

**DETERMINATION OF THE FINANCIAL
BURDEN BORNE BY THE HEALTHCARE
PROVIDER IN TREATING
NASOPHARYNGEAL CARCINOMA (NPC)
PATIENT BASED ON CASEMIX SYSTEM IN
HOSPITAL PAKAR UNIVERSITI SAINS
MALAYSIA (HPUSM)**

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UNIVERSITI SAINS MALAYSIA

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by

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**Thesis submitted in fulfilment of the requirements
for the degree of
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LIST OF ABBREVIATIONS

NPC	Nasopharyngeal Carcinoma
LOS	Length of Stay
EBV	Epstein-Barr virus
PET	Positron emission tomography
WHO	World Health Organisation
DRG	Diagnosis-Related Group
USM	Universiti Sains Malaysia
UKMMC	Universiti Kebangsaan Malaysia Medical Center
UNU-IIGH	United Nations University-international Institute for Global Health
ASIR	Age-standardised Incidence Rate
NCDs	Non-communicable Diseases
SPSS	Statistical Package for Social Sciences
HTAA	Hospital Tengku Ampuan Afzan
HOSHAS	Hospital Sultan Haji Ahmad Shah
THE	The Healthcare Expenditure
SD	Standard Deviation

**PENENTUAN BEBAN KEWANGAN YANG DITANGGUNG OLEH
PENYEDIA PENJAGAAN KESIHATAN DALAM MERAWAT PESAKIT
KARSINOMA NASOFARINXS (NPC) BERDASARKAN SISTEM
CASEMIX DI HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA
(HPUSM)**

ABSTRAK

Karsinoma Nasofarinxs (NPC), sebelum ini dikenali sebagai *lymphoepithelioma*, adalah bentuk karsinoma sel skuamosa yang tidak berdiferensiasi yang berasal dari epitelium nasofarinxs. Ia adalah kanser yang paling sering berlaku di nasofarinxs. Di Malaysia, NPC menduduki tempat keempat (5.2%) daripada semua kanser dan ketiga (8.4%) kanser yang paling sering berlaku dalam kalangan populasi lelaki. NPC di Malaysia kebanyakannya berlaku dalam kalangan orang Cina (49%), diikuti oleh penduduk asal Sabah dan Sarawak (28%) dan Melayu (22%). Kanser adalah salah satu penyakit yang paling mahal untuk dirawat di dunia. Tinjauan kanser oleh Kementerian Kesihatan Malaysia melaporkan bahawa jumlah kos rawatan kanser nasofarinxs di Malaysia adalah kira-kira RM70,000 per individu. Objektif umum kajian ini adalah untuk menentukan beban kewangan kesihatan yang ditanggung dalam merawat pesakit karsinoma nasofarinxs (NPC) oleh HPUSM berdasarkan output Sistem Gabungan Kes. Objektif khusus kajian ini adalah untuk menentukan prevalens kes NPC yang dirawat di HPUSM dari tahun 2020 hingga 2022, mengenal pasti kriteria klinikal kes NPC, menyiasat kos rawatan yang ditanggung oleh penyedia penjagaan kesihatan (HPUSM) dalam merawat pesakit NPC berdasarkan Tarif MY-DRG[®], dan menentukan faktor-faktor yang berkaitan dengan tarif MY-DRG[®] berdasarkan kriteria klinikal

bagi pesakit NPC yang dirawat di HPUSM. Kajian rentas keratan retrospektif ini menggunakan data sekunder yang diperoleh daripada Jabatan Rekod Perubatan, HPUSM, dan data kewangan disediakan oleh Jabatan Kewangan, HPUSM. Data tersebut dianalisis menggunakan perisian IBM Statistical Package for Social Science (SPSS) versi 28.0. Prevalens kes NPC adalah 0.024% dari tahun 2020 hingga 2022. Kriteria klinikal yang dikenal pasti daripada data adalah tempoh tinggal di hospital (*Length of Stay*, LOS), bilangan penyakit, bilangan prosedur, dan tahap keterukan penyakit. Purata LOS pesakit NPC yang dirawat di HPUSM adalah 5.71 hari. Analisis data kes NPC menunjukkan 82.9% pesakit mengalami lebih daripada satu komplikasi, manakala 31.4% pesakit mempunyai tiga komplikasi, yang merupakan bilangan komplikasi paling kerap dialami oleh pesakit. Sementara itu, sebilangan besar pesakit menjalani satu prosedur klinikal (48.6%). Kebanyakan pesakit NPC yang dirawat di HPUSM didiagnosis dengan tahap keparahan 2 (48.6%). Purata Tarif MY-DRG® untuk rawatan NPC adalah sebanyak RM8647.77. Terdapat hubungan yang signifikan antara bilangan penyakit, bilangan prosedur, dan tahap keparahan penyakit, dengan MY-DRG® Tariff ($p\text{-value} < 0.05$). Tempoh tinggal di hospital (LOS) tidak mempunyai hubungan secara signifikan dengan Tarif MY-DRG® ($p > 0.05$). Penemuan daripada kajian menunjukkan bahawa tarif untuk rawatan NPC mempunyai hubungan dengan bilangan penyakit, bilangan prosedur, dan tahap keparahan penyakit. Kajian ini menyediakan maklumat berharga untuk kajian dan penyelidikan masa hadapan mengenai beban kewangan yang ditanggung oleh penyedia penjagaan kesihatan dalam merawat pesakit NPC dan ia juga boleh memberikan pandangan baharu mengenai pengaruh faktor-faktor penting terhadap beban kewangan yang ditanggung oleh HPUSM.

KATA KUNCI: Kanser Nasofarinxs, Sistem Gabungan Kes, Beban ekonomi, Tarif MY-DRG®, Kriteria klinikal

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ABSTRACT

Nasopharyngeal carcinoma (NPC), previously known as lymphoepithelioma, is an undifferentiated form of squamous cell carcinoma arising from the epithelium of the nasopharynx. It is the most common malignancy of the nasopharynx. In Malaysia, NPC is ranked as the fourth (5.2%) of all cancers and third (8.4%) most common cancer among the male population. NPC in Malaysia mostly occurs among Chinese (49%), followed by natives of Sabah and Sarawak (28%) and Malay (22%). Cancer is one of the most expensive medical conditions to treat in the world. The Ministry of Health Malaysia's cancer survey reported that the total treatment cost of nasopharyngeal cancer in Malaysia was approximately RM70,000 per individual. The general objective of this study was to determine the health financial burden borne in treating nasopharyngeal carcinoma (NPC) patients by the HPUSM based on the Casemix System output. The specific objectives of this study are to determine the prevalence of NPC cases treated in HPUSM from 2020 to 2022, to identify the clinical criteria of NPC cases, to investigate the treatment cost borne by the health care provider (HPUSM) in treating NPC patients based on the MY-DRG[®] Tariff, and to determine the associated factors of MY-DRG[®] Tariff between clinical criteria for NPC patients treated in HPUSM.

This retrospective cross-sectional study was conducted using secondary data obtained from the Medical Record Department, HPUSM, and financial data was provided by the Finance Department, HPUSM. The data was analysed using IBM Statistical Package for Social Science (SPSS) software version 28.0. The prevalence of NPC cases is 0.024% from 2020 to 2022. The clinical criteria identified from the data were length of stay (LOS), number of diseases, number of procedures, and disease severity. The average LOS of NPC patients treated in HPUSM is 5.71 days. The NPC cases data analysis showed 82.9% of patients have more than one complication and 31.4% patients have three complications, and this number of complications was the most frequently encountered by patients. While the majority of patients underwent one clinical procedure (48.6%). Most of the NPC patients treated in HPUSM were diagnosed with severity 2 (48.6%). The average MY-DRG[®] Tariff for NPC treatment is RM8647.77. There was a significant relationship between the number of diseases, number of procedures, disease severity, and MY-DRG[®] Tariff (p -value <0.05). The length of stay (LOS) was not significantly associated with the MY-DRG[®] Tariff ($p>0.05$). Findings from the study show that the tariff for the NPC treatment was associated with the number of diseases, number of procedures, and disease severity level. This study provides valuable information for future studies and research about the financial burden borne by the healthcare provider in treating NPC patients and it also can provide novel insights regarding the influence of significant factors on the financial burden borne by HPUSM.

KEYWORDS: Nasopharyngeal carcinoma, Casemix System, Financial burden, MY-DRG[®] Tariff, Clinical criteria

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Nasopharyngeal carcinoma (NPC), formerly known as lymphoepithelioma, is an undifferentiated squamous cell carcinoma that arises from the nasopharyngeal epithelium. It is the most prevalent cancer of nasopharynx. Although it is endemic to parts of Asia and Africa, NPC is found worldwide. The malignancy shows a variable rate of occurrence, ranging from high rates in the southern part of China (25 to 50 cases per 100,000) to a low rate in European populations (1 case per 100,000). A complex interplay of genetic susceptibility and Epstein-Barr virus (EBV) infection is responsible for these epidemiological patterns. The majority is made up of males (Shah & Nagalli., 2024). In Asia, the five countries with the highest standardised incidence of nasopharyngeal cancer are as follows: (1) Malaysia, with a standardised rate of 7.2 per 100,000 people; (2) Singapore, 6.4 per 100,000 people; (3) Indonesia, 5.6 per 100,000 people; (4) Vietnam, 5.4 per 100,000 people; (5) Brunei, 5 per 100,000 people (Mahdavifar et al., 2016). In Malaysia, NPC is ranked as number fourth (5.2%) of all cancers and the third (8.4%) most common cancer among the male population. Malaysia consists of three major ethnicities (Malays, Chinese, and Indian) and other ethnicities. Out of the 33.4 million Malaysian population, the population based on ethnicities in Malaysia in the year 2023 was Malays (70.1%), Chinese (22.6%), Indian (6.6%), and others (0.7%) (Statista, 2024). In Malaysia, Selangor is the state that has the highest population, which is 7.2 million, with Malays (4.0 million), Chinese (1.8 million), Indians (0.7 million), and others (0.084 million). Meanwhile, Perlis is the state that has the lowest population, which is 0.29 million, with Malays (0.25 million), Chinese (0.02 million), Indian (0.0051

million), and others (0.0015 million) (Department of Statistics Malaysia, 2024). NPC in Malaysia mostly occurs among Chinese (49%), followed by natives of Sabah and Sarawak (28%) and Malay (22%) (Raja Omar, 2018).

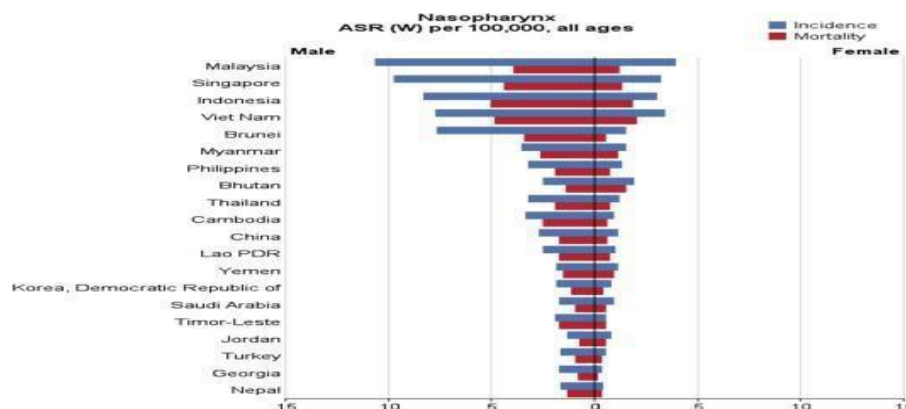


Figure 1.1 Standardised incidence and mortality rate of nasopharynx cancer in Asia in 2012 (extracted from GLOBALCAN). HDI = Human Development Index; LAO PDR = Laos People's Democratic Republic (Mahdavifar et al., 2016).

1.2 NPC Diagnosis and Treatment

NPC is a disease that is often difficult to recognise because the symptoms are similar to other, less serious conditions, and it should also not be confused with other types of cancer that also affect the throat, such as laryngeal cancer and oesophageal cancer (National Health Service, 2021). Also, many people with nasopharyngeal cancer don't have any symptoms, such as a lump in the neck that doesn't go away after 3 weeks, hearing loss (usually only in 1 ear), tinnitus, nosebleeds, double vision, and many others, until the cancer reaches an advanced stage. NPC can be diagnosed by biopsy of the tumour, and imaging techniques (MRI and/or CT scan) may also help determine the extent of the tumour (Cancer Net, 2022). Physical examination and blood tests, Endoscopy, X-ray, Ultrasound, Neurological tests, Hearing test, Positron emission tomography (PET) or PET-CT scan have also been used in diagnosing NPC, and testing of the tumour for EBV is also recommended (Cancer Net, 2022). Patients diagnosed with NPC will be given a specific treatment based on the stage of the cancer.

The treatment may include radiotherapy, chemotherapy, and surgery. The duration of the therapy is determined by the stage of the cancer and how well the body responds to treatment. The prognosis for nasopharyngeal cancer is determined by age, general health, and the stage of the disease at the time of diagnosis (National Health Service, 2021).

1.3 NPC and Its Financial Commitment

The sustainability of Malaysia's healthcare system and its ability to accommodate the country's population, considering the growing demand for healthcare services due to shifting sociodemographic and economic conditions as well as changing disease-related factors, necessitate a thorough comprehension of the issues at hand and the skills needed to resolve them. Making sure the healthcare system is financially sustainable also presents several problems and difficulties (Anand, 2021). The Ministry of Health Malaysia reports that in 2017, the country's total health expenditure (THE) was 2.2% government-funded and accounted for 4.24% of GDP. THE's global average from 2010 to 2016 ranges from 9.4% to 10.0% of GDP (Ministry of Health Malaysia, 2019). The private sector contributed 49% of THE, while the public sector contributed 51%. 38% of THE came from out-of-pocket (OOP) spending, a very high percentage. Seventy percent of THE was used for patient care, with the remaining portion going toward other healthcare operations like administration and public health services (Anand, 2021).

The WHO estimates that the yearly financial costs of cancer were \$1.16 trillion in 2010 and that by 2020, those expenses could double (WHO, 2022). In government hospitals in India, NPC typically costs between Rs 115,000 and Rs 20,000 each month. (Yeoh et al., 2020). Cancer is one of the most expensive medical conditions to treat in the

world. *Financial toxicity* is a term used to describe the harmful effects of the high cost of treatment on a person's quality of life. It may also be described as a financial burden or financial distress (Hussaini, Gupta & Dusetzina, 2022). As the recent term "financial toxicity" suggests, cancer treatment puts any family in a difficult financial situation. The truth about cancer is that it is not only lethal, but it is also expensive to treat once it has taken a person's life, and, in reality, there is very little chance of recovery from this serious illness. The medical inflation rate in Malaysia, however, has been steadily increasing since 2016. For example, it increased to 12.6% from 11.8% in 2017 and to 13.2% in 2018 (Yeoh et al., 2020).

Cancer treatment can be expensive (Cancer Net, 2022). Patients and their families are encouraged to talk about financial concerns with a member of their healthcare team (Khandelwal et al., 2020). A study conducted in Sarawak revealed that 169 NPC patients, or 56.52% of those who received various treatment services in the public hospital, paid an average of RM13,165 for diagnosis, treatment, and follow-up at Sarawak General Hospital in Kuching, Malaysia. On the other hand, 130 patients (43.48% of the total) paid RM 78,860 for the same service in both public and private hospitals (Yeoh et al., 2020). Meanwhile, based on the Future Market Insights Global and Consulting Pvt. Ltd (2023), by the year 2033, the global market for NPC treatment is predicted to reach US\$2.1 billion. The increasing incidence of NPC, rising healthcare costs, and expanding research and development efforts can be attributed to the market growth. Other than that, there is a variety of other health care professionals, such as physician assistants, nurse practitioners, oncology nurses, social workers, pharmacists, counselors, dietitians, and others are involved in the cancer treatment can improve a patient's quality of treatment while also increasing the cost of treatment (American Cancer Society, 2019). Furthermore,

cancer is a disease that needs long-term treatment because the therapy needs to be done more than once, especially if the disease is in advanced stages, and it is costly. For example, for stage 2 and above patients, they usually have chemotherapy with radiotherapy, and before beginning chemoradiotherapy, patients normally have three cycles of chemotherapy. For nasopharyngeal cancer that has progressed to other parts of the body, the patient may receive up to 6 cycles of cisplatin and gemcitabine. Each cycle is 3 weeks (Cancer Research UK, 2021).

As cancer treatment costs are predicted to increase, prevention and early detection efforts become more cost-effective and potentially cost-saving (The Cancer Atlas, 2020). The complexity of cancer treatment resulted in a high financial burden for patients, healthcare systems, and countries due to healthcare spending, as well as productivity losses from morbidity and premature mortality. Many nations around the world have reported financial constrain due to the cancer cases (Haier & Schaefer, 2022). Therefore, it is very important to know the cost of treating NPC cases for appropriate planning and allocation of health care scarce resources for better healthcare provision. It can also provide valuable evidence for clinicians when making treatment decisions to improve the cost-effectiveness of treatment (Pei, Xiao and Yang, 2023). The global approach to tackling the issue of complexity in the medical spectrum of care is by using Casemix outcomes as a measuring variable (Faerron Guzmán, 2022).

1.4 Casemix System as Hospital Management Tool

Casemix System is a patient classification system that classifies patients into homogeneous groups known as Diagnosis-Related Groups (DRG). This group is similar in terms of its clinical criteria and resources used to treat the patients who belong to

each group (Zafirah et al., 2018). The DRG is the smallest entity in the Casemix Classification System. The patient's demographic (age, sex, etc) and clinical algorithms (comorbidities, clinical medical procedures, etc), incorporated with the financial inputs from the hospital, resulted in an excellent DRG Tariff generated from the Casemix System (Zafirah et al., 2018). The tariff is a break-even tariff to treat the patient according to the DRGs. It may also be a reflection of the burden borne by the healthcare provider to treat the patient (Zou et al., 2020). The goal of the system is to ensure that you receive the care you require while preventing needless fees. (Davis, 2023). In order to guarantee that patients receive the finest and most efficient treatments possible, this approach pushes hospitals to standardise the treatment process by utilising clinical guidelines and essential pathways in line with best practices. (Saputra, Aljunid & Muhammad Nur, 2020). Furthermore, the adoption of the Casemix System improves the openness of clinical practice. Because of this visibility, management can have an impact on decisions about admissions, available treatments, discharges, and duration of stay. It allows you to highlight a range of performance variances between any number of entity types (Hovenga and Lowe, 2020). According to the World Health Organisation (2015), DRGs have increasingly been used for hospital funding in higher-income countries such as Australia, Japan, New Zealand, and the Republic of Korea. Pre-existing systems of hospital finance are often based on Fee-For-Service methodologies or, in the case of government hospitals, line-item budgeting. FFS systems are frequently open-ended, which encourages overservicing and makes cost control more difficult, meanwhile DRGs are a financial and administrative tool designed to address these challenges. The Casemix System is used by healthcare providers in over 40 countries, including Australia, England,

Thailand, China, South Korea, Japan, Chile, Vietnam, Mongolia, the Philippines, Uruguay, and the United Arab Emirates (Saizan et al., 2021).

In Malaysia, the Casemix System is at the juvenile stage, where the system is still in the piloting stage, not yet implemented nationwide. However, the Casemix System was successfully developed in 2002 by the Casemix team in Hospital Tunku Mukhriz, Universiti Kebangsaan Malaysia (formerly known as Universiti Kebangsaan Malaysia Medical Centre [UKMMC]) and United Nations University-International Institute for Global Health (UNU-IIGH). The system is known as MY-DRG[®]. The main purpose of its development was to enhance the quality and efficiency of hospital services (Hassan, Aljunid & Nur, 2020). Aware of the importance of having an efficient hospital management tool, the management of Universiti Sains Malaysia (USM) signed an MoA with UNU-IIGH to implement the Casemix System in its teaching hospital in Kubang Kerian, Kota Bharu, Kelantan, objectively to enhance efficiency and quality of healthcare services (United Nations University, 2013). The coders from the Casemix unit will use code for every case. There are two major factors or cost drivers towards MY-DRG[®] Tariff for NPC which is the length of stay and the procedure for NPC cases. The LOS of the patient in the hospital will usually increase along with the patient's age. The reason for increased LOS along with age could be the presence of chronic disease in older ages, which requires a longer hospital stay (Kosravizadeh et al., 2016). Meanwhile, the procedure for NPC care is much more expensive, along with the advanced stage of the cancer, because of the complicated treatment or procedure (Yeoh et al., 2020). In addition, in this study, the MY-DRG[®] Tariff is a proxy for the financial burden of NPC case treatment.

1.5 Problem Statements

Cancer treatment can come with a high financial cost (Cancer.Net, 2022). The increasing cost of cancer care, including NPC, raised concerns among healthcare providers. Cancer patients and their families frequently experience a great deal of stress and anxiety. Due to additional unforeseen fees associated with their care beyond the costs of therapy. Some people are unable to adhere to or finish their cancer treatment plan because of the high cost of treatment. Their health may be at risk, and future expenses may increase. Looking at the health care provider's perspective, the cost to treat NPC patients can increase as the number of cases of the cancer increases. The expensive treatment cost for NPC has become a burden towards the healthcare provider, and it involves many other factors, such as expensive lab tests, such as MRI to diagnose the cancer (Greenberg et al., 2010). Economic research can be hampered by a lack of data linking the diagnosis, outcomes, and costs of individual NPC patient treatment. The HPUSM Casemix System would be able to generate valuable outcomes to determine the real cost borne by this teaching hospital in treating NPC patients, defined from the MY-DRG[®] Tariff. Therefore, this study is designed to observe the health financial burden, particularly in HPUSM, in treating NPC patients. Findings from this study will disseminate important info to the hospital's top management and policymakers on the real economic situation in treating NPC patients, particularly in HPUSM.

1.6 Research Questions

1. What is the prevalence of NPC cases being treated in HPUSM from 2020 to 2022?
2. What are the clinical criteria of NPC cases being treated in HPUSM?

3. How much is the financial commitment borne by the NPUSM in treating NPC patients based on Casemix System outputs?
4. What are the associated factors of MY-DRG[®] Tariff in treating NPC patients in HPUSM?

1.7 Research Objectives

General objective:

To determine the financial burden borne by the health care provider in treating NPC patients based on the MY-DRG[®] Tariff in HPUSM.

Specific objectives:

- 1) To determine the prevalence of NPC cases treated in HPUSM from 2020 to 2022.
- 2) To identify the clinical criteria for NPC cases treated in HPUSM.
- 3) To investigate the treatment cost borne by the health care provider (HPUSM) in treating NPC patients based on the MY-DRG[®] Tariff.
- 4) To determine the associated factors of the MY-DRG[®] Tariff between clinical criteria for NPC patients treated in HPUSM.

1.8 Hypothesis

H₀₁: There is no statistically significant relationship between clinical criteria (length of stay, disease severity, number of diseases, and the number of clinical procedures) and MY-DRG[®] Tariff among NPC patients in HPUSM.

H_{A1}: There is a statistically significant relationship between clinical criteria (length of stay, disease severity, number of diseases, and the number of clinical procedures) and MY-DRG[®] Tariff among NPC patients in HPUSM.

1.9 Significance of the Study

The findings from this study will add new information about the financial burden borne by the health care provider using HPUSM Casemix System outputs, especially in NPC patients. The real cost to treat NPC and the financial burden borne by healthcare providers can be known based on the MY-DRG[®] Tariff. By knowing the real cost of NPC treatment, better treatment options can be made. There is a need for value-based strategies in oncology for providers, payers, and patients to improve access to new therapies, best practices, and patient support services. It is of utmost urgency to consider the cost borne by the healthcare provider to strategies in cancer treatment due to the growing economic challenges in oncology. The impact of the diagnosis on health care costs is also important to consider by decision-makers. It will be a piece of important information for the hospital management in planning for scarce resource allocation for NPC treatment. This study can also increase the transparency of clinical practice. This visibility enables hospital managers to influence decisions regarding admissions (Evelyn, et al., 2020). Since there are lack of fundamental information or data published as a reference to the healthcare provider related to NPC treatment cost, this study outcome will add to the body of literature in this field. With the knowledge obtained, we will have a better understanding and feed into future research. The information from the study would certainly help the hospital management to plan, strategies, and wisely and equitably allocate the scarce resources to departments under the hospital facilities that are related to the NPC treatment. Outcomes generated from this study would possibly provide fundamental input for future advanced research in this area.

1.10 Definition of Term

NPC patient- A person who has been diagnosed with nasopharyngeal carcinoma, which is a malignant tumour arising from the nasopharyngeal epithelium. NPC patients may vary in disease severity, stages of progression, and the type of interventions required, which can significantly influence clinical outcomes and financial considerations (Shah & Nagalli, 2024).

Financial burden- It refers to the detrimental impact of the cost burden of medical care on patients, which can lead to poor health and quality of life. To address this issue, coordinated efforts at the care provider, health system, insurance, and government levels are required, together with emerging research into remedial techniques (Pisu & Martin, 2022).

Casemix System- A system that combines information about patients (for example, age and race) and the associated medical procedures carried out during their hospitalisation into groups, based on the type and mix of patients (Saizan et al., 2021).

MY-DRG[®] Tariff- The break-even cost for treating the patient in accordance with MY-DRG[®] is established. This may also indicate the financial strain faced by the healthcare provider in delivering patient care (Zou et al., 2020).

Clinical criteria- A specific indicators or traits that healthcare professionals use to assess, diagnose, or treat a patient's condition. It is also a critical components that represent the characteristics or attributes being studied (Hassan, 2024).

CHAPTER 2

LITERATURE REVIEW

2.1 Financial Burden by Healthcare Providers

There are 32.4 million people living in Malaysia. Its economy ranks 38th in the world, and the World Bank classifies it as a middle-income nation. With an average annual growth of 5.4% since 2010, Malaysia's economy has been expanding. From 2010 to 2016, Malaysia's annual health expenditures ranged from MYR 33 billion (USD 23.3 billion, PPP 2010) to MYR 51.7 billion (USD 36.6 billion, PPP 2016) per year. In 2016, the entire amount spent on health made up 4.21% of the national GDP. The private sector made up the remaining portion of health spending, with the public sector contributing between 51% and 58% of the total. This represents a fairly equal split between the two sectors. In general, the private sector provides 62% of ambulatory care and 18% of inpatient services, while the public sector provides 82% of inpatient services and 35% of ambulatory care (Ismail et al., 2019).

Patients in Malaysia have options thanks to the dual healthcare system, which maintains the standard of care. The government extensively subsidises public healthcare services through taxation, and it offers comprehensive primary, secondary, and tertiary treatment. Conversely, private healthcare services are either paid for out of pocket or through personal medical insurance and can offer more customised treatment options depending on the patient's financial situation. An increasing number of people are exposed to financially disastrous events due to the rising inflation of healthcare as a commodity, particularly with the quickly evolving medical technologies. This has made it necessary to carefully distribute the limited resources for healthcare, together with the growing budget for its provision (Ku Abd Rahim et al., 2020)

Cancer imposes a financial burden on patients, healthcare systems, and governments through increased healthcare costs and productivity losses owing to morbidity and premature mortality. Economic evaluations can help guide resource allocation and investment decisions in cancer control initiatives such as prevention, early diagnosis, treatment, survivorship, and end-of-life care. The global financial burden of cancer is unknown, but numbers are available in some nations. For example, cancer healthcare spending in the United States was expected to be US\$161.2 billion in 2017, with productivity loss from morbidity at US\$30.3 billion and premature mortality at US\$150.7 billion. Cancer's financial burden in the United States amounts to around 1.8% of GDP. Healthcare spending in the European Union totalled €57.3 billion, whereas productivity losses from sickness and premature death were €10.6 billion and €47.9 billion, respectively. With informal care expenditures of €26.1 billion, the total burden increased to €141.8 billion, or 1.07% of GDP (The Cancer Atlas, 2020).

2.2 Prevalence and Incidence of NPC Cases Worldwide and in Malaysia

The incidence and mortality rate of NPC have changed in recent years. Globally, there was a consistent increase in NPC incidence cases from 2009 to 2019 (from 121.65×10^3 cases in 2009 to 176.50×10^3 cases in 2019, increasing by 45.09%). The age-standardised incidence rate (ASIR) of NPC increased from 1.81 in 2009 to 2.12 in 2019 (EAPC = 1.59, 95% CI 1.36–1.81) (Yu et al., 2021). According to the Ministry of Health Malaysia (2016), the number of new cancer cases is increasing worldwide. In 2012, there were an estimated 86,700 new NPC cases with 50,800 deaths. Although NPC may be considered one of the rarer forms of cancer globally in most parts of the world (including the United States), there's less than one case for every 100,000 people each year (American Cancer Society, 2022). The incidence is notably high in selected

geographic and ethnic populations. However, this cancer is far more common in certain parts of South Asia, the Middle East, and North Africa. There are as many as 25 to 30 cases per 100,000 males and 15 to 20 cases per 100,000 females in some parts of China. It's also more common among Arctic indigenous people (American Cancer Society, 2022). Over 3,000 new cases of NPC are diagnosed in Malaysia each year out of a worldwide total of approximately 11,000 cases. The incidence of NPC in the Malaysian Chinese population ranks second highest in the world after Hong Kong. The lifetime risk of contracting NPC for Malaysian Chinese males and females is 1 in 50 and 1 in 42, respectively (Koay, 2020). Males in Malaysia are disproportionately affected by this cancer. Bidayuh natives in Sarawak, Malaysia have a high incidence rate of NPC (Linton et al., 2021), and a total of 143 newly diagnosed cases of NPC were reported in Pahang throughout the years 2012–2017 (Ahmad et al., 2021). The total number of NPC cases in Pahang reveals an increasing trend from 2012 to 2014 and then a slightly decreasing trend from 2015 to 2017 (Ahmad et al., 2021).

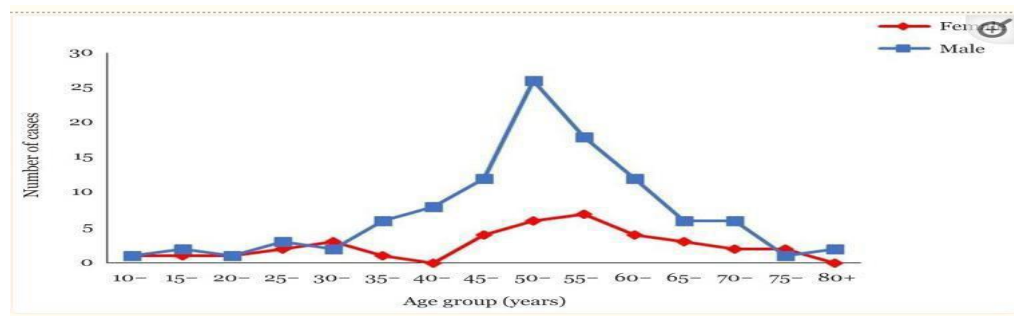


Figure 2.1 Number of newly diagnosed NPC cases by age group and gender in Pahang, 2012–2017 (Ahmad et al., 2021)

The leading factor for NPC in Asia because of a diet high in salt-cured fish, meat, or both (containing a carcinogen known as nitrosamines), in conjunction with genetic characteristics, and EBV is common in Southeast Asia, Southern China, and Northern Africa. It is also common among Inuit people in the Alaskan and Canadian Arctic. In regions where consuming salt-cured foods, particularly Chinese-style salted fish, is

widespread, the incidence of nasopharyngeal cancer is high. (Barret et al., 2019). However, genetic predisposition, environmental exposure, and tobacco smoking can also be included as the leading factors that can cause NPC among people (Linton et al., 2021).

2.3 Clinical Criteria for NPC Cases

2.3.1 Clinical Procedure

In today's ever-changing field of medical discoveries, some medicines and procedures stand out for both their efficacy and astonishing expense. Healthcare provides a variety of possibilities for those seeking cutting-edge treatment, ranging from revolutionary gene therapies to complex surgical interventions (Immad, 2024). Cancer treatment or procedure is quite expensive. The types of treatment are varied based on the type of cancer and its staging. Every cancer treatment plan is unique (National Cancer Society Malaysia, 2018). Furthermore, the most expensive medical treatments and procedures worldwide include a variety of interventions such as organ transplants, heart surgery, and particular cancer therapies. These operations are costly due to surgical intricacy, unique equipment needs, extensive post-operative care, and expensive medical staff and technology expenditures (Immad, 2024). Because of this, patients who need to undergo more than one procedure will also increase the cost of the treatment which also means that the more the number of procedures involved, the higher the cost of the treatments but it also depends on the type of the procedure or treatment that involved (Strik et al., 2016).

There are 5 stages of NPC: stage 0 (zero) and stages I through IV (1 through 4). The stage provides a common way of describing the cancer, so doctors can work together to plan the best treatments (Cancer Net, 2022). The mainstay of treatment for NPC is

radiotherapy in locoregional lesions, as the non-keratinising variety is highly radiosensitive. Surgical intervention is limited to salvage procedures in recurrent diseases, whereas chemotherapy is preferred concomitantly with radiation in advanced stages (Almonani, 2022). According to the National Cancer Institute (2021), there are different types of treatment for patients with NPC, which include radiotherapy, chemotherapy, and surgery.

2.3.1(a) Radiotherapy

Radiation is the management of choice for the locoregional lesion. Radiotherapy is effective in all cases except those for distant metastasis, hence from stage I to stage IV (Almomani, Zulfiqar and Nagalli, 2020). It uses high-energy X or other types of radiation to kill cancer cells or keep them from growing. There are two types of radiation therapy which are external radiation therapy which uses a machine outside the body to send radiation toward the area of the body with cancer and internal radiation therapy uses a radioactive substance sealed in needles, seeds, wires, or catheters that are placed directly into or near the cancer (National cancer Institute, 2021).

2.3.1(b) Chemotherapy

Chemotherapy is a cancer treatment where medicine is used to kill cancer cells. There are many different types of chemotherapy medicine, but they all work in a similar way, which is that they stop cancer cells from reproducing, which prevents them from growing and spreading in the body (National Health Service, 2022). The chemo drug most often used is Cisplatin. Chemoradiation is usually followed by more chemo. Most studies have found that chemoradiation helps people live longer than just radiation therapy alone, but adding chemo can lead to more side effects, which can affect quality of life. It's important to understand what the side effects are likely to be

before starting this treatment (American Cancer Society, 2022). Chemotherapy drugs enter the bloodstream and can reach cancer cells throughout the body when taken orally or injected into a vein or muscle (systemic chemotherapy). Chemotherapy may be administered after radiation therapy to eliminate any remaining cancer cells, and adjuvant therapy is treatment given after radiation therapy to reduce the risk of the cancer returning (Amjad, Kasi and Chidharla, 2023).

2.3.1(c) Surgery

Surgery is a procedure to find out whether cancer is present, to remove cancer from the body, or to repair a body part. Surgery is sometimes used for nasopharyngeal cancer that does not respond to radiation therapy. If cancer has spread to the lymph nodes, the doctor may remove lymph nodes and other tissues in the neck (National Cancer Institute, 2021). According to Almomani, Zulfiqar and Nagalli (2020), Nasopharyngectomies can be performed in a variety of ways, and the approach chosen should be tailored to the surgeon's expertise and the patient's overall condition. The inferior approach via transpalatal incision, the lateral approach via the lateral skull base, the inferolateral approach, the midfacial degloving, and the endoscopic approach are some of the popular approaches to the cavity. Radical neck dissections are often done accompanying the procedures mentioned above, where extensive neck involvement is seen. Also, in recurring diseases, especially nodal recurrence, radical neck dissection is done as a component of salvage therapy (Almomani, Zulfiqar and Nagalli, 2020).

For stages 0 and 1, the usual treatment for these early-stage cancers is radiation therapy aimed at the tumour. Most people with stage II (2) NPC get chemoradiation (chemotherapy given along with radiation therapy) to the nasopharynx and neck lymph nodes. People with stage III or IVA NPC are usually treated with:

- Chemotherapy first (sometimes called induction chemo), followed by chemoradiation to the nasopharynx and neck lymph nodes OR
- Chemoradiation to the nasopharynx and neck lymph nodes, sometimes followed by chemotherapy alone, OR

Chemoradiation to the nasopharynx and neck lymph node. The usual treatment for Stage IVB (4B) NPC is chemo, often with cisplatin and one other drug. If there is no evidence or sign of cancer after chemo, radiation therapy or chemoradiation is administered to try to kill any remaining cancer cells. In some cases, chemoradiation can be used as the first treatment. Immunotherapy is another option for treating some of these cancers, either alone or in combination with chemotherapy.

2.3.2 Diseases

Epidemiologists break the disease burden down into three categories of disability or disease: non-communicable diseases (NCDs); communicable, maternal, neonatal, and nutritional diseases; and injuries (Paudel, 2023). Most of the world's disease burden is caused by noncommunicable diseases. Maternal, neonatal, nutritional, and communicable diseases are the most common, followed by injuries. In 2019, cardiovascular diseases were the primary cause of disease burden globally. Cancer, newborn illnesses, musculoskeletal disorders, respiratory infections, and mental and substance use disorders are the next leading causes. However, in Malaysia, the leading cause is the same worldwide, which is cardiovascular illness, but the following diseases are quite different, which are cancer, musculoskeletal disorders, respiratory infections and TB, mental disorders, and transport injuries (Roser, Ritchie & Spooner, 2024). The annual healthcare cost of cardiovascular diseases, diabetes, and cancer in Malaysia exceeds RM 9.65 billion (WHO, 2022).

2.3.3 Length of Stay

Hospital length of stay (LOS) is the number of days that an inpatient remains in the hospital. LOS has long been used as a measure for hospitals to improve patient care, reduce overall costs, and allocate resources correctly based on staff and patient needs. It can also provide insight into hospital care unit efficiency and patient movement (Stone et al., 2022). There is, of course, considerable diversity. There is significant variation in patient LOS for various patient diagnoses. The LOS for the same diagnosis may differ among patients. This difference can be attributed to a variety of factors, including a patient's traits, social situations, and treatment complexity (Stone et al., 2022). The longer the LOS was, the higher the inpatient costs, which is consistent with current research (Cao et al., 2024). The average length of hospital stays (ALOS) is commonly utilised as a measure of effectiveness. Holding all other factors constant, a shorter stay will decrease the cost per discharge and transition care from inpatient to more affordable post-acute settings. (OECD, 2013). In addition, an unsuitable length of stay would have a negative impact on the promptness and convenience of care for other patients, lower the hospital's operational efficiency, and lessen social benefits. On the one hand, it would directly increase the cost of beds, medications, nursing care, and other basic expenses (Cao et al., 2024). However, a stay that is too brief may harm the patient's comfort and recuperation. Costs per disease episode may only marginally decrease or may increase if this results in a higher readmission rate. (OECD, 2013).

2.3.4 NPC Treatment Cost Across the Severity of the Disease

As the cancer progresses from stage 1 (RM6,453) to stage 2 (RM8,333) and stage 3 (RM13,165), the average overall cost of NPC patients rises. Remarkably, the average total cost for a stage 4 NPC patient has decreased to RM 11,224 from the

previous stage. Furthermore, compared to the average direct cost at stage 1 (RM2,128), stage 2 (RM1,840), stage 3 (RM3,465), and stage 4 (RM3,354) at the public hospital, the average indirect cost at stages 1 (RM4,325), 2 (RM6,493), 3 (RM9,700), and 4 (RM7,870) is two to three times higher. It is assumed that patients at various stages will likely encounter or go through different patterns of treatment and diagnosis (Yeoh et al., 2020). Patients with cancer are receiving increasingly expensive chemotherapy and biologics, both alone and in combination, compared to a decade ago. In addition, the use of costly supportive agents and hematopoietic growth factors has increased. The list price of newly introduced systemic therapies and supportive drug-based treatments is growing, and prices of both infusion and oral drugs continue to increase after product launch. Although prices can vary dramatically between treatments, data on the differences in outcomes are frequently lacking (National Cancer Institute, 2022).

2.4 NPC Cases in HPUSM

The records of one hundred and thirty-four NPC cases confirmed by histopathology in HPUSM between 1st January 1998 and 31st December 2007 (Siti-Azrin, Norsa'adah & Naing, 2017). NPC has a 0.8% occurrence rate among all types of cancer and has many risk factors ranging from viral infections to dietary intake habits (Othaya Kumar & S.M.N. Mydin, 2019). NPC is strongly associated with the variation of geographical regions; therefore, adequate knowledge, early detection, immediate administration of treatment and rapid detection are vital in reducing the global incidence burden (Othaya Kumar & S.M.N. Mydin, 2019).

2.5 NPC Treatment Cost in Malaysia

According to the Ministry of Health's 2013 gazette, radiotherapy can cost up to RM5,720, while consultation fees can range from RM860 to RM1,715. But just as the therapy differs from case to case, so does the cost. The overall cost of treating nasopharyngeal cancer in Malaysia was estimated to be around RM70,000 based on the Ministry of Health's cancer survey (Yeoh et al., 2020). The National Cancer Institute stated that national estimates of cancer treatment expenses are predicted to increase to as much as \$173 billion by 2020, while the Agency for Healthcare Research and Quality reported that the total amount spent on cancer care in 2001 was \$57 billion, up from \$88.3 billion in 2011. Patients, families, governments, and society at large face financial difficulties as a result of these rising expenses. (Park & Look, 2019).

In Malaysia, the public healthcare system offers a comprehensive range of health services, including cancer treatment, financed mainly through taxation and general revenues from the federal government. While public health spending accounted for 43.1% of total national health expenditures, it provided approximately 75.5% of inpatient care and 64.3% of ambulatory care to the population. Patients' fees cover both inpatient and outpatient care services, with fees varying by class of accommodation, citizenship, and additional exemptions. However, Malaysian citizens' charges are heavily subsidised, with only 2.6% of expenditures recovered from patient revenues. Despite its commitments to financial risk protection for its population, rising disease demands and changing demographics continue to strain the public health system (Raman et al., 2021).

2.6 Factors Possibly Contributed to the NPC Treatment

Depending on the stage, NPC patients may undergo a single treatment or a combination of radiation, chemotherapy, targeted therapy, or immunotherapy. Surgical alternatives are limited due to the deep tumour localisation and complex anatomical nature of the tumour site, although they still provide benefits to recurrent NPC (Liu et al., 2024). Treatment for advanced nasopharyngeal cancer is likely to become more customised in the future. With the apparent heterogeneity and distinct molecular aberrations of NPC tumours, the focus has turned to more personalised treatment in NPC (Siak et al., 2023). Plasma EBV-DNA is intended to be the primary indicator for individualised therapy, with the timing and combination of immunotherapy and existing treatments to be determined based on individual circumstances. It is planned to be used to determine the addition of ACT or NACT based on the quantity of EBV-DNA prior to therapy, as well as to determine additional treatment based on the amount of EBV-DNA following treatment. Furthermore, the efficacy of ICI for recurring metastases is debatable, but it is expected to remain one of the primary therapeutic options in the future as the use of numerous agents and the timing of their application are verified (Jiromaru, Nakagawa & Yasumatsu, 2022). Early diagnosis and therapy are the most effective ways to improve the curative effect of NPC. To improve efficiency, population-based NPC screening in the endemic zone must be strengthened and optimised. Improving the therapy technique is also crucial. With significant advancements in staging systems, radiation procedures, and concurrent chemotherapy, NPC patients' locoregional control and overall survival have improved dramatically. In the meantime, molecular targeted therapy and immunotherapy have sparked widespread attention and are currently being used in a variety of clinical trials. (Huang, Zhang & Zhou, 2021).

CHAPTER 3

METHODOLOGY

3.1 Study Design

A retrospective cross-sectional study was conducted at the HPUSM, Kubang Kerian, Kelantan. The list of NPC patients treated from the year 2020 to 2022 was mined from the Medical Record Department, HPUSM. The Finance Department of HPUSM provided the financial data upon receiving ethical approval from the Ethical Board (JEPeM). The requested data set was grouped based on the Casemix Classification System, where the Casemix outputs were generated. The output comprised clinical and cost information related to the NPC patients treated in the fiscal year. MY-DRG[®] Tariff in this study is among the outputs that indicated an NPC financial burden for the health care provider in treating the NPC patient in HPUSM.

3.2 Data Collection

The NPC cases treated in year 2020, 2021 and 2022 were extracted from the Casemix System outputs, HPUSM. All related clinical data and patient demographic data, such as the patient's gender and age, were provided from the system. The patient's demographic (age, sex, etc) and clinical criteria were generated based on the clinical algorithms (comorbidities, clinical medical procedures, etc) that have been embedded in the Casemix System. It also incorporated with the financial inputs from the hospital, resulting in an excellent DRG tariff generated from the Casemix System. Data cleaning was done before analysis to make sure that only relevant, consistent and complete records were included. Additionally, the average DRG tariff for NPC cases was calculated across the three-year period to provide a representative estimation of the economic burden borne by the healthcare provider.

Inclusion Criteria:

1. All inpatients diagnosed as NPC treated at HPUSM between 2020 and 2022.

Exclusion Criteria:

1. Incomplete patient data

3.3 Study Variables

Disease severity level - Referring to the extent of a disease in the body. It is objectively generated through the patient classification system for this study.

Clinical procedure - Any procedure or action performed by a healthcare professional for NPC treatment.

Length of Stay- Length of stay (LOS) is a measure of the duration of a single episode of hospitalisation from admission to discharge.

MY-DRG[®] Tariff – The break-even cost for NPC patient treatment according to the casemix classification system. It is a proxy for the financial burden borne by the healthcare provider to treat the patient in this study.

3.4 Statistical Analysis

The provided data were analysed by using the Statistical Package for Social Sciences (SPSS) version 28. Descriptive analyses were performed and are presented as means and standard deviation (SD) for numerical variables or frequency and percentage for categorical variables. Bivariate analyses, such as Spearman and Pearson, were done for all the numerical variables and for categorical variables that were associated with MY- DRG[®] Tariff; non-parametric tests, such as Kruskal-Wallis and Mann-Whitney, were used. A p-value <0.05 was considered statistically significant.