



Faculty of Medicine and Health Sciences

**ESTIMATION OF HUMAN CAPITAL LOSS DUE TO PREMATURE
MORTALITY AMONG THE PATIENTS WITH COLORECTAL
CANCER IN MALAYSIA**

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Master of Public Health

2020

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**Research Report submitted in partial fulfilment of the requirement for the
degree of Master of Public Health**

**Faculty of Medicine and Health Sciences
UNIVERSITY MALAYSIA SARAWAK**

2020

ACKNOWLEDGEMENT

Assalamualaikum and Salam Sejahtera.

I want to take this opportunity to thank Ass. Prof Zafar Ahmed, my supervisor, for his time, advice, support, and consistent guidance he gave me throughout this study.

Special thanks to Dr Norliza Ibrahim (Ketua Penolong Pengarah Kanan UD54, Sektor HIV/STI/Hep C, Bahagian Kawalan Penyakit, KKM), who inspire me to do this research study.

I want to express my most profound appreciation to Datuk Dr Noor Hisham Abdullah, our Director-General of Health, Dato' Dr Goh Pik Pin (Director of National Institute of health research), and Dr Mohd Anis bin Haron @ Harun (Director of National Cancer Institute for giving me permission to do this research and access the data from the national cancer registry. I also would like to thank Dr Siti Norbayah Yusof (Head of Department of National Cancer Registry, UD54), Dr Sukumaran (Medical Officer of National cancer registry UD54), Dr Nabihah Ali(Medical Officer of National Cancer Institute) and Dr Balqis (Medical officer of National Cancer Institute) for helping me in supplying the data cleaned merge the data with National Registry Department and making my data collection procedure smoothly.

My special thanks to my mother Rosiati Binti Abd Ghani, my husband Adam Harris bin Abd Hamid and my children, Akmal Harris, Affan Harris, and Aqil Harris, for their continuous support, prayers, sacrifices, and patience during this study. Finally, my warmest thank to all family members, friends, colleagues, and UNIMAS lecturer for your helpful guidance.

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LIST OF SYMBOLS AND ABBREVIATIONS

CHE	Catastrophic Health expenditure
DG-MOH	Director-General of Health Malaysia
DOSM	Department of Statistic Malaysia
FCA	Friction Cost Approach
GDP	Gross domestic product
HCA	Human capital approach
MREC	Medical Research ethic community
NCI	National Cancer Institute
NCR	National Cancer Registry
NIH	National Institute of Health
NMRR	National Medical Research Register
PVLE	Present Value of Lifetime earning
YPLL	Years of productive life lost

Estimation of Human Capital Loss Due to Premature Mortality Among the Patients with Colorectal Cancer in Malaysia

ABSTRACT

Introduction: Mortality estimates are essential parameters for monitoring health and routinely used evidence for health policy and planning. Whereby, Colorectal Cancer is ranked first among males and second among females in Malaysia. The objective of this study to estimate the human capital loss due to premature mortality secondary to colorectal cancer in Malaysia. **Methodology:** This research carried out using a retrospective cohort study design by analysing the data from the Malaysian National Cancer Registry each year for ten years period from 2007 to 2016. The human capital approach applied for estimating human capital loss due to premature mortality secondary to colorectal cancer in Malaysia. SPSS was used for data analysis, whereas Microsoft Excel used for economic estimation. **Result:** The total study population (colorectal cancer incidence) for ten years period from 2007-2016 was 29,035. A total of 12,130 (41.8%) patients with colorectal cancer diagnosed at a young age. Total mortality among the sample was 15,625 cases (53.8%), whereas 5,220 (33.4% of total mortality) died prematurely. There are a total of 52,549 years of productive life lost due to premature mortality secondary to colorectal cancer. Among all ethnic groups, the Malays contribute highest to the premature mortality cases with a total of 2,606,

and the YPLL was 27,801. Human capital loss due to premature mortality secondary to colorectal cancer was estimated as RM1.7 billion collectively for ten years study period before the discount. After discounting at 5%, is estimated to be RM53.9 billion with a GDP loss of 0.25% to 0.73% (mean GDP loss 0.56%). **Conclusion:** The value of human capital loss due to premature mortality secondary to colorectal cancer shows that the burden of disease is crucial in Malaysia, and its economic impact is significant. As the productive period in the human capital plays a significant role and plays a key role in our economic development, primary and secondary prevention for colorectal cancer must be promoted at all levels, from screening to improving healthier behaviours.

Keyword: Human Capital, Colorectal Cancer, Productivity Loss

**Anggaran Kehilangan Modal Manusia Kerana Kematian Prematang Di
Kalangan Pesakit dengan Kanser Kolorektal di Malaysia.**

ABSTRAK

Pendahuluan: Anggaran kematian adalah parameter penting untuk memantau kesihatan dan bukti yang biasa digunakan untuk dasar dan perancangan kesihatan. Di mana, barah kolorektal pula adalah antara tertinggi di kalangan lelaki dan kedua tertinggi di kalangan wanita di Malaysia. Oleh Itu, objektif kajian ini untuk menganggarkan kehilangan modal insan akibat kematian pramatang dikalangan pesakit barah kolorektal di Malaysia. **Metodologi:** Penyelidikan ini dilakukan dengan menggunakan reka bentuk kajian kohort retrospektif dengan menganalisis data dari Pendaftaran Kanser Nasional Malaysia setiap tahun selama sepuluh tahun dari tahun 2007 hingga 2016. Pendekatan modal insan digunakan untuk menganggarkan kehilangan modal insan kerana kematian pramatang akibat barah kolorektal di Malaysia. SPSS digunakan untuk analisis data, sedangkan Microsoft Excel digunakan untuk anggaran ekonomi. **Keputusan:** Jumlah populasi kajian (kejadian barah kolorektal) selama sepuluh tahun dari 2007-2016 adalah 29,035. Sebanyak 12,130 (41.8%) pesakit dengan barah kolorektal didiagnosis pada usia muda. Jumlah kematian di antara sampel adalah 15,625 kes (53.8%), sementara 5,220 (33.4% dari jumlah kematian) adalah kematian pramatang. Sebanyak 52,549 tahun kehidupan produktif hilang(YPLL) kerana kematian pramatang akibat barah kolorektal. Di antara semua etnik, orang Melayu menyumbang paling tinggi dalam kes kematian pramatang

dengan jumlah keseluruhan 2,606, dan YPLL adalah 27,801. Kehilangan modal insan akibat kematian pramatang akibat barah kolorektal dianggarkan sebanyak RM1.7 bilion secara kolektif selama sepuluh tahun tempoh kajian sebelum diskaun. Setelah membuat diskaun pada kadar 5%, dianggarkan berjumlah RM53.9 bilion dengan kerugian KDNK 0.25% hingga 0.73% (puratan KDNK kerugian 0.56%).

Kesimpulan: Nilai kehilangan modal insan akibat kematian pramatang akibat barah kolorektal menunjukkan bahawa beban penyakit sangat kritikal di Malaysia, dan kesan ekonominya sangat ketara. Oleh kerana tempoh produktif dalam modal insan berperanan penting dalam pembangunan ekonomi kita, pencegahan utama dan sekunder untuk barah kolorektal mesti dipromosikan di semua peringkat dari penyaringan hingga peningkatan tingkah laku yang lebih sihat.

Kata kunci: *Modal Insan, Kanser Kolorektal, Kehilangan Produktiviti*

CHAPTER 1: INTRODUCTION

The chapter is introduced in six sections. The first section of this chapter will explain the background of this study; the second section will explain the statement of the problem; the third section will re-enact the significant research of the study—fourth and fifth sections regarding the research question and research objective. The last section explained the conceptional framework of this research.

1.1 Background of Study

Human capital plays a crucial role in economic growth. Human capital is a resource and value in the market, and it is vital for our economic productivity and development (Palacios, 2014). The investment of human capital, such as on education and health leads to the good quality of human capital stock. Inadequate investments in education and health can deprive human capital stock. Person's diagnosed with any disease can cause a reduction in productivity. Whereby, if the person died at a young age, resulting in the loss of human capital. Estimation of human capital loss in the health economic study is essential to prevent further loss of productivity in future.

Premature mortality is death that occurs before the average age of death in a certain population. As in Malaysia, the life expectancy at birth is at average 74.5 years old (Islam, Shitan, & Islam Mondal, 2017). Therefore, if the person dies before the expected age to live are considered die prematurely. Premature mortality entails estimating the average time a person would have lived had he or she not died

prematurely. Mortality estimates are essential parameters for monitoring health and routinely used evidence for health policy and planning. In the Global Burden of Disease study, there was a standardized form of years of life lost for measuring the burden of disease. However, in the context of health economic study, it measures the years of productive life lost due to premature mortality. Years of productive life lost define that the years that the person's loss to contribute economic growth if he or she died prematurely.

Meanwhile, cancer disease contributed about 9.6 million death in 2018, and it is the second leading cause of death in the world. In low- and middle-income countries occur, approximately 70% of deaths are due to cancer(GCO, 2018). More than half of mortality from cancer-related due to behavioural and dietary risks such as high body mass index, poor nutritional habits, lack of physical activity, tobacco use, and alcohol use. The impact on economic due to cancer is significant and will increase further approximately US\$1.16 trillion as estimated in 2010 (WHO, 2018). The latest report by GLOBOCAN 2018, there was a total of 18.1 million new cases reported by the year 2018, and a half of it leads to death. Asia regions contribute 48.4% of the cancer incidences, with 57.3% of mortality due to cancer.

Furthermore, the third most common type of cancer in the world is colorectal cancer, with 10.2% out of total cancer incidence and 9.2% out of total cancer mortality (GCO, 2018). In Malaysia, cancer also contributes to the second-highest causes of death. The top 3 highest cancer incidence for both sexes in Malaysia is female breast cancer (17.7% of total cancer cases) followed by colorectal cancer (13.2% of total cancer

cases), and lastly, lung cancer (10.2% of total cancer cases). Whereas if divided for both sex, colorectal cancer ranked 1st in males and second in the female with 16.3% and 9.5%, respectively (Azizah Ab M, 2016). Therefore, it is essential to determine the total number of premature mortality due to colorectal cancer.

The distribution of colorectal cancer burden varies widely, with the highest rates in developed countries rather than in developing countries (F. J. C. C. j. C. Bray, 2018; Ferlay et al., 2013). Prognosis and survival rate, however, different to compare between developed and developing countries. The incidence rate of colorectal cancer disease has been rising in developing countries even though it remains to be the disease of the developed world. In fact, due to the growth and ageing of the population and because of the adoption of westernized behaviours and lifestyles, the global burden is forecasted to increase further (Favoriti et al., 2016).

Even though there are many studies concerning the burden of the disease was done in Malaysia (Aljunid, Zafar, Saperi, & Amrizal, 2010; Azzani, Yahya, Roslani, & Su, 2017; M. R. A. Hassan et al., 2016; Yusoff, 2013). The economic analysis of premature mortality study not well explore in Malaysia. Therefore, the economic study of human capital resources lost due to premature mortality of colorectal cancer would benefit as a reference study on health economic analysis study in Malaysia.

1.2 Statement of Problems

Premature mortality is one of public health concern. The use of premature mortality measures has become somewhat more common as a mechanism for establishing public health priorities. As cancer disease, the second leading cause of death, measurement of premature mortality due to cancer is essential.

Colorectal cancer incidence has shown a significant increase for the last few decades. A total number of a new case of colorectal cancer 1 849 518 (10.2%) with the amount of mortality 880 792 (9.2%) globally reported in 2018. While incidence, mortality, and 5-years prevalence were on the higher side in Asia, 51.8%, 52.1%, and 49.2% of all-region(GCO, 2018).

Apart from that Malaysia National Cancer Registry reported that incidence of young colorectal cases had been observed to diagnose at a younger age with males detected at the age of 30 years while females at the age of 35 years (Azizah Ab M, 2016; Azizah AM. & Nadia SMR., 2019). Consequently, many cancer patients encounter the risk of premature deaths owing to the increased risk of mortality attributable to cancer.

Even though increasing cases and mortality or premature mortality due to colorectal cancer, the prognosis is still favourable and curable if cancer is detected early. Most of the type of colorectal cancer is preventable if intervention started early. Base on the previous study in prevention program of health behaviour modification shows that, such as dietary habit, lifestyle modification can prevent occurring colorectal cancer

(Anderson et al., 2014; Azeem et al., 2015; M. Hassan, M. Suan, S. A. Soelar, N. S. Mohammed, I. Ismail, & F. Ahmad, 2016). And its conclude why the study on estimation of human capital loss secondary to premature mortality among colorectal cancer patients in Malaysia would be beneficial as the first step to measure the real burden of the disease.

Human capital is a resource for production to economic growth (Stockley, 2008). Human Capital requires investment and need to be created in the form of education and training, which will increase the market value but can depreciate with time (Pushkarev, 2003). The increase of premature mortality due to colorectal cancer will decline the economic productivity in the fact of human capital resources depreciated.

1.3 Significant of Study

1. Study of human capital resources loss of colorectal cancer will give comprehensive information on the total economic burden of the disease.
2. Will enable other authorities using this study as part of the literature review to their further in developing activities and program to prevent premature mortality and reduce the incidence of colorectal cancer.
3. Will give more balance in health agenda aimed to decrease the burden of premature mortality and as the first step in estimating the real weight of productivity lost due to premature death.
4. Even though numerous studies on the burden of disease in Malaysia, there are not many studies that focus on productivity loss due to premature mortality. To

fill in the research gap in Malaysia, the study of Estimation of Human Capital Loss Due to Premature Mortality Among the Patients with Colorectal Cancer In Malaysia would be beneficial.

1.4 Research Questions

1. What is the prevalence of young colorectal cases in Malaysia?
2. What is the prevalence of premature mortality due to colorectal cancer?
3. What is total YPLL (Years of productive life lost) of premature mortality due to colorectal cancer?
4. What is National Human Capital Loss due to premature mortality of colorectal cancer in Malaysia?

1.5 Research Objective

1.5.1 General Objective

To estimate the economic loss due to premature mortality among colorectal cancer patients in Malaysia by using the human capital approach.

1.5.2 Specific Objective

1. To determine the total number of patients diagnosed with colorectal cancer at a young age in Malaysia
2. To determine total cases of premature mortality due to colorectal cancer

3. To calculate YPLL (years of productive life lost) of all premature mortality due to colorectal cancer
4. To estimate National Human Capital loss due to premature mortality of colorectal cancer by using Human Capital Methods

1.6 Conceptual Framework

The conceptual framework of this study developed base on this research objective and previous literature. The aim of this study to estimate the human capital loss secondary to premature mortality among the colorectal cancer patient in Malaysia with an applied human capital approach.

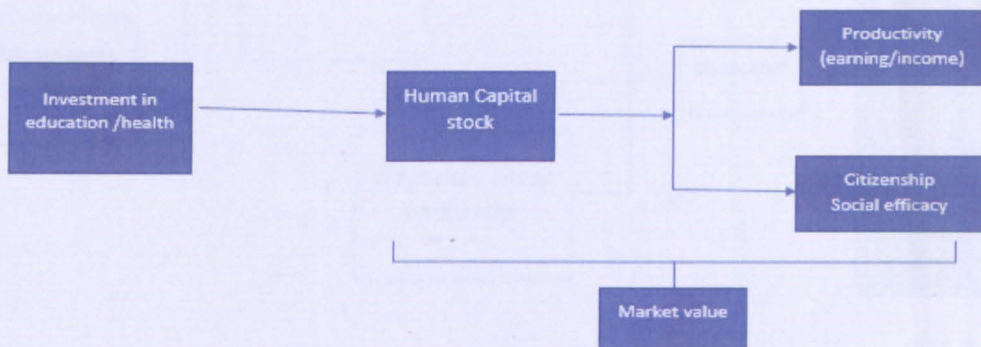


Figure 1.1: Diagram of the Human Capital Approach

Figure 1.1 is the human capital approach applied in this study. This concepts or approach mentioned by Stockley, human capital is the recognition of people are

important and essential assets who contribute development and growth(Stockley, 2008). Human capital in the form of physical assets such as collective attitudes, skills and abilities of people contribute to national performance and productivity(UNECE, 2016). Measuring labour income will give the value of the economy's average stock of human capital as a quality-adjusted sum of the labour of its citizen. Therefore, if human becomes sick, for example, diagnose with colorectal cancer and die prematurely will give impact to human capital stock and directly accumulating the cause of economic loss of the nation. Base on Human capital approach, we adopted and adapted the conceptual framework of this study. (See Figure 1.2)

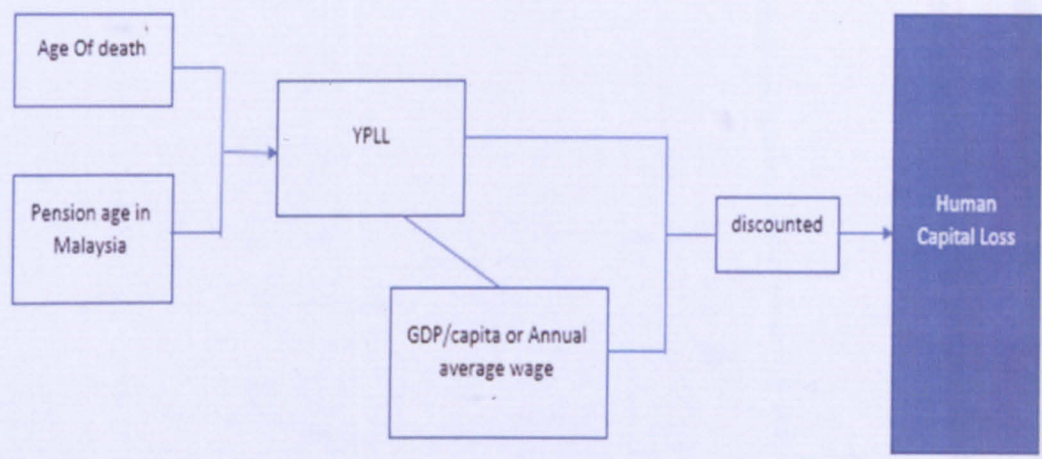


Figure 1.2 Diagram of Conceptual Framework

As shown in Figure 1.2 is the conceptual framework of this study. The age of death and pension age Malaysia will affect the years of productive life lost (YPLL). GDP (gross domestic product) per capita or annual average wage for specific years, and person will affect the outcome of income forgone for the individuals. The most

important of the estimation is the discounted rate used, which will change the total output loss of human capital. The method is part of the human capital approach, which widely used worldwide (Maharaj & Reddy, 2012; UNECE, 2016). Ultimately, to an estimation of the economic burden of colorectal cancer in terms of national human capital loss with some degree of accuracy can be made. The damage to the economy arising from colorectal cancer related premature death from this way calculated given by the discounted value of the output foregone over the period in which the worker is not able to earn an income. The final result is the loss of human capital due to premature mortality in this framework.

CHAPTER 2: LITERATURE REVIEW

The chapter of review literature discussed in six sections. First section literature review human capital definition and application, the second section is about factors affecting human capital, third section human approaches studies, forth section literature review on cancer disease and colorectal cancer disease. Section five review of the study burden of cancer disease and section six regarding review studies of colorectal cancer diseases and health economic study colorectal cancer disease.

2.1 Human Capital

Human capital defines as the skills, knowledge, and experience possessed by an individual or population, viewed in terms of their value or cost to an organization or country(Dictionary, 2020). The concept of human capital substantial in the economic value found since 1780(Mačerinskienė & Viržintaitė, 2003). Human capital measurement is distinguished in the form of human capital investment. According to Mačerinskienė & Viržintaitė (2003), there are three main sources of human capital investment; an individual, an organisation and government. This investment can be in the form of expenditure on formal education, health care, on-job training, job search, mobility and search for information.

There are three main approaches used in the measure the stock of human capital in economic literature: the cost base approach, the output base approach and income-based approach. However, in health economic study, measurement of human capital

usually the output base and the income-based approach(Bloom & Canning, 2003; Kwon, 2009). The context of this study is the measurement labour productivity of an individual loss due to diseases. The aim of this approach is to estimate the output loss of human capital due to illness. Is intended to use the income-based approach in reference to future earnings. This human capital approach widely uses worldwide(Stockley, 2008; UNECE, 2016).

According to Bleakly, (2010), the health status of human capital impact economic growth and there were multiple ways and factors on how health status can affect human capital productivity. Health has a direct effect on the productivity of worker (Bloom & Canning, 2003). A simple example; when a person gets sick, their ability to work reduce, they will invest in treatment of the disease, and they might absent to work.

2.1.1 Mortality Affecting Human Capital

Mortality causes a complete loss of human capital. Whereby, when a person dies, they are no longer able to contributes to national economic growth. The impact of mortality toward economic growth is significant and become an essential parameter for monitoring health(Yusoff, 2013). Mortality due to disease is currently becoming the main agenda and concern of public health. Premature mortality measurement to estimate the human capital loss has become famous for measuring the real weight burden of diseases(Bleakley, 2010; Bloom & Canning, 2003). In addition, cancer second leading cause of mortality and colorectal cancer incidence and mortality ranking 1st in Malaysia(Azizah AM. & Nadia SMR., 2019; F. Bray et al., 2018; F. J.

C. C. j. C. Bray, 2018; Fitzmaurice et al., 2018). Mortality due to cancer disease will affect human capital stock and economic growth of Malaysia.

2.2 Human Capital Approach Studies

The human capital approach used to estimate the economic loss or to portray the burden of diseases in the value of current money. There are several methods in measuring economic damages in applying the human capital approach, for example, by using the LifeLossMOD, a microsimulation model, to quantify the economic effects of premature mortality. This model launched in Australia. The model built based on the 2003 death rate census and extended the forecast from the APPSIM (Australian Complex Population and Policy Microsimulation Model) and predict the contrafactual life paths foregone by 2030 (Carter et al., 2015). Whereby APPSIM developed to evaluate the impact of future fiscal and social policies (Harding, 2010). The LifeLossMod used population mortality dataset with available variable age, sex, cause of death and socioeconomic status recorded in the year 2003. The premature mortality defines in this study as a person die before the age of 80 years old, which is the life expectancy of Australian. The study not specific to particular cancer, and they include all cancer death in the study. The model used able to match mortality dataset 2003 with APPSIM population base data set at random variables, and the discount rate of 3% applied in calculation. They replicated 100 times to create 100 unique datasets and verifies present 95% confidence intervals. Productivity cost was evaluated for Premature Mortality (PCPM) in Australia for Cancer related diseases. The PVLI - present value of lifetime income estimated because of premature mortality with the

characteristics of age, sex, and economic status. As a result, for this study, premature death from 2003 projected to 2030 due to cancer was in charge of an overall loss of 88,000 working time and cost estimated 4.2 billion Australian dollars in the PVLI forgone in 2003. For males, the cost was three times greater than in females. Colorectal cancer, lung cancer, and brain cancer recorded in the highest proportion of costs.

There is an article of Productivity losses, and public finance burden attribute to breast cancer in Poland, 2010-2014 (Łyszczarz & Nojszewska, 2017). This study estimates the indirect cost of productivity losses due to breast cancer. They used human capital method together with a societal perspective to estimate the cost of absenteeism of the sick and caregivers, presenteeism of the sick and caregivers, disability and also premature mortality. The study used retrospective prevalence base data from Polish National Cancer registry and social insurance system to estimate the productivity losses. However, compared to other studies by Carter et al., (2015) in estimating the losses, they used mean GDP per worker for decreasing the marginal productivity of labour. Therefore, as they said, the result is more accurate and present closed to real losses due to Breast Cancer. The final result for this study was 583.7 million euro and rising to 699.7 million euro in 2014 for productivity losses due to breast cancer in Poland. For the period 2010 till 2014 these costs accounted for 0.162–0.171% of GDP, an equivalent of 62,531–65,816 per capita GDP. Łyszczarz & Nojszewska (2017) proved that the high cost of losses attributes by disability and premature mortality with 27.6%–30.6% and 22.0%–24.6% of the total costs respectively. The costs due to caregivers' presenteeism were negligible (0.1% of total costs). Public finance expenditure for social insurance benefits to BC sufferers ranged from €50.2 million

(2010) to €56.6 million (2014), an equivalent of 0.72–0.79% of expenditures for all diseases. Potential losses in public finance revenues accounted for €173.9 million in 2010 and €211.0 million in 2014.

Oliva-Moreno & Peña-Longobardo, (2018) publish the study with the topic Labour productivity loss caused by premature deaths associated with breast cancer: results from Spain over ten years. This study used a similar concept of human capital approaches with Łyszczarz and Nojszewska, (2017) study but focused on Spain data of breast cancer patient. In different from the previous study, instead of GDP per capita, they used average salary from the Salary Structure Survey of Spain in calculating the economic losses. The method of this study combined data from Salary Structure Survey of Spain, occupation (Active Population Survey) and deaths (death registration according to cause of death) in Spain and created simulation model based on the human capital approach was constructed to estimate productivity losses associated with premature deaths caused by breast cancer in Spain. As a result, labour productivity losses in women estimated to cost 2,137 million euros from 22,716 deaths occurring during working age with years of potential productive life loss of 292,848. The finding implies that breast cancer is responsible for 10.45% of all estimated female labour productivity losses caused by premature deaths in the reference.

Meanwhile, Pearce et al. (2018) did the study applied the incidence-based method using the human capital approach for Productivity losses due to premature mortality secondary to cancer in Brazil, Russia, India, China, and South Africa (BRICS). This study about the population-based comparison of economic losses due to premature

mortality secondary to cancer within the five-country as mention (Pearce et al., 2018). They estimated the productivity lost value of cancer-related to premature mortality in BRICS in 2012. The mortality rate then forecasts to the major developing countries such as Russia, China, Brazil, India, and South Africa. The data analysed from GLOBACAN 2012 by extracting dataset related to annual adult cancer mortality. They calculate the years of productive life lost of a cancer patient by subtracting the pensionable age in each country with an age of death of each case and then value the economic lost using the comparison national and international data for workforce and wages statistic. The sensitivity analysis provides different methodological premises. Lastly, in the final calculation of lost, they make assumptions of varying discount rate with a rate of 1.5% to 4.5% of wage growth. The overall cost of productivity lost was US46.3 billion dues to premature cancer death in 2012. In China, the most significant productivity loss (US28 billion) had occurred. The locally tailored methods used to mitigate the economic burden of cancer in developing countries.

Furthermore, P. Hanly, Soerjomataram, & Sharp (2015) also did a study using human capital approaches to estimate productivity losses due to premature cancer-related mortality in Europe. Previously Hanly & Sharp, (2014) publish the article with the title "The cost of lost productivity due to premature cancer-related mortality: an economic measure of the cancer burden" in 2014, and this study only focused on Ireland. Both of the studies applied the human capital approach in estimating economic burden due to cancer. By combining data from average wages of the country for men and women, labour activity and death registration according to cause of death in

methodology is a similar approach that was done by Pearce et al., (2018) with the large scale of calculation the productivity losses within the European country.

Apart from cancer-related mortality Menzin et al. (2012) and Maharaj & Reddy, (2012) using the human capital approach in methodology is estimating economic losses for premature mortality of different angle. Menzin et al. (2012) talk about Lost of productivity due to premature mortality in developed and emerging countries: An application to smoking sensation. Whereby, Maharaj & Reddy (2012) did an economic analysis of human capital loss of young stroke mortality in the Fiji Islands. Menzin et al. (2012) used two approaches in their study the human capital approach and friction cost approach. They selected 29 countries in the study. They also created the model to estimate the productivity loss of the smoking sensation. This model combined data analysis from 2008 WHO life table, 2008 ILO (International Labour Organization), countries specific wage data from International Monetary Fund (IMF) World economic outlook database and from BENESCO (Benefits of Smoking Cessation on Outcomes) case study. However, they unable to apply the friction cost approach in the model for all the country due to the limitation of data available. As a result, the present value of lifetime earnings (PVLE) in a specific subpopulation, younger people, men and people from a developed country are higher. For the country with relevant data available such as Brazil and the US, the PVLE estimate lower using the friction cost method compared to the model that uses only the human capital method. For this reason, the friction cost approach can replace the value absentees of the employee during the patient absenteeism.

Another study used a combined approach human capital, and friction cost to estimate productivity losses (A. M. Pearce et al., 2015). This study estimates productivity loss associated with head and neck cancer focus in Ireland country. As per methodology for this research data were collected from Head and neck survival data of Ireland, merge with population-level survival estimate and national wage data. The study however not focused on premature mortality and they divided the losses to four categories which are: 1) temporary time off work, 2) Permanent time off work, 3) reduce hour at work and 4) premature mortality. Sensitivity analysis was done for the ability to get the impact of various data and the assumptions on overall lost productivity cost. The overall result for the study shows that total productivity losses per employed person of working age were 6,800 euro using FCA and higher using HCA, which is 253,800 euro. The leading contributor cause of productivity loss for FCA was temporary time off, which is 73% and for HCA was premature mortality which is 38% out of total. The discount rate used for this study from 0-6% and for the friction time was a rise and declined by 20%.

In the other hand, Maharaj & Reddy, (2012) did study with the title of "Young Stroke Mortality in Fiji Island: An Economic Analysis of National Human Capital Loss". This study only uses one approach in estimating the human capital loss premature mortality related to stroke. Data for the research was extracted from annual stroke mortality data from Fiji Ministry of health and used the proxied income per capita. The discount value they compute is 8% to get the present amount of loss. This discount value 8 per cent is based on economic growth in Fiji annually. They used the formula of output loss to get the final result. They found that in Fiji for the years they studied out of total stroke

death, 53.8% of it was at a productive age. The person in their forties contributes the highest percentage loss due to stroke-related premature mortality. Total loss estimated was US\$5.31 million, which is 1% from government revenue and 9.7% from the ministry of the health budget.

2.3 Cancer and Colorectal cancer

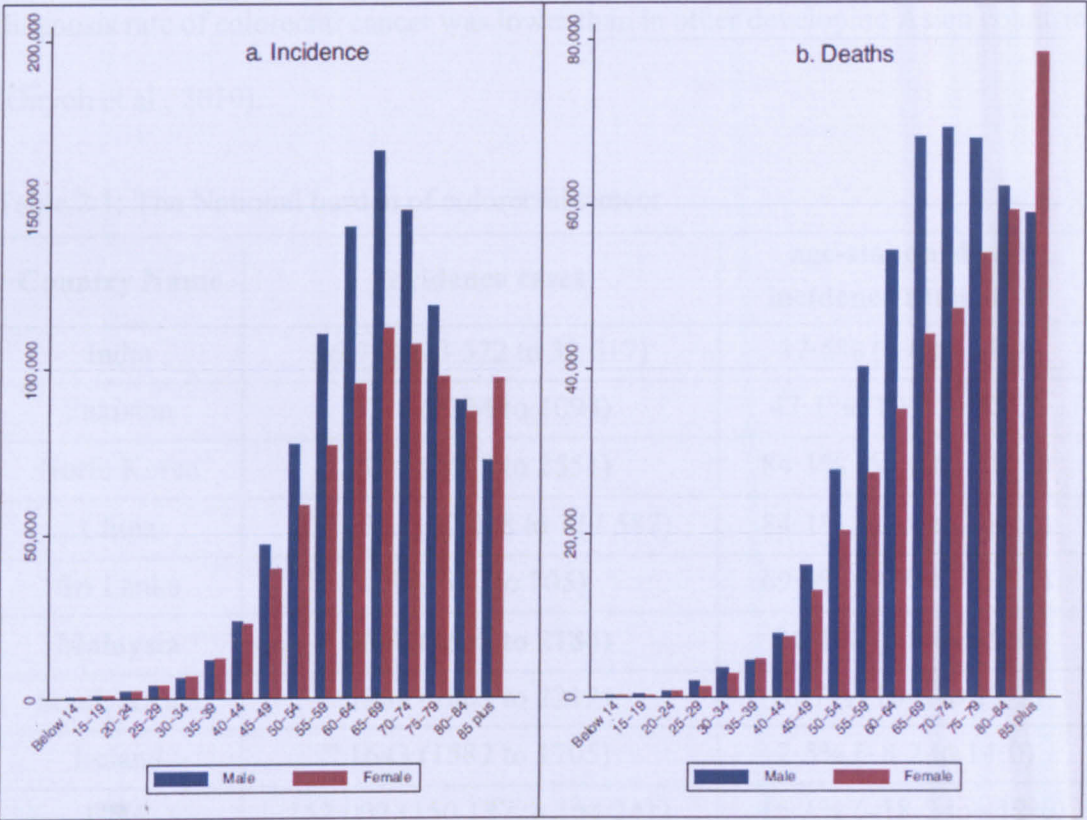
Cancer is abnormal cells grow beyond their healthy boundaries. These abnormal cell growths can invade at any part of the body and can spread to other organs. Malignant tumour and neoplasm also a common term used for cancer (Winawer et al., 1997). Anatomic and molecular subtypes define the type of cancer, and different location of body part require specific tools in diagnosis and management strategies.

The Colorectal cancer is the malignant or neoplasm growth started in the colon and rectum. These cancers can also be named colon cancer or rectal cancer, depending on where they start. Colon and rectal cancer have many standard features that make them being group together (Winawer et al., 1997). Colorectal cancer often begins with polyp and detection of the polyp as precancerous can help prevent the occurring of colorectal cancer (OCL, 2019). Adenocarcinoma is the most common type of colorectal cancer, whereas there are other types of colorectal cancer is gastrointestinal carcinoid tumour, leiomyosarcoma, primary colorectal lymphoma and melanoma (CTCA, 2019; OCL, 2019).

Most of the colorectal cancer types are non-hereditary account about 95%, which is happened by chance after the person being born and 5% left is by hereditary(Mármol, Sánchez-de-Diego, Pradilla Dieste, Cerrada, & Rodriguez Yoldi, 2017; Natrah et al., 2012; OCL, 2019). The large intestine has two main components which are the colon and rectum. There were several layers of the intestinal wall, which include the inner and outer layer of it and the tissue in and around the colon feed by a network of a blood vessel and lymph nodes. Therefore, the staging of colorectal cancer determined by extent those layers of colon and rectum together with or without lymph node and other organs affected by it(CTCA, 2019; OCL, 2019). How colorectal cancer spread and advanced of the disease reflect on each staging. As low the stage of colorectal cancer, the more positive prognosis of it(Ghee, 2014; M. Hassan, M. Suan, S. A. Soelar, N. S. Mohammed, I. Ismail, & F. J. A. P. J. C. P. Ahmad, 2016; Magaji, Moy, Roslani, & Law, 2014).

2.4 The burden of Colorectal Cancers

Colorectal cancer causes substantial mortality worldwide(Sharma, 2019). The sophisticated disease control and cancer management, such as preventive, predictive, personalized medicine (PPPM), involve mitigating the mortality incidence. The PPPM adaption approach requires measuring the cancer burden at various country level and policy level. To achieve this, they examined the colorectal cancer burden in 185 countries in the year of 2018. The dataset retrieved from GLOBOCAN 2018. The MIR - Mortality-to-incidence ratio used as an alternate for the 5-year survival rate. The results that, the mortality rate defined as 6.3/100,000 in 2018.



*sources: (Sharma, 2019)

Figure 2.1: Burden of Colorectal cancer in 2018

Veettil, Lim, Chaiyakunapruk, Ching, & Hassan, (2017) provides the analytical view of the burden of colorectal cancer and estimates the control measurements which assist in decreasing the future weight of colorectal cancer in Malaysia. It performs MEDLINE search through OVID with "Colorectal Neoplasms", PubMed, and MeSH - Medical Subject Headings with the phrases of "colorectal cancer" and "Malaysia" in the year of 1990 to 2015. The percentage of death information extracted from population-based cancer databases. They summarized that colorectal cancer was the 2nd most leading disease in males and 3rd most leading disease in females. The socioeconomic burden of colorectal cancer was consequential in Malaysia. Also, the

diagnosis rate of colorectal cancer was lower than in other developing Asian countries (Onyoh et al., 2019).

Table 2.1: The National burden of colorectal cancer

Country Name	Incidence cases	age-standardized incidence rates from
India	26 950 (23 572 to 33 017)	37.5% (6.0 to 64.0)
Pakistan	3713 (3334 to 4094)	47.1% (10.5 to 82.3)
North Korea	2095 (1683 to 2551)	84.1% (62.0 to 102.2)
China	107 038 (100 408 to 117 587)	84.1% (62.0 to 102.2)
Sri Lanka	654 (610 to 705)	69.4% (32.7 to 110.5)
Malaysia	1800 (1555 to 2184)	31.1% (5.5 to 55.9)
South Africa	1989 (1803 to 2212)	18.7% (10.5 to 27.2)
Ireland	1643 (1582 to 1705)	2.5% (-8.2 to 14.0)
USA	152 002 (150 137 to 154 241)	-15.1% (-18.2 to -12.0)
Belgium	6258 (6013 to 6521)	-10.5% (-18.0 to -2.3)
Netherlands	8553 (8241 to 8849)	21.3% (11.9 to 31.7)
UK	39 729 (39 124 to 40 372)	-2.3% (-5.2 to 1.0)

*source :(Safiri et al., 2019)

The global data of colorectal cancer was varied, and it requires understanding the impact of colorectal cancer among cancer patients. Safiri et al., (2019), on the other hand, provide a report on mortality, incidence, and disability of colorectal cancer between 1990-2017 in 195 countries. Their methods are vital in sample registration, essential registration for generating the incidence report, mortality report, and DALY - disability-adjusted life-year.

2.5 Studies of Colorectal Cancer Disease

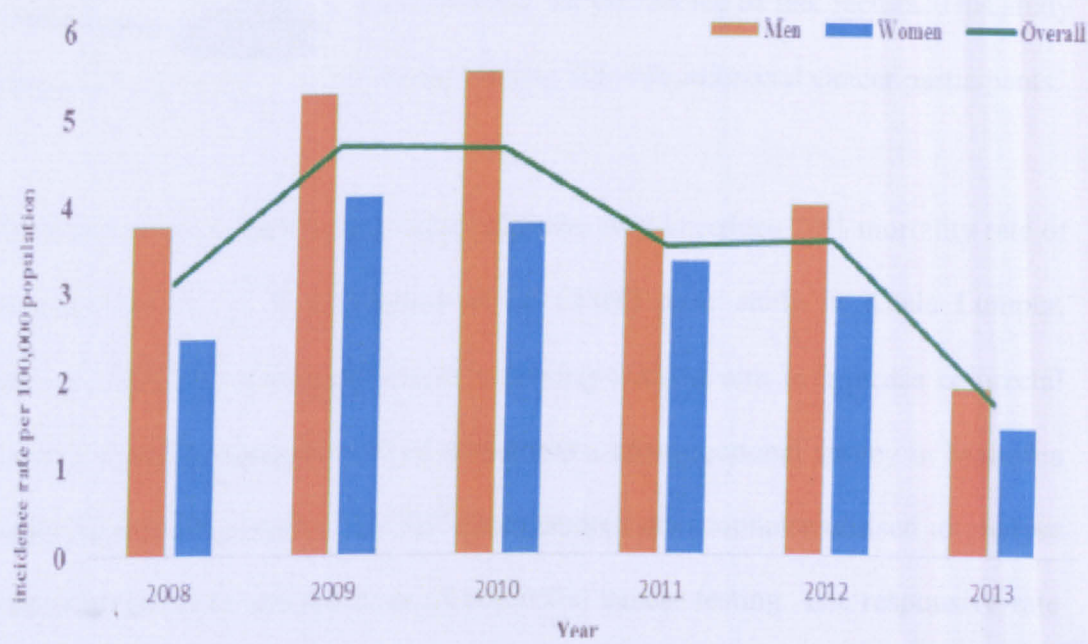
Analysis survival rate was a key factor for efficient early detection of cancer and improvements in cancer treatment (M. Hassan, M. Suan, S. A. Soelar, N. S. Mohammed, I. Ismail, & F. Ahmad, 2016). These researchers analyse colorectal cancer survival in Malaysia. It also combined with prognostic factors among Malaysians. The data utilised from National Cancer Patient Registry (NCPR)-colorectal cancer for the analysis. They retrieved data that contains cases between the years 2008 and 2009. These data include the patient's pathological features, socio-demographic information, and received treatment details. Researchers used the Kaplan-Meier approach for plotting the survival curves. Overall variables of univariate analysis estimated with the Log-rank testing method. The influence factors of patients' survival analysed by using Cox regression. This study contains 1,214 patient's data. The survival rate was 59.1% and 48.7% between 3 to 5 years. In multivariate analysis, diagnosis stages are ($p < 0.001$) primary tumour size, lymph nodes involvement, and ($p = 0.001$) treatment modalities were determined to be survival predictors. Likely, primary tumour size, lymph nodes involvement, and treatment modalities detected in Cox regression. The socio-demographic characteristics didn't give any influence. It concludes the survival rate of colorectal cancer patients in Malaysia was similar to other Asian countries with the factors of primary tumour size, lymph node involvement, and treatment modalities.

Most of the people had not aware of colorectal cancer symptoms. According to the report by Niksic & Forbes (2018), 69% of the people were not able to identify

colorectal cancer symptoms. The main suggestion would increase the awareness of colorectal diseases. The lowest socio-economically people and women had the most inadequate knowledge of colorectal cancer risk factors (Williams et al., 2019). This study mainly aimed to analyse public awareness and symptoms of colorectal cancer. The data analysis contains a large number of data 47,270, which allowed examining the cancer symptoms recognition and risk factors. Descriptive statistics were dissected to analyse the characteristics of socio-demographic. This research mainly highlights the requirements of developing and improving awareness of colorectal cancer early symptoms associated with risk factors. The advantage is that it includes a large amount of sample allowed to analyse the robust statistical analysis. The disadvantage of this study was, they cannot explain the exact proportion of members who concentrated on the set of symptoms.

The percentage of colorectal cancer had increased in Malaysia during the past years (Norwati, Harny, Norhayati, & Amry, 2014). The physician recommendation showed the essential factor that motivates screening experience. This study described the screening practices of colorectal cancer in Malaysia primary care. The patient's data received from 44 primary care clinics and 132 primary care in west Malaysia. The self-administrated questionnaires contain the public information, qualification, practices on colorectal cancer screening, the background of primary care clinic, and barriers to the detection of colorectal cancer. The response rate defines 87.9% from primary care. The common hindrance was "unavailability of the test." It indicates the preventive activities of colorectal cancer were still unfortunate among primary care providers in Malaysia. Additionally, it suggests the minimum test availability in primary care and

minimum awareness about colorectal cancer among patients. It concludes that more awareness programs were mandatory for the public.



*source : (Naing et al., 2017)

Figure 2.2: Incidence rate of colorectal cancer in Malaysia

Favoriti et al. (2016) explained the difficulty of colorectal cancer worldwide. Colorectal cancer was the critical problem in public health. There was a wide variation across various geographic areas because of risk factors exposure, screening uptake, and appropriate treatment service. The screening of colorectal cancer has proved to minimize the mortality rate increase to develop economically in developed countries (Magaji, Moy, Law, Sii, & Roslani, 2019). To improve targeted countries, it could reduce the disease burden. The objective of this paper was to make an incidence review, geographic variations, temporal trends, survival rates, and mortality rates for colorectal cancer. The survival rate increased in the countries of Chile, India, Brazil, and Malaysia during 1990-2009. The survival rate of 38.8% in Europe, Switzerland,

contains 59.9%. In Italy, the survival rate had increased from 50% in the year 2005-2007. The most significant colorectal cancer indicates allowance had noted in Western Asia and Eastern Europe. It also influences the prevalence of risk factors. This study conducted on 7676 diagnosed patients among 506,488 colorectal cancer participants.

Colorectal cancer screening showed an effective way to reduce 70% mortality rate of colorectal cancer. Y. Z. H. Hashim et al. (2016) done study in Kuala Lumpur, Malaysia, related to colorectal cancer screening with an aim to increase colorectal screening on poor population. They performed a cross-sectional survey in Malaysia primary health care centres. The self-administrated questionnaire utilised to analyse the knowledge score and practices of colorectal cancer testing. The responsive rate defines 86.4% for overall risk stratification scenarios. In colorectal cancer screening modalities, the mean knowledge score determines $48.7\% \pm 17.7\%$. This knowledge score increased with Educational graduates and screening guidelines. Adequate resources and screening cost-effectiveness were necessary for the determination of the practice of testing.

M. R. A. Hassan et al. (2016) in the other hand, evaluated the mortality rate and incidence rate in Malaysia for colorectal cancer patients. The data set retrieved from National Cancer Registry -a total of 4,501 patients with colorectal cancer. The survival rate verified with the National registration department. For various colorectal cancer incidence rate and mortality rate, the age-standardized rate computed from 2008-2013. The total incidence rate was 21.32 incidences per 100,000 for colorectal cancer. The Chinese ethnicity had the highest colorectal cancer incidence as 27.35, Indian races

had 17.55 and Malay had an 18.95 colorectal cancer incidence rate. The age-standardized standard rate of colorectal cancer defines 1.33 times greater in males compared than females per 100,000. The total ASR of mortality illustrates 9.79 incidences with 11.85 in Chinese, Malays had 9.56 and Indian had 7.08. It concludes the colorectal cancer mortality rate and incidence rate were higher in males compared to females and higher in Chinese ethnic compared to others.

The survival of colorectal cancer decreased in the ageing population (B. A. Magaji, F. M. Moy, A. C. Roslani, & C. W. Law, 2017a). This is due critical factor of cancer survival is early detection and treatment or management. Besides, the epidemiology of cancer was the scarcity as well as its predictors. They determined the number of years survival and compared the survival rate with ethnic groups. The information contains the diagnosed of colorectal cancer patients with the various characteristics from 1st January 2001 to 31st December 2001. The survival analysis estimated by using the Kaplan-Meier approach at 1-, 3- and 5- year intervals. For comparing the survival rate, the log-rank test utilized. The survival rate compared with some other Asian countries. However, the more developed countries had minimum survival and mortality rate. Health education programs, symptom recognition, risk factor analysis, and awareness programs should be required to implements.

In Malaysia, colorectal cancer was the most common disease with an incidence rate of 21.3 and 9.8 of the mortality rate per 100,000 population (Van Tze et al., 2017). The risk factors of colorectal cancer such as lifestyle, behaviour, such as low dietary,

obesity, age, and red meat consumption and genetic factors. Gender and races also appear to influence the incidence of colorectal cancer with male and Chinese race reported to be the unfavourable predictive factors. Through the systemic analysis of this study, they found about 65% of cases presented late. Therefore, they suggested that The Cancer Advocacy Society of Malaysia mitigate the colorectal cancer toll through screening and Colorectal Cancer Awareness.

Keum & Giovannucci (2019) explained colorectal cancer and prevention strategies. Colorectal cancer represents the aetiologically heterogeneous disease. Almost 25% of colorectal cancer incidences had a genetic cancer syndrome. The genetic factors such as germline MLH1 and APC mutations had individuals predisposing to colorectal cancer. This study provides an analysis of the summary of colorectal cancer epidemiology with nutritional elements. The optimal reduction of colorectal cancer mortality rate and incidence rate would be required to minimize the modifiable risk factors.

Marley & Nan (2016) summarized the current understanding of the colorectal disease among peoples based on nationally published statistics. It highlights the topics of risk factors, descriptive epidemiology, screening, control, prevention, and treatment. They suggest that to increase colorectal cancer screening and epidemiology studies focused on personalized treatment improvement and prevention strategies. There are various researches linked the genetic factor into colorectal cancer, and some researches explained different screening methods. However, it still lacked in many areas and specific communities. Colorectal cancer epidemiology focused on the interaction

between nutrients and genetics. It would increase the understanding of prevention strategies of colorectal cancer.

2.6 Health Economic Evaluation Study of colorectal cancer

Rahim & Farhana (2018) analysed the systematic review of economic evaluation due to Cancer in Malaysia. They also describe the various studies of Cancer-related economic assessment in Malaysia. The dataset received on 20th March 2017 from the Critical Appraisal Skills Program (CASP) and Health Economic Studies (QHES) instrument. In results, 39 text articles selected from scientific electronic databases. Eight articles proved the cancer-related economic evaluation in Malaysia. It computes two cost-effectiveness analyses, five cost-utility analyses, and one cost-minimization analysis.

The healthcare system contains government-based healthcare and private healthcare in Malaysia. Most of the cancer patient will receive treatment in government facilities in Malaysia as the well-known cost of the treatment of cancer patient is the highest compared to other diseases (Azzani, Roslani, & Su, 2016). The financial burden of the cancer patient is part of the whole burden of diseases—this burden of disease given the high impact on economic productivity. Furthermore, in an understanding of the patient's income loss and working hours, this research analyses the financial burden of colorectal cancer patients. The data on patient's cost collected from telephone interviews and self-administered questionnaires for colorectal cancer patient's treatment at the UMMC - University of Malaya Medical Centre. The information

consists of the patients spent on hospital stays, treatment and tests, travel, food, and other medical and non-medical items. In this study, the perceived level of cancer patients and financial difficulties also investigated. The patient cost investigation would start with four stages of colorectal cancer, such as RM 6,544.5, RM 7,790, RM 8,799.1, and RM8,638.2. The total one-year patient spent cost would increase and its influence by stages of cancer and the longevity of treatment also types of treatment received. The frequently used financial scheme combined with current savings and income. Most of the patients detected paying as tricky for their healthcare.

Azzani et al. (2017) has estimated the cost of colorectal cancer among cancer patients and their families in Malaysia. It also investigates the key elements of catastrophic health expenses(CHE) from the management cost of colorectal cancer. The data analysis contains 138 colorectal cancer patients by direct interview and structured questionnaire at the diagnosis time of 6 months and 12 months. This paper used a multivariate binary logistic regression method for analysis. They found that 47.8% of cancer patients' families suffered CHE. The critical factors of CHE were defining the family's economic status and the probability of patients undergoing surgery. It suggests that policymakers and stakeholders should offer financial protection for cancer patients' treatment.

Whereby, Chongpison et al. (2016) find the relationship between the type of treatment colorectal received can affect the psychological and financial well-being of patients during active treatment. This study method of collecting data by a mailed survey with 576 long-term colorectal cancer survivors who were members of Kaiser Permanente

conducted in 2010-2011. Prevalence of current depression ascertained using a score of ≤ 45.6 on the Short Form-12 version 2 mental component summary. The perceived financial burden assessed using a Likert scale ranging from 0 (none) to 10 (severe). Regression analyses used to measure associations after adjustment for covariates. Result of this study shows depression was reported frequently among these long-term colorectal cancer survivors, particularly among post-operative survivors. Depression was associated with a higher perception of the financial burden. Screening for depression and assessing economic well-being might improve care among long-term survivors.

All those studies mentioned, approved the human capital method to examine the potential economic improvements waived because of premature deaths. Human Capital Approach study is beneficial as a result can be part of measurement the premature mortality burden related and were able to use for the technical measure of disease burden that helps decision-makers and researchers. Meanwhile, colorectal cancer disease proves to be the most common cancer in Malaysia, and its burden to patients, families and nation. It justifies why premature mortality due to colorectal cancer included in this study. Countries with limited resources of data limitation challenging to adapt the complicated methods such as friction cost approach. Therefore, Human Capital approach is one of the suitable ways to estimate the economic loss due to diseases.

CHAPTER 3: METHODOLOGY

This chapter will outline the research method adopted and adapted by this study. We illustrate the details of the domain of study, study design, the sampling method and the size of the sample, the inclusion and exclusion criteria for this research. Besides, we would also discuss the data collection process and how the data was extracted and analysed in order to obtain the final result. Finally, the ethical issues, as well as consideration of this study, will be explained.

3.1 Study Domain

This is a health economic study which is intended to quantify the human capital loss due to premature mortality associated with colorectal cancer in market value.

3.2 Study Design

We consider the study is an observational cohort study. This is because the study population consisted of a fixed group of subjects with the same character (Colo-rectal Cancer) over ten years (1st January 2007 – 31st December 2016). In this cohort, we took observation every year how many died every year within their productive life. It is retrospective because we observe the data retrospectively concerning data orientation.

3.3 Study Location

Study location includes the whole of Malaysia. This study used data from the National Cancer Institute, Malaysia. The data analysis and research project report were done in UNIMAS. All the data that received from the National Cancer Institute comprise of all colorectal cancer patient that registered in cancer registry in Malaysia from 2007 till 2016.

3.4 Study Duration

The overall study duration was 12 months from September 2019 till 31st August 2020. This duration including the proposal preparation, proposal presentation and correction, NMRR registration and approval from Director-General of Health Malaysia, data collection and data analysis, progress presentation, final report presentations and until submission of the research report.

3.5 Study Approach

This study applies the human capital approach in calculating the burden of disease by calculating years of productive life lost due to premature mortality (UNECE, 2016). The source of human capital resource loss may include income foregone consequently to the disease, cost of training, recruitment, replacement of labour force, and as a result of increased medical and health care costs, also, the prices of recruiting carer(s), and loss of family carers' financial income, absenteeism of work, and even premature death (Stockley, 2008). However, for this study, we specifically used only premature death

as the key to calculate the productivity loss the base of secondary data chosen and the availability of variables in data.

3.6 Sampling.

3.6.1 Sampling Frame

All the colorectal cancer patient in National cancer registry of Malaysia

3.6.2 Sampling Method

We use a universal sampling method, whereby we studied all the colorectal cancer cases in Malaysia within the study period from 1st January 2007 till 31st December 2016. The data obtained from the National Cancer registry.

3.6.3 Inclusion Criteria

- This study included all patient diagnosed with colorectal cancer and registered in the National Cancer Registry.
- Its included patients diagnosed with colorectal cancer during the study period, between 1st January 2007 till 31st December 2016.
- Its also included all patients who died within the period of study from 1st January 2007 till 31st December 2016.

3.6.4 Exclusion Criteria

- The study excluded all patients diagnosed with colorectal cancer before 1st January 2007 or after 31st December 2016.
- Its also excluded all patient who died before 1st January 2007 and after 31st December 2016.

3.6.5 Variables

The variable of this study extracted from the National Cancer Registry, Department of Statistic Malaysia and World bank open-source data. The list of variables that utilised in estimating human capital loss due to premature mortality secondary to colorectal cancer, as shown in the table below. See table 3.1

Table 3.1 List of Variables.

Incidence date/year	2007 till 2016	
Gender	Male	
	Female	
Ethnic Group	Malay	
	Chinese	
	Indian	
	Others	
Date of birth	NA	NA
Incidence Age of patient	0-14	
	15-29	
	30-44	
	45-59	
	60 years and above	
Date of last seen	NA	
Patient status	Alive	
	Death	
	Unknown	
Date of death	Data merge with National registry data	
Year of death	2007 till 2016	
GDP per capita	2007 till 2016	
Discount rate	5%	

The listed variables in Table 3.1 are the variable that utilised while estimating the result for this study. The Incidence date/year are the dates that the patient diagnosed with colorectal cancer. The study period is ten years from 1st January 2007 till 31st December 2016. Gender is the sex of the patient with two variant Male and Female. Date of Birth is the patient's date of birth which is a crucial variable to calculate the age of death, because of the age of the patient in the data represent the age at diagnosis. Date of last seen is the date that patient last seen in a clinic or hospital as reported to the National Cancer registry. Patient status had three variant alive, death and unknown, the data indicated the patient status base on notification from the hospital or clinics. Date of death is the original date of the patient died merged with data from the Malaysia National Registry department. However, some of the cases do not have a

date of death even though the patient's status is dead. Therefore, we used the date of last-seen to calculate the age of death for these particular cases.

GDP per capita

GDP per capita is gross domestic product per capita. Due to varying levels of income for individuals, the average annual salary and also GDP per capita is proxied by the per-capita income, and the data obtained from the Department of Statistics Malaysia and World bank open-source data. GDP per capita different values from two sources, as shown in Table 3.2 below.

Table 3.2: GDP per capita Malaysia 2007-2016.

Years	Value of GDP per capita (RM)	Malaysia GDP RM (Billion)	Value of GDP per capita (US Dollar)	Malaysia GDP US Dollar (Billion)
2007	24,589	665.34	8,605	193.55
2008	27,929	769.949	8,850	230.81
2009	25,385	712.857	8,559.2	202.26
2010	28,733	821.434	9,040.6	255.02
2011	31,372	911.733	9,372	297.95
2012	32,913	971.252	9743.1	314.44
2013	33,720	1,018.82	10,061.7	323.28
2014	36,165	1,106.58	10,524.1	338.06
2015	36,710	1,176.9	10,912.2	301.35
2016	38,916	1,229.3	11,244	301.26

*Note Source: ¹ GDP and GDP per capita RM Value(Department Of Statistic Malaysia, 2015, 2017, 2018, 2019)

²GDP and GDP per capita USD value(ECONOMICS, 2020)

Discount Rate

A discounted rate of five per cent (5 per cent) used to calculate the present value. A discount rate of 5% per annum has been standard in many health economic and other social policy analyses for many years (Carter, Schofield, & Shrestha, 2016; Organization, 2009; Stockley, 2008; UNECE, 2016). Malaysia consistently achieved more than 7% GDP growth along with low inflation in the 1980s and the 1990s. However, GDP growth reduced to 4.7 per cent in 2015 at constant prices as compared to 5.7 per cent in 2017 and a further reduction in 2019 with GDP growth of 3.6% (Department Of Statistic Malaysia, 2015, 2017, 2019). Therefore the discount value of 5% is more suitable in this study as recommended (Pushkarev, 2003; Stockley, 2008; UNECE, 2016). The maximum replacement period could be the remaining working lifespan, which calculated by subtracting the age of the individual at death due to colorectal cancer from the retirement age.

The present discounted amount is the current value of payments to be made in the future or the past as it should be. A formula to compute the present discounted value (PV) of the income foregone is as follows:

$$\text{Output Loss from the Economy} = S \left(\frac{1}{r} \right) \left[1 - \frac{1}{(1+r)^t} \right]$$

where S is the annual income foregone, r is the chosen rate of discount, and t is the working lifespan lost as the result of colorectal cancer mortality (Maharaj & Reddy, 2012).

The total human capital loss of all cases in the calculation will be sum together. The final result will be the estimation of national loss of human capital due to premature mortality among patients with colorectal cancer, which is the year of death within the study period.

3.7 Operational Definition

- I. colorectal cancer patients refer to the patient diagnosed with colorectal cancer.
- II. Incidence year refer to the year of patients diagnosed with colorectal cancer.
- III. Year of death refers to the year of patients who died due to colorectal cancer.
- IV. Young age refers to the age of the patient before 60 years old.
- V. Pension age refers to Malaysia's official pension age, which is 60 years old.
- VI. Productive age refers to the age of the patient at productive years, and in this research, defined as 15 to 59 years old.
- VII. Premature mortality defines that the patients died at their productive age in between 15 till 59 years old

3.8 Data Collection

3.8.1 Data Collection Procedure

Before starting this research study, we have contacted the Head Of the Department of Registry Department, National Cancer Institute Malaysia, to know whether the study is feasible and what data can be access also; what is the variance that available. The formal letter was sent to the Director of the National Cancer Institute to get official

permission to use the data. The data collected from the National Cancer registry after the consent was obtained. As part of the procedure to obtain the data from NCR (National Cancer Registry), we were required to obtain permission from the Deputy General of Health Malaysia first to conduct the study and also register our research with NMMR. The study registered on 3rd February 2020 and obtain permission from the Director-General of Health Malaysia on 13th February 2020. Furthermore, I received approval from the Director of the National Cancer Institute of Malaysia on 3rd March 2020. (See Appendix 1 and 2 Letter for Director-General of Health, Appendix 6 and 7 prove of permission from Director General Of Health and Director of National Cancer Institute)

After received all approval, a data collection form requested from us before the data release as part of the formality procedure. Data collection form consist list of the variable we need in the study. (See Appendix 8 & 9 Application for Data for and Data release Form). Data were then sent by mail from the National Institute of Cancer as a result of the COVID-19 pandemic MCO (Movement Control Order) that began on 18th March 2020. The data was received on 20th March 2020. The data provided in the form of electronic data.

3.8.2 Data collection technique and arrangement.

Electronic data received in the form of Microsoft Excel and encrypted to ensure data security. There were two sets of data; the first set are the presented the incidence of colorectal cancer from the year 2007 till 2011 and the second set from the year 2012

till 2016. We combined the data to become extensive data for ten years from 2007-2016. After that, data exported to the SPSS application. Data cleaned and descriptive analysis using the SPSS application.

Furthermore, we compute the variable using the date of birth and date of death to get the age of death for the patient with status dead. There are some cases in the data whereby no date of death, so we used the date of last seen as a replacement for the date of death. Patients with a status dead and the cause of death due to colorectal cancer-related included in the estimation.

3.8 Data Analysis

Data transformation and coding have been done before the analysis and estimation—the descriptive data presented in frequency and percentage. Descriptive statistics analysed using SPSS application. Whereby the necessary mathematical calculation using the model to estimate human capital loss used Microsoft Excel (Microsoft office version 365) application. And this result is also expressed in frequency and percentage. Mathematical Model in estimation human capital loss due to premature mortality, as shown in the figure below. (See Figure 3.2 Model of Human Capital loss due to premature mortality)

3.8.1 Model of Human capital loss due to premature mortality

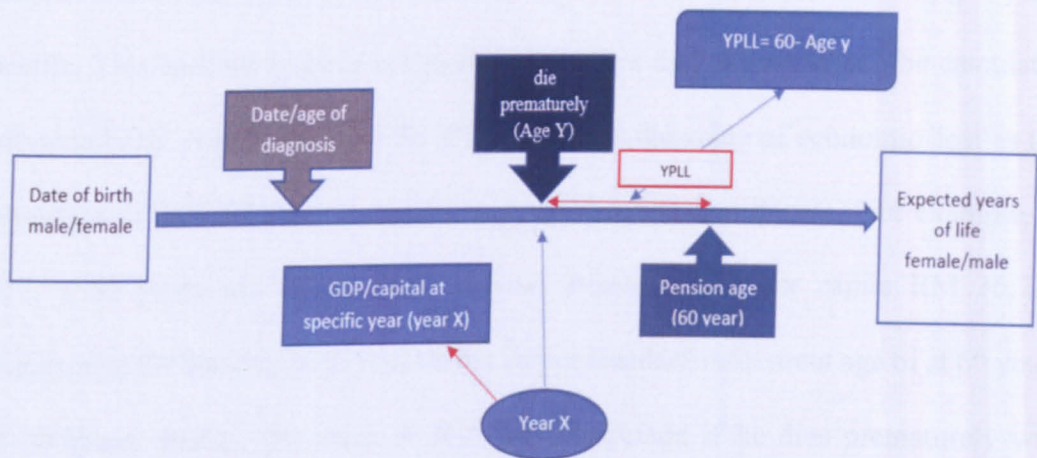


Figure 3.2: Model Human Capital Loss due to Premature Mortality

*YPLL= years of productive life lost

*GDP per capita= Gross Domestic product per capital defines as a measure of a country's economic output that accounts for its number of people. It divides the country's GPD (Gross Domestic Product) by its total population.

Figure 3.2 shown the model of human capital loss due to premature mortality of this study. According to this model, we need the age of death (age Y) of the colorectal cancer patient and Malaysia's official retirement age which is 60 years old(Othman, 2010). By using those two variables, we able to calculate the years of productive life lost (YPLL) for premature death cases. $YPLL = 60 \text{ minus the age of death (age Y)}$. Whereby we only selected the age at the death of colorectal cancer within 15 to 59

years old. The 'lost' then will be calculated by individual YPLL multiple with the GDP per capita year X (years specific) to value the lost to economic value in terms of money. The 'lost' of earning for each YPLL were summed, then discounted according to years specific. This method is more comprehensive ways due to loss should be calculated individually by year X, because the different years the value of economic 'lost' is the proportion of total GDP for a specific year and country is different. For example, in 2015, a 35 years old Malay male had an average GDP per capita RM 36,710 (Department Of Statistic Malaysia, 2019) with a standard retirement age of at 60 years old (Othman, 2010). The value of loss for this person if he dies prematurely was RM917,750 ((YPLL 25 years= 60-35) * 36710). This value is then discounted with 5%, and the final output loss for the particular person at the current value is RM43,801,544.

3.9 Ethical Consideration

All data collected from the registry kept and handled confidentially, per applicable laws and regulations. When publishing or presenting results, the identity of a cancer patient not revealed, and the data obtained are anonymous without the patient detail. The study is retrospectively, and the event had already happened, and it will not give any harm to humans. This study also not directly involved humans as a subject to research—this study registered in National Medical Research Register (NMRR). Ethical clearance from UNIMAS Ethical Board and also the Medical Research and Ethics Committee's Malaysia (MREC) obtained before the analysis or study start.

Formal permission from the Director Of the National Cancer Institute and DG MOH also got before data collection. Once approval and consent were received, encrypted electronic data was sent to us by a special assign officer of the National Cancer Institute, Putrajaya.

The calculation is tailored to the economic burden of colorectal cancer due to premature mortality through an analysis of human capital. There are multiple approaches to estimating human capital loss. The comprehensive way of measuring the financial burden of disease is the full income model recommended by WHO(Organization, 2009). However, opposed to the recommendation, we used the human capital approach because this approach more favourable and able to adapt to data and variables available for this study. Again to mention, this study met the prescribed conditions by the ethical board.

CHAPTER 4: RESULT

This chapter explained the results in four separate sections in this chapter. Section one presents the findings using incidence data and describes the cases by years of the incidence, gender of colorectal cancer patients, incidence age group, and incidence distribution by ethnic group. Section two describes the status and distribution of colorectal cancer patients. Section three presents the results of premature mortality and their distribution by year of death, gender, ethnic group, and YPLL. Finally, the fourth section describes the result of the estimation of human capital loss due to premature mortality secondary to colorectal cancer in Malaysia.

4.1 Incidence of colorectal cancer for ten the year 2007 till 2016.

Ten years of data on colorectal cancer cases from 2007 to 2016 show that the total number of patients diagnosed or reported as colorectal cancer cases are N=29035. The table below explains the prevalence by the years of the occurrence of colorectal events.

Table 4.1: Incidences of Colorectal Cancer for Ten Years (2017-2016)

		Frequency (Incidence=n)	Per cent (%)
Incidence Year	2007	2,480	8.5
	2008	2,650	9.1
	2009	2,778	9.6
	2010	2,844	9.8
	2011	2,793	9.6
	2012	2,854	9.8
	2013	2,916	10.0
	2014	3,073	10.6
	2015	3,183	11.0
	2016	3,464	11.9
Total=N		29035	100.0

The incidences of colorectal cancer are gradually rising over the past year, as shown in Table 4.1. The significant years with the highest incidences of colorectal cancer in 2016, with 3,464 instances contributing 11,9 per cent of the total incidence of colorectal cancer for ten years.

The following table will describe the distribution of colorectal cancer incidence based on their gender, ethnic group, and age group.

Table 4.2: Characteristic of colorectal cancer incidence by Incidence year.

N=29035												
	Incidence Year (n)											
Type of Variable	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total (n)	% of N
Gender												
Female	1,117	1,181	1,236	1,236	1,216	1,265	1,289	1,287	1,401	1,560	12,788	44.0
Male	1,363	1,469	1,542	1,608	1,577	1,589	1,627	1,786	1,782	1,904	16,247	56.0
Ethnic Group												
Malay	900	922	1,050	1,106	1,055	1,123	1,211	1,269	1,281	1,512	11,429	39.4
Chinese	1,266	1,390	1,387	1,361	1,377	1,342	1,322	1,380	1,456	1,491	13,772	47.4
Indian	135	159	147	151	151	156	154	166	186	207	1,612	5.6
Others	179	179	194	226	210	233	229	258	260	254	2,222	7.7
Age Group												
0-14	2	4	1	3	0	1	3	0	1	3	18	0.1
15-29	41	42	49	59	41	43	49	49	32	42	447	1.5
30-44	248	245	249	243	235	252	236	258	290	276	2,532	8.7
45-59	766	858	837	931	875	909	859	951	1,014	1,133	9,133	31.5
more than 59	1,423	1,501	1,642	1,608	1,642	1,649	1,769	1,815	1,846	2,010	16,905	58.2
Sum of Incidence from age 0 till 59 years old=											12,130	41.8
Sum of an incidence at a productive young age (15-59 years old)=											12,112	41.7

* Age Group = age of the patient at the incidence or during diagnosis of colorectal cancer

Table 4.2 shown that among all of the colorectal cancer incidence, 16,247 cases (56%) dominated by male gender, and 12,788 cases (44%) were female with the ratio of Male and females were 1.4:1.1 respectively. If we see the distribution of colorectal cancer incidence by ethnic group predominantly by Chinese ethnicity with 13,772 cases (47.4%) followed by Malay ethnic 11,429 patients (39.4%), then Others and Indian race, 2,222 (7.7%) and 1,612 cases (5.6%) respectively.

Furthermore, Table 4.2 also shown the distribution of colorectal cancer incidence according to age group. The total of the young age patients diagnosed with colorectal cancer was 12,130 cases, contribute prevalence of 41.8%. Whereby the number of colorectal cancer incidence at productive age 12,112 (41.7%) and more than 59 years old contributes the highest of colorectal cancer incidence with the total number of 16,905 (58.2 %).

4.2 Status of colorectal cancer incidence and mortality

There was three status of colorectal cancer patient according to data from the National cancer registry. The following tables are shown the distribution of patient status according to the year of the incidence and the mortality cases according to gender, ethnic group, and age group-specific.

Table 4.3: Crosstabulation between Incidence Year and Patient Status

		Total(n)	Patient Status(n)		
			Alive	Dead	Unknown
Incidence Year	2007	2,480	731	1,666	83
	2008	2,650	840	1,772	38
	2009	2,778	940	1,819	19
	2010	2,844	1,035	1,792	17
	2011	2,793	1,069	1,716	8
	2012	2,854	1,115	1,726	13
	2013	2,916	1,269	1,638	9
	2014	3,073	1,555	1,506	12
	2015	3,183	1,910	1,256	17
	2016	3,464	2,711	734	19
Total		N=29,035	13,175 (45%)	15,625(53.8%)	235(0.8%)

*n =number of cases, *Alive= status of patients from the date of diagnosis until 31st December 2016

In the table, 4.3 describe the distribution of colorectal cancer patients according to years of incidence and patient status. It has shown the number of alive cases in the data from years 2007 till 2016 was 13,175 which contribute 45% out of the total number of cases, a significant amount of mortality with 15,625 (53.8%) more than half incidence has already died, and only 235 (0.8 %) of patients were unknown status.

Given this study focus on mortality cases, therefore, the next table will be explained in detail the distribution of colorectal cancer incidence with status dead according to gender, ethnic group, and age group.

Table 4.4 Characteristic of The Incidence by Mortality

Type of variable		Total number of cases(n)	Mortality	
			% of N	% of n
Gender(n)	Female	6,630	22.8	42.4
	Male	8,995	31.0	57.6
Ethnic group (n)	Malay	6,549	22.6	41.9
	Chinese	7,135	24.6	45.7
	Indian	796	2.7	5.1
	Others	1,145	3.9	7.3
Age Group(n)	0-14	4	0.014	0.026
	15-29	212	0.7	1.4
	30-44	1,243	4.3	8.0
	45-59	4,392	15.1	28.1
	more than 59	9,774	33.7	62.6
	Σ from age 0 till 59 years old =	5,851	20.15	37.4
Σ at a productive young age (15-59 years old)=		5,817	20.0	37.2

* Age Group = Age of patient at the incidence or at diagnosis of colorectal cancer

* N= study Population = 29035

* n = total mortality cases=15625

* Σ= sum

Table 4.4 shows the crosstabulation between mortality cases with gender, ethnic group and age of the patient at an incidence. The total mortality cases of ten years incidence 2007 till 2016 are n= 15,625. Male gender dominated a large number of mortality with 8,995 (57.6% of total mortality and 31% of N), whereby female mortality cases are 6,630 (42.4% of mortality and 22.8% of N). The prevalence of death according to an ethnic group, Chinese ethnic 7,135 mortality (45.7% of mortality and 24.6% of N), followed by Malays ethnic 6,549 (41.9% of total mortality and 22.6% of N). Comparing between two ethnics groups, Chinese and Malays, the prevalence of mortality cases is more in Chinese ethnic; this is because the Chinese incidence is highest among all colorectal cancer incidence.

Another characteristic shown in Table 4.4 is the distribution of mortality cases according to age at the incidence of the patient. The total of 5,851 (37.4% out of total mortality) mortality diagnosed at a young age. Most of the mortality cases are from the patient age group for more than 59 years, 9,774(62.6% of n and 33.7% of N).

4.3 Premature Mortality and YPLL

Premature Mortality, in the definition of this research, is the person that dies productive age within 15 to 60 years old. The YPLL are the years of productive life lost estimated from the age of death and retirement age in Malaysia. The table below is a summary of the total population included in this section.

Table 4.5: Summary of Mortality and Premature Mortality

Type	Total number of cases	Prevalence
Total Mortality cases	15,625	53.8% of N
Total Premature Mortality	5,220	33.4% of mortality cases

*N refers to study population =29035

Table 4.5 provides the overview table of overall mortality and premature mortality cases and their prevalence. The number of premature mortality cases is 5,220(33.4% out of total mortality cases). The number of mortalities is 15,625(53.8% out of total study population N). The following table is the crosstabulation of premature mortality between to incidence years and years of death.

Table 4.6: Premature Mortality crosstabulation tables between Incidence year and year of death.

Incidence Year	Year of Death(n)										Total (n) (%)
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
2007	175	153	104	49	33	15	12	4	5	2	552 (10.6)
2008	1	193	184	107	38	38	14	14	4	6	599 (11.5)
2009	0	1	180	192	100	57	24	23	12	9	598 (11.5)
2010	0	0	2	192	195	104	58	29	20	10	610 (11.7)
2011	0	0	1	1	178	194	102	64	28	19	587 (11.2)
2012	0	0	0	0	0	195	175	127	46	27	570 (10.9)
2013	0	0	0	0	0	1	186	186	98	61	532 (10.2)
2014	0	0	0	0	0	0	0	198	216	118	532 (10.2)
2015	0	0	0	0	0	0	1	0	189	218	408 (7.8)
2016	0	0	0	0	0	0	0	0	1	231	232 (4.4)
Total n (%)	176 (3.4)	347 (6.6)	471 (9.0)	541 (10.4)	544 (10.4)	604 (11.6)	572 (11.0)	645 (12.4)	619 (11.9)	701 (13.4)	5220 (100)

* note: the percentage in the table are out of total premature mortality at productive age n=5220

Table 4.6 shown that among all premature mortality; 2010 incidence contributes the most cases with 610 mortality (11.7%), and according to the year of death, 2016 are the highest number of premature mortalities 701 (13.4%). The next table will describe the premature mortality and YPLL distribution according to years of death.

Table 4.7: Years of Productive Life Lost (YPLL)

Year of death	n	n%	Σ YPLL	Mean YPLL
2007	176	3.4	1,908	11
2008	347	6.6	3,770	11
2009	471	9.0	4,650	10
2010	541	10.4	5,379	10
2011	544	10.4	5,483	10
2012	604	11.6	5,839	10
2013	572	11.0	5,798	10
2014	645	12.4	6,744	10
2015	619	11.9	6,168	10
2016	701	13.4	6,811	10
Total =	5,220	100.0	52,549	NA

Table 4.7 shows that the majority of the prematurely died cases in 2016 was 701 (13.4%) and also 6,811 years in YPLL (13% out of total YPLL) and then total mortality 645 and 6,744 YPLL (12,4% and 12,8%) respectively. The mean YPLL is 10-11 years.

The next table will describe the distribution of premature death at a productive age base on the type of variables. Male are more than Female gender dies at a productive age, Malays ethnic contribute most premature mortality compared to three other ethnic groups, and age of death between 45-59 are the highest contributor to YPLL. (See Table 4.8)

Table 4.8: Characteristic of colorectal cancer-related premature mortality

Type of variables		Premature Mortality (n)=5220		YPLL =52549		Mean YPLL
		n	n%	Σ YPLL	%YPLL	
Gender	Female	2,320	44.4	24,319	46.3	10
	Male	2,900	55.6	28,230	53.7	10
Ethnic Group	Malay	2,605	49.9	27,801	52.9	11
	Chinese	1,766	33.8	15,080	28.7	9
	Indian	316	6.1	3,141	6.0	10
	Others	533	10.2	6,526	12.4	12
Age at Death(years)	0-14	NA	NA	NA	NA	NA
	15-29	138	2.6	4,774	9.1	35
	30-44	980	18.8	20,977	39.9	21
	45-59	3,566	68.3	24,015	45.7	7
	More than 59	536	10.3	2,783	5.3	5

* notes: percentage table in are the prevalence of n overall premature mortality cases.* Σ=sum

Table 4.8 shown premature mortality and YPLL according to gender, ethnic group, and age of death. According to gender, male premature mortality higher compared to females with 2,900 cases (55.6%) and YPLL of 28,230(53.7%). For average years of productive life lost, both genders are the same ten years. However, for ethnic groups, the Malay ethnic contribute highest with 2,605 death (49.9%) with YPLL of 27,801(52.9%), followed by Chinese ethnic 1,766 mortality (33.8%) and YPLL of 15,080 (28.7%). The mean YPLL compared Malay and Chinese ethnic were 11 and 9 respectively, this shows that Chinese ethnic survive longer with colorectal cancer compared to Malays, even if we see back (Table 4.4) Chinese incidence and mortality are the highest the opposite finding for premature mortality. According to the age group at death, the colorectal cancer-related mortality that dies within the age of 45 till

59 years are the highest rank with 3566 death (68.3%) and YPLL 24012(45.7%) with mean YPLL of 7 years.

4.4 Estimation of Human Capital Loss due to Premature Mortality secondary to colorectal cancer.

Utilizing all the data obtained from the national cancer registry period of ten years incidence (2007-2016) and also Malaysia GDP per capita for each year, with a discounted rate of 5%, the total output loss due to premature mortality secondary to colorectal cancer was estimated. The total number of cases in productive age who die prematurely was 5,220 cases with contributing to entire years of productive life lost (YPLL) 52,549 years. The average loss of economic income due to premature mortality secondary to colorectal cancer from the Malaysia GDP estimated an average of 0.56% for years specific.

Table 4.9 below shown estimation of human capital loss due to colorectal cancer related to premature death according to years of death. The table has demonstrated that the total amount of loss was highest in years 2014, which is the sum of annual income forgone RM 0.24 billion, and total output lost after discounted 5% was RM8.11 billion, with 0.73% lost from GDP years specific. Furthermore, combine lost from all years of death, the sum of annual income forgone is RM1.72 billion, which is the real output loss after discounted 5% is RM53.89 billion for the colorectal cancer incidence and mortality of ten years 2007 till 2016. This estimation combines figures to portray that

the economy lost from human capital resources due to premature mortality related to colorectal cancer average GDP of 0.56% of years specific.

Table 4.9: Estimation Value Human Capital Resources loss due to premature mortality in colorectal cancer-related.

Years of death	Premature mortality (n)	Σ YPLL	GDP per capita RM	Σ Annual Income forgone	Σ Output Lost after discounted	Malaysia GDP(RM) (Billion)	% GDP lost
2007	176	1,908	24,589	46,910,758	1,676,339,777	665.34	0.25
2008	347	3,770	27,929	105,280,305	3,394,280,984	769.949	0.44
2009	471	4,650	25,385	118,034,609	3,525,770,705	712.857	0.49
2010	541	5,379	28,733	154,543,793	4,749,578,835	821.434	0.58
2011	544	5,483	31,372	172,027,578	5,668,476,376	911.733	0.62
2012	604	5,839	32,913	192,174,801	5,802,733,565	971.252	0.60
2013	572	5,798	33,720	195,512,213	6,267,241,168	1,018.82	0.62
2014	645	6,744	36,165	243,891,134	8,110,663,824	1,106.58	0.73
2015	619	6,168	36,710	226,413,718	6,828,755,925	1,176.90	0.58
2016	701	6,811	38,916	265,069,740	7,866,779,642	1,229.30	0.64
Combine	5,220	52,549	NA	1,719,858,648	53,890,620,801	NA	Mean = 0.56

*notes: 1. The discount rate of 5% used as a standard discount rate (Stockley, 2008; UNECE, 2016)

2. source GDP and GDP per capita as mention in Table 3.1 Chapter Methodology

3. Method of calculation explained in the methodology

4.4.1 Characteristic specific Human Capital resources lost.

Among all premature mortality cases, the male gender, Malay ethnic, and age at death within 30 to 44 years old contribute the highest number of human capital resources loss after discounted. In table 4.10 shown the distribution of output loss according to gender, ethnic group, and age at death. Human capital resources loss for the male after discounted 5% is RM28.1 billion, which is 52.2% out of total human capital resources loss. Whereby, if according to ethnic group Malay ethnic output loss was RM30.4 billion (56.5%). Age at death within 45-59 years has a higher sum of annual income forgone RM 0.784 billion, but the age of death within 35-44 years has the highest output loss after discount, which is RM27.5 billion (51.1% of output loss).

Table 4.10: Characteristic of Human Capital Loss Colorectal Cancer- Related Premature Mortality for The Period of 2007-2016

Type of Variables		Premature mortality		Σ Annual income forgone	Σ Output Loss after discounted	% of Output Loss
		n	Σ YPLL	RM	RM	
Gender	Female	2,320	24,319	797,398,873	25,741,853,090	47.8
	Male	2,900	28,230	922,459,775	28,148,767,711	52.2
Ethnic Group	Malay	2,605	27,801	913,282,072	30,443,133,665	56.5
	Chinese	1,766	15,080	489,999,255	12,577,187,804	23.3
	Indian	316	3,141	102,824,916	2,852,660,618	5.3
	Others	533	6,526	213,752,405	8,017,638,714	14.9
Age at death (Years)	0-14	NA	NA	NA	NA	
	15-29	138	4,774	154,063,072	13,888,466,289	25.8
	30-44	980	20,977	688,972,599	27,521,548,416	51.1
	45-59	3,566	24,015	784,916,313	8,940,672,679	16.6
	More than 59	536	2,783	91,906,665	3,539,933,417	6.6

*n= number of colorectal cancer-related Premature mortality (die at productive years 15 till 59 years old)

YPLL= years of productive life lost (age of death deducted with 60 which is pension age of Malaysia)

Age group more than 59 years old included, which because the individual does not reach 60 years old at period.

The discount rate of 5% is used as a standard discount rate. (Stockley, 2008; UNECE, 2016)

% of output loss is the percentage of loss from total combine loss RM 53.8 billion

CHAPTER 5: DISCUSSION

This chapter is discussed in three sections for the review portion. In the first section, the results of the incidence and prevalence of colorectal cancer patients were addressed. The second section is the prevalence of premature mortality and YPLL, and, in the third section, the outcome of this study is discussed.

5.1 Incidence of colorectal cancer for ten years 2007-2016 in Malaysia

The total number of colorectal cancer incidences for ten years period (2007-2016) in Malaysia was 29,035. This overall incidence for ten years is a considerable large number of colorectal cancer incidence. Because this study focused on the economic analysis of human capital loss; therefore, we didn't do the detail of the epidemiology of data. We focus on finding the result that fits our objective as the first specific objective was to determine the total number of young age patients diagnosed with colorectal cancer, which is 12,130 cases with a prevalence of 41.8% out of the total study population. The result of our study in this matter comparatively same with the other report as we use the same data but different study period (Azizah Ab M, 2016; Azizah AM. & Nadia SMR., 2019; M. Hassan, M. Suan, S. A. Soelar, N. S. Mohammed, I. Ismail, & F. Ahmad, 2016; M. R. A. Hassan et al., 2016).

Based on our analysis, there are two essential findings to discuss the distribution of cases between gender and ethnicity. Male colorectal cancer patients are much higher compared to females (Azizah Ab M, 2016, Azizah AM. and Nadia SMR., 2019).

According to two studies done by the same author, the frequency of colorectal cancer much higher in males compared to females also the survival rate of females better compared to males (Hassan et al., 2016a, Hassan et al., 2016c). This finding even the same worldwide incidence of colorectal cancer much higher in males compared to females (Favoriti et al., 2016). In evidence to that statement, there are study mention female contained reproductive hormone that can help to prevent cancer also can lead to an increase in the survival rate compared to male (cancer, 2018; Topi et al., 2017; Wong, Ding, Wang, Chan, & Huang, 2019). Topi et al. (2017) also found that significantly higher estrogenic receptor beta ($ER\beta$) expression is independently associated with a better prognosis and hormone status but not lifestyle indicators in female colorectal cancer patients. One meta-analysis study found strong evidence that men are more susceptible to have colorectal cancer because they are prone to varying risk factors (Nguyen, Bent, Chen, & Terdiman, 2009).

As we know, Malaysia is a multi-ethnic nation. There are three major ethnicities in Malaysia, which are Malays, the largest ethnic population; secondly, Chinese ethnic then followed by Indians ethnic and others. What makes us wonder why the incidence of colorectal cancer among the Chinese is more comparable to Malays. We have done some literature review regarding the susceptibility of colorectal cancer comparatively by ethnicity. The finding from the previous study mentioned, this might be due to the genetic factor that Chinese more susceptible to mutation of mucosal to neoplasm (cancer, 2018; M. Hassan, M. Suan, S. A. Soelar, N. S. Mohammed, I. Ismail, & F. Ahmad, 2016; Lau et al., 2014; Magaji et al., 2017a; Veettil, Lim, Chaiyakunapruk, Ching, & Hassan, 2017; Wong et al., 2019). In addition, one study

reported that hereditary non-polyposis colorectal cancer (HNPCC), mainly due to germline MLH1 / MSH2 mutations, is the most common form of hereditary colorectal cancer; they found nine novel and four recurring mutations were in Chinese ethnic patients (Lee et al., 2005). Apart from that, dietary, lifestyle, and culture might be another modifiable risk factor that leads the Chinese ethnic more prone to getting colorectal cancer(Wong et al., 2019). Even though the Chinese incidence 1st in the rank of colorectal cancer incidence in Malaysia, the incidence rate of other ethnic are rising, especially Malays. Westernise diet, chronic diseases, physical inactivity, obesity, smoking habit, and additional modifiable risk might cause the rising of colorectal cancer incidence.

Based on our study result, incidence from age group more than 59 years old, contributes the most with a total number of 16,905(58.2%). Apart from that, this study results have shown that increasing age, the number of incidences is also growing. And the number of incidences in the younger generation is growing slightly over time. Veettil et al. (2017) said that 90% of Malaysian cases of colorectal cancer occurred in individuals older than 40 years, and no differences between ethnic groups. The study also mentioned the highest proportion of cases were patients aged 60–69 years. It is similar to this study finding, whereby almost 60% of the incident are age above 59 years old. A similar trend was seen in Singapore and other Asian countries(Onyoh et al., 2019; Peng, Yew, Tin, Yun, & Ho, 2013; Wong et al., 2019).

5.2 Premature Mortality and YPLL

Based on our data and our definition of premature mortality, we found the number of mortality cases due colorectal cancer was 15625, with prevalence out of total study population is 53.8%, and premature mortality cases are 5220(18% out of total study population). The total number of premature mortalities is the key to our study in estimating the loss. The premature mortality among male are higher compared to female same goes to YPLL, and this correlates with the incident rate of colorectal cancer according to gender in Malaysia. However, we unable to examine the age range of premature mortality cases as there are different age groupings used in calculating the prevalence of premature death in the previous study done in Malaysia. Compared to research conducted in Korea, premature mortality among males still higher than females. However, the female has higher YPLL, colorectal cancer survival in Korea was lower in female than male patients, and female colorectal cancer patients died early in that country compared to male patients (Byun et al., 2014). Even said so, this study done using a different approach in estimating the economic burden from both sides' direct and indirect costs.

Among all premature mortality, incidence from 2010 contributes the most. Whereby according to the year at death, the highest premature mortality from the year 2016. This finding showed like colorectal cancer is diagnosed in 2010 and died in 2016. In order to illustrate this finding, numerous previous studies indicated that most colorectal cancer patients were diagnosed at a late stage with a relative survival rate of 5 years. (M. Hassan, M. Suan, S. A. Soelar, N. S. Mohammed, I. Ismail, & F. Ahmad, 2016;

B. A. Magaji, F. M. Moy, A. C. Roslani, & C. W. J. B. c. Law, 2017b; Veettil et al., 2017). All those studies clarify why the incidence from the years 2010 contributes to the highest premature mortality, and according to years of death, were higher in 2016. The reason might be patients die prematurely about five years after the years of their diagnosis. Its also support our finding of the total YPLL and the mean YPLL from 10-11 years with age because they found the mean age of incidence was 55 +- 14 years, even though they used the cut-off point to estimate premature morality with a life expectancy age of Malaysia(GOH et al., 2005; Onyoh et al., 2019).

There are numerous of Malaysian literature concerning disease burden among the ethnic community. Its shows that the Chinese had the highest incidence of colorectal cancer and the death rate with a lower survival rate relative to other ethnic groups. This finding, on the other hand, different from our result of premature mortality. Our analysis found the burden of premature mortality due to colorectal cancer is more in Malays ethnic. A total of 2605 Malays patients dies at a productive age, with prevalence among all premature death was 49.9%. This number leads to the highest YPLL from the Malays among all then followed by Chinese ethnic. The mean years of YPLL also higher in Malays compared to Chinese.

Furthermore, this finding shows that Malays die more at a younger age compared to Chinese, and even though the mortality rate higher for Chinese ethnicity. One study found that knowledge and awareness of colorectal cancer much better in Chinese ethnicity that helps them to detect early and survive longer(Sindhu et al., 2019).

Meanwhile, another study has different findings, and the result showed that Malay and Indians had more likely willing to undergo screening colorectal cancer as compared to Chinese (Hilmi, Hartono, & Goh, 2010). The findings from both studies contradict each other; it might also be due to socio-demography differences between the ethnic group.

Whereby, according to multiple demography study done in Malaysia, the life expectancy of Chinese ethnic are the highest with 77.3 years whereby Malays has lower life expectancy 73.3 years (Islam et al., 2017). Higher education and higher socioeconomic status can affect the survival rate and life expectancy (C. Hashim, 2010). Longevity can be due to many factors, including growing living standards and improving lifestyle and education, a culture of different ethnicity, as well as greater access to high-quality health facilities, and the genetic makeup of the ethnic community in Malaysia. Thus, the demographic changes, socioeconomic inequalities, and availability of health factors influence life expectancy (Islam et al., 2017). Its concluded that why Malays die more at a young age due to colorectal cancer.

5.2 Estimation of Human capital loss due to Premature Mortality Secondary to Colorectal Cancer

Estimating human capital resources lost colorectal cancer-related premature mortality in Malaysia for ten years incidences from 2007 until 2016 shows a significant impact on Malaysia's economic growth with a mean GDP loss of 0.56%. For discussion of this section, we couldn't find any similar study in Malaysia regarding the human

capital loss secondary due to colorectal cancer or other diseases. Therefore, this study might be the first study on human capital loss due to colorectal cancer in Malaysia. This study attempts to estimate the human capital loss secondary to premature mortality—as a result of this approach, obtaining adding value in terms of human capital loss due to colorectal cancer. Another contribution of this paper is identifying the premature death in the multi-ethnic society of Malaysia.

Over time the estimation of the loss of human capital rose. Between 2007 and 2014, the losses from GDP amounted to around RM 1 billion, representing approximately 17%, from 0.25% to the peak in 2014, at 0,74%. In 2014 and 2016, the number of premature deaths was lowest as compared with the loss of human capital value, and the annual revenue overlooked. However, the gross loss of productivity was higher when it was discounted in 2014. It is due to colorectal cancer patients who die prematurely in 2014 is the younger. The result is to approximate the real value of loss; thus, the sum of people's loss years over time. This estimate gives an analysis of the importance of human resources for years to come. The value of human capital in the years that it meant to be profitably gone in this estimate.

When we see the estimate of human capital loss in this content of gender distribution, the male has a loss of about RM 28 billion, which is 52.2% out of the total loss. The situation is understandable due to the prevalence of males dies prematurely, and the YPLL is more compared to females. In different studies worldwide also shown the same result(Safiri et al., 2019; Weir, Li, Henley, & Joseph, 2017). This finding,

however, excluded the unemployment rate in Malaysia and the female employment rate.

In comparison with other ethnic groups, Malays contribution to human capital was the highest in income forfeited in RM 913 million, with the total output loss of RM30 billion after discounted, contributing to 56.5% of its combining loss over a 10-year study period. As discussed earlier, this result may be due to multiple factors such as the genetic factor, life expectancy of Malaysian ethnic groups, lifestyles, attitudes, and culture towards colorectal cancer itself. A more in-depth study may be appropriate to address this issue.

Age of death within 45 to 59 years old patient contributes the most considerable number of fatalities with 3,566 cases and YPLL of 24,015, and the sum of annual income forgone RM785 million. However, the output lost after discounted in this group (RM8.9 billion) was lower compared to the age group of death within 30 to 44 years. Even though the premature mortality cases within the age group of 30 to 44 years were lesser, 980 cases and YPLL of 20,977, the value of RM 27.5billion (51.1% out of combine lost) after discounted are higher compared to the previous age group. Its is because they have a mean YPLL of 21 years higher compared to the mean YPLL 7 years of the previous age group. Therefore, it shows how comprehensive the estimation of human capital loss to portray the burden of premature mortality in current value.

Numerous studies have reported on productivity cost attribute to premature death in another country. One previous study found that in 2012 alone for all mortality lost was 46.3 billion USD with 0.33% combined GDP and up to 0.49% country-specific GDP lost (A. Pearce et al., 2018). Meanwhile, in their study, they include all types of cancer-related mortality and include in 5 countries (BRICS). The study also mentions about cancer-specific premature death cost by gender. They said that among males, colorectal cancer premature death cost 1.9 billion USD in 2012 alone for all five (BRICS) countries. The pension age assumed at 65 years old for each country was. However, their studies result cannot compare with our study result due to different methodologies; geographically, of study took place and various socio-economic and sociodemographic, currency, and economic growth.

Korean studies found Colorectal cancer had an economic burden of 3 trillion in 2010, and Korean Won (KRW) of 100 billion in 2010, respectively. Direct costs included KRW 1 trillion and KRW 960 billion (62.85 per cent) and indirect costs 1 trillion and KRW 160 billion (37.15 per cent) respectively (Byun et al., 2014). A total estimate of colorectal cancer mortality cost can be avoided in with Lower Educational Attainment (2008–2012) was 2 billion USD (Weir et al., 2017). Nonetheless, due to a complex country demography and cancer form, including study methods, the exact loss amount is again very different and hardly comparable to our estimate of human capital loss due to colorectal cancer related premature mortality. Besides, the magnitude of economic burden depends on the country's specific characteristic of economy; and increase retirement age in a country will elevates the human capital loss due to premature death.

In Malaysia, alternatively, multiple economic burdens of colorectal cancer studies were done. One of Malaysian systemic assessment, incidence and death figures from population-based cancer logs/databases from the 1990-2015 study period showed that the economic burden of colorectal cancer was significant and is likely to rise over time (Veettil et al., 2017). The study gives the figures of the economic burden of colorectal cancer management of new cases alone is estimated to be around RM108 million per year. Inversely, the analysis excludes costs regarding new treatment and specific treatment for certain cases. They also remove charges for non-incidents such as recurrence diagnosis and recovery of patients in Stage 4 who live longer than one year. The burden of this disease is very high concerning the rate loss due to death and the burden endured during treatment. Therefore, it concludes the value of our study to be added to the literature.

5.4 Study Limitation

There still many limitations of our estimates to be acknowledged. This study is mainly is about estimating the economic lost secondary premature death among colorectal cancer patients in Malaysia for ten years from 1st January 2007 until 31st December 2016. For that purpose, which uses secondary data, the retrospective data observations from three primary sources (National Cancer Registry, World Bank, and DOSM). Firstly, estimate figures also reflect the increased economic pressure of already economically deprived counties. Our calculations are based on deaths and do not cover certain indirect expenses or cash losses related to time spent on medical services, time spent on jobs, i.e., lack of morbidity productiveness. Informal staff, families, and

patients are responsible for these costs. A cost estimate for the detection and treatment of these cancers will help provide a more accurate image of the potential economic gain if all people collaborate to the screen are equipped with regular screening, diagnostics, and follow-up care. These flaws make us rely on the availability of data incompleteness and outdated. Secondly, we had to make some methodological choices, and applying the human capital method is subject to criticism in health economics research. Principally, the technique may over-estimate the real burden of the disease because it's built on the assumption that an unemployed one cannot replace a dead person. It also fails to take account of economic volatility and implicitly assumes that no unemployment occurs, while workers are completely efficient(Brouwer & Koopmanschap, 2005; Zhang, Bansback, & Anis, 2011). Despite these drawbacks, the human capital method is the most widely used method of estimating productivity losses attributable to various diseases because it has strong economic foundations and tradition(A. M. Pearce et al., 2015; Stockley, 2008; UNECE, 2016).

CHAPTER 6: CONCLUSION AND RECOMMENDATION

6.1 Conclusion

In summary, we predict the loss of human resources from colorectal cancer secondary premature mortality from 1st January 2007 until 31st December 2016. The value of human capital loss due to premature mortality secondary to colorectal cancer shows in this study are significant. - RM 53 billion within ten years. For the incidence of colorectal cancer, the male is higher than female. Chinese ethnic contributes most to the incidence of colorectal cancer, and colorectal cancer patients are usually diagnosed at a late stage, within age above 59 years old.

This study determines that young age patients diagnosed with colorectal cancer were 12,130(41.8%). The number of young age patient is almost half out of the total study population, which increase the risk to die prematurely. Our result also showed that mortality with a total of 15,625(53.8%), which is more than half of the study population. Among the mortality, 5220(33.3 %) cases die prematurely at a productive age. Apart from that in this study shows that the Malays ethnic contribute more with the majority of 49.9% form out total premature death even though the Chinese incidence is higher.

Human capital's productive period, as they are the canter of our economic development, is indeed crucial to every country in the world. The public health issues

we have to take into account are colorectal cancer, which is one of the most cancer diseases in Malaysia. Moreover, in Malaysia, the burden of premature death is rising, social and health workers are concerned. Although this result is just one key factor in Malaysia's economic effect on colorectal cancer, this study shows that loss of human resources because of early death can be substantial and does not document well in literature. This analytical approach can be applied for more study to determine the various dimension of human capital loss provided that the data are available. With this approach, we can also do projection studies to predict future losses due to premature mortality.

6.2 Recommendation

This study showed a significant value of human capital loss due to premature mortality in colorectal cancer-related and its impact on our economic growth. These issues suggested that our primary and secondary prevention must be promoted to precisely to reduce the financial burden of colorectal cancer. Primary prevention, health education, community behavioural changes program, eating a healthy diet should start at an earlier age.

Secondary prevention, the colorectal cancer screening program in Malaysia for high-risk patients at age 45 and above should be as early as age 30 (Fuzi, Hassan, Sabirin, & Bakri, 2015; Hilmi et al., 2010; Van Tze et al., 2017; Winawer et al., 1997). Furthermore, we should empower the community and give them knowledge so that participatory levels in colorectal cancer screening increase along with improving

healthier behaviours. This public health measure is essential to reduce the economic burden of colorectal cancer.

An earlier study of the financial cost of colorectal cancer shows the extent of the disease's inadequacy in terms of its management(Azzani et al., 2016; Azzani et al., 2017; Byun et al., 2014; Veettil et al., 2017). For health budgeting, therefore, it is more important to focus on the public health program to improve the quality of life and prevent the disease from occurring and from targeting high-risk populations.

Besides, public awareness of the disease and screening program is on the middle-low side is evident to intervene further to the subject matter(Chor Yau Ooi, Hanafi, & Liew, 2019; GOH et al., 2005; Y. Z. H. Hashim et al., 2016; Hilmi et al., 2010; Sindhu et al., 2019). As a personal part of public health education, we should be more open to indicate the number or reporting of all incidences of disease like what we have done in the COVID-19 pandemic. Our data and reports are less accessible to the public, and we have to make it more accessible and understandable to get public attention.

For a future researcher, this study would be beneficial as a guide to empowering their research in disease burden and as an input to their literateness. Moreover, this work can be extended into various types of diseases and expanded to include other forms of productivity estimates lost. This type of research should be exploring more in Malaysia, and the value of human capital express with the currency is more understandable to the public.

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Yusoff, U. N. (2013). Burden of premature mortality in Malaysia. *International Journal of Public Health Research*, 3(1), 249-256.

Zhang, W., Bansback, N., & Anis, A. H. (2011). Measuring and valuing productivity loss due to poor health: A critical review. *Social Science & Medicine*, 72(2), 185-192. doi:<https://doi.org/10.1016/j.socscimed.2010.10.026>

APPENDIX

Appendix 1: Letter of Application for Permission to Carry Out the Study and to Access the Data From The National Cancer Institute

Dr Aisyah Binti Anuar
Pelajar Sarjana Kesihatan Awam (No Pelajar: 19030141)
Universiti Malaysia Sarawak (UNIMAS)
Kota Samarahan, 94300 ,Sarawak
HP No: 0123685450 , Email: draisyahanuar@gmail.com

Date : 4 Febuari 2020

Datuk Dr. Noor Hisham bin Abdullah (Ketua Pengarah Kesihatan)
Kementerian Kesihatan Malaysia
Aras 12, Blok E7, Kompleks E
Pusat Pentadbiran Kerajaan Persekutuan
62590 Putrajaya

YBhg Datuk Dr.

PERMOHONAN BAGI MENAJALANKAN KAJIAN DI INSTITUT KANSER NEGARA DENGAN MENGAKSES DATA KANSER REGISTRASI BAGI MENJALANKAN PENYELIDIKAN.

Dengan hormatnya saya merujuk kepada perkara tersebut di atas:

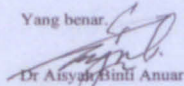
2. Saya perlu mengakses data registri kanser dari Institute Kaser Negara bagi menganalisa penyelidikan saya yang bertajuk "Nombor Pendaftaran NMRR: 19-3781-51537, Estimation of Human Capital Loss Due to Premature Mortality Among the Patients with Colorectal Cancer In Malaysia". Penyelidikan ini telah diluluskan oleh Jawatankuasa Etika Penyelidikan Perubatan JEPP (Medical Research Ethics Committee MREC) dan juga Jawatan Kuasa Etika UNIMAS.

3. Besama-sama ini disertakan:

- Surat Kebenaran MREC
- Surat Kelulusan Jawatan Kuasa Etika Perubatan UNIMAS
- Kertas Kajian(Protocol)/ makluman ringkas kajian
- *Data Collection Form*

Kami Berharap mendapat kebenaran YBhg Datuk Dr.
Sekian terima Kasih

Yang benar,



Dr Aisyah Binti Anuar
Pelajar Sarjana Kesihatan Awam , Universiti Malaysia Sarawak (UNIMAS).

Appendix 2: Permission Letter to DG MOH (Dean Official)

Fakulti Perubatan dan Sains Kesihatan
Faculty of Medicine and Health Sciences
Dekan/ Dean



www.unimas.my

UNIMAS/NC-21.02/04-02/07 Jld. 4 (86)

5 Februari 2020

YBhg Datuk Dr. Noor Hisham bin Abdullah
Ketua Pengarah Kesihatan
Kementerian Kesihatan Malaysia
Aras 12, Blok E7, Kompleks E
Pusat Pentadbiran Kerajaan Persekutuan
62590 Putrajaya

YBhg Datuk Dr. Noor Hisham bin Abdullah,

Permohonan Kebenaran Mendapatkan Maklumat Berkaitan Penyelidikan Ilmiah
Pelajar Pascasiswazah UNIMAS
-Aisyah binti Anuar (No. Pelajar:19030141)

Dengan hormatnya saya merujuk kepada pekara di atas.

Dimaklumkan bahawa penama di atas merupakan pelajar Sarjana Kesihatan Awam daripada Universiti Malaysia Sarawak, sedang menjalankan kajian bertajuk "*Estimation of Human Capital Loss Due to Premature Mortality Among the Patients with Colorectal Cancer in Malaysia*".

Ringkasan kertas kerja adalah seperti di lampiran A. Kajian ini juga telah mendapat kelulusan NMRR (Nombor Pendaftaran NMRR: 19-3781-51537), Jawatankuasa Etika Penyelidikan Perubatan JEPP (Medical Research Ethics Committee MREC) dan juga Jawatan Kuasa Etika Perubatan UNIMAS (lampiran B dan lampiran C).

Kajian ini memerlukan beberapa data mengenai pesakit kanser kolorektal seperti di lampiran D. Sehubungan itu, pelajar memohon kebenaran YBhg Datuk Dr untuk menggunakan data registri kanser daripada Institut Kanser Negara.

Sebarang maklumat lanjut mengenai kajian ini boleh berhubung terus dengan pelajar berkenaan di talian 0123685450 atau melalui email draisyahanuar@gmail.com.

Kerjasama dan pertimbangan YBhg Datuk Dr. amat saya hargai dan didahului dengan ucapan terima kasih.

Sekian.

Yang benar,


Prof. Dr. Asri bin Said
Dekan

s.k. Penyelia Kajian – Prof. Madya Dr. Zafar Ahmed



94300 Kota Samarahan, Sarawak, MALAYSIA | Tel + 60 82 581 000 samb 7006/7001 | Fax + 60 82 665 116

Appendix 3: UNIMAS Ethics Approval

Fakulti Perubatan dan Sains Kesihatan
Faculty of Medicine and Health Sciences



www.unimas.my

UNIMAS/NC-21.02/03-02 Jld.4 (36)

17 Januari 2020

Dr Aisyah Binti Anuar
Fakulti Perubatan Dan Sains Kesihatan
Universiti Malaysia Sarawak
94300 Kota Samarahan,
Sarawak.

Dr,

Kelulusan Mesyuarat Etika Perubatan Untuk Kajian:
- Estimation Of Human Capital Loss Due To Premature Mortality Among The Patients With Colorectal Cancer In Malaysia

Dengan segala hormatnya perkara di atas dirujuk.

Sukacita dimaklumkan bahawa kertas kerja penyelidikan seperti di atas yang dijalankan oleh Dr Aisyah Binti Anuar dan diselia oleh Prof Dr Zafar Ahmed telah diluluskan dalam Mesyuarat Jawatankuasa Etika Perubatan Fakulti bil 01/2020 pada 7 Januari 2020.

Sehubungan itu, penyelidikan tersebut boleh dimulakan dan diharap ia dapat dijalankan seperti yang dirancang.

Yang benar,

Professor Dr Lela Hj Su'ut
Pengerusi
Jawatankuasa Etika Perubatan
Fakulti Perubatan dan Sains Kesihatan



94300 Kota Samarahan, Sarawak, MALAYSIA | Tel + 60 82 581 000 | Fax + 60 82 665 152

Appendix 5: MREC Approval (English)



JAWATANKELOKA ETIKA & PENYELIDIKAN PERUBATAN
(MEDICAL RESEARCH & ETHICS COMMITTEE)
KEMENTERIAN KESEHATAN MALAYSIA
110 Kompleks Institut Kesihatan Negara
Unit A, No 1, Jalan Setia Murni U1/352,
Setia Alam, Dendang Setia Alam,
40170 Shah Alam, Selangor



Tel: 03-3562 8886/8200

Ref Kemi: KKM/NIHREC/ P20-164 (5)
Tarikh : 03-Februari-2020

DR AISYAH DINTI ANUAR
UNIVERSITY MALAYIA SARAWAK (UNIMA S)

U210 / TUN PUSAN

SURAT KEKULUHAN ETIKA: NMBR 12 1711 51637 (NB)
ESTIMATION OF HUMAN CAPITAL LOSS DUE TO PREMATURE MORTALITY AMONG THE
PATIENTS WITH COLORECTAL CANCER IN MALAYSIA

Dengan hormatnya perkara di atas adalah dimaklumkan.

2. Bersama dengan surat ini dilampirkan surat kelulusan saintifik dan etika bagi projek ini. Segala maklumat data subjektif adalah SUKUT dan harus dijaga sekiranya tidak dipaparkan kepada orang ramai. Prosedur mengenai data confidentiality mesti dipatuhi. Kebanyakan daripada Pengarah Hospital / Institut di mana kajian akan dijalankan mesti dipaparkan terlebih dahulu sebelum kajian dijalankan. U210 / TUN / Pusan perlu ikut dan mematuhi keputusan tersebut dan undang-undang lain yang berkaitan, termasuklah Akta Akses Kepada Sumber Biologi dan Pengawalan Tissue 2017.

3. Penyelidik, penyidik dan lokasi kajian yang terlibat ialah:

NATIONAL CANCER INSTITUTE (NCI)
Dr Aisyah Dinti Anuar (Penyelidik Utama)

UNIVERSITY MALAYSIA SARAWAK (UNIMA S)
Dr Aisyah Dinti Anuar (Penyelidik Utama)
Dr Zuhir Ahmad

4. Adalah dimaklumkan bahawa kelulusan ini adalah sah sehingga **02-Februari-2021**. Tunai/Puan perlu mengemukakan dokumen-dokumen seperti berikut selepas mendapat kelulusan etika. Dokumen-borang berkaitan boleh dimuat turun daripada laman web Jawatankuasa Etika & Penyelidikan Perubatan (JEPPI) (<http://www.nth.gov.my/mrec>).

- Consent/Review Form: Meliputi-baikannya (boleh berbilang 2 hujah (20 hujah) sekiranya bentuk tempoh kelulusan ini bagi memperbaharui kelulusan etika.
- Safety Plan Report: Meliputi-baikannya kajian.
- Mendapat kelulusan etika sekiranya terdapat perubahan ke atas sebarang dokumen kajian / lokasi kajian / penyelidik. Pihak JEPPI mempunyai hak untuk membuat lebih kelulusan etika sekiranya terdapat perubahan dokumen kajian yang tidak dinyatakan.

5. Kajian tersebut hanya melibatkan pengumpulan data melalui:

- Retropektif
- Data sekunder

6. Sila ambil maklum bahawa sebarang urusan surat-mengirim berkaitan dengan pengesahan ini haruslah dinyatakan **nombor rujukan surat** ini untuk melancarkan urusan yang berkaitan.

KKM/NIHREC/ P20-164 (5)

Sekian (sila ada) : Tiada

Komen (sila ada) : Tiada

Lokasi Kajian:
NATIONAL CANCER INSTITUTE (NCI)
UNIVERSITY MALAYSIA SARAWAK (UNIMA S)

Kepulauan Jawatankuasa Etika dan Penyelidikan Perubatan:
() Ikat
() Tidak Ikat

Tarikh kelulusan etika : 03-Februari-2020

"BERKHIDMAT UNTUK NECARA"

Saya yang menandatangani ini,

DR AISHAH DINTI ANUAR
Pegawai
Jawatankuasa Etika & Penyelidikan Perubatan
Kementerian Kesihatan Malaysia
No. MPM. 27117

2020/Appendix 5/15/2020/2020

Appendix 6: Approval from DG MOH

Fwd: Memohon Kebenaran Menggunakan Data Kanser Registri daripada IKN untuk tujuan Kajian

YBhg. Datuk Dr. Noor Hisham Abdullah

Wed 2/5/2020 5:54 AM

To: NUR HIDAYAH BINTI ZULKIFLI <nurhidayahz@mo.gov.my>

12 attachments (1 MB)

Surat Rasmi Permohonan Ketua Pengarah Kesihatan.pdf; ATT00001.htm; Protocol version 02.pdf; ATT00002.htm; Surat Kebenaran MREC BI.pdf; ATT00003.htm; Surat Kebenaran MREC BM.pdf; ATT00004.htm; Surat Kelulusan Jawatan Kuasa Etnik Perubatan UNIMAS.pdf; ATT00005.htm; Data Collection Form V1.docx; ATT00006.htm;

Sent from my iPhone

Begin forwarded message:

From: Aisyah Anuar <draisyahanuar@gmail.com>
Date: 4 February 2020 at 21:49:25 GMT+8
To: "YBhg. Datuk Dr. Noor Hisham Abdullah" <nurhidayahz@mo.gov.my>
Subject: Memohon Kebenaran Menggunakan Data Kanser Registri daripada IKN untuk tujuan Kajian

Assalamualaikum dan Salam Sejahtera

Untuk makluman Datuk, saya, Dr. Aisyah Binti Anuar, IC: 840204035496, MMIC no: 68226, adalah pelajar Sarjana Kesihatan Awam di Universiti Malaysia Sarawak ID:19030141 ingin memohon kebenaran menjalankan kajian yang bertajuk "Estimation of Human Capital Loss due to Premature Mortality Among Colorectal Cancer Patient in Malaysia" NIMRO ID:19-3781-51537 dengan menggunakan data daripada (National Cancer Registry) Institut Kanser Negara Putrajaya.

Atiqah
Forward the letter to *Barisan, Institut Kanser Negara*
bagi permohonan data NCR.
Solih 10/2

Bersama email ini saya sertakan:

1. Surat Rasmi permohonan
2. Portokot Kajian
3. Surat Kelulusan MREC BI
4. Surat Kelulusan MREC BM
5. Surat Kelulusan Jawatankuasa Etnik UNIMAS
6. borang data koleksi.

Saya berharap mendapat kebenaran dan Kelulusan dari pihak Ybg. Datuk Dr.

Sekian Terima Kasih
Aisyah Binti Anuar

To report this email as SPAM, please attach the original email as an attachment to spam@govuc.gov.my by holding Ctrl + Alt + F keys concurrently (for Outlook client) or right click on the email and forward as Attachment (for OWA).

Appendix 7: Approval from NIH and NCI



INSTITUT KESIHATAN NEGARA
NATIONAL INSTITUTES OF HEALTH (NIH)
KEMENTERIAN KESIHATAN MALAYSIA
Institut Penyelidikan Klinikal
Blok D4, Kompleks Institut Kesihatan Negara
No. 1, Jalan Setia Murni U13/S2
Setiayen U13, Setia Alam
40170 SHAH ALAM, SELANGOR

Telefon : 603-3362 7700
Faksimili : 603-3362 7701
Email : contact@nrc.gov.my
Web : http://www.nrc.gov.my

Pengarah
Institut Kanser Negara
No. 4, Jalan P7, Presint 7
62250 PUTRAJAYA



YBrs Dr.

**MEMOHON KEBENARAN MENGGUNAKAN DATA KANSER REGISTRARI DARIPADA
INSTITUT KANSER NEGARA (IKN) UNTUK TUJUAN KAJIAN**

Dengan segala hormatnya saya merujuk kepada perkara tersebut diatas.

2. Dimaklumkan bahawa pihak Institut Kesihatan Negara (NIH) telah menerima surat daripada pejabat Ketua Pengarah Kesihatan berkaitan permohonan Dr Aisyah binti Anuar, Pelajar Sarjana Kesihatan Awam dari Fakulti Perubatan dan Sains Kesihatan, Universiti Malaysia Sarawak (UNIMAS) ingin memohon kebenaran menggunakan data kanser registri daripada IKN dan permohonan tersebut bukan di bawah seliaan pihak NIH.

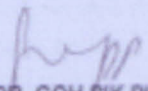
3. Bersama-sama ini dipanjangkan surat permohonan tersebut untuk makluman dan tindakan pihak YBrs Dr selanjutnya kerana data tersebut adalah di bawah seliaan pihak IKN.

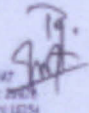
Kerjasama dan jasa baik YBrs Dr. dalam perkara ini didahului dengan ucapan terima kasih.

Sekian,

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,


(DATUK DR. GOH PIK PIN)
No. MMC/27735
Pengarah
Institut Penyelidikan Klinikal
Kementerian Kesihatan Malaysia

13/2/20
HOD Cancer Registry.
Dr. Nisha Rajstry.
utk. tindakan.
19.

DR. HASNAH BINTI SAHAT
Pegawai Pembaharuan Perubatan 2008
Tetapan Pengasas (Pegawai) GDS4
Jabatan Pengurusan Perubatan
Institut Kanser Negara

Appendix 8: Application for Data Form



Malaysia Cancer Registry Department
National Cancer Institute
No 4, Jalan P7, Presint 7,
62250 Putrajaya Malaysia
Tel : 03 88925555/99, Fax 03 88925625

Application for use of data for Research Project / Publications / Poster or Oral Presentation.

Please fill up the relevant information related to your research project / publications / poster or oral presentation.

Title of the study : Estimation of Human Capital Loss due to Premature Mortality Among the patient with Colorectal Cancer in Malaysia.

Objectives:

General Objective

To estimate the economic loss due to premature mortality of colorectal cancer in Malaysia by using human capital approach.

Specific Objective

1. to estimate the total number of patient with colorectal cancer during the productive life (18-60 years) cases in Malaysia
2. to estimate total cases of premature death due to colorectal cancer
3. to calculate YLL (years of life loss) of all premature death due to colorectal cancer
4. to calculate National Human Capital loss due to premature mortality of colorectal cancer by using Human Capital Methods

First authors :

Dr Aisyah Binti Anuar (MPH student of UNIMAS 2019/2020)

Other authors :

Asst. Prof Dr Zafar Ahmed (Supervisor & Co Investigator)

Variables needed :

- | | |
|-------------------------------|---------------------------------|
| 1. ID of patient given by NCR | 2. Sex & ethnicity |
| 3. Date of birth | 4. Patient status (Death/Alive) |
| 5. Diagnosis | 6. Date of death/age of death |
| 7. Date of diagnosis | 8. Year of death |

Name : Dr Aisyah Binti Anuar

Uc / Passport No : 840204-03-5996

Email Address : draisyahbinti@gmail.com

No Tel : 012-3685459

Signature :

Date : 18/02/2020

For enquires, please email : ncr.putrajaya@ncri.gov.my

Office use :

Appendix 9: Data Release Form

DATA RELEASE FORM MALAYSIAN NATIONAL CANCER REGISTRY NATIONAL CANCER INSTITUTE

Office use only:	
Date received:	...
Request ID #	...

SECTION 1: PROJECT/ STUDY DETAILS (to be completed by applicant)			
1	Name of the project/ study:	Estimation Of Human Capital Loss Due To Premature Mortality Among The Patients With Colorectal Cancer In Malaysia	
2	Organization/ Hospital/ Agency responsible for the project:	Faculty Medicine and Health Sciences, Department of Community Medicine and Health Sciences, UNIMAS (University Malaysia Sarawak)	
3	Name of the person in charge (applicant):	Dr Azyan Hani Amir	
4	Designation:	MPH Student 2019/2020	
5	Phone / fax numbers:	012-3656456	
6	Email:	drasyanhan@gmail.com	
7	Address:	Faculty Medicine and Health Sciences, Department of Community Medicine and Health Sciences, UNIMAS (University Malaysia Sarawak), Kota Samarahan, 94300 Sarawak	
8	Date of submission/ request (dd/mm/yyyy):	10/02/2020	
9	Date data release is expected (dd/mm/yyyy):		
10	Urgency of the request:	☐ Low ☐ Medium ☒ High	
11	Purpose of the data request:	☒ Research ☐ Project / Publication ☐ Presentations ☐ Others, specify:	
12	Attached together with this form:	A Study proposal/ protocol (address as well the benefits/ overall importance of this project) ☒ Yes ☐ No Ethics committee approval/ statement ☒ Yes ☐ No Study sponsor approval or other documentation of permission received, specify: ☒ Yes ☐ No Contribution/ view of the person in charge (name in item no.3 above) ☒ Yes ☐ No	
13	Affiliates / key research personnel (Other key persons with access to the data):		
	Name	Designation	Organization / Institute / Agency
1.	Asst. Prof. Zafar Ahmed	Lecturer	Department of Community Medicine and Health Sciences, UNIMAS
2.	Dr Nabihah bt. Ali	Medical Officer	MINCR

Data release form, MINCR

3.	Dr Nabihah bt. Ali	Medical Officer	MINCR
----	--------------------	-----------------	-------

SECTION 2: DETAILS OF THE DATA REQUEST (to be completed by applicant)	
14	Agree to release of the data requested: 01/01/2020 to 31/12/2019
15	Type of data required: ☒ Tabulation/ summary/ aggregated data ☐ Records files with identifiers ☐ Records files without identifiers ☐ Others, specify:
16	List of data elements requested (please attached a copy of the list if it is too long) or the summary data/ tables with the descriptions: As attached with this form (Table 1) (Table 2) (Table 3)
17	Format of the data file: ☒ Excel ☐ Others specify:
18	Indicate how the data will be used: ☐ Own Department / Unit use ☐ Own Hospital / Agency Organization use ☐ International purpose ☐ Research ☐ Publication ☐ Other, specify:
19	Duration usage of the data for the study (dd/mm/yyyy): 1/03/2020 to 30/09/2020
20	Disposition of the data (including any printouts or copies that contain individual identifiers) Method: Delete all the soft copy, no print out Estimate date of disposition: maximum till 1/03/2022
21	Indicate how project/ study results will be disseminated and identify target audience: - ongoing research project will be present to UNIMAS exam board community for education grading purpose and publication if indicated.
22	Data security measures to be used (state where and how the data will be stored and maintained): Personal Computer of person in charge (no.3) and will be deleted once the research project is coming to end

Data release form, MINCR

Appendix 9: Data Release Form (Continue)

23

Additional information/ Comments (if any):

SECTION 3: DECLARATION BY APPLICANT (to be completed by applicant)

- I hereby acknowledge that upon approval the data given to me will be used for the purposes outlined in the original request and agree upon at the time of provision of the data and will not be communicated to other parties.
- The obtained data are prohibited to be re-produced for other studies (ie. sub studies).
- I will give the above mentioned state registry and MNCIR prior notice of any intended publication for provision of the data and will acknowledge the above mentioned state registry and MNCIR as the source data. I will take responsibility and guarantee the security and confidentiality of the data throughout the duration of my access/ contribution.
- I will not grant a third party access to the data unless the third party has obtained written approval from above mentioned state registry and MNCIR. Any information obtained from this data released may only be published in aggregate tables or as part of the analysis of the data.
- No individual person or organization is to be identified/ mentioned in at any stage of the analysis.
- I will share the findings of the final study with MNCIR before publications.
- I will provide registry with a copy of all published and pertinent results when accepted for publications.
- I understand that if deemed necessary MNCIR has authority to withhold the publication until the suggested amendments are done and approved.

SIGNATURE OF APPLICANT: 

NAME OF APPLICANT: DR ARSYIAH BINTI ANWAR

DATE: 19/02/2020
Note:

- If there is a change of purpose / scope, a new data release form must be submitted prior to the applicant used of the released data.
- The applicant is required to report in writing to the state registry or MNCIR when data are re-produced or all agreed.
- MNCIR will contact you after processing your initial request and upon completion of the study.

SECTION 4: CORRESPONDENCE ADDRESS (for office use only)

All correspondence regarding this application should be direct to: Research Unit Officer

Name/ Affiliation: Malaysian National Cancer Registry / Research Unit

Address: No 4, Jalan P7, Precinct 7 82250 Putrajaya.

Telephone/ Fax: M 03- 89925555 / 03- 89934625

Email: ncr.putrajaya@ncc.gov.my

Malaysian National Cancer Registry

Data release form, NCR

Appendix 10: Gantt Chart

Activities	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Apr 2020	May 2020	Jun 2020	July 2020	Ogos 2020
Proposal preparation										
Proposal presentation and approval										
NMRR registration, MREC ethical approval from DG MOH and NCI										
Data collection										
Data entry and data analysis										
Report writing										
Report presentation and submission										

Thank You