Dissertation Training

At

Yashoda Super Specialty Hospital

&

Cancer Institute

Oncology and the Use of Diagnostics: Evaluation and Understanding of Advanced Diagnostic Methods Utilized in the Oncology Outpatient Department of a Super Specialty Hospital

by

Dr. Prasun bowlia

PG/22/078

Under the guidance of

Dr. Altaf Yousuf Mir

PGDM (Hospital & Health Management)

2022-24

International Institute of Health Management Research New Delhi

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(Completion of Dissertation from respective organization)

The certificate is awarded to

Dr. Prasun Bowlia

In recognition of having successfully completed his/her Internship in the department of

Operations

And has successfully completed his/her Project on

Oncology and the Use of Diagnostics: Evaluation and Understanding of Advanced Diagnostic Methods Utilized in the Oncology Outpatient Department of a Super Specialty Hospital

1st March 2024 to 30 June 2024

Yashoda Super Specialty Hospital

&

Cancer Institute

He/She comes across as a committed, sincere & diligent person who has a strong drive & zeal for learning.

We wish him/her all the best for future endeavours.

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This is to certify that **Dr Prasun Bowlia** student of PGDM (Hospital & Health Management) From International Institute of Health Management Research, New Delhi has undergone Dissertation training at **Yashoda Super Specialty Hospital & Cancer Institute** from 1 March 2024 to 30 June 2024

The Candidate has successfully carried out the study designated to him during dissertation training and his/her approach to the study has been sincere, scientific and analytical.

The dissertation is in fulfilment of the course requirements.

I wish him all success in all his/her future endeavours.

Dr. Sumesh Kumar
Associate Dean, Academic and Student Affairs
IIHMR, New Delhi

Dr. Altaf Yousuf Mir
Associate Professor
IIHMR, New Delhi

Certificate of Approval

Certificate of Approval

The following dissertation titled "Oncology and the use of diagnostics: "**Evaluation and understanding of advance diagnostics method utilized in the oncology outpatient department of a super specialty hospital"** at **"Yashoda Super specialty Hospital and Cancer Institute "** is hereby approved as a certified study in management carried out and presented in a manner satisfactorily to warrant its acceptance as a prerequisite for the award of **PGDM (Hospital & Health Management)** for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed, or conclusion drawn therein but approve the dissertation only for the purpose it is submitted.

Dissertation Examination Committee for evaluation of dissertation.

Name	Signature
Dr. Aman Raj Gupta	Aman Raj Gupta
Dr. Sumeet Swain	

Certificate from Dissertation Advisory Committee

This is to certify that **Dr. Prasun Bowlia**, a graduate student of the PGDM (Hospital & Health Management) has has worked under the guidance and supervision of Dr. Altaf Yousuf Mir , Associate Professor, IIHMR, New Delhi. He is submitting this dissertation titled " **Oncology and the Use of Diagnostics: Evaluation and Understanding of Advanced Diagnostic Methods Utilized in the Oncology Outpatient Department of a Super Specialty Hospital**" at "**Yashoda Super Specialty Hospital & Cancer Institute**" in partial fulfilment of the requirements for the award of the PGDM (Hospital & Health Management).

This dissertation has the requisite standard and to the best of our knowledge no part of it has been reproduced from any other dissertation, monograph, report or book.

Dr. Altaf Yousuf Mir,
Associate Professor,
IIHMR, New Delhi
Hospital

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INTERNATIONAL INSTITUTE OF HEALTH MANAGEMENT RESEARCH, NEW DELHI

CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled "**Oncology and the Use of Diagnostics: Evaluation and Understanding of Advanced Diagnostic Methods Utilized in the Oncology Outpatient Department of a Super Specialty Hospital"** and submitted by **Dr. Prasun Bowlia**, **PG/22/078**(Enrolment No.) under the supervision of **Dr. Altaf Yousuf Mir,** Associate Professor,IIHMR for the award of PGDM (Hospital & Health Management) of the Institute carried out during the period from 1st March 2024 - 30 June 2024. It embodies my original work and has not formed the basis for the award of any degree, diploma, associateship, fellowship, titles in this or any other Institute or other similar institution of higher learning.

Dr Prasun Bowlia

FEEDBACK FORM

FEEDBACK FORM

Name of the Student: Dr. Prasun Bowlia

Name of the Organisation in Which Dissertation Has Been Completed:

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Suggestions for Improvement: None, continue the good work.

Suggestions for Institute (course curriculum, industry interaction, placement, alumni):

Date: 29 JULY 2024

Place: GHAZIABAD.

Signature of the Officer-in-Charge/ Organisation Mentor (Dissertation)

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ABSTRACT

In India, the rising prevalence of cancer, coupled with a notably younger age of diagnosis compared to global standards, highlights a critical need for effective diagnostic strategies. This study examines the utilization of diagnostic tests in the oncology outpatient department (OPD) of a super specialty hospital to improve resource allocation and patient outcomes. Utilizing a prospective, descriptive research design with a cross-sectional framework, the study analyzed data from 280 patients over a two-month period. The primary objectives are to evaluate the percentage of diagnostic tests advised during initial versus follow-up consultations, identify the most frequently utilized tests, and understand the correlation between diagnostic tests and cancer types. The study identifies significant patterns: initial consultations predominantly involve tests aimed at obtaining definitive diagnoses, such as biopsies and viral markers, whereas follow-up consultations focus on monitoring treatment efficacy and disease progression through tumor markers and genetic assays. Tests like PET-CT, CBC, and KFT emerge as frequently used across both stages, underscoring their crucial roles in staging, health monitoring, and treatment planning. Specific diagnostic tests were linked to particular cancer types, revealing tailored approaches for conditions such as breast cancer, where CA 15.3 and hormone receptor assays are pivotal, and prostate cancer, where PSA and TRUS are central. The findings are expected to enhance understanding of diagnostic practices in oncology, facilitate better resource management, and contribute to improved patient care. Data confidentiality was maintained through the use of Unique Hospital Identification (UHID) numbers, ensuring no personally identifiable information was included. This study provides a comprehensive overview of diagnostic test utilization, offering valuable data to optimize oncology practice and address the growing cancer burden in India.

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LIST OF TABLES AND FIGURES

ACRONYMS/ ABBREVIATIONS

MRI - Magnetic Resonance Imaging

USG KUB - Ultrasound Kidney, Ureter, and Bladder

PSMA PET-CT - Prostate-Specific Membrane Antigen Positron Emission Tomography-Computed Tomography

EUS - Endoscopic Ultrasound

TRUS - Transrectal Ultrasound

ECHO - Echocardiography

UGIE - Upper Gastrointestinal Endoscopy

FOL - Fiberoptic laryngoscopy

FNAC - Fine Needle Aspiration Cytology

ER - Estrogen Receptor

PR - Progesterone Receptor

HER2NEU - Human Epidermal Growth Factor Receptor 2

AFP - Alpha-Fetoprotein

Yashoda Super Specialty Hospital & Cancer Institute : A brief Introduction

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Yashoda Superspeciality Hospital & Cancer Institutes, located in Sanjay Nagar, Ghaziabad, is a premier cancer treatment center in Delhi NCR. Established in 2019, the hospital has quickly earned a stellar reputation for providing comprehensive and affordable cancer care.

The hospital employs a multi-disciplinary strategy, integrating services from various medical specialties to provide coordinated and comprehensive care. This team includes highly experienced ex-army specialists trained at renowned institutions like Tata Memorial Hospital. The diverse team comprises medical, surgical, and radiation oncologists, along with reconstructive surgeons, neuroradiologists, onco-pathologists, hematologists, and uro-oncologists.

Yashoda is equipped with cutting-edge technology, such as the Varian Halcyon 2.0 radiotherapy machine, which offers advanced radiotherapy techniques including IGRT, IMRT, SBRT, SRS, 3D CRT. The hospital provides a wide range of treatments, including chemotherapy, hormone therapy, immunotherapy, radiation therapy, surgery, and targeted therapies. This extensive range of treatment options allows for personalized and effective care for each patient.

The Cancer Institutes treat various types of cancer, including brain tumors, head & neck cancers, breast cancer, lung cancer, liver cancer, pancreatic cancer, kidney cancer, ovarian cancer, prostate cancer, and neuroendocrine tumors.

Combining expert oncologists, advanced technology, Yashoda Superspeciality Hospital & Cancer Institutes provides exceptional cancer care and support.

Oncology and the Use of Diagnostics: Evaluation and Understanding of Advanced Diagnostic Methods Utilized in the Oncology Outpatient Department of a Super Specialty Hospital

CHAPTER 1 : INTRODUCTION

Background: In India, the prevalence of non-communicable diseases like cancer is rapidly increasing. Not only has the number of cancer cases dramatically increased, but the average age of incidence has also become significantly younger. In India, the most prevalent malignancies for women are of the breast, cervix, and ovary, while for males they are the mouth, prostate, and lung. (1)

Compared to other nations, India has a lower median age at which cancer is diagnosed. Apollo's research indicates that the average age at which breast cancer is diagnosed in India is 52, while it is 63 in the USA and Europe. Similarly, the average age of a lung cancer diagnosis is 59 years, while in Western nations, it is approximately 70 years. (1)

Strangely low cancer screening rates in India persist in spite of these trends. In India, the rate of breast cancer screening stands at 1.9%, while in the USA, UK, and China, it is 82%, 70%, and 23%, respectively. India has a 0.9% cervical cancer screening rate, compared to 73% in the USA, 70% in the UK, and 43% in China.(1)

India may become the world's cancer capital as the country's cancer case count is expected to rise in the upcoming years. Projections show that there would be a notable 13% increase in just five years, from 13.9 lakh cases in 2020 to 15.7 lakh cases in 2025. (1)

Given this context, the need for diagnostics is crucial. It is essential not only for screening purposes to enable early intervention but also to efficiently manage the already existing prevalence of the disease.

In the field of oncology, diagnostic tests are used for a variety of scenarios, such as confirming the disease, staging the cancer, assessing the effectiveness of treatment, and monitoring for recurrence. These tests include imaging studies like PET-CT, MRI, and ultrasound; blood tests for tumor markers; biopsies; and genetic testing among others. The efficient utilization of these diagnostic tools is vital for improving patient outcomes and managing the growing cancer burden in India.

Importantly, no single diagnostic method can confirm the presence of cancer. A combination of tests, including imaging, biopsy, and biomarker analysis, is often required to achieve an accurate diagnosis.

There are many diagnostic investigations that are advised, some maybe advised routinely and some case to case basis.

Diagnostic tests are often expensive, adding to the financial burden already borne by the patient and their family. This financial strain can be particularly challenging in a country like India, where out-of-pocket healthcare expenses are high.(2)

RATIONALE:

The oncology OPD at a super specialty hospital serves a diverse patient population with varying diagnostic needs. By analyzing the utilization patterns of diagnostic tests, this study aims to optimize resource allocation, streamline clinical workflows. It will provide insights into the most commonly used diagnostic tests or their relevance to different types of cancer, offering a comprehensive overview of test utilization patterns . The research aims to comprehensively analyze the diverse range of diagnostic investigations prescribed daily in oncology, exploring how they are utilized. By discussing the findings, the study seeks to illuminate the dynamic nature of oncology practice.

RESEARCH OBJECTIVE: **To evaluate and understand the various advanced diagnostic methods utilized in the oncology outpatient department (OPD) of a super specialty hospital.**

RESEARCH QUESTION:

1. **What is the percentage of diagnostic tests advised during initial consultations compared to follow-up consultations?**
2. **What are the most frequently advised diagnostic tests in the oncology outpatient department (OPD)?**
3. **What are different diagnostic tests advised in relation to the type of cancer?**

CHAPTER 2: METHODOLOGY

Study Design:

This study employs a **prospective, descriptive research design** to evaluate the utilization of diagnostic tests in an oncology outpatient department. The framework is **cross-sectional**, allowing for the assessment of diagnostic practices at a single point in time.

Study Area:

The research is being conducted in the Medical Oncology Outpatient Department (OPD) of a super specialty hospital.

Study Population:

The study population includes medical oncology patients who visit the oncology outpatient department (OPD) during the study period.

Sampling:

A purposive sampling method is utilized, encompassing all medical oncology patients who have been prescribed diagnostic investigations. This method ensures that every eligible patient presenting at the OPD for treatment during the study period is included in the sample.

Sample Size:

A total of 280 patients are included in the study.

Inclusion and Exclusion Criteria

Inclusion Criteria: Patients in medical oncology OPD who underwent at least one diagnostic test during the study period.

Exclusion Criteria: IPD Patients.

Data Collection:

Sources of Data: Data for this study were sourced from Patient Prescriptions and Patient Records for UHID.

Data Collection Tools and Instruments: A **custom checklist** was developed to extract relevant data from patient prescriptions, including test types (e.g., PET-CT, CBC), dates of tests, New or follow-up consultations etc.

Procedures for Data Collection: Data collection was conducted over a Two-month period, from April to May 2024.

Raw data are collected and transcribed systematically from daily prescriptions and patient records.

Variables:

Definition and Classification:

- **Independent Variables**: Type of diagnostic test (e.g., PET-CT, MRI).
- **Dependent Variables**: Frequency of test utilization.
- **Control Variables**: Patient demographics and cancer type.

Data Analysis:

Statistical Methods and Tools: Data were analyzed using Microsoft Excel software .

Descriptive statistics, including frequencies and percentages, were used to summarize test utilization patterns. Charts, diagrams, and tables will be used to visually represent the data and facilitate the understanding of key findings.

Techniques for Data Processing and Interpretation: Data cleaning involved removing duplicate entries and addressing missing values. Data were then categorized by test type and analyzed to identify trends and patterns.

Ethical Considerations:

Confidentiality and Data Protection - To protect patient privacy, the data used in this study consist solely of the Unique Hospital Identification (UHID) numbers. No personally identifiable information such as patient names, age, or sex was included. Data were stored securely in a password-protected database, and access was restricted to authorized research personnel only

Limitations

- Single-Centre Study: The study is confined to one hospital, which may limit the generalizability of the findings to other settings or populations.
- Short Study Duration: The Two-month data collection period may not capture long-term outcomes or trends

CHAPTER 3: RESULTS

A. The bar chart presented elucidates the percentage distribution of various investigations advised during initial and follow-up consultations within the oncology OPD.

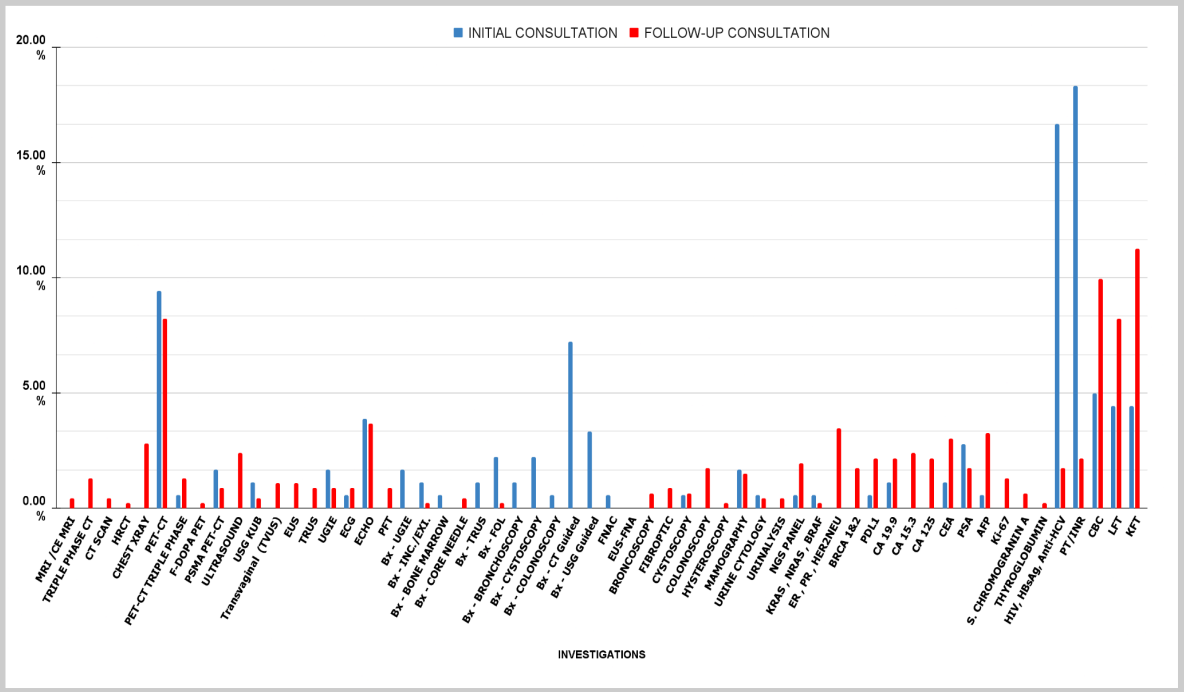

Figure 3.1 : Percentage Utilization of Various Investigations Advised During Initial and Follow-Up Consultations. The x-axis represents the different types of investigations, while the y-axis shows the percentage of patients undergoing each test during initial (blue bars) and follow-up (red bars) consultations relative to the total number of advised tests

<u>The key findings are as follows:</u>

1. **Investigation Distribution:**

*Initial Consultations***:** In Figure 1.1, some of the tests advised during the initial consultation represent a higher percentage compared to the other tests advised at that time.

Biopsies, such as CT-guided biopsy (7.2%) and USG-guided biopsy (3.3%), along with those performed using various procedural techniques like Bx-Cystoscopy (2.2%), Bx-Fiberoptic Laryngoscopy (2.2%), and Bx-Upper GI Endoscopy (1.7%), are among the tests only observed to be advised more initially, as compared to follow up consultation.

Viral markers such as HIV, HBsAg, and Anti-HCV are advised together and contribute 16.7%, while among **blood tests**, PT/INR accounts for 18.3% of all investigations advised during the initial consultation

Follow-Up Consultations:

Tumor markers, such as CA 19.9 (2.2%), CA 125 (2.2%), CA 15.3 (2.4%), CEA (3%), and AFP (3.2%), are observed more frequently in follow-up consultations and are much less common in initial consultations.

Genetic markers and **hormonal markers**, such as HER2 neu and ER/PR, together contribute 3.5%, while BRCA 1&2 contribute 1.7%, with none of these tests being observed during the initial consultation..

The percentage distribution for blood tests such as CBC, LFT, and KFT is initially 5%, 4.4%, and 4.4%, respectively, but increases twofold to 10%, 8.3%, and 11.3%, respectively, in follow-up consultations.

2. **Common Investigations:**

Certain investigations, such as PET-CT (8-10%) and echocardiography (about 3.8%), are seen to have been advised both in the initial and follow-up consultations.

3. **Infrequent Investigations:** Several other investigations like Hysteroscopy, Colonoscopy, and Bronchoscopy were less frequently advised overall, reflecting their use in specific clinical scenarios rather than as routine diagnostic tests.

B. Distribution of Most Frequently Advised Diagnostic Investigations

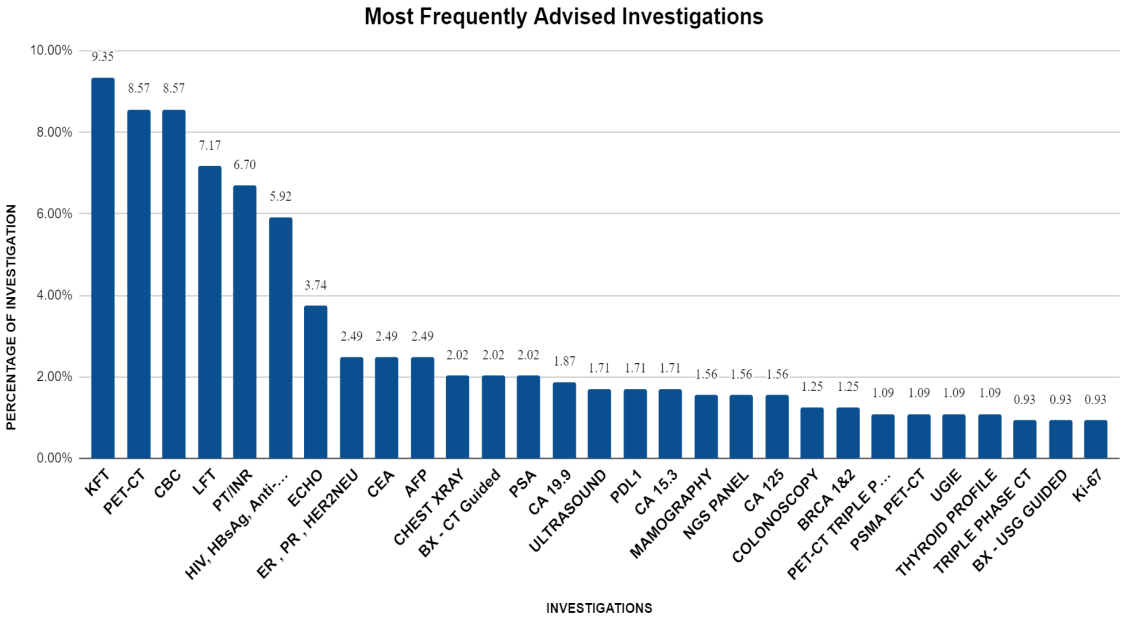

Figure 3.2: Distribution of Most Frequently Advised Diagnostic Investigations in the Oncology Outpatient Department. The x-axis represents the different types of investigations, while the y-axis shows the percentage of patients undergoing each test relative to the total number of advised tests.

The data presented in the bar graph illustrate the percentage of different diagnostic investigations advised in an oncology outpatient department (OPD). Among the various investigations, Kidney Function Test (KFT) was the most frequently advised, accounting for 9.35% of all investigations. This was closely followed by PET-CT scans and Complete Blood Count (CBC), which were advised 8.57% of the time each.

Liver Function Tests (LFT) were the next most common investigation, representing 7.17% of the total, followed by Prothrombin Time/International Normalized Ratio (PT/INR) at 6.70%, and HIV-HBsAg-Antibody tests at 5.92%.

Echocardiograms (ECHO) were advised 3.74% of the time, with ER, PR, HER2NEU testing slightly lower at 2.49%. Tumor marker tests such as Carcinoembryonic Antigen (CEA) and Alpha-Fetoprotein (AFP) also constituted 2.49% each.

Chest X-rays and Biopsy guided by CT each accounted for 2.02% of investigations. The Prostate-Specific Antigen (PSA) and CA 19-9 tests were slightly less frequent, both at 1.87%. Ultrasound examinations were advised 1.71% of the time, followed by PDL1 testing and CA 15.3 tests at 1.71% each.

Less frequent investigations included Upper Gastrointestinal Endoscopy (UGIE), thyroid profile, and CT (triple phase) each at 1.09%, as well as biopsy guided by ultrasound at 0.93%. Lastly, the Ki-67 proliferation index test was advised 0.93% of the time.

C. The study examined the use of various diagnostic tests for different cancer types in the oncology outpatient department. We calculated the percentage of patients undergoing each test relative to the total number of advised tests. This analysis highlights the most and least frequently used tests for specific cancers, shedding light on their role in diagnosis and management.

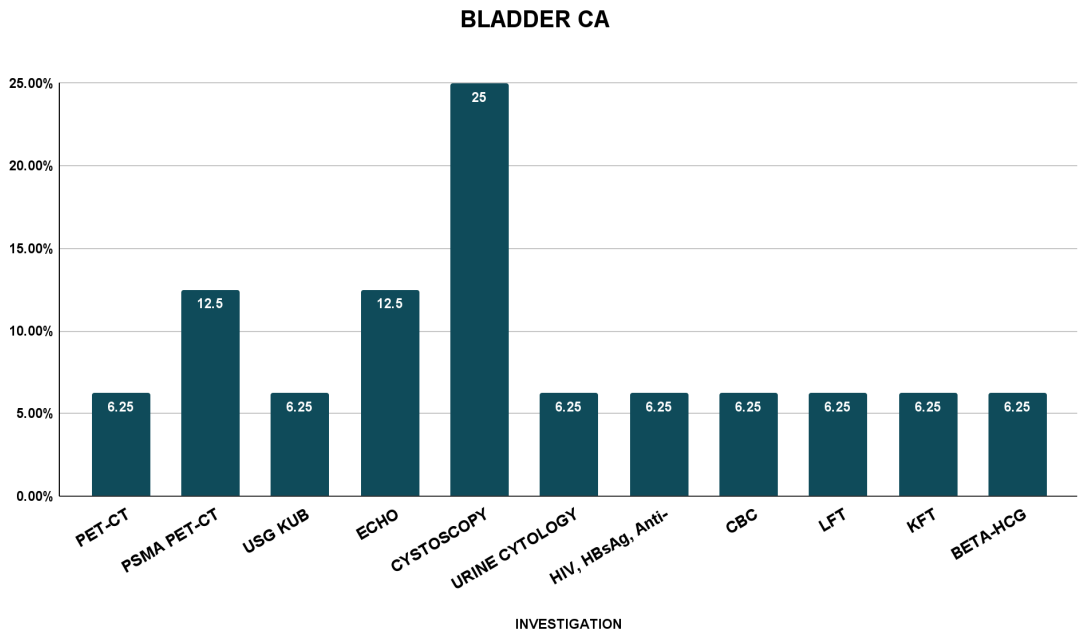

Figure 3.3 : Percentage Utilization of Diagnostic Investigations in Patients Diagnosed with Bladder Cancer. The x-axis represents the different types of investigations, while the y-axis shows the percentage of patients undergoing each test relative to the total number of advised tests

Among the diagnostic tests examined, **Cystoscopy** was the most frequently conducted investigation, accounting for 25% of the total tests advised.

PSMA PET-CT advised in 12.5% of cases. These tests are commonly used for detailed imaging and assessment of cancer.

The remaining diagnostic tests were advised with equal frequency, each constituting 6.25% of the total tests. These include **PET-CT**, **USG KUB**, **Urine Cytology**, **HIV, HBSAg, Anti-HCV**, **CBC**, **LFT**, **KFT**, and **Beta-HCG**. This uniform distribution indicates their less frequent, but still relevant, use in the diagnostic process.

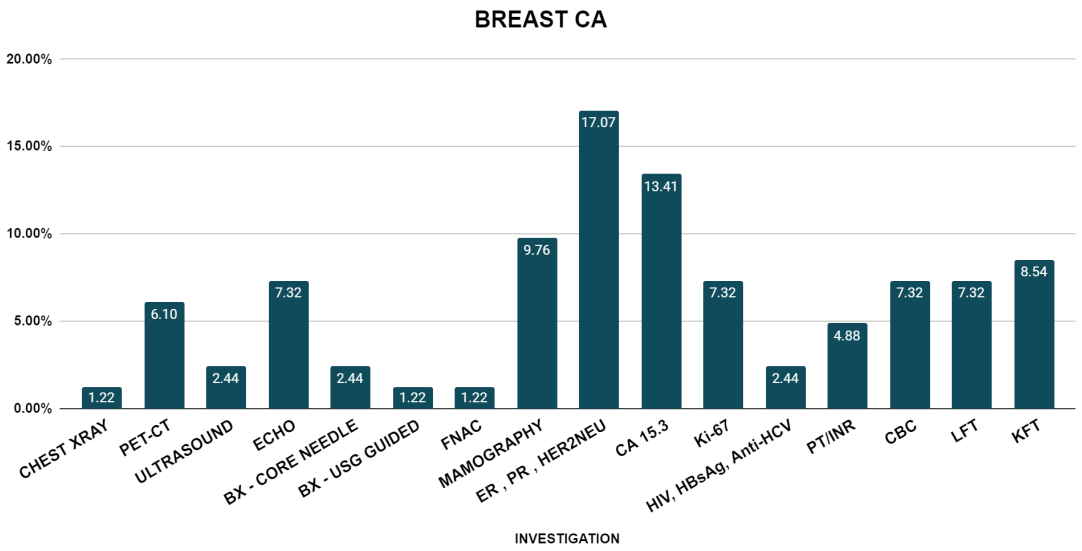

Figure 3.4 : Percentage Utilization of Diagnostic Investigations in Patients Diagnosed with Breast Cancer. The x-axis represents the different types of investigations, while the y-axis shows the percentage of patients undergoing each test relative to the total number of advised tests

CA 15.3 emerged as the most commonly utilized investigation, accounting for 17.07% of the total tests advised. The second most frequent investigation was ER, PR, HER2NEU, utilized in 13.41% of the cases. KFT (Kidney Function Test) followed, being employed in 8.54% of the instances, while FNAC (Fine Needle Aspiration Cytology) was used in 9.76% of cases. Several other tests, such as ECHO (7.32%), CBC (Complete Blood Count) (7.32%), and LFT (Liver Function Test) (7.32%), also showed significant usage.

One of the advised investigations was Ki-67, with a percentage of 7.32%. PET-CT was utilized in 6.10% of the cases, demonstrating its relevance in the diagnostic process. Less frequently used investigations included PT/INR (4.88%), Ultrasound (2.44%), and HIV, HBsAg, Anti-HCV (2.44%). Chest X-ray, BX - Core Needle, BX - USG Guided, and Mammography each had a usage rate of 1.22%.

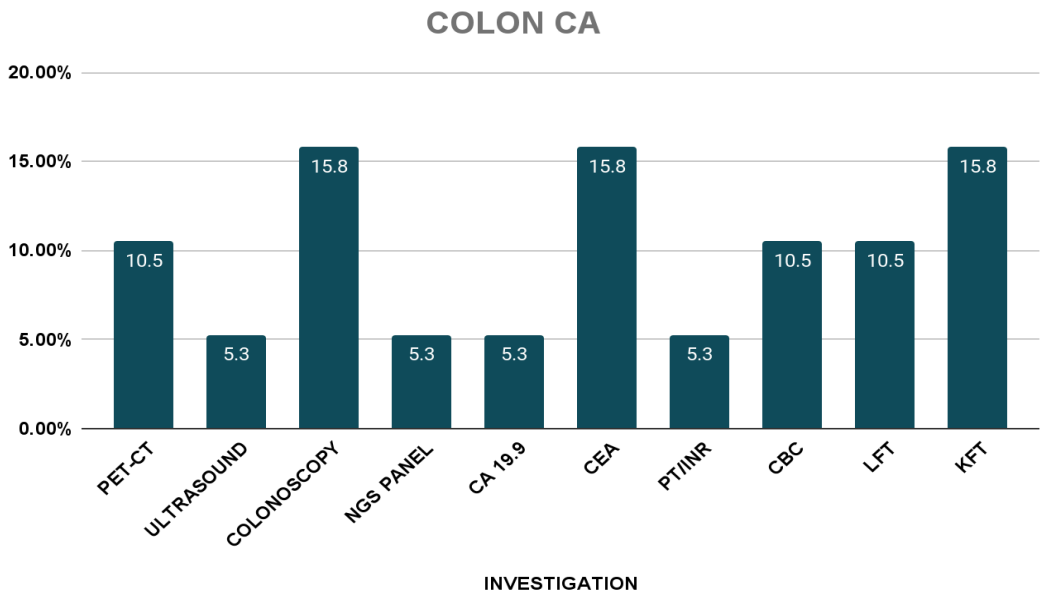

Figure 3.5 : Percentage Utilization of Diagnostic Investigations in Patients Diagnosed with Colon Cancer. The x-axis represents the different types of investigations, while the y-axis shows the percentage of patients undergoing each test relative to the total number of advised tests

The bar graph displays the distribution of different investigations conducted for colon cancer, represented as percentages. The findings are as follows:

- **Colonoscopy**, **CEA**, and **KFT** are the most frequently conducted investigations, each at 15.8%.
- **PET-CT**, **CBC**, and **LFT** follow, each at 10.5%.
- **Ultrasound**, **NGS Panel**, **CA 19.9**, and **PT/INR** are conducted at 5.3% each.

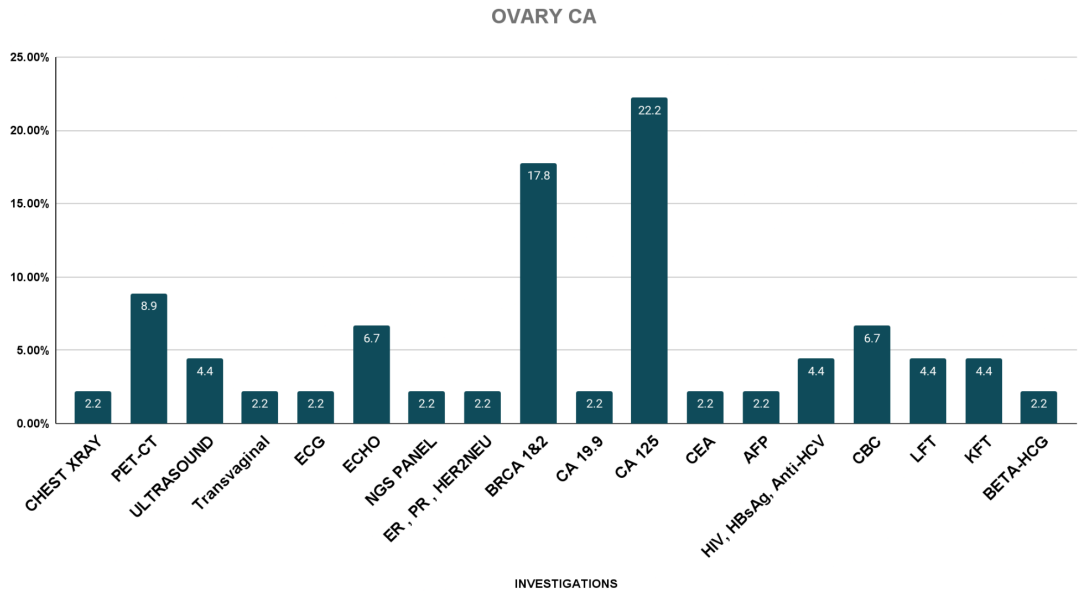

Figure 3.6 : Percentage Utilization of Diagnostic Investigations in Patients Diagnosed with Ovary Cancer. The x-axis represents the different types of investigations, while the y-axis shows the percentage of patients undergoing each test relative to the total number of advised tests

In the analysis of diagnostic tests advised for ovarian cancer , the following observations were noted:

- CA 125 was the most frequently advised test, with 22.2% of patients receiving this test.
- Followed by BRCA 1&2 with 17.8% among all the advised tests
- CA 19.9 was the second most common test, advised for 2.2% of patients.
- ECHO was used in 6.7% of cases, and NGS Panel and HIV, HBsAg, Anti-HCV tests were each advised for 2.2% of patients.
- Other tests, such as PET-CT (8.9%), Ultrasound (4.4%), and Transvaginal Ultrasound (TVS) (2.2%), were advised at lower frequencies.

The prevalence of certain tests, particularly CA 125 and BRCA 1&2, highlights their importance in the diagnostic and monitoring process for ovarian cancer.

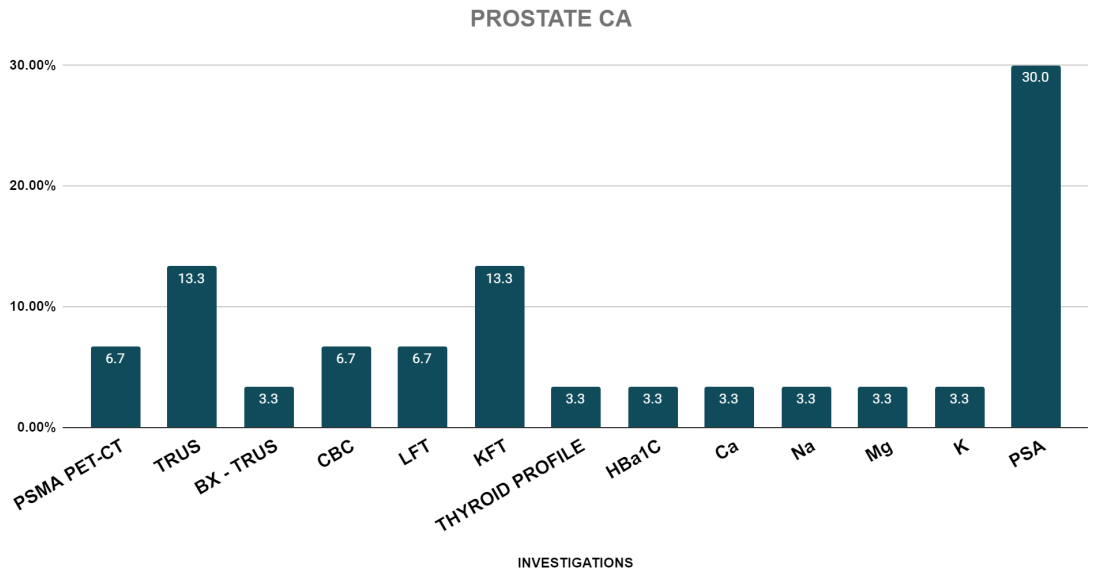

Figure 3.7 : Percentage Utilization of Diagnostic Investigations in Patients Diagnosed with Prostate Cancer. The x-axis represents the different types of investigations, while the y-axis shows the percentage of patients undergoing each test relative to the total number of advised tests

In the analysis of diagnostic tests advised, the following findings were observed:

- **PSA** was the most frequently advised test, with 30.0% of patients receiving this test.
- **TRUS (Transrectal Ultrasound)** and **KFT (Kidney Function Test)** were each advised for 13.3% of patients.
- **PSMA PET-CT** was advised for 6.7% of patients, alongside **CBC (Complete Blood Count)**, **LFT (Liver Function Test)**, and **HBa1C**.
- **BX - TRUS (Biopsy - Transrectal Ultrasound Guided)**, **Thyroid Profile**, **Ca (Calcium)**, **Na (Sodium)**, **Mg (Magnesium)**, and **K (Potassium)** were each advised for 3.3% of patients.

These results indicate that PSA testing is the most commonly utilized, reflecting its significant role in prostate cancer diagnosis and management. Other tests, including TRUS, KFT, and PSMA PET-CT, are also commonly used but to a lesser extent.

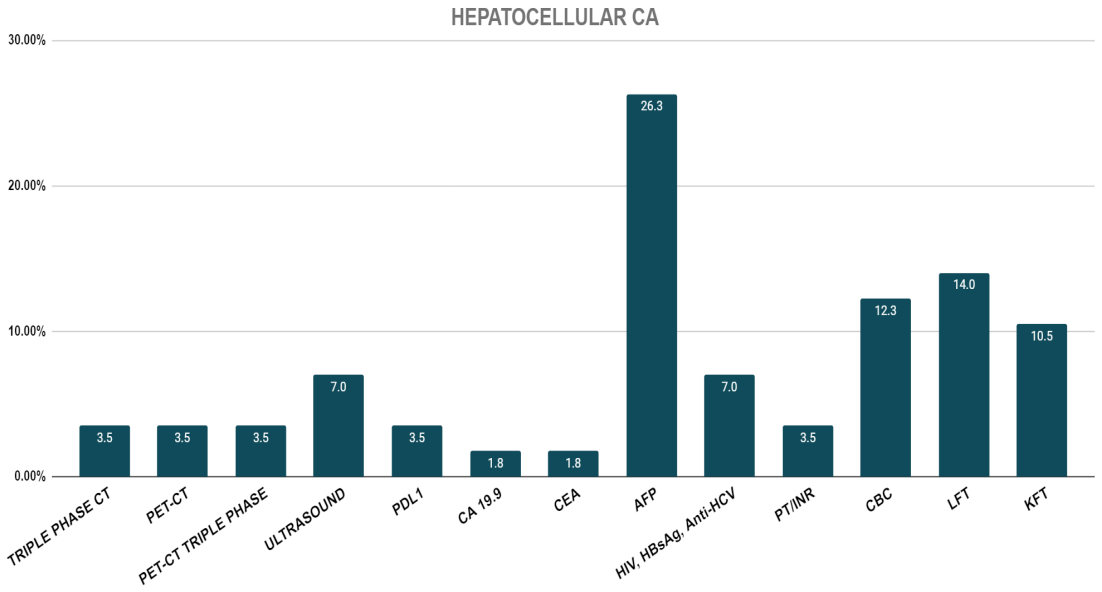

Figure 3.8 : Percentage Utilization of Diagnostic Investigations in Patients Diagnosed with Hepatocellular Cancer. The x-axis represents the different types of investigations, while the y-axis shows the percentage of patients undergoing each test relative to the total number of advised tests.

In the analysis of diagnostic tests advised, the following observations were noted:

- **AFP (Alpha-Fetoprotein)** was the most frequently advised test, with 26.3% of patients receiving this test.
- **LFT (Liver Function Test)** followed, advised for 14.0% of patients.
- **KFT (Kidney Function Test)** was advised for 10.5% of patients.
- **CBC (Complete Blood Count)** was used in 12.3% of cases.
- **Triple Phase CT**, **PET-CT**, and **PET-CT Triple Phase** were each advised for 3.5% of patients.
- **Ultrasound** was advised for 7.0% of patients, along with **PDL1** and **PT/INR**.
- **CA 19.9**, **CEA (Carcinoembryonic Antigen)**, and **HIV, HBsAg, Anti-HCV** tests were advised less frequently, each at 1.8%.

- These results highlight the prominence of AFP in diagnostic assessments, with significant usage of LFT and KFT for monitoring. Imaging techniques such as Triple Phase CT and PET-CT were less commonly used but remain important in specific diagnostic contexts.

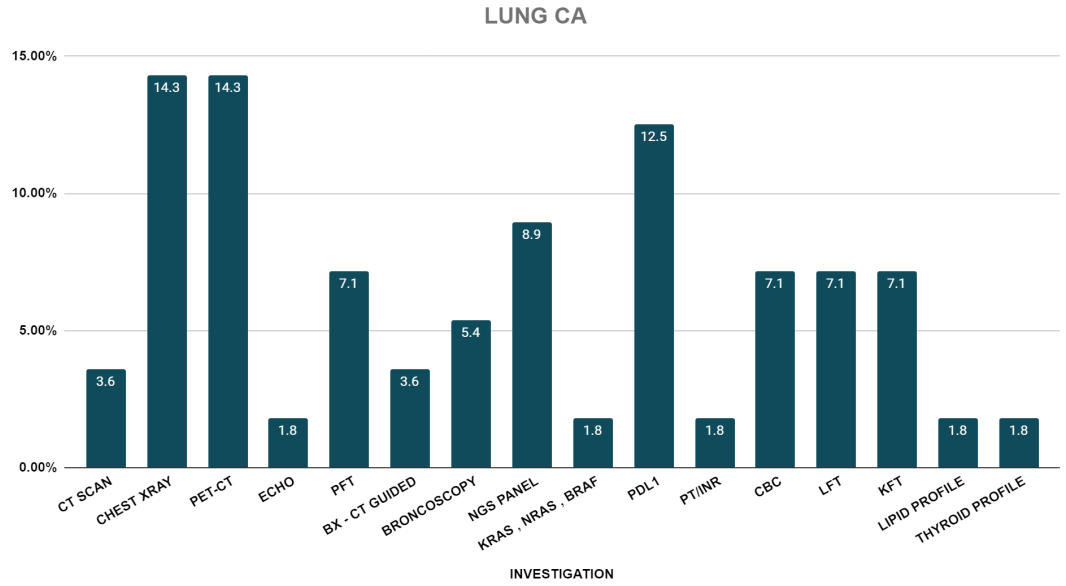

Figure 3.9 : Percentage Utilization of Diagnostic Investigations in Patients Diagnosed with Lung Cancer. The x-axis represents the different types of investigations, while the y-axis shows the percentage of patients undergoing each test relative to the total number of advised tests

In the analysis of diagnostic tests advised, the following results were observed:

- Chest X-ray and PET-CT were the most frequently advised tests, each used in 14.3% of cases.
- PFT (Pulmonary Function Test) was used in 7.1% of cases, along with LFT (Liver Function Test), KFT (Kidney Function Test), and Lipid Profile.
- NGS Panel was advised for 8.9% of patients.
- CT Scan and BX - CT Guided were each used in 3.6% of cases.
- Bronchoscopy was used in 5.4% of cases.
- KRAS, NRAS, BRAF testing and PDL1 evaluation were each advised for 1.8% of patients.
- ECHO (Echocardiogram), PT/INR (Prothrombin Time/International Normalized Ratio), CBC (Complete Blood Count), Thyroid Profile, and Chest X-ray were each used less frequently, ranging from 1.8% to 14.3%.

CHAPTER 4: DISCUSSION

A. **The data presented in this study provide valuable insights into the distribution and frequency of various diagnostic investigations advised during initial and follow-up consultations in an oncology outpatient department (OPD).** Several notable patterns emerged from the analysis, highlighting differences in the types of tests recommended at different stages of patient management.

1. Initial Consultations

During early consultations, a higher percentage of specific tests were seen, indicating a concerted effort to develop an accurate diagnosis. Biopsies, such as CT-guided biopsy (7.2%) and USG-guided biopsy (3.3%), along with procedural techniques like Bx-Cystoscopy (2.2%), Bx-Fiberoptic Laryngoscopy (2.2%), and Bx-Upper GI Endoscopy (1.7%), were more frequently advised initially. This pattern reflects the need to obtain definitive tissue diagnosis and histopathological confirmation early in the diagnostic process.

The high percentage of viral marker investigations, such as HIV, HBsAg, and Anti-HCV (16.7%). Testing for HIV, HBsAg, and Anti-HCV before a biopsy is essential for managing infection risks, ensuring patient safety, and facilitating procedural planning.

Identifying these blood-borne infections helps protect healthcare workers and other patients, and enables tailored post-procedure care.

Similarly, the emphasis on PT/INR (18.3%) highlights the necessity of evaluating coagulation status before any invasive procedures.

PT/INR testing is crucial for identifying potential bleeding risks, ensuring that any coagulation abnormalities are managed appropriately to prevent excessive bleeding during and after the procedure. This evaluation allows for the adjustment of medications, such as anticoagulants, and ensures that the patient's clotting ability is within a safe range, thereby optimizing the safety and success of the invasive procedure.

2. *Follow-Up Consultations*

In follow-up consultations, there was a noticeable shift towards monitoring and evaluating the progression of disease and treatment response. Tumor markers such as CA 19.9 (2.2%), CA 125 (2.2%), CA 15.3 (2.4%), CEA (3%), and AFP (3.2%) were more commonly advised, underscoring their role in tracking cancer progression and detecting recurrence. The relatively lower frequency of these markers in initial consultations suggests that their primary utility lies in ongoing patient management rather than initial diagnosis.

Genetic and hormonal markers, including HER2 neu and ER/PR (3.5%) and BRCA 1&2 (1.7%), were predominantly advised during follow-up consultations. This indicates the relevance of these markers in tailoring treatment strategies and assessing genetic predisposition to cancer, which becomes more pertinent once a primary diagnosis is established.

The increase in percentage distribution for blood tests such as CBC (10%), LFT (8.3%), and KFT (11.3%) during follow-up consultations reflects the necessity of routine investigation that is required to be done before administering chemotherapy or sometimes before radiotherapy . In general it helps in monitoring the patient's overall health and organ function during treatment.

3. *Common and Infrequent Investigations*

Certain investigations, like PET-CT (8-10%) and echocardiography (about 3.8%), were consistently advised during both initial and follow-up consultations.

The frequent use of PET-CT across both stages emphasizes its critical role in staging, treatment planning, and monitoring treatment response.

Echocardiography Is consistent use is likely due to its importance in evaluating cardiac function, particularly in patients undergoing treatments that may have cardiotoxic effects.

In contrast, investigations like Hysteroscopy, Colonoscopy, and Bronchoscopy were less frequently advised, indicating their use in specific clinical scenarios rather than as routine diagnostic tests. These procedures are likely reserved for cases where there are specific indications based on the patient's symptoms and initial diagnostic findings.

B. Distribution of Most Frequently Advised Diagnostic Investigations

Kidney Function Test (KFT) being the most frequently advised investigation at 9.35% highlights the critical importance of assessing renal function in oncology patients. This is likely due to the necessity of ensuring optimal kidney function before administering chemotherapy drugs or imaging contrast dyes used in procedures such as PET-CT or contrast-enhanced (CE) imaging. Proper renal function is crucial to prevent potential nephrotoxicity from these agents, making KFT a routine and essential test. (3)

PET-CT scans and Complete Blood Count (CBC) were equally frequent at 8.57%, underscoring their dual roles in initial diagnostic evaluation and ongoing monitoring of cancer patients.

PET-CT is a vital imaging modality used not only for initial staging of cancer but also for follow-up consultations to assess treatment response and detect possible recurrence.(4) . The high frequency of CBC reflects its broad utility in evaluating the overall health status, detecting anemia, infection, and other hematological conditions that may complicate cancer treatment.

Liver Function Tests (LFT), accounting for 7.17%, further emphasize the importance of evaluating liver function. The liver is a common site for metastasis, and many chemotherapy drugs are metabolized hepatically, necessitating regular monitoring through LFTs.

PT/INR at 6.70%, is crucial in assessing bleeding risk, particularly in patients undergoing invasive procedures or those at risk of coagulopathies due to their disease or treatment.

The frequency of HIV-HBsAg-Antibody tests (5.92%) indicates the need for screening and managing viral infections that could complicate cancer treatment. Viral hepatitis and HIV can significantly impact the management plan and prognosis in cancer patients.

Echocardiograms (ECHO), advised 3.74% of the time, reflect the need to monitor cardiac function.Certain cancer treatments have the potential to harm the circulatory system and the heart. These side effects, which include hypertension, arrhythmias, and heart failure, can be brought on by or made worse by radiation and chemotherapy, as well as by more recent cancer treatment modalities such immunotherapies and targeted therapies. (5)

C. different diagnostic tests advised in relation to the type of cancer:

1. **Bladder CA**

The diagnostic test usage patterns reveal a focused approach to cancer management. Cystoscopy was the most frequently performed test (25%), reflecting its crucial role in diagnosing and managing bladder cancer through direct visualization and biopsy.

PSMA PET-CT and ECHO, each at 12.5%, highlight the importance of advanced imaging techniques for detailed cancer evaluation and monitoring. PSMA PET-CT is essential for prostate cancer staging, while ECHO assesses cardiac function, which can be impacted by cancer treatments.

The equal frequency of PET-CT, USG KUB, Urine Cytology, HIV, HBSAg, Anti-HCV, CBC, LFT, KFT, and Beta-HCG (6.25% each) indicates their supplementary roles in the diagnostic process. These tests are used to assess overall health and specific conditions, though less frequently compared to primary tests like Cystoscopy and advanced imaging.

2. **Breast CA**

The diagnostic testing patterns for **breast cancer** in this dataset reveal a diverse approach.

CA 15.3 was the most frequently advised investigation, representing 17.07% of the total tests. This biomarker is well-established in monitoring breast cancer progression and response to treatment, underscoring its critical role in patient management. Its high utilization aligns with its importance in assessing disease status and guiding therapeutic decisions.

The second most commonly used tests were ER, PR, and HER2NEU assays, utilized in 13.41% of cases. These tests are essential for determining hormone receptor status and HER2/neu overexpression, which are pivotal in planning targeted therapies or hormonal therapies and predicting prognosis.

KFT (Kidney Function Test), utilized in 8.54% of cases, and FNAC (Fine Needle Aspiration Cytology), used in 9.76% of instances, are also notable.

FNAC, on the other hand, is a valuable diagnostic tool for obtaining cytological specimens for further analysis, especially in evaluating palpable lumps or suspicious areas.

Several other tests showed substantial usage: ECHO, CBC, and LFT, each at 7.32%, and Ki-67, also at 7.32%. These tests provide critical information on heart function, overall blood health, liver function, respectively.
The inclusion of Ki-67 highlights the importance of understanding tumor proliferation rates in treatment planning.

PET-CT, utilized in 6.10% of cases, remains an important imaging modality for evaluating metastatic spread and response to therapy. Its lower frequency compared to CA 15.3 and receptor assays reflects its specific role in staging and monitoring rather than routine diagnostics.

Less frequently advised tests include PT/INR (4.88%), Ultrasound (2.44%), and HIV, HBsAg, Anti-HCV (2.44%). PT/INR is relevant for assessing blood coagulation, particularly in patients planned for biopsy. Ultrasound is often used for imaging but may be less preferred compared to other imaging modalities like mammography or PET-CT.

3. Colon CA

Colonoscopy, CEA, and KFT are the most frequently conducted investigations, each accounting for 15.8%. Colonoscopy is a key diagnostic tool for visualizing the interior of the colon, identifying polyps, and taking biopsies. CEA (Carcinoembryonic Antigen) is a tumor marker commonly used in the follow-up of colon cancer patients. Kidney Function Tests (KFT) are essential to ensure that kidney function is not compromised during cancer treatment.

PET-CT and CBC (Complete Blood Count) are used in 10.5% of cases. PET-CT scans provide detailed images and help in detecting metastases, while CBC is a routine test to monitor overall health and detect potential complications like anemia or infection.

4. Ovary CA

The diagnostic tests most frequently advised for ovarian cancer in this study were CA 125, BRCA 1&2, and ECHO. CA 125 was notably the most common test, reflecting its established role in monitoring .

The prominence of BRCA 1&2 testing underscores the importance of genetic assessment in ovarian cancer, which can inform treatment strategies and family planning.

The relatively lower frequency of CA 19.9 suggests it is less central in initial evaluations

ECHO and PET-CT, used in 6.7% and 8.9% of cases respectively, indicate their role in assessing disease progression and staging.

5. **Prostate CA** .

PSA (Prostate-Specific Antigen) was the most frequently advised test, with 30.0% of patients receiving this test. This underscores its critical role in screening, diagnosing, and monitoring prostate cancer.

TRUS (Transrectal Ultrasound) and KFT (Kidney Function Test) were each advised for 13.3% of patients. The significant use of TRUS indicates its importance in detailed imaging of the prostate, aiding in the precise localization of abnormalities. KFT's frequent usage highlights the necessity of monitoring renal function, especially in patients undergoing various cancer treatments that may impact kidney health.

PSMA PET-CT was advised for 6.7% of patients, demonstrating its advanced role in detecting prostate cancer metastasis and providing a comprehensive evaluation of disease spread. Less frequently advised tests, including the use of BX - TRUS underscores the importance of obtaining tissue samples for histopathological analysis to confirm diagnoses.

6. **Hepatocellular CA**

The analysis of diagnostic tests revealed that AFP (Alpha-Fetoprotein) was the most frequently advised test, reflecting its significant role in diagnosing and monitoring various malignancies, particularly liver cancer. This high frequency underscores AFP's importance in the clinical management of patients with suspected or confirmed cancer.

Liver Function Tests (LFT) and Kidney Function Tests (KFT) were also commonly used, highlighting their essential role in assessing organ function and overall patient health during cancer management.

Imaging techniques such as Triple Phase CT, PET-CT, and PET-CT Triple Phase were

advised less frequently, each at 3.5%. This lower frequency may reflect their role in specific diagnostic scenarios or follow-up evaluations rather than routine initial assessment.

PDL1 (Programmed Death-Ligand 1) is a biomarker used to evaluate the expression of a protein that helps cancer cells evade the immune system. It plays a role in assessing eligibility for immunotherapy treatments

7. Lung CA

Chest X-ray and PET-CT were the most frequently advised tests, each used in 14.3% of cases. Their high frequency underscores their essential roles in initial cancer diagnosis, staging, and monitoring treatment response.

The NGS Panel was advised for 8.9% of patients, reflecting the growing importance of genetic profiling in personalized cancer treatment. This test helps identify mutations that can guide targeted therapies, showcasing the shift towards precision medicine.

PFT (Pulmonary Function Test), LFT (Liver Function Test), KFT (Kidney Function Test), and Lipid Profile were each used in 7.1% of cases. These tests are crucial for assessing the overall health and organ function of patients, ensuring that they can tolerate various cancer treatments.

Bronchoscopy (5.4%) and CT-guided biopsy (3.6%) were used to obtain tissue samples for histopathological and molecular analysis, critical for accurate diagnosis and treatment planning. Unique tests such as KRAS, NRAS, BRAF mutations, and PDL1 evaluation were each advised for 1.8% of patients. These tests are pivotal in identifying specific biomarkers that can predict response to targeted therapies and immunotherapies, emphasizing the move towards more individualized treatment approaches.

CHAPTER 5: CONCLUSION

Initial consultations prioritize accurate diagnoses and procedural safety through frequent use of biopsies and viral marker tests, with a focus on managing infection risks and coagulation status. Follow-up consultations emphasize monitoring disease progression and treatment response, with tumor markers, genetic, and hormonal tests guiding ongoing management and treatment strategies. Routine blood tests are crucial for tracking organ function and overall health during treatment. PET-CT and echocardiography are vital in both stages for staging and monitoring, while less frequent tests like hysteroscopy, colonoscopy, and bronchoscopy are used for specific clinical indications.

For the most Frequently advised test the study highlights the critical importance of Kidney Function Tests (KFT) at 9.35%, essential for ensuring renal function before chemotherapy or imaging procedures. PET-CT scans and Complete Blood Count (CBC) each at 8.57%, are vital for initial diagnostics and ongoing monitoring. Liver Function Tests (LFT) at 7.17% and PT/INR at 6.70% underscore the necessity of evaluating liver function and bleeding risk. HIV-HBsAg-Antibody tests (5.92%) reflect the need to screen for viral infections. Echocardiograms (3.74%) are crucial for monitoring cardiac function, given the cardiotoxic potential of cancer treatments

The diagnostic test usage patterns across various cancers demonstrate a comprehensive and targeted approach to patient management. Each cancer type has some primary tests: **Cystoscopy** for bladder cancer, **CA 15.3** for breast cancer, **Colonoscopy** for colon cancer, **CA 125** for ovarian cancer, **PSA** for prostate cancer, **AFP** for hepatocellular carcinoma etc.. Advanced imaging techniques such as **PET-CT** and genetic profiling tests like the **NGS Panel** highlight the shift towards precision medicine and personalized treatment.

Understanding these patterns can help in optimizing diagnostic workflows, improving early detection, and enhancing patient management.

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CHAPTER 7: PLAGIARISM REPORT

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