection; all five – participating hospitals demonstrate that they used an electronic Health Information System (Avicenna) to document the medical file for the patients and also to be used for data collection, in addition to data available in cancer registry department at the Health Information Unit at MoH. When we asked about the frequency of preparing such reports and statistics and transmission to a superior level, they answered that they have to do this when it is required of them, mainly annually, especially when there is a need to estimate their needs for oncology drugs in the annual MoH tenders.

When we asked about scheduling morbidity and mortality meeting assessments, they answered that such seminars are organized by the MoH, especially when the treatment protocols for oncology patients are modified or amended according to the results we obtain regarding survival rate, morbidity, and mortality rates.

The electronic health system was evaluated from good to bad, with some criticism regarding the frequent malfunctions, which hinder the process of registering patients and giving them their treatments.

4.4.7 Analysis of Section Seven: Chemotherapy stock management

In the last section, which talks about chemotherapy stock management, all five hospitals have a dedicated pharmacy for cancer therapy, which is separated from the main pharmacy in the hospital, and it is located mainly near the oncology department.

All of the medications are dispensed to oncology patients free of charge, as government health insurance covers all their treatment and diagnostic costs 100%. However, in case the treatment or diagnostic tests required for the patient are not available, an electronic referral request is submitted by the government hospital to transfer the patient to one of the private hospitals to receive the missing service.

Regarding the number of persons in charge of chemotherapy stock management, Coordination takes place between the director of pharmacy in each hospital and the pharmacist in charge of the oncology department to follow up on the provision of shortages of medicines, through communication with the MoH warehouses, which are located in Nablus. In general, drug orders are prepared for a period of two months related to each hospital's estimated needs for each drug item.

Moreover, Data were collected from the five hospitals to describe the rational use and prescription of cancer drugs. As a result, Appendix G shows in detail the Distribution of the number of patients and all consumed chemotherapy medications among the Governmental hospitals in 2023.

Implementing these steps in the Improve phase will help enhance the quality of oncology departments and services, leading to better patient outcomes and improved operational efficiency.

As a result, and after an analysis of the given data from Service Purchase Unit, a comparison was made between the years 2022 and 2023 concerning bills and financial claims for oncology referrals based on the data obtained from the SPU, which indicates that there was a decrease of approximately 51 million shekels in the oncology bills value compared to the previous year, 2022. With a notable decrease of approximately 35% in referral Cancer drug costs. This means that applying the above-mentioned Six Sigma methodologies was able to reduce the value of referrals' costs outside the MoH centers. Tables 8 and 9 show the difference in total oncology referral costs and bills, as well as the difference in referral cancer drugs costs, between 2022 and 2023, respectively.

4.5 Discussion

This study investigates optimizing the quality of oncological departments among five governmental hospitals in Palestine. Compared to the results that were obtained by (Nwachukwu CR, et al., .2018) about evaluating the barriers to delivering high-quality care in a resource-limited setting at two hospitals in Nigeria, the results of the two studies were classified into the 4S domains, which include Staff, Stuff, Space , and System. As shown below in more detail.

Staff: In this study, a Lack of human resources was identified as a key deficiency in the five participating hospitals, which leads them to work overburdened and may prohibit them from delivering high-quality care services to the increasing number of cancer patients. For example, in Al Watani Hospital, only 4 medical oncologists, with the assistance of another

six residents, serve all the cancer patients, who are estimated at 860 patients per month. This lack of staff is not limited to the lack of oncologists only, but also the deficiency in clinical pharmacists, pathologists, surgeons, etc. This leads to a delay in the treatment for many patients or even limits the time spent with their care.

On the other hand, lack of specialty training and continuing educational meetings is considered another major key deficiency, which may lead to a lot of medical errors related to drug-related problems, e.g., surgical complications due to the scarcity of specialization programs in oncology surgery and the few number of specialists in that field.

On the other hand. Nwachukwu, C. R. (2018) found that the key deficiencies identified in cancer care include a shortage of healthcare staff and a lack of continuing medical education. Providers reported being overburdened due to a high patient load, with some treating over 50 cancer patients daily without adequate support staff. This limited their ability to provide quality care. Additionally, gaps in specialty training and access to medical resources led to reliance on outdated surgical techniques, increasing the use of more invasive procedures.

Stuff: In this study, Limitations were investigated in the five participating hospitals, including a lack of diagnostic machines such as MRI, PET scan, CT scan, and mammography machines, or even if this equipment exists, it needs regular maintenance due to its frequent damage. Machines remained nonfunctional for days to months because of unreliable maintenance or unavailability of equipment or parts, or repair services, so patients either did not get the best diagnosis, or they did not receive their treatment. As a final solution, the MoH has to refer the patients to other private hospitals, which may lead to postponement and

obstruction of their treatment plan, and increase the burden of costs on the MoH. According to hospitals' administrators' interviews, other limitations emphasized included Lack of patient access to the MoH essential drug list with a limited number of targeted / biological drugs, lack of access to cancer screening/preventive programs, lack of diagnostic lab tests, and lack of standardized evidence-based protocol for cancer management and treatment; all are considered as constraints for providing good quality of cancer

On the other hand, the unavailability of infusion chairs, infusion pumps, and porta-catheter equipment, also, the lack of a radiotherapy and nuclear medicine unit with the need to refer the patient to another private hospital (e.g. AVH); constitutes an obstacle to the patient receiving full and continuous treatment in one hospital and with one specialist.

.Nwachukwu, C. R. (2018). Both hospitals faced significant limitations, including a lack of diagnostic radiology machines, an absence of standardized treatment protocols, and restricted access to essential medicines due to high costs. Radiation therapy was severely strained, with a single overworked machine treating 80–140 patients daily. At LUTH, the linear accelerator was nonfunctional, while ABUTH's cobalt-60 machine was intermittently operational. Maintenance delays left machines unusable for extended periods, forcing patients to seek treatment elsewhere if financially feasible. Additionally, cancer screening and prevention programs were limited, with cervical cancer screening at LUTH available only to HIV-positive patients.

System: Several concerns were highlighted, including:

a lack of cancer awareness campaigns at the national level, insufficient electricity(power) supply, and limited computerized information systems and technology (IT) support. by which the physicians, several times, may need to document manual medical reports. Also a lack of a clear methodology and working mechanism for registering cancer cases with limitations of access to the national cancer registry; the five institutions rely on hospital-based cancer registries, by which the hospitals may fail to capture all the cancer cases and they are easily lost to follow-up.

Undefined admission and discharge criteria, with a lack of polices regarding organizing the overall procedures that are included in oncology care; such as; registration steps and requirements, and drug stock management (Supply chain management).

Patient safety remains a top priority. Just Culture: A just culture fosters a safety-first mindset, encouraging the reporting of safety risks without fear of punishment. This culture holds everyone accountable, from the staff to the board of trustees, through a transparent evaluation process that distinguishes between system flaws, human errors, and risky behaviors. It also includes support for second victims—healthcare providers traumatized by adverse events or errors. Support programs and education on the second-victim effect are crucial.

Error Reporting and Review System; A critical aspect of the medication safety system is having a mechanism to report and review errors, aiming to enhance patient safety and prevent harm. This system should encourage the reporting of both errors and close calls.

On the other hand, Nwachukwu, C. R., . (2018) , highlighted several concerns and identified major challenges in cancer care, including the absence of a national cancer registry, limited awareness campaigns, infrastructure issues like inconsistent electricity and IT support, and reliance on manual medical records. Hospital-based registries fail to capture complete follow-up data, leading to patient loss. Funding is inadequate, and cancer is not a national health priority. The National Health Insurance Scheme (NHIS) covers only a small portion of the population with limited oncology services. Addressing these issues requires improved data management, increased funding, and policy reforms.

Space: one of the key barriers to the assessment is the limited space in the oncological departments, and the lack of oncological beds, so the oncologists have to treat the cancer patients in other departments, including medical, surgical, etc. Furthermore, The National (Al-Watani), Jenin Governmental hospitals, PMC, and Thabet-Thabet Hospital, reported no dedicated oncology department, so they provide their services through a day-care unit only, and in case they have to manage the cancer patients medically with protocols needed admissions (e.g. FOLFOX, FOLFIRI, EPOCH, DHAP, ICE, BEACOPP, etc); the oncologists have to treat the patients in other sections in the hospital or they to upload a referral form the Service Purchase Unit at MoH to refer the patients to other private hospitals where the place is found; by which consumes additional costs and time. Generally, the oncology unit size and the number of beds are considered very challenging components that require a thorough discussion with real solutions to keep up with the vision of MoH towards the improvement of cancer care in Palestine.

On the other hand, Cabinet space to safely store chemotherapy drugs and personal protective equipment, often needed for mixing chemotherapy drugs, was limited.

However, Nwachukwu, C. R. (2018) investigates that the effective design of patient waiting areas and navigation aids is crucial for enhancing the hospital experience. A spacious and well-organized waiting room can improve perceptions of care quality and comfort, leading to higher patient satisfaction. Conversely, overcrowded or poorly designed spaces can increase stress and frustration. Incorporating elements like self-help resource centers, children's play areas, and comfortable seating arrangements can further enhance the waiting experience.

Hospital wayfinding—the process of navigating through a hospital—can be challenging due to complex layouts and inconsistent signage. Difficulties in navigation can lead to confusion, stress, and delays in receiving care. To address these challenges, hospitals should implement clear and consistent signage, color-coded pathways, and visual landmarks to assist patients and visitors. Digital tools, such as interactive maps and wayfinding apps, can also provide real-time navigation assistance.

In the context of the West Bank, patients have reported challenges related to hospital infrastructure. For instance, the absence of dedicated oncology units and overcrowding in existing wards have been significant concerns. Patients have described situations where they had to wait for available beds, sometimes leading to postponed admissions. Additionally, the lack of cleanliness, insufficient facilities for accompanying family members, and inadequate privacy have been highlighted as areas needing improvement.

Addressing these issues requires a multifaceted approach, including redesigning waiting areas to enhance comfort, implementing effective wayfinding systems to reduce navigation challenges, and improving hospital infrastructure to meet patient needs. Such efforts can lead to a more positive hospital experience, reduced stress, and improved overall patient satisfaction.

5 Chapter Five: Conclusions, Recommendations, and Future Research Directions

5.1 Conclusions and Recommendations

In conclusion, there are several main obstacles that face the oncology/hematology treatment at governmental hospitals, several improvement action plans should be taken to improve such services. To accomplish this vision, the MoH seeks to adopt a strategic plan to develop and localize oncology services in Palestine in cooperation with many non-profit institutions, which aims to improve the quality of services provided to these patients. One of the most important strategic plans that received great attention in 2023 to develop oncology services is the formation of Palestinian National Cancer Control Plan (PNCCP), which aspires to achieve a vision of " Making state of Palestine among countries with low cancer burden (cancer incidence, and mortality reduced, survival and quality of life improved ", Also to achieve a mission of " Providing a coordinated, comprehensive accessible, and responsive national cancer control program that leads to a reduction in incidence and mortality through effective partnerships and collaborations for prevention, early detection, diagnosis, treatment, palliation, and financing of cancer control activities to improve the wellbeing of Palestinian ".

These action plans are classified into five main domains:

5.2 First Domain: Primary Prevention and Risk Factors Mitigations:

- Specific Objective: To reduce by 10% the incidence of preventable cancers in a 10-year period through reducing the prevalence of main cancer-related factors such as tobacco smoking and obesity.

- Action 1a: Supporting the National NCD Control and Prevention Program (NCDCP) in reducing the prevalence of tobacco consumption through organizing Workshop organized and implemented before the "Palestine Against Lung Cancer Day (PALCO), increase taxes and prices on tobacco products, and implementation of effective mass media campaigns and large graphic health warnings on all tobacco packages; that educate the public about the harms of smoking and encourage behavior change.

  -Action 1b: Reducing the prevalence of other cancer-related risk factors (Obesity) through the collaboration between the National NCD and prevention program and other stakeholders within the MoH

5.3 Second Domain: Early Detection (Screening & Early Diagnosis)

- Specific objective 2: To reduce the proportion of patients that are diagnosed in advanced stages of breast and colorectal cancer (e.g. 15% reduction in 10 years)
    - Action 2a: Upgrade diagnostic centers into Early Detection Clinics (EDCs) for breast and colorectal cancer in the West Bank, improve referral systems, and engage in the WHO Global Breast Cancer Initiative. By mapping the existing diagnostic centers available in hospitals providing cancer care and Mammography facilities, and preparing a list of the required infrastructure, equipment and medical devices, human resources needed.. Also, QC / QA measures should be integrated into all medical imaging including MG.
    - Action 2b**:** Launch public awareness campaigns on early cancer signs and symptoms, focusing on common and curable cancers (breast, colorectal, prostate).

- Action 2c**:** Train primary healthcare providers on early cancer detection, referrals, treatment management, and patient follow-up through e-learning and partnerships with health education institutions.

5.4 Third Domain: Cancer Management (Diagnosis & Treatment)

- Specific objectives 3: Increase access to cancer care ensuring at least 80% of cancer patients have access to essential diagnostics, oncology medicines, and technologies; reducing the number of referrals of cancer patients per year (in 30%) and their cost (in 25%)
    - Action 3a: Enhancing the Referral System & Diagnostic Pathways
    - Assess barriers to timely cancer diagnosis through consultations with experts (CDTG, MoH, PHC professionals, and data specialists).
    - Conduct a mapping of diagnostic facilities, evaluating equipment, workforce, and waiting times.
    - Develop standardized referral pathways to ensure diagnostic confirmation within a set timeframe (e.g., ≤4 weeks).
    - Address facility, equipment, and HR gaps based on the mapping results.
    - Formulate a long-term cancer diagnostics development plan (5–10 years) focusing on pathology and medical imaging.
    - Establish a quality assurance program for diagnostic equipment.
    - Action 3b: Expanding Access to Radiotherapy
    - Conduct a detailed assessment of current and projected radiotherapy capacity (public & private).

- Develop the Palestine Radiotherapy Development Plan (RTDP) to expand services and ensure quality assurance.
- Establish a certification/accreditation system for radiotherapy services.
- Action 3c: Strengthening Cancer Surgery Capabilities
- Review and assess existing and required surgical training programs.
- Develop a Cancer Surgery Development Plan, evaluating surgical capacity in both public and private sectors.
- Address gaps in facilities, equipment, and human resources to improve cancer surgical services.

5.5 The Fourth Domain: Palliative Care:

Specific Objective 4: To scale- up the capacity to deliver hospital-based palliative care and home-based palliative care for cancer patients ensuring access to 80% of them.

- Action 4a: Integrating palliative care and symptom relief into primary health care.
- Action 4b: Ensuring access to specialized palliative care to patients needing them

5.6 The Fifth Domain: Governance and Surveillance

Specific objective 5: Strengthen the cancer control surveillance system to monitor trends of cancer incidence, early detection rates, treatment outcomes (mainly survival), and mortality of cancer to inform policymakers and all cancer control stakeholders, including the Palestinian general population

- Action 5a: Improve Cancer Information System – Ensure quality, availability, and accessibility of data on cancer incidence, mortality, diagnosis stage, and survival.

- Action 5b : Establish Hospital-Based Cancer Registries (HBCRs**)** – Implement HBCRs in major cancer centers to enhance data quality, enable benchmarking, and monitor national cancer programs.
- Action 5C: Develop a Unified Mammography e-Registry – Strengthen collaboration among service providers for an integrated national system to improve breast cancer screening data.
- Action 5d: Create a Cancer Coordination Unit (CCU) – Oversee stakeholder coordination, implement the cancer control strategy, monitor KPIs, and liaise with MoH focal points.

5.7 Future Researches

This study recommends researchers investigate the potential of applying Six Sigma at other aspects related to the oncology/Hematology Departments; as well as to apply this study from the perspectives of patients. In addition, it is recommended to measure the waiting time for the administration of cancer therapy in the relationship between Six Sigma management tools and patient satisfaction. Additionally, research on the use of digital applications and how they contribute to reducing waiting time waste as well as implementing Six Sigma, within the extensive usage of modern information and communications technology (ICT), is advised.

5.8 Limitations of the Study

– The study has been conducted based on a random sampling technique, which covers a percentage of the whole representative sample.

- The study is limited to Public Cancer departments (Governmental), in which there might be different results when applying the study at private hospitals.
- Resource constraints: lack of funding, which is necessary for providing the essential chemotherapy(drugs), computers, and other equipment.
- Poor communication: between the pharmacy department and other departments(less cooperation)
- Lack of infrastructure: lack of inpatient oncology departments at many governmental hospitals
- Lack of qualified health care providers staff: e.g, oncologists, clinical pharmacists, oncological nurses, etc.
- Lack of previous studies in such field in Palestine to compare the results with
- The study is limited to the administrators and oncologists of the hospital, in which the results reflect the employees' point of view

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Appendices

- Appendix A

Oncology / Hematology Drugs that are included among the Essential Drug List of MoH , Pharmaceutical Information Department , General Directorate of Pharmacy , 2022.

#	Code	ACTIVE INGREDIENT	UNIT
1	ONC01	5- FLUROURACIL(50 MG/ML 20 ML) 1 G Vial	INJECTION
2	ONC02	ABIRATERONE ACETATE 250 MG TAB	TAB
3	ONC03	ACTINOMYCINE 0.5 MG VIAL	INJECTION
4	ONC04	ADRIAMYCINE 50 MG(DOXORUBICIN) VIAL	INJECTION
5	ONC05	AZACITIDINE 100 MG VIAL	INJECTION
6	ONC06	B.C.G freeze dried 5X10*8 cfu	INJECTION
7	ONC07	BENDAMUSTINE 2.5 MG/ML(100 MG)	INJECTION
8	ONC08	BENDAMUSTINE 2.5 MG/ML(25 MG)	INJECTION
9	ONC09	bevacizumab 100 mg (25mg/ml) 4ml vial	INJECTION
10	ONC10	BEVACIZUMAB 400MG(25 MG/ML 16 ML) VIAL	INJECTION
11	ONC11	bicalutamide 50 mg tab	TAB
12	ONC12	BLEOMYCINE 15000 I.U VIAL	INJECTION
13	ONC13	BORTIZOMIB 3.5MG VIAL	INJECTION
14	ONC14	BRENTUXIMAB VEDOTIN 50 MG POWDER FOR SOLUTION FOR INFUSION	INJECTION
15	ONC15	CALCIUM FOLINATE 50 mg vial	INJECTION
16	ONC16	Calcium Folinate 15 mg tab	TAB
17	ONC17	capecitabine 500mg tab	TAB
18	ONC18	CARBOPLATIN 10MG/ML 45ML	INJECTION
19	ONC19	cetuximab 5 mg/ml 100ml vial	INJECTION
20	ONC20	CETUXIMAB 5 MG/ML 20ML	INJECTION
21	ONC21	CHLORAMBUCIL 2MG TAB	TAB
22	ONC22	CISPLATIN 50 MG(1MG /ML 50 ML)VIAL	INJECTION
23	ONC23	CLADRIBINE 10MG (1MG/ML) VIAL	INJECTION
24	ONC24	CYCLOPHOSPHAMIDE 500 MG VIAL	INJECTION

25	ONC25	CYCLOPHOSPHAMIDE 50MG TAB	TAB	
26	ONC26	CYTARABINE 100 MG VIAL	INJECTION	
27	ONC27	DAUNORUBICIN 20MG VIAL	INJECTION	
28	ONC28	DEFERASIROX 250MG TAB	TAB	
29	ONC29	DENOSUMAB 120MG/1.7 ML VIAL	INJECTION	
30	ONC30	docetaxel 20mg(10 mg/ml 2 ml)vial	INJECTION	
31	ONC31	docetaxel 80mg vial	INJECTION	
32	ONC32	ELTROMBOPAG 25 MG TAB	TAB	
33	ONC33	ELTROMBOPAG 50 MG TAB	TAB	
34	ONC34	erlotinib 150mg tab	TAB	
35	ONC35	ETOPOSIDE VP(20MG/ML 5 ML) 100 MG VIAL	INJECTION	
36	ONC36	EVEROLIMUS 10 MG TAB	TAB	
37	ONC37	EVEROLIMUS 5 MG TAB	TAB	
38	ONC38	EXEMESTANE 25 MG TAB	TAB	
39	ONC39	FILGRASTIM 300 MCG/ ML VIAL	INJECTION	
40	ONC40	FLUDARABINE 50MG VIAL	INJECTION	
41	ONC41	FULVESTRANT 250 MG/5 ML PFS	INJECTION	
42	ONC42	GEMCITABINE 1GM VIAL	INJECTION	
43	ONC43	GOSERELIN 10.8 MG PREFILLED SYRINGE OR ALIKE	INJECTION	
44	ONC44	GOSERELIN 3.6MG PREFILLED SYRINGE OR ALIKE	INJECTION	
45	ONC45	HYDROXYUREA.500MG CAP	TAB	
46	ONC46	IBRUTINIB 140 MG CAP	TAB	
47	ONC47	imatinib 100mg cap	TAB	
48	ONC48	imatinib 400mg tab	TAB	
49	ONC49	IMMUNOGLOBULIN 5GM 100ML VIAL	INJECTION	
50	ONC50	IRINOTECAN HCL 100MG/5ML VIAL	INJECTION	
51	ONC51	irinotecan 300mg(20 mg/ml)15 ml vial	INJECTION	

52	ONC52	ISOFOSFAMIDE 2 G VIAL	INJECTION	
53	ONC53	LAPATINIB 250 MG TAB	TAB	
54	ONC54	LENALIDOMIDE 10 MG CAP	TAB	
55	ONC55	LENALIDOMIDE 15 MG CAP	TAB	
56	ONC56	LETROZOL 2.5MG TABLET	TAB	
57	ONC57	MEGESTROL ACETATE 40MG TAB	TAB	
58	ONC58	MERCAPTOPURINE 50mgTAB	TAB	
59	ONC59	MESNA 400 MG VIAL	INJECTION	
60	ONC60	METHOTREXATE SOD 2.5MG TAB	TAB	
61	ONC61	METHOTREXATE SOD. 50 MG VIAL	INJECTION	
62	ONC62	METHOTREXATE SOD. 500MG VIAL	INJECTION	
63	ONC63	MITOMYCINE 10 MG VIAL	INJECTION	
64	ONC64	MITOMYCINE 40 MG VIAL	INJECTION	
65	ONC65	NILOTINIB 200MG CAP	TAB	
66	ONC66	NIVOLUMAB 10 MG/ML 10 ML INJ.	INJECTION	
67	ONC67	NIVOLUMAB 10 MG/ML 4 ML INJ.	INJECTION	
68	ONC68	OCTREOTIDE 20MG AMP	INJECTION	
69	ONC69	oxaliplatin 100mg vial	INJECTION	
70	ONC70	paclitaxel 100mg vial	INJECTION	
71	ONC71	paclitaxel 300mg (6 mg/ml 50 ml) vial	INJECTION	
72	ONC72	PAZOPANIB HCl 400 MG TAB	TAB	
73	ONC73	PEG ASPARGINASE 3750 IU/5 ML INJ	INJECTION	
74	ONC74	PEMBROLIZUMAB 25 MG/ ML 4 ML INJECTION	INJECTION	
75	ONC75	pemetrexed 100mg/10 ml vial	INJECTION	
76	ONC76	pemetrexed 500 mg /50 ml vial	INJECTION	
77	ONC77	PERTUZUMAB 420 MG /14 ML INJ	INJECTION	
78	ONC78	RASBURICASE 1.5 MG VIAL	INJECTION	

79	ONC79	RIBOCICLIB 200 MG TAB	TAB	
80	ONC80	RITUXIMAB 100MG(10MG/ML 10 ML) VIAL	INJECTION	
81	ONC81	RITUXIMAB 500MG(10 MG/ML 50 ML)VIAL	INJECTION	
82	ONC82	ROXULITINIB 5 MG TAB	TAB	
83	ONC83	ROXULITINIB 15 MG TAB	TAB	
84	ONC84	ROXULITINIB 20 MG TAB	TAB	
85	ONC85	sunitinib 50mg cap	TAB	
86	ONC86	tamoxifen 20mg tab	TAB	
87	ONC87	THALIDOMIDE 50MG TAB	TAB	
88	ONC88	THIOGUANINE 40MG TAB	TAB	
89	ONC89	TRASTUZUMAB 440MG VIAL	INJECTION	
90	ONC90	TRASTUZUMAB 600MG VIAL	INJECTION	
91	ONC91	TRASTUZUMAB 420MG VIAL	INJECTION	
92	ONC92	TRIPTORELIN 3.75MG AMP	INJECTION	
93	ONC93	VINBLASTINE SULPHATE 10MG VIAL	INJECTION	
94	ONC94	VINCRISTINE SULPHATE 1 MG(1MG/ML 1ML) VIAL	INJECTION	
95	ONC95	vinorelbine 50 mg 5ml amp.	INJECTION	
97	ONC97	eribulin 0.88 MG/ML VIAL	INJECTION	

- Appendix B

Questionnaire in English:

Questionnaire

Ladies/gentlemen

The researcher is conducting a study entitled:

Evaluation of the Possibility of Optimizing Oncological Services Quality in Palestinian Governmental Hospitals: A Six Sigma Approach from the Perspective of Hospital Administration.

This study aims to examine the extent to which Governmental Hospitals including Cancer Services can apply Six Sigma management tools in order to develop their services and meet the needs of its beneficiaries.

This study comes as a completion of the requirements for obtaining a master's degree in the (Quality Management in Healthcare) program from the Arab American University.

In order to achieve this goal, I request your assistance in providing honest, accurate, and objective answers to the questions contained in this questionnaire, which depend on your experience, noting that filling out the questionnaire takes approximately 10-15 minutes.

With an emphasis that all data will be treated in strict confidentiality and will only be used for scientific research purposes. If you have any questions, you can e-mail me at:

Student: Dua’a H. Al*Hamed

Section 1: Health facility information and Infrastructure

1.1	**Address**	
	Name of health facility	
	Department/service:	
	Catchment area/ population served :	
	City:	
	Tél 1:	
	E-mail:	
1.2	**Type**	
	Public	
	Private	
1.3	**Health facility category**	
	First category (Central , Regional Hospital)	
	Second category (Hospital that only serve the patients of a specific city)	
1.4	**Cancer care and treatment service capacity**	
	Pediatric chemotherapy	
	Adult chemotherapy	
	Pediatric palliative care	
	Adult palliative care	
	Surgery for pediatric cancers	
	Surgery for adult cancers	
	Radiotherapy	
1.5	**Total number of beds in the hospital**	
	Number	
1.6	**Number of beds reserved for cancer cases (Adults)**	
	Number	
1.7	**Number of beds reserved for cancer cases (Pediatric)**	

	Number	
1.8	**Percentage of beds occupied by cancer patients?**	
	Percentage	
1.9	**Do you often reach full bed capacity?**	
	Yes	
	No	
1.10	**If yes, where do you hospitalize when in full capacity?**	
	Different unit in hospital – specify	
	Another health facility – specify	
1.11	**Total adults attending outpatient clinic for chemotherapy (per month)(day care unit)**	
1.12	**Total children attending outpatient clinic for chemotherapy (per month)**	
1.13	**Performance of lumbar punctures for intrathecal chemotherapy (Average per month)**	
1.14	**Ambulatory bed for oncology (adults)/bed**	
1.15	**Ambulatory bed for oncology pediatric)/bed**	
1.16	**Number of Isolation rooms (single person, infection)**	
1.17	**Total clinic visits for outpatient care (per month) کمرضی اورام او مضاعفاتها**	
1.18	**Number of patients per day in the clinic**	
1.19	**Average wait time for receiving treatment at the hospital (time from registration to taking drugs)**	
1.20	**Number of infusion chairs**	
1.21	**PORTA CATH INSERTION procedure availability**	
1.22	**PUMP INFUSION service availability**	
Pathology (Number of procedures in 2022)	Blood Films	
	Bone marrow morphology	
	Flow cytometry	
	CSF Cytospin	

	Cytology	
	Tumor diagnosis by histopathology	
	Immunohistochemistry	
	Cytogenetics (conventional)	
	Cytogenetics (Molecular)	
Diagnostic procedure (Number of procedures in 2022)	Interventional radiology procedures	
	Fine needle aspiration (FNA)	
	Core needle biopsy	
	Image-guided biopsy	
	Surgical biopsy	
	Punch biopsy	
Diagnostic imaging (Number of procedures in 2022)	Fluoroscopy unit	
	Ultrasonography	
	Mammography machines	
	CT	
	MRI	
	PET Scan	
	Gamma cameras (SPECT) and SPECT/CT	
	Interventional Radiology (I.R) Suite	
	C-arms	

Section 2: Human resource

2.1	**Number of healthcare workers involved in cancer care & treatment (management)**	
Medical oncology	Medical oncologist	
	Pediatric oncologist	

	Radiotherapist	
	Pharmacist (Oncology)	
	Nurse (Oncology)	
Surgical oncology	Gynecologist/surgeon	
	GI Surgeon (Oncology)	
	Breast Surgeon (Oncology)	
	Thoracic Surgeon (Oncology)	
	Neurosurgeon (Oncology)	
Pathology	Pathologist	
	Biomedical laboratory scientist	
	Psychosocial agent	
	Other – specify	

Section 3: Chemotherapy

Section 3A: Pediatric chemotherapy				**Section 3B: Adult chemotherapy**		
3a1	**Number of pediatric cancer cases diagnosed in 2022?**			3b1	**Number of adult cancer cases diagnosed in 2022?**	
	Burkitts				Head & Neck	
	Wilms				Breast	
	Retinoblastoma				Prostate	
	Rhabdomyosarcoma				Colorectal	
	Lymphoid leukaemia (<18yo)				Liver	
	Hodgkin lymphoma (<18yo)				Ovarian	
	CNS low grade tumours (<18yo)				Stomach	
					Pancreas	
	Neuroblastoma				Uterus /cervical	
	Ewing’s sarcoma/ Osteosarcoma				Lung	
					Lymphoid Leukemia	

Section 3A: Pediatric chemotherapy				**Section 3B: Adult chemotherapy**		
					Bladder	
					Thyroid	
					Skin / Melanoma	
3a5	**Treatment protocols per pediatric cancer type (require hospitalization so the patient was referred to other private hospitals) please specify the PROTOCL)**			3b5	**Treatment protocols per adult cancer type require hospitalization so referred to other private hospitals) please specify the PROTOCL)**	
	Burkitt's lymphoma				Prostate	
	Wilms tumor (nephroblastoma)				Breast	
	Retinoblastoma				Cervical	
	Rhabdosarcoma				Colorectal	
	ALL				Liver	
	AML				Ovarian	
	Hodgkin's lymphoma				Stomach	
	NHL				Pancreas	
	Neuroblastoma				Uterus	
	Ewing's sarcoma				Lung	
	Osteosarcoma				NHL	
					Bladder	

Section 3A: Pediatric chemotherapy				Section 3B: Adult chemotherapy		
					Skin	
3a6	Availabilty of pre-treatment work ups for pediatric cancers?			3b6	Availability of pre-treatment work ups for adult cancers?	
	CBC				CBC	
	SGPT				SGPT	
	SGOT				SGOT	
	CREAT				CREAT	
	Glycaemia				Glycaemia	
	Electrolytes				Electrolytes	
	X-ray				X-ray	
	Ultrasound				Ultrasound	
	Others – specify				Others – specify	
3a9	Do you organize multidisciplinary meetings for treatment initiation and follow-up?			3b9	Do you organize multidisciplinary meetings for treatment initiation and follow-up?	
	Yes				Yes	
	No				No	
3a10	If yes, how often?			3b10	If yes, how often?	
	Weekly				Weekly	
	Monthly				Monthly	
	Other – specify				Other – specify	
3a11	Who are the principal participants of these meetings?			3b11	Who are the principal participants of these meetings?	

Section 4: Radiotherapy and nuclear medicine

Section quarter A: Radiotherapy services	
4a1	Do you carry out radiotherapy for cancer treatment ?

	Yes
	No
4a2	If no, where do you refer clients for radiotherapy?
	1.
	2.
	3.
4a3	Why is radiotherapy not offered?
	No staff
	No space
	Faulty equipment
	Absence of equipment
	Other
4a4	If yes, what is the cost of one session?
	Normal session cost
	Intensive session cost
4a5	How many sessions do you typically run in one week?
4a9	How many staff have been trained on radiotherapy?
	Radiotherapist
	GP medical doctor
	Radiophysicist
	Technical support staff
	Others
4a20	What is the number of clients who were eligible for radiotherapy in 2022?
4a21	What is the number of patients that effectively received radiotherapy treatment in 2022?
4a26	Is there a Nuclear medicine unit?
	Yes
	No

4a27	Do you have a nuclear medicine specialist?
	Yes
	No
4a28	If no, are there plans for a nuclear medicine unit?
	Yes
	No
4a29	If yes, what is the estimated time for the unit to be operational?
	<2 years
	2–5 years
	>5 years

Section 4B: Surgery for cancers

4b1	Do you carry out surgery for cancer treatment?
	Yes
	No
4b2	If yes , what are the most common types of surgeries that have been executed ?
4b3	If no, where do you refer clients for surgery for cancer treatment?
	1.
	2.
	3.
4b4	Why is surgery not offered?
	No staff
	No space
	Faulty materials
	Absence of equipment
	Other

4b5	Average cost of surgical intervention when referred to other private hospitals outside the MOH?
	Normal surgery
	Complex surgery
4b5	How many surgeries do you typically carry-out in a week?
	Total
4b8	How many staff work at the surgical department for the management of cancers?
	Surgeon – please specify type and number
	Gynaecologists – please specify type and number
	Surgical nurses
	Nursing assistants
	Others – please specify
4b10	Can you evaluate the success of your surgeries in the management of cancers?
	Complications following surgery
	Death rates after surgery
	Others – please specify
4b11	Can you suggest any elements to improve upon the surgical management of cancers in your institution?

Section 5: Patient follow-up and palliative care

5.1	Preparation and administration of chemotherapy	
5.1.1	Number of personnel involved in chemotherapy session preparation	
	Pharmacist	
	Nurse / Nurse assistant	
	Other – please specify	
5.1.2	Number of personnel trained on the preparation of a chemotherapy session	
	Pharmacist	
	Nurse	

	Other – please specify	
5.1.4	Personal protective material available for session preparation	
	Gloves	
	Gowns	
	Goggles	
	Face masks	
	Laminar flow cabinet	
	Others – please specify	
5.1.5	Space of preparation of chemotherapy	
	Bed side	
	Special room	
	Common room	
	Laminar flow cabinet	
5.2	**Patient education**	
5.2.1	Who does the disclosure of cancer status to the caregivers – informs the parent of the child/accompanying the adult patient about his or her cancer status (e.g., diagnosis, treatment, side effects and their management)?	
	Oncologist	
	Residents/ GP medical doctor	
	Nurse	
	Psychosocial worker	
	Other – specify	
5.2.2	Who does disclosure of cancer status to the child/adult patient – informs the child/adult of his/her disease (e.g., diagnosis, treatment, side effects and their management)?	
	Parents	
	Oncologist	
	Other specialist – specify	
	Residents / GP medical doctor	
	Nurse	

	Psychosocial worker	
	Other – specify	
5.2.4	Have these ‘educators’ been trained on disclosure of cancer status? Yes/No	
5.2.5	If so, how many educators have received training?	
	Oncologist	
	Residents / GP medical doctor	
	Nurse	
	Psychosocial worker	
	Other – specify	
5.2.6	Is there any material used to educate parents/caregivers about cancer and its care?	
	Yes	
	No	
5.2.7	If so, indicate how they are being used (e.g., documents, counselling sessions, text messages and video messages) and when they are published	
	Type of material	**Method of use**
1		
2		
3		
5.2.8	Is there any material used to educate people with cancer?	
	Yes	
	No	
5.2.9	If yes, indicate how they are being used (e.g., documents, counselling sessions, text messages and video messages) and when they were released	
	Type of material	**Method of use**
1		
2		
3		
5.2.10	Do you organize cancer education forum , with parents/families of people with cancer	

	Yes	
	No	
5.2.11	If yes, how often do you organize them?	
	Every month	
	Every quarter	
	Every semester	
	Every year	
	Others – specify	
5.2.12	On average, how many parents attend such a forum?	
	Average number	
5.2.13	Do you organize cancer education fora, with people living with cancer	
	Yes	
	No	
5.2.14	If yes, how often do you organise them?	
	Every month	
	Every quarter	
	Every semester	
	Every year	
	Other – specify	
5.2.15	Are there other forums to share information about childhood/adult cancers with community members	
	Yes	
	No	
5.2.16	If yes, indicate which ones?	
	Schools	
	Religious institutions	
	Media	
	Associations	

	Others – specify	
5.2.17	On average, how many times a year do you organize these sessions to educate the community?	
	Number	
5.3	**Follow-up of patients on chemotherapy**	
5.3.3	What was the number of patients who discontinued treatment in 2022?	
	Men	
	Women	
	Children	
5.4	**Palliative care**	
5.4.1	Do you carry-out palliative care?	
	Yes	
	No	
5.4.1.1	How many people are involved in palliative care?	
	Number	
5.4.1.2	Who are the specialists involved in palliative care in your hospital?	
5.4.2	What are the palliative care services offered?	
	Male cancers	
	Female cancers	
	Pediatric cancers	
	Congestive heart failure	
	HIV/AIDS	
	Liver diseases	
	Renal disorders	
	Sickle cell	
	Dementia	
	Other – specify	

5.4.3	What are the essential medicines which you regularly use for palliative care	
	NA	
	Atropine	
	Benztropine	
	Clonazepam	
	Dexaméthasone	
	Halopéridol	
	Hyoscine	
	Métoclopramide	
	Morphine	
	Naloxone	
	Promethazine	
	Diazepam	
	Midazolam	
	Propofol	
	Others , please specify	
5.4.4	If you do not offer palliative care, where do you refer clients for palliative care?	
	1	
	2	
	3	
5.4.5	Why is palliative care not offered?	
	Lack of trained personnel	
	Lack of infrastructure	
	Absence of essential medicines	
	Other – specify	

Section 6: Data systems

6.1	What tools do you use for data collection?
	Cancer registry
	Monthly report form
	Service register
	Other – specify
6.2	How often do you prepare reports/statistics?
	Daily
	Weekly
	Monthly
	Every semester
	Annual
	When necessary
	Other – specify
6.3	How often do you transmit your reports to a superior level?
	Daily
	Weekly
	Monthly
	Every semester
	Annual
	When necessary
	Other – specify
6.4	Do you organize morbid and morality review meetings? i.e., meetings to with staff to examine the performance and other issues
	Yes
	No
6.5	If yes, kindly indicate the frequency?
	Daily
	Weekly

	Monthly
	Every semester
	Annual
	How could you evaluate the efficacy of Health information system (HIS) which is used to document the medical information of the patients ?
	Excellent Good Bad
	What are the main problems in HIS that faced you ?

Section 7: Chemotherapy stock management

7.1	Is there a pharmacy dedicated for anticancer medicines?	
	Yes	
	No	
7.2	What is the number of persons in charge of chemotherapy stock management?	
	Number	
7.3	What is the number of persons trained on the chemotherapy stock management?	
	Number	
7.4	Do all patients get drugs from the hospital?	
	Yes	
	No	
7.5	If no, kindly indicate the reasons-	
7.6	Where else do patients source for cancer medications?	
	Private pharmacy	
	From another hospital	
	Importation	
	Other – specify	

Name of medicine	Dosage (mg)	Form	Qty used in 2022	Sale price		Is it available all the months per year of 2022		The month when the stock was zero											
								2022											
Paediatric medicines								**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Asparaginase	10^3U	Vial	1																
Cytarabine	100	Vial	1																
Cyclophosphamide	1,000	Vial	1																
Doxorubicin	50	Vial	1																
Etoposide	50	Capsules	20																
Mercaptopurine	50	Tablet	25																
Methotrexate	25	Tablet	100																
Vincristine	1	Vial	1																
Daunorubicine	20 or 50	Vial	1																
Ifosfamide	2,000	Vial	1																
Actinomycine D	0.5	Vial	1																
Bléomycine	15	Vial	1																
Filgrastim	0.3 or 0.48	SPR	1																

Name of Medicine	Dosage (mg)	Form		Sale price		Qty used in 2022		The month when the stock was zero 2022											
Adult medicines								**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**

letrozole	1	Tablets																	
Bicalutamide	50	Tablets																	
Bleomycin	15	Vial																	
Capecitabine	500	Tablets																	
Carboplatin	450	Vial																	
Cisplatin	50	Vial																	
Cytarabine	100	Vial																	
Docetaxel	80	Vial																	
Doxorubicin	50	Vial																	
Epirubicin	50	Vial																	
Fluorouracil	500	Vial																	
Gemcitabine	1,000	Vial																	
Leucovorin (folic acid)	15	Tablets																	
Methotrexate	50	Vial																	
Oxaliplatin	100	Vial																	
Paclitaxel	100	Vial																	
Vinblastine	10	Vial																	
Tamoxifen	20	Tablets																	
Letrozole	2.5	Tablets																	
Cyclophosphamide	500 or 1,000	Vial																	
Irinotecan	40 or 100	Vial																	
Filgrastim	0.3 or 0.48	SPR																	

- In your opinion what are the main causes for referral the Cancer patients to the private sectors ?

- Shortage of drugs
- Unavailability of stuff
- Unavailability of diagnostic procedures (specify please …….)
- Unavailability of Space (beds)
- Long waiting list

- Others (please specify ……..)

In your Opinion , what are the suggested improving strategies to improve the quality of oncological services at your hospitals ?
……

Appendix C

Table 21: FMEA Analysis

PROCESSES & SUBPOCESSES	FAILURE MODES	PROXIMATE CAUSES	EFFECTS	SEVERITYS	PROBABILITY	LIKELIHO	RPN	ACTIONS TO REDUCE FAILURE MODES

Assess the patient	-Misdiagnosis - Wrong treatment plan -availability of diagnostic procedures Availability of therapy (drugs/radiotherapy)	-Diagnostic tests or procedures not performed -Unavailability of diagnostic tests or procedures -Misinterpretation of diagnostic results Or incorrectly analyzed -Diagnostic tests not available at timely manner	-the patient was undiagnosed or diagnosed incorrectly -Patients receive medications when not indicated -Patients did not receive correct treatment when indicated	9	4	3	108	-Introducing Early Detection Clinics -Strengthen the capacity and the scope of the existing diagnostic centers linked to hospitals -Cancer care services and the PHC provide mammography services with well-trained specialists on early signs and symptoms of cancer as well as the family risk associated with them . this process will include six stages: **1. Mapping the existing diagnostic centers** available in hospitals providing cancer care and Mammography facilities. 2. **Prepare a list of the required infrastructure**, equipment and medical devices, human resources needed 3. Develop **a plan for upgrading t**he services 4**. Implementation of the upgrading plan** for the current services.

								5. Establish **a clear pathway/ referral system** between primary, secondary, and tertiary health care levels. 6. Developed an **information system** to support the referral system 7. Engaging in **the WHO Global Breast Cancer Initiative (GBCI)** at all health system levels. -Create and implement **the accreditation system of units providing Mammography,** to ensure they are operating according to the international standards with a quality control program. - Early detection of colorectal cancer since it is considered one of the three most common cancers in Palestine and a curable disease when detected earlier. With early signs and symptoms and inviting the " high risk population " using IFOB test and when positive results

								to do colonoscopy 1. Interdisciplinary treatment guidelines for the use of some drugs which include prescribing and dispensing guideline, drug administration, and monitoring 2. Use more than one test to diagnose when possible 3. Improve the timeliness of reporting critical results
	-Lack of standardized medication administration protocols/oncology - Miscommunication between the medical team	No specific oncology Guidelines in MoH	Given wrong drugs to the wrong patients -misuse of medication - Increase the risk of Drug-related problems and side effects	8	4	5	160	Establishment of National Oncology/ Hematology Guidelines by organizing scientific meetings with the related medical field Systematic - coordination communication with the health education groups at the MoH to ensure education on public -Awareness campaigns for the population to be developed on specific dates of the year: World Cancer Day, breast cancer day,etc with specific topics.

Defining treatment plan	-Errors in the entry of the treatment plan -Failure or delay in updating treatment guidelines	-Failure of HIS -Unavailability of drugs -Increasing number of patients - a shortage in staff - Lack of evidence-based oncology Protocol -Unavailability of Cancer medications	-The patient does not take his treatment as guidelines -Patient does not take his treatment on time - Disease progression or maybe death	9	5	4	180	-Developing the final product of resource-appropriate guidelines : The foundation of cancer management (CMTG) is composed by relevant professions to coordinate: 1. Review and update the cancer management national guidelines of priority cancers 2. Review the access to essential oncology medicines in Palestine; firstly by reviewing the WHO List of essential oncology medicines by setting priority groups of oncology medicines' update 3. Guaranteed patients' access to standard oncology medicines (chemotherapy, hormonotherapy, Immunotherapy/ targeted therapy, and supportive medicines) in Palestine will impact patients' quality of life, survival, and curability and

								will reduce the number of referrals and cost. 4. Ensure the continuous availability of oncology medicines and other diagnostic oncology services in the public sector.
Cancer cases registry	-Failure to register all the cancer cases -Loss to follow up	-Lack of registry staff -Lack of communication between registry staff and medical team Lack of organized HIS for cancer registry	-Loss of follow-up patient - lack of accurate data about Cancer incidence rate and mortality	6	4	4	96	- Establish hospital-based cancer registries (HBCR) in main centers providing cancer care services. Available experience from electronic-based data sources should be used as a model to learn from and adapt to in Palestine. In addition, HBCR information will contribute to the population - based registries -Strengthen the coverage and quality of the population based cancer registries (West bank , Gaza) -Strengthen collaboration of mammography service providers (governmental and non-governmental)for an effective unified national mammography

								e-Registry implementation .
Oncology staff and training programs	-Inadequate training and education on medication administration and its side effects -Lack of regular teaching meetings	1. Inadequately arranged meeting 2. Inadequate time for training related to overload work	-Wrong administration of drugs by patients, side effects - Misdiagnosis -Drugs related problems	7	7	6	294	-Development /adoption of an evidence-based program for training healthcare providers on cancer early detection, referral system , management of treatment, side effects, and follow up of cancer patients after treatment -Coordination with the Health Training Providers (Universities, CME , Programs and other health education centers /bodies) to implement the e-learning course . -Coordination with the universities to include the training program for under-graduates studying medicine , nursing , etc.
Infrastructure & Human Resources Capacity & Communication	High workload and time pressure on staff	-Inadequate staff number -Inadequate waiting area -Inadequate Oncological wards	-Medical mistakes that affect patient health -Refer the patients to other	8	7	8	448	increase in the staff number

			private hospitals					
	Insufficient communication between healthcare providers	Communication-related problems, inadequate programmed staff meetings	- Misdiagnosis -Wrong treatment plan	9	4	5	180	Managing communication skills lectures and enhancing meeting between the team
Drug-related problems	-Incorrect treatment plan - the wrong drug is given to the selected patient	1. Clinical diagnosis not known/considered 2.Knowledge deficit about drug indication 3. Drug-specific contraindication not known 4. Standard protocol /guideline not known 5. Look alike,sound alike drugs	1.Overdose 2.Subtherapeutic dose 3. Death 4. permanent health inability 5.Side effects	10	4	5	200	-Computerized prescriber order entry -Pharmacy Monitoring service -Communicate patient information to the pharmacy -label sound alike,look alike ,high alert drugs to distinguish between them with yellow, red cards
	Drug Prescription/dispensing errors : 1.Wrong drug form or route of administration 2. wrong dose (daily dose, loading dose, maintenance dose, titration) 3. Unsafe drug consistent use with other drugs 4. Failure to adjust the dose when administering with other drugs	.Clinical situation not known or considered (weight, age , renal function, platelet account) 2. No distinction between treatment and prophylaxis 3. Lab error 4. Calculation error 5. Wrong selection from list		10	4	3	120	1. Interdisciplinary treatment guidelines for the use of some drugs which include prescribing and dispensing guideline, drug administration, and monitoring 2. Use more than one test to diagnose when possible 3. Improve the timeliness of reporting critical results

Providing treatment to the patient	Patient waiting for treatment administration	-Long waiting lists -Increased number of cancer patients -Overcrowded waiting area with limited space -Shortage of drugs -Long waiting due to defects in the transportation of drugs from the central stores at MOH	-Delay in treatment -Disease progression and maybe death	7	8	7	392	1. Streamline process 2. optimizing staff resources management and allocation 3. Enhance communication 4. KPI & predictive analytics measuring e.g. waiting time 5. appointment scheduling
Radiation Therapy	-Incorrect targeting -Equipment malfunctions, - Incorrect number of sessions .	-Lack of radiotherapy unit among governmental hospitals	-Wrong treatment plan which leads to adverse events that harm the patient	6	5	5	150	-Evaluation about the ability to establish a radiotherapy unit among MoH through an investment study Regular equipment maintenance and calibration -Use of advanced imaging for precise targeting, -Implementation of checklists, and peer review of treatment plans.
Patient Identification and Communication	--Misidentification -lack of communication between departments -Incomplete patient records.	Lack of regular training in communication skills among the medical team -maintenance defects in the electronic system for registration	The wrong patient was given the treatment plan	8	3	3	72	-Use of electronic health records (EHR) with integrated communication tools -Standardized patient identification protocols, and regular interdepartmental meetings.

Surgical Oncology:	Incorrect surgical site, surgical instrument left inside the patient, infection.	-lack of medical knowledge, awarness, experience -increased number of surgeries and overload of work -Lack of surgical equipment	-unnecessary surgery to the wrong patient -The target patient with the wrong surgery type, -Life-threatening complications -Serious infections	9	3	3	81	-Implement surgical safety checklists -Use intraoperative imaging, -Ensure thorough instrument counts -Adopt strict aseptic techniques.
Follow-Up and Monitoring	-Missed follow-up appointments -Delayed recognition of recurrence - Incomplete patient education.	-increased patients' number With an insufficient staff number	Many complications can affect the treated patient regarding the medications	5	5	5	125	Automated reminder systems for appointments, use of telemedicine for follow-up, comprehensive discharge planning, and patient education programs.

- Appendix D :

Table 22: Description of Health Facility information & Infrastructure

Characteristic	**National Hospital /Nablus**	**Beit Jala Governmental Hospitals**	**Palestinian Medical Complex**	**Thabet-Thabet Hospital**	**Jenin Governmental Hospital**
Department/service:	Oncology/ hematology	Oncology/ hematology	Oncology/ hematology	Oncology/ hematology	Oncology/ hematology
Catchment area/ population served :	North area	South area	Intermediate area	Tulkarm	Jenin
City:	Nablus /Qalqilia , Tulkarem , Jenin	Bethlehem, Hebron	Ramallah and Al Bireh, Jericho, Salfit	Tulkarm	Jenin
Health facility category	First category (Central, Regional Hospital)	First category (Central, Regional Hospital)	First category (Central, Regional Hospital)	Second category (Hospitals that only serve the patients of a specific city)	Second category (Hospitals that only serve the patients of a specific city)
Oncology services	Adult chemotherapy, Adult palliative care	Pediatric and adult chemotherapy and palliative care, and pediatric and adult surgery	Pediatric and adult chemotherapy and palliative care, and pediatric and adult surgery	Adult chemotherapy, Adult palliative care, and surgery	Adult chemotherapy, Adult palliative care, and surgery

Total No. of beds in the hospital	62	154	312	129	223
No. of beds reserved for cancer cases (Adults)	0 (There is no oncology department, the cancer patients occupy other departments)	24 (4 in ICU)	0 (741 total admissions for cancer pts with a total number of 1887 days)	0 (641 admissions for cancer pts with a total number of 1206 days)	0 (761 admissions for cancer pts with a total number of 1640 days)
No. of beds reserved for cancer cases (Pediatric)	0	14	0	0	0
Percentage of beds occupied by cancer patients?	Total overnight days for the 416 admissions during the year 2022=1567= 3.8 days average length of stay	100%	100%	100%	100%
Total adults attending outpatient clinic for chemotherapy (per month)(daycare unit)	860 (1924 for other services and treatments such as Venofer and po)	900 (762 regarding HIS)	524	372	356
Total children attending outpatient clinic for chemotherapy (per month)	0	150	0	0	0

Performance of lumbar punctures for intrathecal chemotherapy (Average per month)	0	Bm: 10-15 Lp: 17	0	0	0
Ambulatory bed for oncology (adults)/bed	28	12	12	7	18
Ambulatory bed for oncology pediatric)/bed	0	4	0	0	0
Number of Isolation rooms (single person, infection)	2	2 Children, 4 adults	0		1
Total clinic visits for outpatient care as complications (per month)	392	745	283	154	292
Number of patients per day in the clinic				0	
Average wait time for receiving treatment at the hospital (time from registration to taking drugs)	One week	One-two hour	Two weeks	0	
Number of infusion chairs	25	12	12	0	0
Pathology (Number of procedures in 2022					

Blood Films		100		0	0
Bone marrow morphology	0	200		0	0
Flow cytometry	0	150		0	0
CSF Cytospin	0	0		0	0
Cytology	0	400		0	0
Tumor diagnosis by histopathology	0	253		0	0
Immunohistochemistry	0	2329		0	0
Cytogenetics (conventional)	0	0		0	0
Cytogenetics (Molecular)	0	0		0	0
Diagnostic procedure (Number of procedures in 2022)					
Interventional radiology procedures	0	0		0	0
Fine needle aspiration (FNA)	0	190	Available with unknown number	0	0
Core needle biopsy	0	162	Available with unknown number	0	0

Image-guided biopsy	0		Available with unknown number	0	0
Surgical biopsy	0	2319 (320 positive cases)	600	0	0
Punch biopsy	0	10 (10 positive cases)	0	0	0
Diagnostic imaging (Number of procedures in 2022)					
Fluoroscopy unit	0		0	0	0
Ultrasonography	0	3540 (300 positive cases oncology)	0	100 / month	0
Mammography machines	0	500 (395 positive cases)	2 machines	0	0
CT	0	11176 (2100 positive cases oncology)	available	80 /month	0
MRI	0	0	1	0	1
PET Scan	0	0	0	0	0
Gamma cameras (SPECT) and SPECT/CT	0	0	0	0	0
Interventional Radiology (I.R) Suite	0	0	0	0	0

C-arms	0	17124(225 oncology)		0	0

- Appendix E

List of Diagnostic and genetic Lab tests that are applied in MoH , 2023

Test Type	Lab Section	Tube Type	Specimine Type
23 Mutation – FMF	GENETICS	EDTA	whole Blood
Activated Protien C Resistance by PCR	GENETICS		
Angiotensin Converting Enzyme (ACE) I/D By PCR	GENETICS	EDTA	whole Blood
ASKL1 Exon 11 and 12	GENETICS	EDTA	whole Blood
Beta Thalassemia Mutations By PCR	GENETICS	EDTA	whole Blood
BRAF Screening Test	GENETICS	Tissue Block	Tissue FFPE
BRCA1, BRCA2, PTEN and P53 genes	GENETICS	Whole Blood/Tissue Block	EDTA/Tissue FFPE
C282Y Mutation	GENETICS	EDTA	whole Blood
CALR Screening Test (Exon 9)	GENETICS	EDTA	whole Blood
CBFB–MYH11 A fusion gene transcripts (Inv16)	GENETICS	EDTA/Heparine	Whole Blood/Bone marrow
Citrullinemia Causing mutations	GENETICS	EDTA	whole Blood
Classic Galactosemia (Known mutations)	GENETICS	EDTA	whole Blood
Clopidogrel (Plavix) Therapy and CYP2C19 Genotype	GENETICS	EDTA	whole Blood
Colony Stimulating Factor 3 Receptor (CSF3R) (Exon 14 and 17)	GENETICS	EDTA	whole Blood
Cross Match Organ Transplantation	GENETICS	EDTA	Whole Blood/serum
DNA analysis of alpha thalassemia	GENETICS	EDTA	whole Blood
Epidermal Growth Factor Receptor (EGFR) Oncogene	GENETICS	Tissue Block	Tissue FFPE
Factor II mutation	GENETICS	EDTA	whole Blood
Factor V (Leiden mutation)	GENETICS	EDTA	whole Blood
Factor XIII by PCR	GENETICS	EDTA	whole Blood
Familial Mediterranean Fever (FMF) Genetic testing	GENETICS	EDTA	whole Blood
Glycine Encephalopathy, Nonketotic Hyperglycinemia (NKH) (Known Mutations)	GENETICS	EDTA	whole Blood
GPIIIa BY PCR	GENETICS	EDTA	whole Blood
Hereditary Hemochromatosis Mutation(C282Y, H63D, S65C) , PCR	GENETICS	EDTA	whole Blood
HLA (ABC)	GENETICS	EDTA	whole Blood
HLA (B 51)	GENETICS	EDTA	whole Blood
HLA (B27)	GENETICS	EDTA	whole Blood
HLA (B5)	GENETICS	EDTA	whole Blood
HLA (DQ)	GENETICS	EDTA	whole Blood
HLA DR by PCR	GENETICS	EDTA	whole Blood

Test Type	Lab Section	Tube Type	Specimine Type
Human Actionable Insight Solid Tumor Panel	GENETICS	Tissue Block	Tissue FFPE
Human Myeloid Neoplasms Panel	GENETICS	EDTA/Heparine	Whole Blood/Bone marrow
IDH1/2 Screening Test	GENETICS	Tissue Block	Brain Tissue FFPE
Jak 2 mutation	GENETICS	EDTA	whole Blood
JAKII Exon 12	GENETICS	EDTA	whole Blood
KRAS proto-oncogene	GENETICS	Tissue Block	Tissue FFPE
Lung Cancer (DNA and RNA Focused Panels)	GENETICS	Tissue Block	Tissue FFPE
Methyl Tetrahydrofolate Reductase (MTHFR)	GENETICS	EDTA	whole Blood
MPL W515L and MPL W515K	GENETICS	EDTA	whole Blood
MTHFR A1298	GENETICS	EDTA	whole Blood
MTHFR C677	GENETICS	EDTA	whole Blood
PAI-1 4G/5G By PCR	GENETICS	EDTA	whole Blood
Panel Reactive Antibody (PRA)	GENETICS	EDTA	Whole Blood/serum
PDGFRA p.D842V	GENETICS	EDTA/Tissue Block	Whole Blood/Tissue FFPE
Philadelphia chromosome, Qualitative	GENETICS	EDTA/Heparine	Whole Blood /Bone marow
Philadelphia chromosome, Quantitative	GENETICS	EDTA/Heparine	Whole Blood /Bone marow
PITX2 Methylation Ratio Test	GENETICS	Tissue Block	Tissue FFPE
PML-RARA FG transcripts	GENETICS	EDTA/Heparine	whole Blood/Bone marow
RUNX1 Exons 4-8	GENETICS	EDTA	whole Blood
Spinal Muscular Atrophies (SMAs) by PCR (Qualitative)	GENETICS	EDTA	whole Blood
Spinal Muscular Atrophies (SMAs) by PCR (Quantitative)	GENETICS	EDTA	whole Blood
Thrombophilia Panel (12 mutation) (CVD)	GENETICS	EDTA	whole Blood
Wilm's tumor (WT1) gene transcripts	GENETICS	EDTA/Heparine	whole Blood/Bone marrow
Y Chromosome Microdeletion	GENETICS	EDTA	whole Blood

- Appendix F

Palliative Care Drug Formulary

Drug	Indication	Dose	Dosage form	Therapeutic range
PARACETAMOL	For mild pain	500 mg/tab 250mg/5ml syrup 250 mg/suppository, 150 mg/ suppository 1g/100ml IV infusion	Tablet, Syrup, suppositories(supp), Intravenous (IV)	500mg-1g PO/IV q4h to q6h (max dose= 4g) (Included within the EDL of MoH)
DEXAMETHASONE	Other indications: cachexia Anti-allergy/anaphylaxis Antiemetic Nerve compression pain vasogenic edema	2mg/Tablet 4mg/1ml Amp	Tablet Amp (IV and IM)	2 mg-16 mg (Included within the EDL of MoH)
BACLOFEN	Skeletal muscle relaxant hiccups	10mg , 25 mg	tab	5-10 mg three times daily (Included within the EDL of MoH)
DIPYRON	Mild-moderate pain Other: antipyretics	1g/2ml Amp 500mg/tab 250 mg/ml syrup 500 mg/ml (drops)	Amp (IV and IM) Tab syrup Drops	Oral: 500 mg to 1 g up to 4 times daily; maximum: 4 g/day. IM, IV: 1 to 2.5 g up to 4 times daily; maximum: 5 g/day.
Naproxen	Pain (monotherapy or as adjunctive agent)	500 mg/tab	tablet	250mg-500mg q12h (max dose=1g)

	Others: Anti-inflammatory Fever			
Diclofenac sodium	Pain (monotherapy or as adjunctive agent)	75 mg/3ml amp Intramuscular(IM)	IM ampule	75 mg up to two times/day PRN only (max dose=150mg) (Included within the EDL of MoH)
Diclofenac	Local pain	1% topically	Topical Emulgel	Apply to affected area up to 4 times per day Do not apply on an open wound, or on areas of infection or rash
PREGABALIN	Cancer-associated neuropathy	25, 75mg,150mg	capsule	Initial dose range 25mg daily to 75mg twice daily
CARBAMAZEPINE	For neuropathic pain especially trigeminal or glossopharyngeal neuralgia	200mg/ tab 100mg/5ml syrup	Tablet syrup	200 to 400 mg/day, gradually increasing maintenance dose: 600 to 800 mg/day; (Included within the EDL of MoH)
DULOXETINE	For neuropathic pain especially chemotherapy-induced peripheral neuropathy Musculoskeletal pain,	30 mg, 60mg	capsule	Initial dose 30mg to 60mg daily. Maximum 120mg in 24 hours
GABAPENTIN	Neuropathic pain	300mg	Tab	Initially 300mg once daily on day 1, then 300mg twice daily on day 2, then 300mg three times a day on day 3. Adjust in 300mg steps according to response; maximum 3.6g in 24 hours
TRAMADOL	For moderate pain	100 mg/Tablet Tramadex drops 100mg/2ml Amp	Tablet OD (once daily) Tramadex oral drops Amp (IM, SubQ, I.V. infusion after dilution)	Maximum dose 400mg in 24 hours max dose of tramadex OD® =300mg/day
FENTANYL	For severe pain	12.5mcg,25mcg,50mcg, 75mcg,100mcg/ hours/PATCH	Transdermal patch Abstral PIcFent	Titrate through dose range

			Actiq Fentora	(Included within the EDL of MoH)
MORPHINE SULPHATE	Morphine sulphate Controlled Release tablet	Morphine sulphate oral tablet (MCR) (10mg ,30mg,100mg)	Tablet	For background pain (Included within the EDL of MoH)
MORPHINE SULPHATE	Morphine sulphate Immediate Release tablet Morphine HCl Amp	Morphine sulphate oral tablet (MIR 15mg, 30mg) Morphine HCl Amp (I.V. , IM, SubQ,) Amp (5mg, 10mg, 100mg	Tablet Amp	For Breakthrough pain (Included within the EDL of MoH)
OXYCODONE (Oxycontin)	For severe pain	Continuous release:5mg, 10mg, 20mg,40mg,80mg /tab	tab	For background pain
OXYCODONE (Percocet)	For severe pain	Immediate Release 5 mg, 10mg	tab	For Breakthrough pain (Included within the EDL of MoH)
OXYCODONE (Oxycode forte)	For severe pain	Immediate Release 5 mg/0.5 ml	Syrup	For Breakthrough pain

- Appendix G

Table 23 : Distribution of the number of patients and all consumed chemotherapy medications among governmental hospitals, 2023

item	unit	Watani		PMC		Beit Jala		Jenin		Tulkarem		Total	
		Quantity	Patients	Quantity	Patients	Quantity	Patients	Quantity	Patients	Quantity	Patients	Quantity	Patients
ADRIAMYCIN E 50 MG(DOXORUBICIN)	SINGLE	510	75	601	86	920	138	303	34	216	30	2,550	363
B.C.G freeze dried 5X10*8 cfu	SINGLE	80	13	140	31	180	46	53	13	44	10	497	113
bicalutamide 50 mg tab	Tablet	4,779	51	2,970	28	2,843	73	7,050	34	309	9	17,951	195
BLEOMYCINE 15 I.U VIAL	SINGLE	144	19	97	17	153	24	5	1	37	3	436	64
CALCIUM FOLINATE 15MG TAB	Tablet	0	0	0	0	50	3	0	0	0	0	50	3
CALCIUM FOLINATE 50MG AMP	SINGLE	161	14	2	1	3,328	105	417	14	368	8	4,276	142
calcium folinate 500mg vial	SINGLE	0	0	0	0	122	71	0	0	0	0	122	71
capecitabine 500mg tab	Tablet	40,477	113	33,816	88	33,062	103	18,671	60	23,961	63	149,987	427
CARBOPLATIN 10MG/ML 45ML	SINGLE	442	86	294	54	610	137	298	46	201	32	1,845	355
CISPLATIN 50 MG VIAL	SINGLE	203	21	82	9	118	20	143	13	24	4	570	67
Cladribine 10 mg tab	Tablet	74	8	74	6	43	3	14	1	18	1	223	19
CYCLOPHOSPHAMIDE 50 MG TAB	Tablet	0	0	0	0	0	0	30	1	0	0	30	1
CYCLOPHOSPHAMIDE 500 MG VIAL	SINGLE	984	123	738	88	969	141	402	47	454	52	3,011	451
dacarbazine 500mg vial	SINGLE	119	16	202	18	309	28	10	1	38	3	678	66
DENOSUMAB 120MG/107 ML VIAL	SINGLE	115	29	156	42	128	58	74	73	6	3	479	205
DOCETAXEL 20 MG/ ML 1 ML VIAL	SINGLE	104	18	4	1	24	11	37	12	10	5	179	47
Docetaxel 20mg 0.5ml vial	SINGLE	63	10	109	12	12	5	57	15	72	20	313	62
Docetaxel 80mg vial	SINGLE	465	65	271	43	304	56	175	29	240	39	1,455	232
EPIRUBICIN 50MG VIAL	SINGLE	196	18	158	22	121	14	41	7	56	5	572	66
ERIBULIN 0.44 MG /ML (2.26ML VIAL)	SINGLE	0	0	0	0	12	1	0	0	0	0	12	1
ETOPOSIDE VP 100 MG VIAL	SINGLE	199	17	200	12	254	18	246	13	0	0	899	60
FILGRASTIM 300 MCG VIAL	SINGLE	1,772	153	2,097	97	3,190	202	49	21	55	15	7,163	488
FLUROURACIL 1 G VIAL 12	SINGLE	99	16	15	1	4,524	196	327	15	168	12	5,133	240

GEMCITABINE 1GM VIAL	SINGLE	766	50	173	17	547	57	237	17	198	12	1,921	153
GOSERELIN 3.6MG REFILLED SYRINGE	SINGLE	938	167	667	154	1,587	333	490	101	451	69	4,133	824
GOSERELIN 10.8 MG PREFILLED	SINGLE	34	28	45	44	24	24	64	56	6	6	173	158
HYDROXYUREA.500MG CAP	Tablet	20,245	68	14,070	47	20,626	40	13,795	47	11,207	44	79,943	246
imatinib 100mg cap	Tablet	120	1	0	0	0	0	0	0	0	0	120	1
imatinib 400mg tab	Tablet	17,299	64	8,250	34	9,350	39	3,380	16	4,320	15	42,599	168
irinotecan 300mg/15ml vial	SINGLE	82	22	14	4	262	60	45	11	64	12	467	109
irinotecan hcl 100 mg/5ml	SINGLE	207	15	3	1	239	49	50	8	40	9	539	82
LETROZOL 2.5MG TABLET	Tablet	71,035	353	27,540	177	37,480	243	23,590	119	26,910	126	186,555	1,018
MELPHALAN 2MG TAB	Tablet	0	0	0	0	25	1	0	0	0	0	25	1
MERCAPTOPURINE 50mgTAB	Tablet	0	0	0	0	7,275	38	150	1	175	3	7,600	42
MESNA 400 MG VIAL	SINGLE	0	0	0	0	347	23	0	0	0	0	347	23
METHOTREXATE SOD 2.5MG TAB	Tablet	0	0	9,890	142	8,030	38	0	0	0	0	17,920	180
METHOTREXATE SOD. 50 MG VIAL	SINGLE	36	3	37	21	17	3	33	22	39	2	162	51
MITOMYCINE 20 MG VIAL	SINGLE	6	1	0	0			62	9	0	0	68	10
MITOMYCINE 40 MG VIAL	SINGLE	12	2	0	0	18	6	27	9	3	1	60	18
Nilotinib 200mg	Tablet	19,684	23	12,096	18	24,116	25	8,924	7	3,496	3	68,316	76
OCTREOTIDE 0.1 MG/ML AMP	SINGLE	0	0	1,409	50	42	2	298	9	55	2	1,804	63
octreotide 20mg amp	SINGLE	33	6	87	18	103	12	1	1	3	1	227	38
Oxaliplatin 50mg vial	SINGLE	0	0	88	15	109	50	57	17	29	14	283	96
Oxaliplatin 100mg vial	SINGLE	500	56	433	47	1,235	176	271	40	364	40	2,803	359
paclitaxel 100mg/17ml vial	SINGLE	71	20	59	20	86	50	23	9	16	6	255	105
paclitaxel 300mg vial	SINGLE	439	93	265	79	913	173	154	49	99	25	1,870	419
exemestane 25mg tab	Tablet	8,938	53	1,020	8	1,620	15	710	5	570	3	12,858	84
RITUXIMAB 100MG/10ML VIAL	SINGLE	226	29	185	26	317	62	148	19	59	7	935	143

RITUXIMAB 500MG /50ML VIAL	SINGLE	593	167	194	38	589	135	405	114	87	31	1,868	485
Tamoxifen 20 mg	Tablet	33,460	150	21,830	126	30,539	224	24,110	112	12,930	54	122,869	666
Thalidomide 50 mg tab	Tablet	5,430	27	210	2	3,300	23	630	4	840	5	10,410	61
TRIPTORELIN 3.75MG AMP	SINGLE	0	0	0	0	0	0	0	0	2	2	2	2
THIOGUANINE 40MG TAB	Tablet	0	0	0	0	56	3	0	0	0	0	56	3
VINBLASTINE SULPHATE 10MG VIAL	SINGLE	74	15	137	18	223	28	5	1	29	3	468	65
VINCRISTINE SULPHATE 1 MG VIAL	SINGLE	64	10	90	14	153	23	6	1	67	9	380	57
vinorelbine 50 mg amp.	SINGLE	116	13	16	4	67	10	19	5	2	2	220	34
Fludarabine 50 mg vial	SINGLE	17	7	0	0	0	0	0	0	0	0	17	7
MEGESTROL ACETATE 40MG TAB	Tablet	420	3	0	0	0	0	100	1	0	0	520	4
megestrol acetate 160mg tab	Tablet	810	14	0	0	0	0	0	0	0	0	810	14
CHLORAMBUCIL 2MG TAB		75	3	0	0	0	0	0	0	0	0	75	3
Zoledronic acid 4mg vial	SINGLE	811	295	411	211	706	299	238	93	227	92	2,393	990
Total Patients*			2,623		1,991		1,316		1,353		912		10,596

Appendix H

Table 24 : Distribution of patients in correlation with their referring and referral facility (Cross-Tabulation)

Referring Hospital * Referral Hospital Cross tabulation					
		Referral Hospital			Total
		Najah Hospital	Istishari Hospital	AVH	
Referring Hospital	Beit Jala	5	16	71	92
	PMC	4	28	39	71
	National	66	16	28	110
	Jenin	12	5	11	28
	Thabet-Thabet	8	1	3	12
	Jerusalem	0	0	12	12

	Gaza	10	16	28	54
Total		105	82	192	379

Table 25 : Description of the main causes for cancer referral outside the Palestinian MoH (Cross-Tabulation between the main referral cause and the referring hospital)

referring hospital * Main referral cause Cross-tabulation

		Main Referral Cause									Total
		EDL NA	NON EDL	HOSPITALIZATION	INPATIENT ADMISSION	EDL NA GAZA	CHEMO/ RADIOTHER	SARCOMA	HEAD & NECK	QUDS	
Referring Hospital	**Beit Jala**	53	21	6	5	0	1	4	2	0	92
	PMC	41	6	15	6	1	1	1	0	0	71
	National	52	22	20	8	0	2	4	2	0	110
	Jenin	8	7	5	2	0	1	4	1	0	28
	Thabet-Thabet	0	2	6	3	0	0	1	0	0	12

	Jerusalem	7	1	0	1	0	0	0	0	3	12
	Gaza	11	4	10	4	17	8	0	0	0	54
Total		172	63	62	29	18	13	14	5	3	379

الملخص

هدفت الدراسة إلى تقييم جودة خدمات الأورام التي تطبقها أقسام الأورام في المستشفيات الحكومية في فلسطين وتحديد إمكانية استخدام أدوات ستة سيجما لتحسين جودة هذه الخدمات. ولتحقيق هذه الغاية، استخدمت الدراسة المنهج الوصفي والتحليلي المناسب لهدف الدراسة. وبشكل أكثر تحديدًا، تم استخدام الأساليب الكمية والنوعية لجمع البيانات الشاملة اللازمة من وجهات نظر مديري المستشفيات الحكومية من خلال الاستبانة. تم تقسيم مجتمع الدراسة إلى مجموعتين على مرحلتين خلال هذه الدراسة؛ تضمنت المجموعة الأولى خمسة مستشفيات حكومية في ثلاث محافظات (شمال ووسط وجنوب) تطبق إدارة الأورام. أما الجزء الآخر من مجتمع الدراسة يعتمد على مراجعة التقارير الطبية المحولة لجميع مرضى السرطان الذين تم تحويلهم خارج مرافق وزارة الصحة نتيجة لنقص الأدوية بين الفترة من 1 يناير 2023 إلى 31 ديسمبر 2023. تم اعتماد أسلوب أخذ العينات العشوائية لجمع المعلومات اللازمة من مرضى السرطان في وحدة شراء الخدمات التابعة لوزارة الصحة. في المجموع، تم اختيار 379 تقريرًا طبيًا للمراجعة.

تم إجراء تحليل البيانات المجمعة بواسطة برنامج SPSS 26. كشفت النتائج عن تطبيق بعض أدوات Six Sigma في المستشفيات الحكومية. وبشكل أكثر تحديدًا، فيما يتعلق بمكونات التعريف والقياس والتحليل والتحسين والتحكم(DMAIC) ، وجد أن أبعاد التعريف والتحليل والتحسين مطبقة بشكل جيد للغاية، بينما خرجت عناصر القياس والتحكم في DMAIC في تطبيق متوسط.

الكلمات المفتاحية: Six Sigma، DMAIC، السرطان، خدمات الأورام، المستشفيات الحكومية الفلسطينية