Prescription Analysis of Cancer Patients

By

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A thesis submitted to the School of Pharmacy in partial fulfillment of the requirements for the degree of Bachelor of Pharmacy

School of Pharmacy

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Declaration

It is hereby declared that

1. The thesis submitted is my own original work while completing a degree at Brac University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I have acknowledged all main sources of help.

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Approval

The project titled “Prescription Analysis of Cancer Patients” submitted by Sumaiya Binta Shahadat (20346025), of Summer 2024 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Bachelor of Pharmacy (Hons.)

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Ethics Statement

This project does not involve any kind of animal and human trial. An ethical permission is given by the ethical committee of Ahsania Mission Cancer and General Hospital to conduct the survey (attached in appendix 1).

Abstract

A significant number of people around the world lose their lives due to cancer. Over the past decade, the cancer mortality rate has risen by 28%, which is three times greater than the overall mortality rate of 9% during the same time frame. The fight against cancer continues to be a tremendous obstacle in the field of medicine, necessitating ongoing improvements in treatment methods. Analysis of the prescription of cancer patients is very important because it will help to identify if there is any discrepancy or any kind of prescription errors so that improvement can be done in the mode of treatment of cancer patients. Therefore, more studies should be done in order to identify such issues. However, substantial studies are not done in this field in our country. In the current study, data were collected from there 34 prescriptions of cancer patients and analyzed. From the study, it was found that carboplatin was the most prescribed medication for lung cancer patients. Additionally, in one case dexamethasone and levofloxacin were co-administered together which can lead to drug-drug interaction.

Keywords: Carboplatin; Lung cancer; Prescription analysis; Cancer; Drug interactions; Chemotherapy.

Dedication

Dedicated to my parents

Acknowledgement

First and foremost, I would like to thank the Almighty Allah for giving me strength and patience to complete this project with proper knowledge and wisdom, which I hope will reflect through my project. It was a great journey working with my project and the support of a lot of people who are thankfully acknowledged here.

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List of Acronyms

TSG – Tumor Suppressor Gene

PP - Prescription Pattern

IMRT- Intensity Modulated Radiation Therapy

SBRT- Stereotactic body radio therapy

PDI- Potential Drug Interaction

DDI- Drug-drug interaction

UV- Ultraviolet

WHO- World Health Organization

IV- Intravenous

3D- Three dimensional

QOL- Quality of life

5FU- 5-fluorouracil

GERD- Gastroesophageal reflux disease

MOA- Mechanism of action

5HT- 5-hydroxytryptamine

cAMP- Cyclic adenosine monophosphate

dGTP- Deoxyguanosine triphosphate

DNA- Deoxyribonucleic acid

RNA- Ribonucleic acid

SDIs- Severe drug interactions

OTC- Over the counter

Chapter 1

Introduction

1.1 What is Cancer?

Cancer is a persistent illness that calls for therapy over an extended period of time (Batalik et al., 2021). Cancer develops when cells in any organ or tissue begin to divide uncontrollably. In normal tissues, apoptosis or programmed cell death, is replaced by uncontrollable cell proliferation in cancerous cells. The development of metastases is the primary factor leading to mortality in the majority of cancer patients (Yu et al., 2024). Malignant cells are defined as abnormally growing cells and the state in which a normal cell becomes malignant is known as "malignancy." Through blood or lymphatic flow, these cancerous cells might go to any other organ and cause cancer there. This process is known as metastasis (Bergers & Fendt, 2021). Tissue surrounding a malignant cell might also get infected. The most prevalent malignancies worldwide include lung cancers, skin cancers, colorectal cancers, bladder cancers, stomach cancers, leukaemia, liver cancers, bone cancers and breast cancers (Adhikari et al., 2018). The World Health Organization claims that in many nations cancer ranks as the main cause of early mortality (age 70 years) (Ficarra et al., 2022). It is caused by various external and internal variables including chemicals, radiation, tobacco, pathogenic organisms, hormones, immunological disorders, inherited mutations, and random mutations. Abnormal cell development is caused by changes in DNA structure, often known as genes (Dey et al., 2024). Many factors, including heavy alcohol usage, cigarette smoking, being overweight, being inactive, eating poorly, being exposed to UV and ionizing radiation and pollution can be avoided to prevent cancer. However, the most uncontrollable risk factor at the moment is age (Das et al., 2020). Most malignancies are produced by mutations in somatic cells (Balmain, 2020).

Every year, cancer claims the lives of 10 million individuals and results in 6 million fatalities globally (Huang et al., 2021). In the next 25 years, it is projected that there will be 300 million new cancer diagnoses globally and 200 million cancer-related fatalities, with developing countries representing more than two-thirds of all cancer cases (WHO, 1999). Changes in proto-oncogenes can cause cancer cells to divide out of control, which can increase life even after treatment and spread (Massague & Ganesh, 2021).

1.2 Prescription and its Pattern

As of 2019, the American Cancer Society reported that over 17 million individuals in the United States were diagnosed with cancer. By 2030, that number is likely to have grown to 22 million. So, there is an increasing demand for health care workers to find the best ways to help cancer survivor deal with their symptoms (Jairam et al., 2020). Due to the development of newer medications and improved understanding of the underlying pathophysiology of cancer, the prescription pattern for anticancer medications has changed dramatically in recent years. Finding out how medicines are used among individuals can be done in part by looking at prescription trends. Budgeting for healthcare is substantially aided by this (Tichy et al., 2020). Prescription patterns are analyzed to determine drug usage. Inappropriate drug use might pose a concern to patients. Drug use reviews that happen on a regular basis can lower the risks for patients and make sure that therapy is safe and efficient. The 'prescription' is a crucial tool for patients and clinicians to diagnose and prevent diseases, resulting in optimal healthcare outcomes (Manichavasagam et al., 2017). In order to achieve universal healthcare—which is especially important in middle- and low-income countries—and to ensure excellence, security, equity, and a manageable price of treatment, it is crucial to use medicine appropriately. The pharmacy department at a hospital is essential for dispensing medications to patients. Nonetheless, its efficacy is significantly affected by prescribing patterns (George et al., 2020). WHO estimates indicate that more than 50% of drugs are improperly given and distribute. This

results in irrational medicine consumption, supply shortages, expirations, ineffective financial management, failures of therapy, and antibiotic resistance. Consumers and community members endure the financial burden of utilising costly medications (Mbabazize et al., 2024). Improving treatment efficacy and reducing unfavorable consequences requires monitoring irrational pharmaceutical usage is a worldwide problem that costs resources. Prescribing medicines involves several steps, including selecting the appropriate drug for the patient, choosing the most relevant drug from different categories, setting a suitable dosage and dosing time frame, and monitoring the patient's progress with the drug (Vyas et al., 2022).

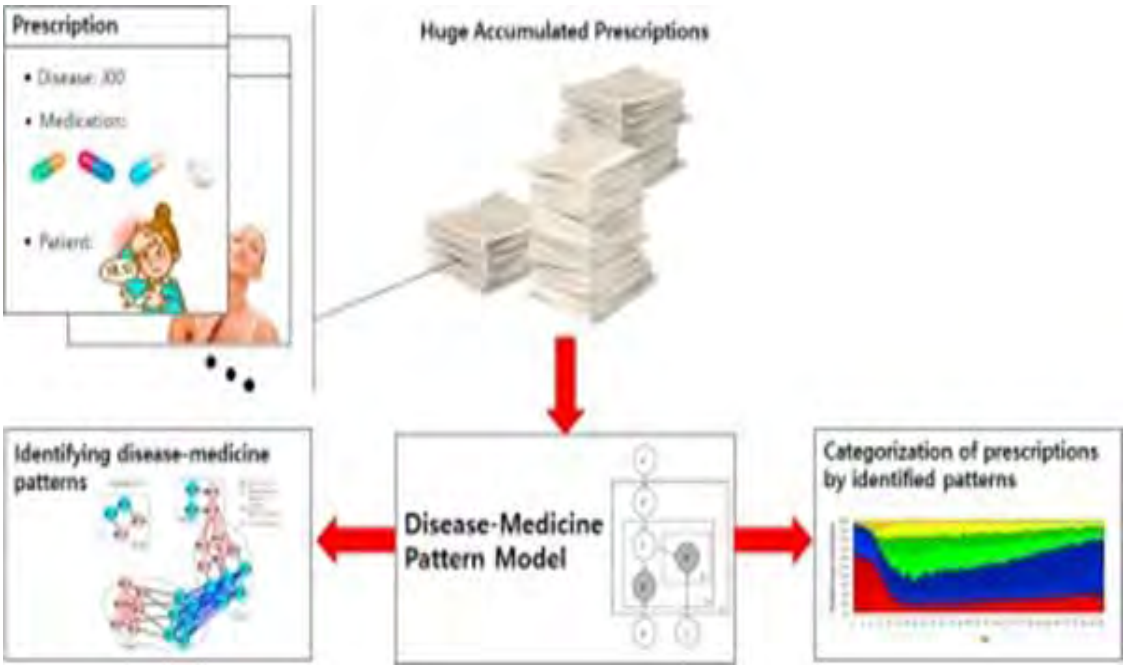

Figure 1: Prescription Pattern (Park et al., 2017)

1.3 Treatment of Cancer

The primary cancer treatment approaches include radiation therapy, stem cell transplantation, hormone therapy, immunotherapy, chemotherapy and precision or customized medicine, which is a more recent or emerging approach. When selecting a therapy, various factors associated with the patient, tumour, and treatment are carefully considered (Aghamohammadi et al., 2019).

Radiation therapy, chemotherapy, and surgical procedures are the three most common treatments for cancer at the moment (Arruebo et al., 2011). The traditional classification of antineoplastic drugs is based on their source or mode of action. The primary categories consist of 16 alkylating and alkylating-like compounds, plant alkaloids, antimetabolites, antitumor antibiotics, tertiary agents and hormonal agents (Aghamohammadi et al., 2019).

Plant alkaloids cause mitotic arrest during metaphase by attaching to microtubule proteins. When a cell cannot divide, it collapses. For the M phase, this category is primarily cell cycle phase specific (Mondal et al., 2019). Various agents are distinct from each of the main categories of cytotoxic agents. The common miscellaneous agents include hydroxyurea and asparaginase. Topoisomerase inhibitors preserve single-strand breaks by preventing DNA strand realignment. The extracellular and intracellular environments are changed by hormonal agents (Mastrangelo et al., 2022). In recent advancement, different treatment procedures are followed by the health professionals and here two major types of treatment are explained below.

1.3.1 Chemotherapy

Chemotherapy is a standardized regimen of one or more anti-cancer medications used to treat cancer. Chemotherapy is the most important cancer treatment modality. It stops cancerous cells from developing and spreading by destroying them with chemicals or medications (Suhail et al., 2024). The most effective treatment is chemotherapy, especially for cancers that have metastasized (Behranvand et al., 2021). This drug has pros and cons that affect both the mental and physical parts of life, such as pain, stress, anxiety, nausea, vomiting, and problems with the digestive system. The majority of chemotherapy medications or combinations of drugs are selected with consideration given to the type of cancer and the stage it is in. These medications are primarily intended to ease the stress that is caused by the growth of the tumor and to

neutralize the cells that are malignant (Anand et al., 2023). Chemotherapeutics mostly aim at and harm the DNA, leading to hindered DNA replication and the synthesis of DNA and RNA. Many cytotoxic medications, including vinblastin, fosfamide, mytomycin C, etoposide, 5-fluorouracil, epirubicin and carboplatin, are prescribed to treat cancer patients. The most often given anticancer medications are 5-fluorouracil and cisplatin (Boogaard et al., 2022).

One interesting approach of administering cancer medications is orally. It is important to note that the gastrointestinal system is characterized by specific and efficient chemical, physical, and physiological limitations that reduce the absorption of medications, mainly chemotherapy agents (Parodi et al., 2021). Oral medications are often administered to patients who have late-stage solid tumors (such as lung, breast, pancreas, kidney, prostate, and colorectal cancer) as an alternative to or in along with intravenous chemotherapy to treat their condition. When prescribing oral cancer medications to patients who have solid tumors, it is essential to give serious consideration to both the benefits and the drawbacks of the treatment for cancer (Given et al., 2017). In 2020, 67% cancer drug approvals were OACDs (oral anticancer drugs). Oral anticancer medications can ease travel and appointment scheduling compared to parenteral therapy. As with other innovative medicines, OACDs have notable out-of-pocket expenses, which can delay prescription delivery and prevent treatment (Doshi et al., 2022).

1.3.2 Radiation Therapy

Radiotherapy is an essential treatment for oncology patients that either directly generates destruction of DNA by ionized radiation (IR) or indirectly induces damage from oxidation through reactive oxygen species (ROS), which ultimately leads to the destruction of cancer cells (Liu et al., 2020). Recent developments in 3D conformal radiation treatments, such as stereotactic body radiotherapy (SBRT) and intensity-modulated radiation therapy (IMRT), have allowed for the precise delivery of radiation doses that match the tumor's exact dimensions

while decreasing radiation exposure to normal tissue around (Chen & Kuo, 2017). High-energy radiation beams are utilized to either kill or shrink cancer cells in order to prevent the growth and spread of cancer cells. This is done in order to stop the progression of cancer. Despite the significant progress made in radiotherapy, there is a persistent difficulty in improving the radiation damage to cancerous tissue while minimizing collateral effects on healthy tissue (Gong et al., 2021).

1.4 Side Effects of Cancer Treatment

Chemotherapy agents that successfully eliminate cancer cells may also cause adverse effects and damage to cells that are healthy. This may affect patients' physical well-being and quality of life (QOL). Depending on the specific treatment administered, cancer treatment regimens might result in both local and systemic alterations and consequences (Albano et al., 2021).

For example, in a clinical trial, patients undergoing chemotherapy based on fluorouracil/oxaliplatin/leucovorin for three months and capecitabine/oxaliplatin for six months, respectively, saw a frequency of diarrhea of 34% and 45%. In clinical practice, an observational research on the side effects of chemotherapy revealed that 75% of patients with colorectal cancer experience diarrhea of any severity (Katta et al., 2023).

The frequency of problems and the severity of those problems are both determined by a number of elements, such as the total amount of radiation that is provided, the length of time that the radiation is delivered, and the particular parts of the body that are exposed to radiation (Brook, 2021). A wide range of side effects are possible with radiation therapy, based on the area being treated and the individual individual's reaction. Common adverse effects include drowsiness, rashes, loss of hair, and swelling in certain areas. It also causes skin reactions, which can be anything from redness to blistering, are more apparent in places that have been exposed to radiation. Radiation can also negatively impact surrounding tissues or organs, which might

result in side effects include swallowing problems, lung inflammation, bladder irritation, or recurrent cancers (Singh et al., 2024). Approximately half of cancer patients have radiation therapy regularly during the duration of their disease. People with head and neck cancer (HNC) often get painful radiation-induced mucositis and they also lose lean mass (LM). When undergoing radiation treatment for non-small-cell lung cancer (NSCLC), 20% of patients experience oesophagitis or pneumonitis. In the same way, gastrointestinal and genitourinary effects are common in people with prostate and rectal cancer who are getting RT (Piraux et al., 2021).

1.4.1 Management of Side Effects

Recent advancements in the diagnosis and treatment of cancer at an earlier stage have led to an increase in the total amount of people who have survived the disease all over the world. The current models of care do not sufficiently meet the wide range of physical, psychological, and supportive care requirements of cancer patient survivors (Emery et al., 2022). To manage common side effects like nausea, vomiting, fatigue, hair loss, neuropathy, diarrhea and constipation, require medicine or change the dosage of the chemotherapy. Medication can be used to treat fatigue, nausea, and vomiting. Doctors frequently reduce dosages for neuropathy and provide drugs that can help in the formation of new nerve cells (Singh et al., 2024). Before starting chemotherapy, patients should reveal all relevant medical history. For instance, people with diabetes may be eligible for chemotherapy, but this is handled carefully to avoid worsening nerve injury and other complications that are more prevalent in this population (Rahman et al., 2022). To alleviate the health-related anguish of cancer patients, it is essential to educate them on undesirable effects management and involve them in preventative measures It may facilitate their enhancement of solutions to problems, mitigation of worry, and facilitation of self-care (Almohammadi et al., 2020).

The ability of an individual to effectively manage the indications, medical care, both emotional and physical impacts, and lifestyle adaptations that are normal when dealing with a chronic illness is referred to as self-management. This comprises the capacity to evaluate one's state and employ behavioural, and emotional reactions required for maintaining a desirable quality of life (Howell et al., 2021). When it comes to cancer patients, effective self-management may comprise the appropriate monitoring oneself, recognition, submitting reports, and management of signs and symptoms and therapy for the treatment of undesirable effects and control of issues that keep coming back (Dilalla et al., 2020). Management of side effect encompasses the efficient management of biologically consequences and concurrent illnesses to enhance daily functioning, adherence to multiple medications, effective management of modifications and coordination of care across different stages of the disease and levels of care, and implementation of healthy lifestyle habits to minimize the risks of late effects (Gress et al., 2020).

1.5 Drug- drug Interaction

Drug interactions are widely recognized to result in detrimental effects. Records of drug interactions can assist physicians in identifying these interactions and preventing their adverse effects (Hahn & Roll, 2021). Oncology patients often encounter drug-drug interactions, with most of these interactions resulting in considerable adverse pharmacological reactions. Drug–drug interactions are estimated to account for mortality in around 4% of cancer patients in a one particular study (Leeuwen et al., 2013). Patients suffering with cancer may have altered pharmacokinetic characteristics which increases the possibility of medication interactions (Riechelmann et al., 2007). Pharmacokinetic parameters may change due to factors such as mucositis, malnutrition, reduced serum-binding proteins, edema, and renal/hepatic dysfunction. Some cancer treatments, like chemotherapy or targeted therapies, can affect liver enzymes that metabolize medicines (Loele et al., 2022). The clearance of drugs from the body

might be impacted by cancer and its therapies on the liver and kidneys. Drug buildup or decreased clearance can occur when these organs are not functioning properly. Drug breakdown speed can change with this modification. Drug interactions are classified into three types: pharmacodynamic, pharmacokinetic and pharmaceutical (Tsoukalas et al., 2022). Pharmacodynamic interactions typically arise when two medications with comparable modes of action are combined, or an electrolytic variation caused by one medication affects the overall impact of another situation. An example of a pharmacokinetic interaction is when one medication has an effect on the way another medication is absorbed, distributed, metabolized, or eliminated from the body. A pharmaceutical interaction happens when two medications that are not compatible chemically are combined prior to intravenous injection, which causes one or both of the pharmaceuticals to become inactive (Lavan et al., 2021). Since every interaction are not equally detrimental, effective control of the discovered interactions depends on classification of the interactions into several levels (Dechanont et al., 2014).

1.5.1 Classification of Anti-cancer Drug Interaction

Pharmacokinetic and pharmacodynamic are two categories that can be applied to PDIs. The ways in which medications are absorbed, distributed, metabolized, and eliminated are all influenced by pharmacokinetic interactions. Interactions between pharmacokinetics and liver enzymes involving cytochrome P450 are often characterized by inhibition or induction. Several anticancer medications are metabolized through the use of this mechanism (Popa et al., 2014). Cytochrome P450-related PDIs may arise. According to the severity of the DDI, the following categories are used:

1. Major: The interactions between the prescription medications pose a serious risk to life and should be addressed right once. Alternative medicine use is advised (Zhang et al., 2009).

2. Moderate: This DDI may not keep up with the patient's clinical progress. Although not lethal, this can undoubtedly interfere with the patient's other medications and treatments and need to be further monitoring (Wang et al., 2022).

3. Minor: These DDIs don't need much attention because they are rather general (Leeuwen et al., 2011).

1.6 Patient Compliance

In accordance with the World Health Organization (WHO), compliance is when a patient does what their doctor tells them to do for treatment and makes ideas for changes to their diet and way of life. Noncompliance with anticancer treatment is not defined by the WHO (Baryakova et al., 2023). A significant proportion of cancer patients were administered treatment intravenously (IV), while oral anticancer drugs currently make up 25% of the oncology drugs now under research. The vast majority of patients (>90%) favor oral drugs over IV treatments due to the ease and sense of independence that the drugs offer (Lin et al., 2017). Most of the time, chemotherapy is used to treat cancer, but there are other options as well. In chemotherapy adherence, both the patient and the healthcare worker work together to quietly figure out how well the other person is following their daily treatment plans, which include dosage, frequency, duration, and stopping the treatment (Bekalu et al., 2023). The practice of consistently taking one's medication as prescribed to the recommendations of clinicians and taking over 80% of the prescribed drugs as directed, while also maintaining the planned treatment regimen for the whole recommended period. Nonadherence may be defined as the persistent discontinuation of prescription medicine by a patient for a duration beyond 60-180 days (Peddie et al., 2021). Nonetheless, the challenge of non-compliance is a substantial barrier for individuals receiving oral antineoplastic therapy. Anticancer medications are more accessible, inexpensive and widely available, yet treatment adherence remains a serious issue (Puts et al., 2014). Cancer

patients taking oral medications often do not follow their treatment programs. Understanding patient problems throughout therapy is crucial for addressing pharmaceutical nonadherence (Talens et al., 2021).

1.6.1 Factors and Barriers Affecting Medication Adherence

Adherence to treatment plans is essential for recovery and an enhanced quality of life, as cancer disorders predominantly affect older individuals. Age, comorbidities, sensory and cognitive impairments, and misconceptions about medications can all affect adherence (Hall et al., 2016). The problem can be worsened by language barriers and inadequate health literacy. Comorbidity also elevates the possibility of nonadherence. Cost, treatment difficulty, drug-food and drug-drug combinations, adverse effects, and patient-related variables such as forgetfulness and carelessness are all factors that can affect adherence (Smith et al., 2016).

Stress, hopelessness, physical limitations and treatment issues can all impact in medication adherence. Injectable pharmaceuticals can be inconvenient and patients may experience difficulty in administering medication as a result of physical limitations (Tan et al., 2021). Nonadherence can also be influenced by inadequate coordination, fragmented care and communication disruptions. Health insurance is a substantial impediment in low-income countries. Factors such as depression, medication use and comorbidities can contribute to nonadherence (Konstantinou et al., 2020).

1.7 Prescription Errors

An error in medication is a malfunction in the treatment process that either causes damage to the individual receiving treatment or has the potential to cause harm to the patient (Moon et al., 2019). In developing countries, the incidence of cancer is increasing among both adults and children, and as a result, there has been an equivalent rise in the employment of anti-cancer drugs as a type of cancer therapy. Nevertheless, when drug use rises, the likelihood of

medication errors also increases. These errors can happen at any point throughout the prescription, transcribing, distribution, and administration of anti-cancer medications, leading to incapacity, extended hospital stays, and even death itself (Dorothy et al., 2021). Medication errors with anticancer treatments can be extremely risky due to the high toxicity and low therapeutic index of these drugs. This is in alongside the medical condition of cancer patients. Antineoplastic drugs were shown to be the second most common cause of fatal prescription errors, as indicated by a study (Ranchon et al., 2011). Errors in prescriptions can range from being somewhat insignificant and unimportant to being quite serious and even potentially lethal. It is estimated that between one and two percent of individuals in hospitals in the United States and the United Kingdom are affected by pharmaceutical errors. The bulk of these errors are caused by prescription errors (Mathaiyan et al., 2015). At least one to three percent of adolescent and pediatric oncology patients are affected by chemotherapy errors, and these errors happen at a rate of around one to four on every thousand orders. Chemotherapy errors are present at every stage of the pharmaceutical usage process. Cytotoxic medicines commonly employed in cancer chemotherapy have a high risk of toxicity due to their limited therapeutic effectiveness (Weingart et al., 2018). So far, prescriptions of cancer patients has been analyzed and assessed in order to look for what kind of drugs are administered in what types of cancers which are rare in our country. Therefore, the lacking of these kinds of data and findings in our country, prescriptions can be analyzed vastly and carefully to see how much relevant the findings got from this work and if the procedures are being followed while giving treatment to the patients.

1.8 Aim and Objective

Prescription analysis is very important as different types of problems can be occurred due to error. The objective of this project is:

- To analyze the data obtained from the collected prescriptions to investigate the accuracy in prescribing anti-cancer medications for specific types of cancers
- To look for drug-drug interactions or any presence of prescription errors
- To suggest preventive measures to avoid drug-drug interactions.

Chapter 2

Methodology

In this project, prescription analysis of cancer patients was analyzed which were collected from the previous work done by questionnaire based survey on 103 patients who were admitted in the Ahsania Mission Cancer Hospital in Dhaka. Ethical permission has been taken from the hospital which has been attached here. In the previous paper, prescription analysis was not done. Those prescriptions that were collected were a single prescription from each patient during their admission in the hospital at that particular time and those prescriptions were analyzed in this work. Variations were observed in the prescription pattern of different anti-cancer drugs to look for any DDIs. Prescriptions were collected and among them 34 prescriptions were analyzed here to look for different aspects such as what anti-cancer drugs were mostly used to the cancer patients and the presence of any drug-drug interactions in the given treatment which were not discussed in the previous paper.

Chapter 3

Result and Discussion

The total number of prescription for this study was 34. The prescriptions were analyzed based on the socio-demographic characteristics, disease related characteristics, diagnosis type, medication related characteristics, drug-drug interaction related, associated side effects rate and the common drugs prescribed together with anti-cancer drugs are expressed in tabular and graphical form right below.

3.1 Mostly used Chemotherapy Medication

From the table 1, we can observe that 5 types of chemotherapy was used for different patients according to their severity of cancers. Among 34 patients, chemotherapy was given to 9 different patients that we found from the collected prescription but not all the information given in there. Among 9 patients, carboplatin was given to most patients around 3 patients, cisplatin was given to 2 patients, 5-fluorouracil was given to 2 patients also oxaliplatin and cyclophosphamide were given on 1 patient each.

Table 1: Types of Chemotherapy

Chemotherapy name	No. of patients
Carboplatin	3
Cisplatin	2
5-fluorouracil	2
Oxaliplatin	1
Cyclophosphamide	1

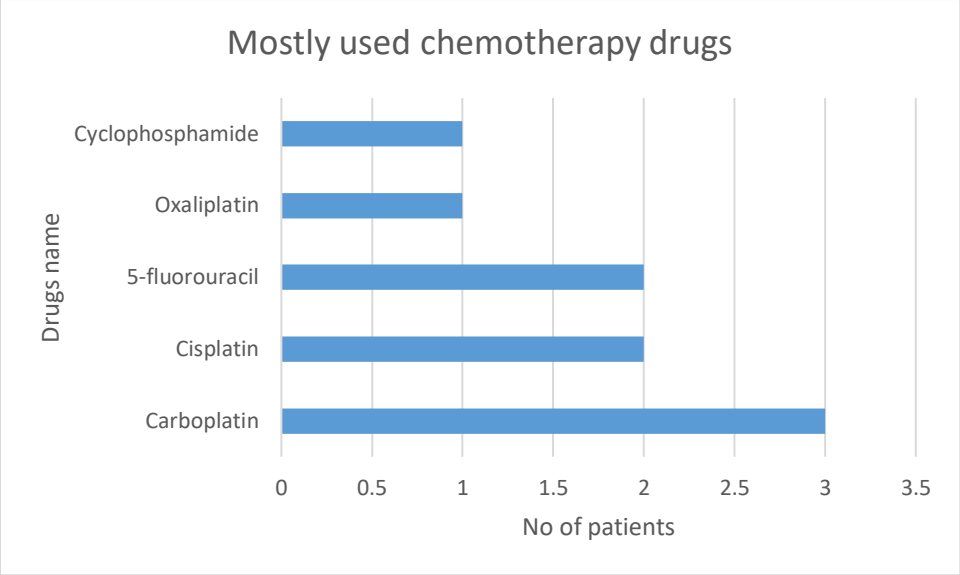

Figure 2: Mostly used Chemotherapy Medication

Carboplatin was used mostly in lung cancer treatment in 3 patients. Approximately 66% of short-cell lung cancer (SCLC) patients are diagnosed with advanced-stage illness, which is linked to a negative outlook and a rate of survival of five years of less than 7%.Carboplatin (CP) combined with etoposide (ET) is the established treatment for over 20 years (Liu et al., 2021). The medications that contain platinum are responsible for the establishment of intra- or inter-strand cross-links with DNA. These cross-links result in the arrest of the cell cycle or death, and they also cause the inhibition of proliferation. Nucleotide excision repair (NER) and base excision repair (BER) are two examples of DNA repair processes that play a role in facilitating the repair of oxidative damage to DNA (Tiwari et al., 2022).

Also, cisplatin was used in 2 patients associated with sinus cancer and bone cancer. Cisplatin is a pharmacological agent that is well-established as an anti-cancer agent due to its therapeutic implications. The anticancer activity of cisplatin is determined by its molecular structure, which inhibits the synthesis of Deoxyribonucleic Acid (DNA) in a manner that is depending on the dose (Tchounwou et al., 2021). Neoplasms affecting the paranasal sinuses are uncommon, comprising just 3.0% of neck and head carcinomas and as just a few as 0.5% of all malignant disorders. For people with maxillary sinus carcinoma, chemoradiotherapy does not

always lead to good treatment results. Recently, RT with concurrent intra-arterial infusion chemoradiotherapy has been used on patients (Doi et al., 2016). Osteosarcoma is a type of tumor that made up 15% of all discovered cancers in kids and teens. The survival rate for people with primary OS is only 65–70%, and the survival rate for people who have metastasized is only 19–30%. This means that the treatments we have now for osteosarcoma do not work well enough to fix it. These days, surgery along with combination chemotherapy like doxorubicin and cisplatin is the standard way to treat patients (Ferretti & Leon, 2021).

5-FU is a chemotherapeutic drug that is often used in the treatment of some malignancies, including those that are found in the breast, pancreas, cutaneous, stomach, esophageal, and head and neck regions (Vodenkova et al., 2021). Here, 5-FU was used in one patient who was admitted for stomach cancer. Although chemotherapy with 5-fluorouracil (5-FU) is the main treatment for colorectal cancer, there are additional treatments available, it has drawbacks including systemic toxicity, limited efficacy and selectivity, and the emergence of resistance (Alzahrani et al., 2023).

Oxaliplatin was used in one patient who was admitted for the treatment of liver cancer. Cisplatin, carboplatin, and oxaliplatin, which are classified as platinum-based medicines, are among the limited number of chemotherapeutic medications that have shown efficacy in treating liver cancer. Oxaliplatin is a novel third-generation platinum anticancer medication that received approval from the US FDA in 2002 (Jiang et al., 2023).

Moreover, cyclophosphamide was prescribed for breast cancer treatment. The alkylating drug cyclophosphamide (CP) is a cancer treatment for both solid and blood cancers (Helsby et al., 2021).

3.2 Prescriptions with Potential Drug-drug Interactions

In table 2, we can see that among 34 prescriptions, 10 prescriptions were discovered to include a combination of several drug-drug interactions, which would be detrimental to cancer patients. On the other hand, 24 prescriptions were determined to contain no interactions at all.

Table 2: Presence of DDIs in Prescriptions

DDIs status	No. of prescription	Percentage (%)
Yes	10	29
No	24	71

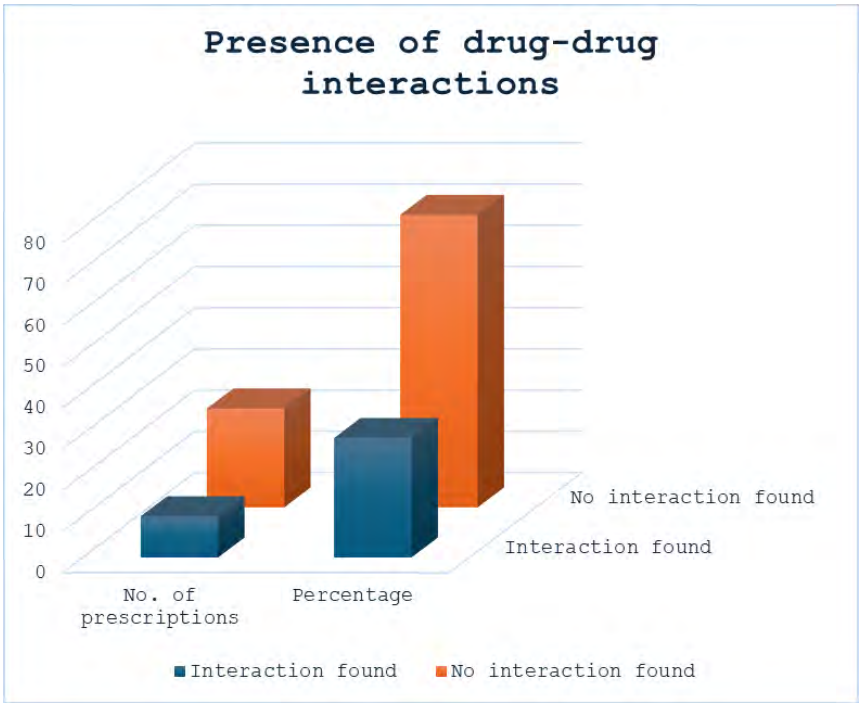

Figure 3: Number and Percentage of Drug-drug Interacting Prescriptions

As can be seen in figure 3, the number of prescriptions that were associated with drug-drug interactions was 10, and the percentage of those prescriptions was 29%. On the contrary, prescriptions with no drug-drug interaction number and percentage was 24 and 71%.

A pharmacist or healthcare professional should be well informed about any new prescription drugs or over-the-counter medication before starting the treatment, even if it is just vitamins or

other nutritional supplements. It is important to verify whether any supplements or pharmaceuticals have a "Drug Interaction Precaution" listed as a major warning (Hamadouk er al., 2022).

3.3 Severity of DDIs

In table 3, three stages of severity were found. Among 34 prescriptions, 1 minor interactions, 6 moderate and 1 major drug-drug interactions were found.

Table 3: Number of Prescription Based on Severity of DDIs

Severity	No. of prescriptions	Percentage (%)
Minor	1	3
Moderate	6	18
Major	1	3

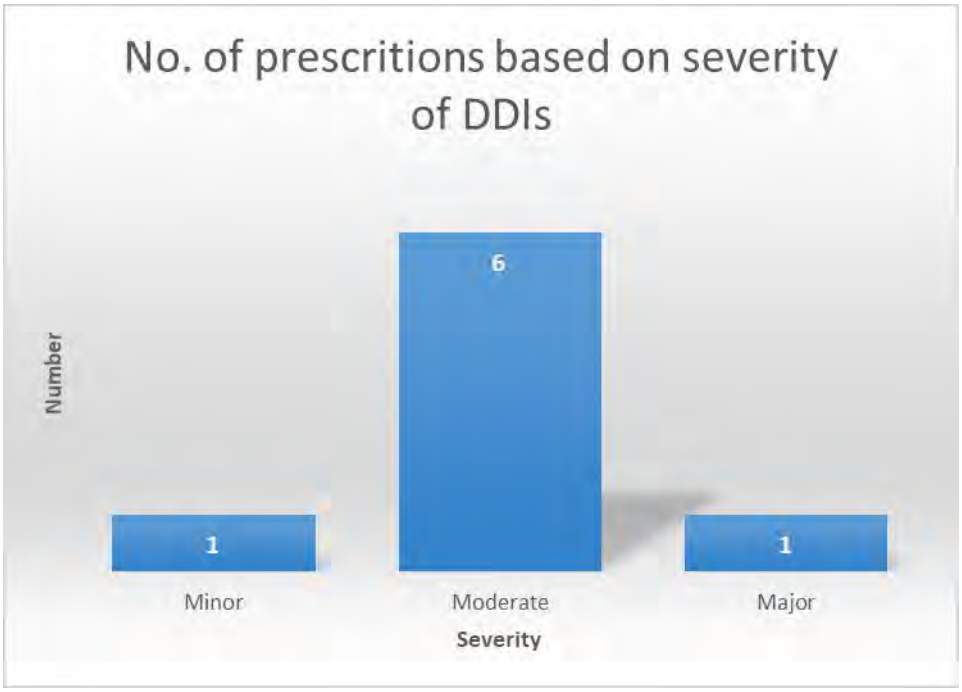

Figure 4: Number of Prescriptions Based on Severity of DDIs

In the figure 4, we can see there were highly moderate drug-drug interactions and the percentage was 18%, major and minor both type of drug-drug interactions were 3%.

In table 4, we can see some examples of drug-drug interactions that were found in the prescriptions. Patients are frequently prescribed a large number of medications, which increases the likelihood that they will experience adverse drug reactions. Among all the other medication errors, drug-drug interactions are a serious concern.

Table 4: Eight Examples of DDIs Found in Prescriptions

Drug- 1	Drug- 2	Severity
Cyanocobalamin	Esomeprazole	Minor
Pegfilgrastim	Oxaliplatin	Moderate
Dexamethasone	Lactulose	Moderate
Metronidazole	Capecitabine	Moderate
Capecitabine	Esomeprazole	Moderate
Fluconazole	Dexamethasone	Moderate
Lactulose	Fluconazole	Moderate
Dexamethasone	Levofloxacin	Major

- Combining esomeprazole molecule with vitamin B12 should be done carefully by specialists. The renal function (creatinine clearance) should also be established under close observation of plasma concentrations. By contrast, esomeprazole has been found to interfere with laboratory examinations. Treatment with esomeprazole should be halted temporarily for at least five days before evaluation of this parameter (Fosca et al., 2021). It shows minor DDI in cancer patients as esomeprazole reduce stomach acid and hamper the absorption of cyanocobalamin (vit B12). If the cyanocobalamin is given in the IV as injected form and it will bypass by GIT, which will not be affected anymore even if the stomach acid reduced there (Tao et al., 2022).
- Incidence of hypersensitivity responses (HSR) to antineoplastic drugs is rising. The incidence of hypersensitivity reactions (HSR) to carboplatin and oxaliplatin has been documented to range from 12% to 17%, with over 50% of patients experiencing moderate to severe symptoms if it is used with pegfilgrastim (Apraxine et al., 2022). It

could be used with bevacizumab to reduce moderate drug drug interaction which occurs when pegfilgrastim and oxaliplatin are used together (Saleem et al., 2020).

- Dexamethasone and lactulose shows moderate drug interactions in patients if both are used together. According to some estimates, interactions among drugs (DDIs) are responsible for 20% to 30% of all adverse drug events (ADEs). Interactions between medications, also known as drug-drug interactions, can have a detrimental impact on the results of treatment, resulting in unanticipated adverse effects and/or a decrease in the efficacy of the treatment (Rawal et al., 2023). Dangerous drug-drug interactions (DDIs) occur in hospital units involving 3-5% of cancer patients, while 60–70% of them are of significant clinical importance and majority of them might lead to adverse drug reactions (ADRs) (Spanakis et al., 2021).
- Metronidazole and capecitabine cause moderate drug drug interactions in cancer patients. Capecitabine is used as oral chemotherapy medications to treat different types of cancers. Both drugs cause gastrointestinal issues like nausea, vomiting and diarrhoea (Leeuwen et al., 2022).
- Extended acid suppression by proton pump inhibitors (PPIs) in cancer patients was shown to decrease the effectiveness of capecitabine in fighting tumours. Capecitabine with esomeprazole shows moderate drug drug interactions in the patient body (Re et al., 2021). The increasing incidence of most cancers with age poses a greater challenge in the field of oncology. Moreover, cancer and other anticancer medications induce symptoms and unfavorable physiological responses. Esomeprazole reduces stomach acid and so capecitabine cannot be reuptake properly (Lanser et al., 2023).
- Drug interactions between fluconazole and dexamethasone in cancer patients are modest. Osteoporosis and hyperglycemia are side effects that can become more likely at higher doses of dexamethasone. A majority (58.4%) of the DDIs recorded in the

current study were determined to be of moderate severity, which aligns with findings from previous studies within the same range (Gholipourshahraki et al., 2023).

- Dependent on the database, drug-drug interactions (DDIs) are a common occurrence in hospitalised paediatric hemato-oncology patients varies from 44.7% to 51.3% to 56.8% to 74.1%, and may reach 83.5% in outpatients. Antifungal medications are commonly implicated in the incidence of drug-drug interactions (DDI). There is a moderate level of medication interaction between lactulose and fluconazole in the treatment of cancer (Oleszkiewicz et al., 2023).
- Dexamethasone and levofloxacin shows major drug drug interactions in cancer patients. As a result of their small therapeutic index, most TKIs can cause DDIs that lower the therapeutic effects to both drugs or link to dangerous or even fatal side effects (Wang et al., 2023). It constitutes 20-30% of all negative effects. As a result of the fact that cancer patients are taking multiple medications in conjunction with anticancer treatments, they are at a greater risk of creating drug-drug interactions (DDIs). This is done in an effort to reduce the negative effects that are caused by immunotherapy (Bektay et al., 2022).

Chapter 4

Conclusion

Overall, this study shows the mostly used chemotherapeutic drugs in cancers and how common drug-drug interactions are across the nation which is quite high. Presuming the existing state of Bangladesh's healthcare services is not too difficult. This study can help future and present healthcare providers become more aware of basic but important issues. Healthcare workers have to keep an eye on and double-check most prescriptions to make sure there are not any interactions. Computerized systems that check for drug interactions can be helpful when figuring out if a medication is safe because of drug interactions. Patients should be knowledgeable about their drugs. It is not too late to reconsider the proverb 'there is a medication for every ill'. Prescribers should prioritize healthcare service over business interests. To address the insufficient number of prescribers, authorities should closely monitor their prescribing methods and license validity. Furthermore, the Bangladesh Drug Administration and other policymakers in Bangladesh must create suitable regulations and make sure they are followed.

Future Work

More conclusions and proof regarding the prescribing process and shortcomings in Bangladesh will come from more research using a larger set of data. Other parameters can be used to assess the data generally. First and foremost, accurate diagnostic and follow-up reports must be kept track of so that we can learn more about how drug interactions affect people who already have other diseases that are related to the one we are studying. Secondly, experts in the various fields of practice of physicians can assess the samples. Thirdly, prescriber degrees can be used to study prescription errors and identify the impact of education levels in the healthcare system. The prescriptions that were collected from the hospital were one time prescription. A cancer

patient gets lots of prescriptions while staying in the hospital but here only one prescription was collected. So it was a drawback that in all prescriptions there was data and lots of information about administered drugs and treatment. However, here data were lacked due to this issue. Also, in our country Bangladesh, these types of prescription analysis of cancer patients are not so commonly analyzed so it should be more focused.

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Appendix 1: Permission by Ethical Committee of AMCGH to Conduct the Survey.

Ahsania Mission Cancer & General Hospital
Plot # 03, Embankment Drive Way, Sector- 10, Uttara Model Town, Uttara, Dhaka-1230, Bangladesh
Phone: +880-2-55092196-7, 09678016391, Mob: 01531 291 810, 01841 556 601
E-mail: info.amcgh@gmail.com, Website: www.ahsaniacancer.org.bd
A Non Profit Organization of Dhaka Ahsania Mission

DAM/AMCGH/1900/2022- 1017

28/11/2022

Golam Morshid
Student ID: 19146089
School of Pharmacy
BRAC University

Sub: **Letter of permission to conduct a questionnaire survey on cancer patients.**

In the light of your application dated 26.11.2022, you are permitted to collect data for your research work entitled "**The Current Cancer Situation in Metropolitan Dhaka**" from Ahsania Mission Cancer and General Hospital, Dhaka.

28.11.2022

Brig Gen (Dr) Md Zakir Hassan (Retd)
Director, Medical Services
Ahsania Mission Cancer & General Hospital
Uttara, Dhaka-1230

CC to:

- Managing Director
- Head of IT
- Deputy Director, Medical Services
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It is essential to understand the limitations of AI detection before making decisions about a student's work. We encourage you to learn more about Turnitin's AI detection capabilities before using the tool.

Disclaimer

Our AI writing assessment is designed to help educators identify text that might be prepared by a generative AI tool. Our AI writing assessment may not always be accurate (it may misidentify writing that is likely AI generated as AI generated and AI paraphrased or likely AI generated and AI paraphrased writing as only AI generated) so it should not be used as the sole basis for adverse actions against a student. It takes further scrutiny and human judgment in conjunction with an organization's application of its specific academic policies to determine whether any academic misconduct has occurred.

Frequently Asked Questions

How should I interpret Turnitin's AI writing percentage and false positives?

The percentage shown in the AI writing report is the amount of qualifying text within the submission that Turnitin's AI writing detection model determines was either likely AI-generated text from a large-language model or likely AI-generated text that was likely revised using an AI-paraphrase tool or word spinner.

False positives (incorrectly flagging human-written text as AI-generated) are a possibility in AI models.

AI detection scores under 20%, which we do not surface in new reports, have a higher likelihood of false positives. To reduce the likelihood of misinterpretation, no score or highlights are attributed and are indicated with an asterisk in the report (*%).

The AI writing percentage should not be the sole basis to determine whether misconduct has occurred. The reviewer/instructor should use the percentage as a means to start a formative conversation with their student and/or use it to examine the submitted assignment in accordance with their school's policies.

What does 'qualifying text' mean?

Our model only processes qualifying text in the form of long-form writing. Long-form writing means individual sentences contained in paragraphs that make up a longer piece of written work, such as an essay, a dissertation, or an article, etc. Qualifying text that has been determined to be likely AI-generated will be highlighted in cyan in the submission, and likely AI-generated and then likely AI-paraphrased will be highlighted purple.

Non-qualifying text, such as bullet points, annotated bibliographies, etc., will not be processed and can create disparity between the submission highlights and the percentage shown.