Kingdom of Cambodia
Nation-Religion-King

Report

on

Health Costs Associated with Active Tobacco Use

National Center for Health Promotion, Ministry of Health, Cambodia

Dr. Chhea Chhordaphea[1], MPH, PhD; Dr. Sin Sovann[1], MD, MPHM;

Dr. Ray Rany[1], MD, Dr Sann Boremey, MD[1]

Adviser: Dr. Hana Ross,

Supported by

International Development Research Center (IDRC)

2015

[1] National Centre for Health Promotion

Contents

Contents 2

List of Tables 5

List of Figures 5

Abbreviations 6

Forwards 7

Acknowledgments 8

Executive Summary 10

Introduction 13

Objectives: 15

Conceptual and theoretical framework 15

Data and Methods 16

Phase 1: Estimating health care costs 17

Step 1: Estimating the number of cases by gender per health condition per year 17

Step 2: Estimating the cost of treating a typical case of each selected health condition 18

Step 3: Estimating the smoking attributable fraction (SAF) 19

Step 4: Calculating the total health care cost for selected diseases that are attributable to smoking 21

Step 5: Estimating the full provider cost 21

Phase 2: Estimating the Productivity Loss 21

Step 1: Estimating mortality-related productivity costs using human capital approach 22

Step 2: Estimating morbidity-related productivity cost 22

Phase 3: Case studies 23
Ethical Issues 23
Results 24
Phase 1: Health care costs 24
Step 1: Number of cases 24
Step 2: Estimating treatment cost per one case of each health condition 25
Step 3: Estimating smoking attributable fraction (SAF) 25
Step 4: Calculating the total health care costs for selected diseases that are attributable to smoking 28
Step 4: Estimating the full cost of treatment by taking into account the depreciation and the fixed costs 30
Phase 2: Estimating Productivity Loss 31
Step 1: Estimating productivity cost of premature mortality 31
Step 2: Estimating productivity cost due to morbidity 31
Phase 3: Case Studies 34
Health seeking behavior of patients 35
Health care cost 40
Smoking Behavior of Patients Participating in the Case Studies 40
Discussions 41
Limitations 43
Conclusions and recommendations 43
Annex 1: Survey of costs for a standard diagnosis, the treatment and a follow up 45
Ischemic Heart Disease 45
Lung Cancer 47

Stroke 49

C O P D 51

Annex 2: Interview guide for case studies with patients suffered from tobacco related diseases 54

List of Tables

Table 1: Relative risk 20

Table 2: Ever smoker prevalence 21

Table 3: Average number of days a patient spent at hospital and at home for one time of treatment and care 22

Table 4: Number of cases of each disease by sex and age in year 2013 24

Table 5: Relative Risk of the five diseases 26

Table 6: Summary of the SAF of the five diseases 26

Table 7: Total variable health care costs attributable to smoking in Cambodia in 2013 30

Table 8: Productivity costs of smoking related morbidity 34

Table 9: Estimation of the total costs attributable to smoking tobacco 34

List of Figures

Figure 1: Conceptual and theoretical framework 16

Figure 2: Cost per case of four diseases in Calmette Hospital and for TB from CNAT 2013 25

Abbreviations

CNAT	Centre National Anti-Tuberculeux
COPD	Chronic Obstructive Pulmonary Disease
HIS	Health Information System
IHD	Ischemic Heart Disease
LC	Lung Cancer
NCD	Non-Communicable Disease
NCHP	National Center for Health Promotion
NGO	Non-Government-Organization
OOP	Out of Pocket
RH	Referral Hospital
RR	Relative Risk
SAF	Smoking Attributable Fraction
THE	Total Health Expenditure

Forwards

Preventing smoking and smokeless tobacco use among people is vital to curbing the epidemic of tobacco use. Nowadays, tobacco use is one of the four major risk factors (unhealthy diet, tobacco use, alcohol consumption, and physical in-activities) of Non-Communicable Diseases; it kills nearly six million people per year. Tobacco is the only legal consumer products that can harm everyone expose to it, and tobacco companies tremendously invest on tobacco advertising to absorb more smokers.

This study provides first time local evidence about cost of smoking among ischemic heart disease, lung cancer, stroke and other cerebro-vascular disease, chronic obstructive pulmonary disease, and tuberculosis patients in five main national hospitals namely Kosomak hospital, Khmer-Russia Friendship hospital, Calmette hospital, and NGO Hope center in Cambodia. Despite health care cost shown in this study is potentially under-estimated, it shows insights on economic and psychological burden caused by cigarette on individuals, family and society.

The findings suggest the program intervention to combat the tobacco epidemic in Cambodia, it is also useful for documenting the changes in cost of smoking for monitoring the implementation of different provisions of the tobacco control legislation and the relevant Articles of the WHO Framework Convention.

Tobacco use is the single most preventable cause of disease and death in the world today. A coordinated program intervention including mass media campaigns, price increase, comprehensive ban of tobacco product advertising, promotion and sponsorship, prominent pictorial health warning, and community-level changes protecting people from second hand smoke and norms are effective in reducing the initiation of tobacco use among youth. However, many of these tobacco control programs remain underfunded, it is imperative that the tobacco control stakeholders continue investing in tobacco prevention and control. An increasing in spending on sustained comprehensive tobacco control programs will results in reductions in youth and adult smoking rates and ultimately in health care cost.

The Ministry of Health sincerely congratulates the National Center for Health Promotion, development partners and relevant stakeholder for successfully conducting this study.

Phnom Penh,……., 2016

Minister of Health

Acknowledgments

We, the National Center for Health Promotion, Ministry of Health, Cambodia sincerely deep gratitude and appreciation to a number of people who have put valuable contribution to make this research possible.

The International Development Research Center (IDRC), Canada for funding this important research, our special thanks go to Mr. Greg Hallen and Pamela Osborne for their guidance and support throughout the project.

Our deep appreciation to Dr Hana Ross for her endless support and guidance to research team from the first day of research formulation until report writing.

We are indebted to research participants (cases study) patients and the family for sharing their valuable story, this research could not be concluded without this invaluable contribution.

Last but not least our special gratitude to our research partners who have been actively engage in every step of research process, research formulation, data collection and analysis.

Department of Planning and Health Information System:
- Dr Sok Kanah
- Dr Khol Khemerary

Department of Preventive Medicine
- Dr Hok Sirany

National Centre for Tuberculosis and Leprosy Control
- Dr Koeut Pichenda
- Dr Tieng Sivanna
- Mr Tek Sophoeun

Kosomak Hospital
- Dr Khathdun Daraphal
- Dr Ny Chanty
- Mr Thak Bungor,

Calmette Hopital:
- Prof Chhouy Meng
- Prof Chan Sarin
- Prof Chhor Nareth

Khmer-Russia Friendship Hospital
- Dr Chet Chiva
- Mr. San Sothy
- Mr. Phonn Nara

Preah Kethmealea Hospital
- Dr Koeut Siyuth
- Dr Hang Sereivuth

Dr Kim Buntheng
Royal Rotanak Hospital
Dr Kham Sophea

And special thanks to our partners World Health Organization and Cambodia Movement for Health for supporting this research.

Phnom Penh,……., 2016

National Center for Health Promotion

Director

Executive Summary

Smoking imposes significant health burden, leading to morbidity and mortality associated with many diseases, including lung cancer, cancers of the upper aero-digestive tract, chronic obstructive pulmonary disease (COPD), ischemic heart diseases, and stroke. As found elsewhere, smoking increases the direct health care costs that can be classified as inpatient costs, outpatient costs, and costs associated with self-treatment; it also imposes costs related to productivity losses from premature mortality and morbidity. This study aimed to provide scientific evidence of the direct and indirect health-related costs attributable to active smoking to support the development and implementation of tobacco control policies in Cambodia.

The study examined costs related to active smoking of tobacco for both male and female (age 30 and over) from the society's perspective, including the health care costs and the productivity loss.

However, it did not estimate the costs related to second-hand smoke, the opportunity cost of tobacco purchases (expenditure on tobacco products), the costs associated with the risk of fires, the health cost of using tobacco products that are not smoked (e.g. chewing tobacco), and expenditure on buying cigarettes. The study focused on costs associated with hospital treatment of five health conditions 1)-Ischemic heart disease (IHD), 2)-Lung cancer, 3)-Stroke and other cerebro vascular diseases, 4)-Chronic Obstructive Pulmonary Disease (COPD), 5)-Tuberculosis. The cost of outpatient care was not included due to the lack of data.

This is the first study investigating the costs of smoking in Cambodia and both primary and secondary data were collected for this research. It followed three phases, the first phase explored the health care costs attributable to active tobacco use, and the second phase estimated the productivity loss due to missed days at work and premature deaths attributable to active smoking. The third phase consisted of eight case studies of patients who suffered from one of the four health conditions (except tuberculosis), to explore their health care seeking behavior and to provide an input into the second phase that required an estimate of the number of days a patent and his/her caregiver spend not working due to the illness.

The calculation cost of smoking in phase one followed four steps: 1)-Estimating the number of admissions from the selected hospitals, 2)-Calculating of the cost of treating the selected health conditions based on consultations and data collected from selected hospitals, 3)-Estimating the smoking attributable fraction (SAF), based on the gender-specific relative risk (RR) for each disease category, and 4)-Calculating the total health care cost attributable to smoking for the selected diseases.

In phase two, the study estimated productivity loss due to mortality and morbidity related to active smoking. We used the estimate of the annual number of deaths attributable to smoking

and the average number of life year lost per smoker to estimate mortality-related productivity cost using the human capital approach. The human capital (or the labor productivity) is measured by GDP per capita and the annual rate of inflation is assumed to equal the rate of depreciation. The calculation of the morbidity-related productivity cost is based on average daily income, the average number of days a patient and his/her caregiver spend not working due to the illness.

Case studies (phase three) were conducted with patients suffering from Lung Cancer, Ischemic Heart Diseases, stroke and COPD. Eight patients (7 men and one woman) were interviewed and their data recorded. Each patient sought health care from multiple sources including private, government and oversea facilities. The cases that were diagnosed and treated in private or oversea facilities were not registered in national statistic as a case of that particular disease. This means that many cases of tobacco related diseases and their treatment are not reported in the official government statistics. The health care costs incurred by the patients in our case studies from combined providers were about double of costs estimated for a patient treated in a national hospital.

There were 6, 801 cases of the four diseases (IHD, LC, Stroke, COPD) treated at National government health facilities in 2013. Only few cases were treated at regional hospitals dues to their limited capacity. There were 12, 896 cases of TB treated by all TB Centre in the whole country in 2003.

The study found that the total health care cost (in US$) treating the five diseases attributable to smoking was US$ 34.5 million. The productivity cost of premature mortality for those disease reached US$ 120.8 million and the productivity cost of morbidity was about US$ 7.3 million. In total, the costs attributable to health damage due to smoking reached US$**162.7 million.** These costs are underestimated due to following factors: 1)-Number of disease-specific cases is under-reported, because many patients seek treatment at private health care facilities or oversea and we were not able to capture those cases. 2)-Many patients may not be able to afford the treatment cost at public or private facility[2]. 3)-Our study only covered 5 diagnoses, but there are many other diseases associated with smoking. 4)-We did not include costs associated with second-hand smoke, the costs associated with use of noncombustible tobacco, and the costs associated with fires caused by smoking. Despite this underestimation, the costs we captured represent about 1.05% of Cambodia's 2013 GDP[3]. Our estimate is comparable to similar

[2] Health sector review report, MoH, 2014
[3] World Bank, Cambodia's 2013 GDP was US$15.23 billion

estimates from Vietnam where the smoking-related health costs represent 1.17% of Vietnam's 2010 GDP[4], from the US (1.40% of 2005 GDP) and from China[5] (0.7% of 2008 GDP).

The costs of treating tobacco related diseases and the associated productivity loss is nearly 12-time higher than the tobacco domestic tax revenue (US$13,825,230) generated by General Department of Taxation (GDT) only in 2013.

The results show that smoking imposes an enormous financial burden on Cambodia society in particular among the poor. Raising awareness among policy makers about this significant negative impact of smoking on Cambodia economy will be critical to ensure the adoption of stronger tobacco control policies in Cambodia. Raising awareness among the general population about the burden that tobacco use poses on their household financial security is also necessary to gain support on tobacco control program. Raising excise tobacco taxes has been proven to be the win-win approach to reduce tobacco consumption while raising government tax revenue.

[4] Hoang Anh et all, 2012 Health care cost attributed to smoking in Vietnam, 2012

[5] Lian Yang et all. Economic cost attributable to smoking in China: update and an 8-year comparison, 2000-2008. Tobacco Control 2011;20:266-272

Health Cost Associated with Active Tobacco Use

Introduction

Smoking imposes an enormous economic burden on society. It can lead to illness in both smokers and non-smokers exposed to second-hand smoke. The resulting smoking-related illnesses lead to the need for healthcare services and result in costs incurred in obtaining them. Smoking causes people to lose time from their regular activities and results in premature deaths. Understanding the economic burden of smoking both in terms of monetary costs and in terms of lost time and lives can be helpful for determining how to reduce the impact on society[6].

Although the tobacco industry claims it creates jobs and generates revenues that enhance local and national economics, the industry's overriding contribution to any country is suffering, diseases, and deaths. Tobacco use currently costs the world hundreds of billions of dollars each year[7]. Smoker waste vast amount of money on their tobacco addition, illness, and ill health can trigger a slide into extreme poverty. Tobacco kills one quarter of all smokers during their most productive years. Family member must expend valuable time and scarce resources for caring for their sick and dying smoking relatives. In United State of America, in the year 2005, the direct health care costs attributable to tobacco use were US$ 184.54 billion, which equal to 1.40% of GDP and in China was US$4.29 billion (Mackay et al, 2006)[8], which equal 0.19% of GDP. The total cost attributable to tobacco use in China in 2008 was 0.7% of GDP[9].

The costs of smoking have been conducted in a number of developed countries, including the United States (Rice and Hodgson et al., 1986; Miller and Zhang et al., 1998a; Miller and Ernst et al., 1999; CDC, 2002), Canada (Collishaw and Myers, 1984; Kaiserman,1997), Australia (Collins and Lapsley, 2008), and Germany (Neubauer and Welte et al, 2006). These estimates have proven to be exceedingly helpful for tobacco control efforts. Far fewer studies of smoking-related costs have been conducted in the developing world, though some research has been conducted, including studies in China (Jin et al., 1995, Sung et al., 2006), India (John et al., 2009), Vietnam (Ross et al., 2007), and South Africa (Yach et al., 1992). The research in the developing countries has been limited by the availability of data and resources to conduct such analyses.

In Cambodia, smoking prevalence among adult men remains high. The National Adult Tobacco Survey of Cambodia 2011 conducted by the National Institute of Statistics, Ministry of Planning

---

6Economics of Tobacco Toolkits: Assessment of the Economic Costs of Smoking, WHO, 2011

[7]WHO report on the Global Tobacco Epidemic, 2008

8Judith Mackay, Michael Eriksen, and Omar Shafey, the tobacco atlas, second edition, WHO, 2006.

[9] Lian Yang et all. Economic cost attributable to smoking in China: update and an 8-year comparison, 2000-2008. Tobacco Control 2011;20:266-272

indicates that about 2 million Cambodian adults currently consume tobacco products, of whom 1.4 million (42.5% of adult men and 3.5% of adult women) smoke cigarettes, and more than half a million (0.8% of adult men and 13.8% of adult women) chew tobacco in the form of a betel quid. According to the Global Youth Tobacco Survey (GYTS) 2003, 8.8% of youth currently use any tobacco product (Male = 11.4%, Female = 3.2%), while 5.5% currently smoke cigarettes (Male = 7.9%, Female = 1.0%). The total annual cash expenditure on cigarettes (manufactured, and hand-rolled) by current adult smokers of Cambodia was US$ 101,789,000 in year 2011[10].

To reduce tobacco consumption and to reduce burden related to tobacco related diseases, the government of Cambodia gradually imposes stronger tobacco control measures. The Royal Government of Cambodia (RGC) ratified WHO Framework Convention on Tobacco Control (FCTC) on 15 November 2005. Consequently programs and activities were carried out to reduce consumption of tobacco use including establishing the high-level Inter-Ministerial Committee for Education and Reduction of Tobacco use (IMC) and the FCTC Secretariat[11]. The government of Cambodia has implemented important articles of the FCTC that lead to the reduction of tobacco use, for example, article 8 to ensure smoke-free environment by encouraging government ministries and institution to adopt smoke-free regulations. To date 16 government ministries in Cambodia has issued such regulation and ban in-door smoking in their institutions.

The implementation of article 12 and 14 of the FCTC aims to increase awareness of public about the harm of active and passive exposure to tobacco smoke. In 2009 and 2010 the government has issued sub-decree on health warning (health warning label must cover 30% of a cigarette pack) and ban advertisement, promotion and sponsorship of tobacco. These two sub-decrees had come to effect in 2010 and 2011, respectively.

The National Assembly and the Senate have ratified the tobacco control law in April 2015 and signed by the King in May 2015. The law will allow for stronger measures to be implemented in support of the FCTC, which will likely result in further reduction of tobacco consumption in Cambodia. At the same time, the IMC had proposed an increase of tobacco tax that will help to reduce the uptake of tobacco use among youth. The preparatory work for developing these new tobacco control measures has been led by a working group combined of members from Ministry of Economic and Finance. The working group is demanding rigorous local data and analyses of the costs and benefits related to the proposed regulations. One of the important inputs is the estimate of the costs of smoking to the society.

However, the costs to treat tobacco related diseases within the existing health care system, and the burden this represents for individuals, families, and the government are not known in

[10]National Adult tobacco Survey Cambodia (NATCS) 2011, National Institute of Statistic, Ministry of Planning

[11]FCTC Secretariat is a technical team from relevant member of the IMC, its main role is to provide technical support to the IMC and to advocate the policy makers of the line ministry of support tobacco control program in Cambodia.

Cambodia. This knowledge gap severally limits the arguments for stronger legislation and policies to control tobacco use in Cambodia.

To address this shortcoming, the National Centre for Health Promotion of the Ministry of Health Cambodia and its partners conducted a research project to examine the costs of active smoking from the society perspective, including both the health care costs as well as the productivity loss.

Health Insurance for every Cambodian has not yet existed, although there are small scale private health insurance but it covers only a small portion of the population. The government of Cambodia subsidizes some diagnosis and treatment, but individuals and family have to be responsible for the main health care cost through out of pocket expenses[12], and large number of Cambodia population fall under this category. Such cost accounted for 60% of total health care expenditure in 2014 (US$ 622 million out of a little more than US$ 1 billion)Error! Bookmark not defined..

Objectives:

The research aims to generate evidence of society costs attributable to smoking. This evidence will be used to advocate for adoption and enforcement of tobacco control laws and policies related to increase of tobacco tax in Cambodia.

The specific objectives of this study are:

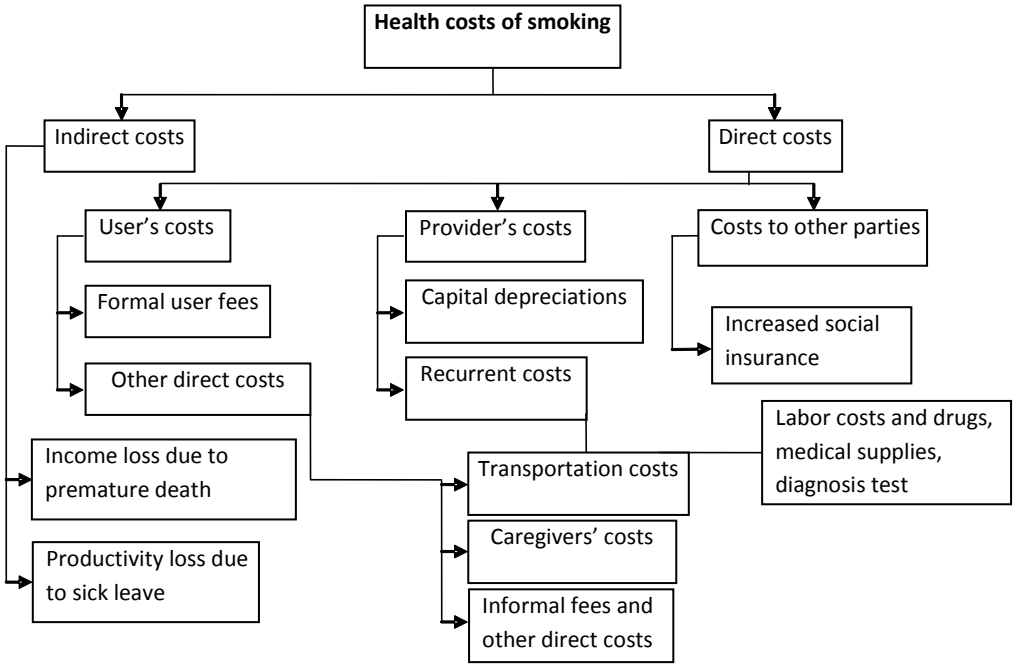
1. To generate an estimate of health care costs directly attributable to active smoking.
2. To generate an estimate of productivity loss related to both morbidity and mortality attributable to active tobacco use.
3. To increase awareness and knowledge among policy makers and the general public about the society costs attributable to active tobacco use in Cambodia.

Conceptual and theoretical framework

The cost of smoking composes of direct and indirect costs. This study aims to calculate both of these components: the direct costs (i.e. health care cost for treating tobacco-related diseases) and the indirect costs (i.e. productivity loss due premature death and sickness). The conceptual framework is defined below:

[12] MoH's Annual's Health Financing Report, 2015

Figure 1: Conceptual and theoretical framework



Data and Methods

The study examined costs related to active smoking of tobacco for both male and female (age 30+) from the society's perspective, including the health care costs and the productivity loss.

This research does not estimate the costs related to second-hand smoke, the opportunity cost of tobacco purchase (expenditure on tobacco products), and the cost of using tobacco products that are not smoked (e.g. chewing tobacco).

In order to capture the majority of the costs, but still make the study manageable and within the budget, we focused on costs associated with five health conditions:

1. Ischemic heart disease (IHD)
2. Lung cancer
3. Stroke and other cerebro-vascular diseases
4. Chronic Obstructive Pulmonary Disease (COPD)
5. Tuberculosis

This is the first study investigating the costs of smoking in Cambodia and both primary and

secondary data were collected for this research.

Given the lack of readily available hospital data and limited understanding of health care seeking behavior among tobacco users, the research team conducted the study in three phases. The first phase explored the health care costs attributable to active tobacco use, and the second phase estimated the productivity loss due to missed days at work and premature deaths attributable to active smoking. The third phase consisted of eight case studies of patients who suffered from one of the four health conditions (except tuberculosis), to explore their health care seeking behavior and to provide an input into the second phase that required an estimate of the number of days a patent and his/her caregiver spend not working due to the illness.

Each phase of the research is described below:

Phase 1: Estimating health care costs

The first phase was to calculate health care costs attributable to active use of smoking tobacco. In doing so, there was a need for data such as the annual number of cases of each health condition in the entire country by gender, the average treatment cost for each health condition, the prevalence of ever smokers and the relative risk (RR) for each health condition. The calculation of health care cost attributable to active smoking followed 5 steps:

Step 1: Estimating the number of cases by gender per health condition per year

The number of cases per each health condition per hospital was based on the 2013 hospital records. The gender specific data were obtained from five selected national hospitals in Phnom Penh, and regional hospitals in provinces. The national hospitals, namely (1) Kosomak hospital, (2) Khmer-Russia Friendship hospital, (3) Calmette hospital, and (4) an NGO hospital (Hope Centre), whereas, the regional hospitals were from Chey ChumNeah hospital in Kandal province, Battambang hospital in Battambang province, and KampongCham hospital in KampongCham province. These hospitals were selected due to the fact that these are the main health care facilities in the country that have the capacity to treat the above mentioned health conditions of interest. The four national hospitals received the majority of cases being treated in Cambodia.

Before collecting the hospital data, the research team convened a one-day workshop in February 2014 with health professionals who worked in the four selected national hospitals and the three regional hospitals. The purpose of the workshop was to identify treatment standard that each hospital applied to treat the related health condition and to understand how cases of the four health conditions were recorded. We found that there was no national standard procedure for diagnosis and treatment of IHD, Lung Cancer, Stroke & other cerebro vascular diseases, and COPD. In fact, the diagnosis and treatment of these health conditions varied across the health facilities and ability of the patients to cover the diagnosis and treatment. Health professionals who attended the workshop were heads of hospitals' technical offices,

directors and health specialists for the four diseases. In the workshop, health specialists discussed current practices to diagnose and treat each health condition and reached a consensus on the standard diagnosis and treatment procedures in each hospital. In addition, the workshop participants discussed how each case was recorded, the most appropriate approach to collect number of cases from the hospitals and potential challenges regarding the data collection. Following the workshop, the research team designed a survey tools to collect data on the number of cases being treated in each hospital and the costs of diagnosis, treatment and follow up of each disease included in the study.

Before the commencement of data collection, research team of the NCHP visited each hospital and convened meetings with the Director or the Deputy-Director or and technical bureau of each hospital to establish a local research coordinator in each hospital. The role of the local research coordinator, which composed of one or two persons, was to facilitate the data collection, communicate with the investigators from the NCHP and to collect data on the four diseases in the whole year 2013. The research coordinator worked closely with a nurse in each specialized ward to review medical records and extract the data on the number of cases being treated in 2013. The research coordinators also followed up with other wards in case of a referral to avoid duplication of cases recorded.

To capture the cases that were not referred to the national hospitals in Phnom Penh, the research team also collected comparable data from three regional referral hospitals (3RHs) located in three different provinces using identical methodology. However, only few cases of COPD and stroke were found in the provincial hospitals.

Unlike the number of cases for IHD, Lung cancer, Stroke & other cerebro vascular diseases, and COPD, the number of cases for TB were taken from Report on Tuberculosis published by the Centre National Anti-Tuberculeux (CNAT), Ministry of Health, Cambodia with data for 2013. The report provided the number of TB cases by age and gender.

The research team attempted to cross-validate the hospital data using the Health Information System (HIS) working closely with the Department of Planning and Health Information (DPHI). However, the available data was not detailed enough to extract the number of cases for each health condition as the cases for the diseases of interest were lumped into the category of 'other' diseases.

Step 2: Estimating the cost of treating a typical case of each selected health condition

The cost per a typical case includes the cost of diagnosis, the cost of in-patient treatment, and the cost of outpatient follow-up within a year (Annex 1). The costs vary according to the facilities where the treatment is provided. For example, health facilities that have better facilities, equipment, and specialists could charge more for the diagnosis, treatment and follow-up. The cost of treatment at a government health care facility is partly subsidized while the cost of treatment in a private clinic covers all the costs and contributes to the profit.

To determine the costs of treatment of a typical case (excluding TB), the research team met with health specialist in-charge of each specialized ward and head of technical bureau to assess the estimated cost of each procedure for diagnosis and treatment of each tobacco related diseases. The NCHP also cross-validated the fees with the finance office of the each hospital to ensure that the fees for the standard treatment were correct. The research team further consulted a costing report Complementary Package of Activities (CPA1, 2, 3) published by the Ministry of Health[13] that contains estimates of treatment costs. However, the report did not contain any of the costs associated with any diseases relevant for this study.

In order to compare costs between the government hospitals and the private and non-profit hospitals, the research team included one non-for-profit hospital (HOPE Center), one medium size private hospital, the Sain Maries and one well-established private hospital with high quality of care (Royal Rattanak Hospital, a branched of a private hospital in Bangkok).

After collecting the costs for all diagnoses, it became clear that only Calmette hospital is able to treat all diagnosis of interest, and the most comprehensively. Therefore, the costs provided by Calmette became the standard for the treatment costs. Costs collected from the private hospital were similar to Calmette, but the private hospital's services were not as comprehensive as Calmette's services. In fact, private hospitals often sent patients to Calmette if the patient's condition required advanced care. Alternatively, the private hospital (Royal Rattanak) would send patients to Bangkok Hospital. Therefore, basing the treatment costs in Cambodia on the costs in the Calmette hospital is well justified.

The costs of treating a typical TB case included the cost per case of inpatient and outpatient treatment as well as the cost per case for identifying patients. These estimates were obtained from the study of K. Pichenda, et al. (2012) [14], and the study of Rajendra P. Yadav, et al., 2014.

Step 3: Estimating the smoking attributable fraction (SAF)

The WHO's proposed method[15] was employed to estimate SAF for each disease category stratifying the data by sex.

[13]Guidelines for complementary package of activity (CPA) of the referral hospital from 2006 to 2010, December 2006, ministry of health: In Cambodia, at sub-national level, the health system classified into three packages; CPA1, CPA2 and CPA3, according the capacity of the health facility, in which the CPA 3 is the highest level of health care which provide comprehensive care.

[14] K. Pichenda, K. Nakamura, A. Morita, M. Kizuki, K. Seino, T. Takano, Non-hospital DOT and early diagnosis of tuberculosis reduce costs while achieving treatment success. (2012)

[15]World Health Organization Economics of Tobacco Toolkit. Assessment of the Economic Costs of Smoking

$$SAF_{ij} = \frac{P \times (RR_{ij} - 1)}{P \times (RR_{ij} - 1) + 1} \text{ x } 100\%$$

Where RR is the relative risk for cause-specific mortality related to tobacco use, P is the prevalence of ever smokers (Table 2), (i) represents the specific diseases and (j) is sex.

The study estimated SAF based on Relative Risk (RR) of four diseases based on the global standard of the CPS-II study (Table1).

Table 1: Relative risk

	Age groups	CPS-II RRs[16]	
Diseases (ICD-10 codes)		Male	Female
Lung cancer (C33-C34)	<70 yrs	21.3	12.5
Chronic obstructive pulmonary disease (I27, J40-J44)	<70 yrs	10.8	12.3
Ischemic heart diseases (I20-I25)	30-44 yrs 45-59 yrs	5.51 3.04	2.26 3.78
Stroke (I60-I69)	30-44 yrs 45-59 yrs	2.44 3.12	2.18 4.61

Source: CPS-II RRs from 3 studies: 1) Ezzati M, Henley SJ, Thun MJ, Lopez AD (2005) Role of smoking in global and regional cardiovascular mortality. Circulation 112: 489–497; 2) Ezzati M, Henley SJ, Lopez AD, Thun MJ (2005) Role of smoking in global and regional cancer epidemiology: current patterns and data needs. Int J Cancer 116: 963–971; 3) Thun MJ, Apicella LF, Henley SJ (2000) Smoking vs other risk factors as the cause of smoking-attributable deaths: confounding in the courtroom. JAMA 284: 706–712

Given that the life expectancy in Cambodia is 70 and 75 for male and female, respectively[17], we did not employ the RR for the age group70+.

The RR estimate for TB disease ranges from 2.33 (95% CI, 1.97-2.75) to 2.66 (95% CI, 2.15-3.28)[18]. The RR for TB is not gender specific.

We assumed that the SAF of acquiring the disease is identical to SAF of the total costs of treating the disease. This means that we assume that the cost of treatment of a particular disease is identical for smokers and non-smokers. This assumption results in underestimation of the total costs, because it is often violated in studies outside Cambodia. The data from Cambodia is currently not sufficient to uphold this claim.

[16]Michael J. Thum 2010, Luis F. Apicella, S. Jane Henley. Smoking vs Other risk factors as the cause of smoking Attributable Death. The authors calculated for 30% reduction of RRs

[17] World Health Organization, http://www.who.int/countries/khm/en/ retrieved on 13 July 2015

[18]Michael N. Bates, PhD; Asheena Khalakdina, PhD; MadhukarPai, MD, PhD; Lisa Chang, MPH; Fernanda Lessa, MD, MPH; Kirk R. Smith, PhD, Risk of Tuberculosis From Exposure to Tobacco Smoke, A Systematic Review and Meta-analysis (2007)

The prevalence of ever smoker was based on the 2012 National Adult Tobacco Survey of Cambodia. The ever-smoking prevalence was calculated by subtracting the percentage of never smokers from all Cambodian adults aged 15 and over. (Table 2)

Table 2: Ever smoker prevalence

	Male	Female	All
Never-smoker	55.60%	96.10%	77.8%
All	100%	100%	100%
Ever smokers	44.40%	3.90%	22.2%

Step 4: Calculating the total health care cost for selected diseases that are attributable to smoking

We used results of Steps 1 – 3 to calculate the total health care costs attributable to active smoking for the selected heath conditions.

One year health care costs (per disease) = cost per a typical case * number of cases in one year * SAF

Step 5: Estimating the full provider cost

Diagnosis and treatment costs obtained from the Calmette hospital represent the costs of treatment, but do not cover the capital depreciation and the hospital fixed costs also referred to as recurrent costs.

Despite multiple efforts, the research team was unable to obtain estimates of the depreciation and the recurrent costs. Not including these costs would lead to the underestimation of the total costs. To solve this problem, it is assumed that the health care cost structures in Cambodia resemble that of Vietnam where the rate of capital depreciation and recurrent costs was 54.7% of the total treatment cost based on a 2012 study[19].

Phase 2: Estimating the Productivity Loss

The second phase of the study estimated the productivity loss due to mortality and morbidity related to active smoking as well as the productivity loss due to providing care for those with the selected health conditions.

[19] Hoang Anh Pham Thi, Thu Le Thi, Hana Ross, Quynh Anh Nguyen, Linh, Bui Ngoc. Direct and Indirect Costs of Smoking in Vietnam. Tobacco Control 2014; doi:10.1136/tobaccocontrol-2014-051821

Step 1: Estimating mortality-related productivity costs using human capital approach

One possible approach to estimate the impact of smoking-related mortality on a country's economy is to employ smoking-attributable DALY estimates. However, these estimates have been criticized due to their upward bias, which is particularly pronounced in countries with relatively low life expectancy such Cambodia. An alternative approach employed in this study involves an estimate of the annual number of deaths attributable to smoking and the average number of life year lost per smoker. The productivity is measured by GDP per capita and the annual rate of inflation is assumed to equal the depreciation rate.

Mortality productivity cost = (average current smoker's year life lost*number of death/year)*GDP per capita

The number of deaths attributable to tobacco was provided by the WHO (10,000 deaths per year) and the estimate of the number of life years lost by a smoker (12 years of life) came from the Surgeon General report, 2014. The GDP per capita (1,007 USD) came from the World Bank[20].

Step 2: Estimating morbidity-related productivity cost

The morbidity-related productivity cost for a patient with one of the health conditions is calculated as followed:

Morbidity-related productivity cost= average income per day of a worker*(# of days in hospital+# of unproductive days at home)* # of cases in year 2013* 2*SAF

The average income per day is based on the average salary of garment factory worker (USD 7per day), the estimate of the number of days spent in a hospital is based on data from Khmer_Russia Friendship Hospital and it varies by disease (Table 3). Number of cases of each disease in one year (2013) is based on hospital records. Since each patient in Cambodia requires at least one caregiver (based on the information from the case studies), the costs per patient are multiplied by 2, and multiplied by smoking attributable fraction (SAF).

Table 3: Average number of days a patient spent at hospital and at home for one time of treatment and care

Disease	Average number of day of treatment in Hospital	Average number of day of care at home
Lung cancer	10 days	10 months = 210 Days
Ischemic heart disease	8 days	10 days
Stroke, and other celebro-vascular diseases	10 days	1 Year

[20] http://data.worldbank.org/indicator/NY.GDP.PCAP.CD retrieved on 22 April 2015

Chronic Obstructive Pulmonary Disease	10 days	20 days
Tuberculosis		21 days

The total cost attributable to smoking is calculated by adding the health care costs and the costs associated with the productivity loss.

Phase 3: Case studies

The research team conducted eight case studies to explore the socio-demographic background, of patients to examine their health seeking behaviour from the disease onset until the time of the interview as well as costs associated with health care.

The cases were selected from Calmette hospital and from Khmer-Russia Friendship hospital. Being smoker is a condition for being eligible to participate in the study. The hospital provided list of patients who sought care from the hospital during the research period. The research team members contacted the patients, explained to them the purpose of the study and invited them to participate in it. If the patient agreed to participate, researcher made an appointment for an interview. The interview took place at patient's residence or at hospital according to patient's choice.

On the interview day, a researcher reiterated the study objectives, outlined the risks and the benefits to participate in the research and seek consent to tape record the interview. A structured interview took approximately 90 minutes and was based on an interview guide developed by the research team (see Annex 2) and the research advisor. Each participant was contacted several weeks later for a follow-up interview in order to assess the progress of their disease and to clarify any concerns related to their health seeking behavior and their costs associated with health care.

The total of eight cases was conducted including seven men and one woman. The research originally aimed to have equal number of men and women, but because the smoking participation among women in Cambodia is extremely low (2.4% in 2014) and it was not possible to recruit sufficient number of women suffering from the diseases included in our study. Therefore, the research team proceeds with selection of more male cases. Summary of case characteristic is in Annex 2.

Ethical Issues

The study (quantitative and qualitative) has obtained an ethical approval from the National Ethics Committees on Health Research (NEC) on 20 March 2015.

The participation in the study was voluntary. All study participants signed an informed consent to participate in the study. The individual-level data collected during the study are kept

confidential and only research team had access to them in order to conduct the analyses. In addition, the information provided by the hospital was approved by the management of the hospital to ensure its accuracy for research purpose.

Following the completion of data collection and preliminary analysis, the NCHP convened the second workshop in March 2015, with an international research adviser, heads of hospital technical offices, directors, disease specialists and local research coordinators to present findings from the national and regional hospitals who provided their data to the research team. The purpose of this workshop was to validate the number of cases, the costs per diagnoses, and to discuss the data limitations. Participants at the workshop agreed that the number of cases and the costs per case were realistic and captured well the situation in Cambodia.

Results

This section presents findings on the direct health care costs, including depreciation costs as well as the productivity lost related to smoking.

Phase 1: Health care costs

There are five steps to estimate the health care costs of smoking.

Step 1: Number of cases

The participating hospitals and the CNAT provided the number of cases for the five diseases stratified by sex and age groups. There were 19,697 cases (9,207among female) in Cambodia in 2013. (Table 3)

Table 4: Number of cases of each disease by sex and age in year 2013

Diseases	# of case (Male)			# of case (Female)			# of case (Total)
	30 to 45 years	45 years or above	≥30 years old	30 to 45 years	45 years or above	≥30 years old	≥30 years old
Lung Cancer	61	153	214	55	138	193	407
Ischemic Heart Disease	117	247	364	146	268	414	778
Stroke and other cerebro-vascular diseases	407	1,425	1,832	534	1,386	1,920	3,752
COPD	430	556	986	392	486	878	1,864
TB[21]	2529	4565	7094	1972	3830	5802	12896
Grand Total	3,544	6,946	10,490	3,099	6,108	9,207	19,697

[21] Report on Tuberculosis cases year 2013, Centre National Anti-Tuberculeux (CNAT), Ministry of Health, Cambodia

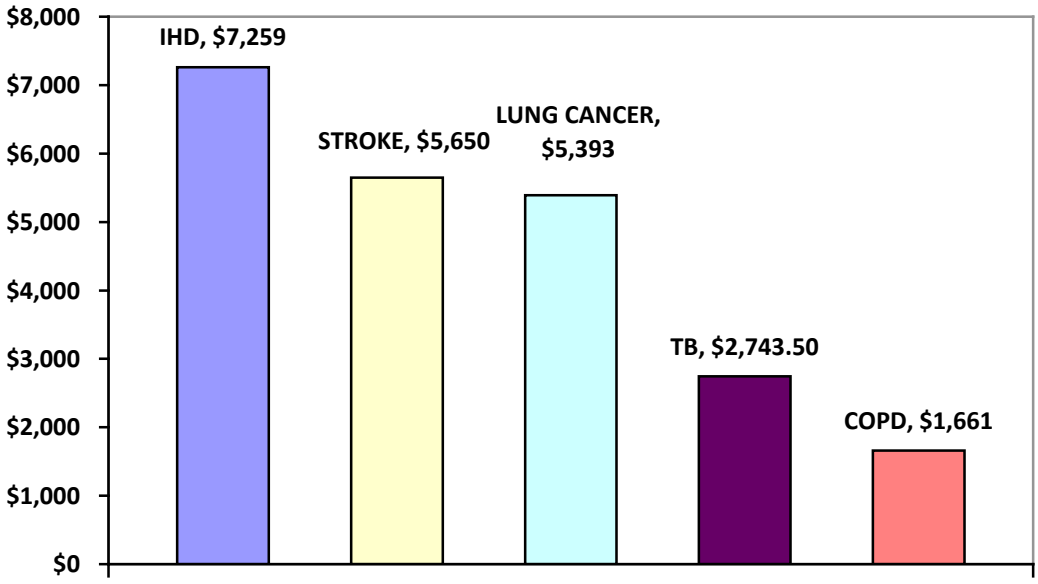
Step 2: Estimating treatment cost per one case of each health condition

The costs per case were obtained from the Calmette hospital, because this hospital offers the most comprehensive data on the costs of various procedures required for a standard diagnosis and treatment. (Annex 1)

The cost per case of Tuberculosis was based on the two studies conducted by Centre National Anti-Tuberculeux (CNAT). The total costs of TB consist of the cost of inpatient treatment (US$1,900 per case), the cost of outpatient treatment (US$395 per case)[22] and cost of identifying a patient (US$448.50)[23]. The total cost of TB treatment was US$2,743.50 per case.

The treatment costs vary by the disease with Ischemic Heart Disease (IHD) being the most expensive followed by Stroke.

Figure 2: Cost per case of four diseases in Calmette Hospital and for TB from CNAT 2013



Step 3: Estimating smoking attributable fraction (SAF)

After obtaining the cost per case, the next step was to determine what percentage of these costs can be attributed to smoking. The investigators estimated the SAFs based on the RR of each disease. The RRs and the resulting SAFs are presented in Table 4 and 5

[22]K. Pichenda, K. Nakamura, A. Morita, M. Kizuki, K. Seino, T. Takano,Non-hospital DOT and early diagnosis of tuberculosis reduce costs while achieving treatment success. (2012)

[23]Rajendra P. Yadav, Nobuyuki Nishikiori, PeouSatha, Mao T. Eang, and YoelLubell, Cost-Effectiveness of a Tuberculosis Active Case Finding Program Targeting Household and Neighborhood Contacts in Cambodia, (2014)

Table 5: Relative Risk of the five diseases

	Age groups	CPS-II RRs[24]	
Diseases (ICD-10 codes)		Male	Female
Lung cancer (C33-C34)	<70 yrs	21.3	12.5
Chronic obstructive pulmonary disease (I27, J40-J44)	<70 yrs	10.8	12.3
Ischemic heart diseases (I20-I25)	30-44 yrs 45-59 yrs	5.51 3.04	2.26 3.78
Stroke (I60-I69)	30-44 yrs 45-59 yrs	2.44 3.12	2.18 4.61
The summary RR for TB infection	N/A	1.73	

Table 6: Summary of the SAF of the five diseases

Diseases	Male		Female	
	30-45 years old	49-59 years old	30-45 years old	46+ years old
IHD	66.70%	47.50%	4.70%	9.80%
Lung Cancer	90.00%		31.00%	
Stroke	39.00%	48.50%	4.40%	12.30%
COPD	81.30%		30.60%	
TB	13.94%			

SAF of Ischemic Heart Diseases:

SAF of Ischemic Heart Diseases for male age 30-45 years old
P=0.444, and RR(M)=5.51, therefore

SAF (M)=[0.444*(5.51-1)]/{[0.444*(5.51-1)]+1}*100=66.7%
This means that 66.7% of the cost of IHD for male aged from 30 to 45 can be attributed to smoking.

SAF of Ischemic Heart Diseases for male age 45-59 years old
P=0.444, and RR(M)=3.04, therefore

SAF (M)=[0.444*(3.04-1)]/{[0.444*(3.04-1)]+1}*100= 47.5%
This means that 47.5% of cost of IHD for male aged 46 + can be attributed to smoking.

SAF of Ischemic Heart Diseases for female aged 30-45 years old
P=0.039, and RR(F)=2.26, therefore

[24]Michael J. Thum 2010, Luis F. Apicella, S. Jane Henley. Smoking vs Other risk factors as the cause of smoking Attributable Death. The authors calculated for 30% reduction of RRs

SAF(F)=[0.039*(2.26-1)]/{0.039*[(2.26-1)]+1}*100=4.70%
This means that 4.7% of cost of IHD for female aged 30 to 45 can be attributed to smoking.

SAF of Ischemic Heart Diseases for female aged 46+ years old
P=0.039, and RR(F)=3.78, therefore

SAF(F)=[0.039*(3.78-1)]/{0.039*[(3.78-1)]+1}*100=9.8%
This means that 9.8% of cost of IHD for female aged 46+can be attributed to smoking.

SAF of Lung Cancer

SAF of Lung Cancer for male
P=0.444, and RR(M)=21.3, therefore

SAF (M)=[0.444*(21.3-1)]/{0.444*[(21.3-1)+1]}*100=90%
This means that 90% of cost of lung cancer among male can be attributed to smoking

SAF of Lung Cancer for female
P=0.039, and RR(M)=12.5, therefore

SAF(F)=[0.039*(12.5-1)]/{0.039*[(12.5-1)]+1}*100=31%.
This means that 31% of cost of lung cancer among female can be attributed to smoking.

SAF for Stroke

SAF for male age 30-45 years old
P=0.444, and RR(M)=2.44, therefore

SAF (M)=[0.444*(2.44-1)]/{[0.444*(2.44-1)]+1}*100=39%
This means that 39% of cost of stroke for male aged from 30 to 45 can be attributed to smoking.

SAF for Stroke for male age 46+ years old
P=0.444, and RR(M)=3.12, therefore

SAF (M)=[0.444*(3.12-1)]/{[0.444*(3.12-1)]+1}*100= 48.5%
This means that 48.5% of cost of stroke for male aged from 46 + can be attributed to smoking.

SAF for Stroke for female aged 30-45 years old
P=0.039, and RR(F)=2.18, therefore

SAF(F)=[0.039*(2.18-1)]/{0.039*[(2.18-1)]+1}*100=4.4%
This means that 4.4% of cost of stroke for female aged 30 to 45 can be attributed to smoking.

SAF for Stroke for female aged 46+ years old
P=0.039, and RR(F)=4.61, therefore

SAF(F)=[0.039*(4.61-1)]/{0.039*[(4.61-1)]+1}*100=12.3%
This means that 12.3% of cost of stroke for female aged 46+can be attributed to smoking.

SAF for COPD

SAF for COPD for male
P=0.444, and RR(M)=10.8, therefore

SAF (M)=[0.444*(10.8-1)]/{0.444*[(10.8-1)+1]}*100=81.3%
This means that 81.3% of cost of COPD for male can be attributed to smoking.

SAF for COPD for female
P=0.039, and RR(F)=12.3, therefore

SAF(F)=[0.039*(12.3-1)]/{0.039*[(12.3-1)]+1}*100=30.6%
This means that 30.6% of cost of COPD for female can be attributed to smoking.

SAF for Tuberculosis (TB)

P=0.222, and RR=1.73[25], therefore
SAF=[0.222*(1.73-1)]/{0.222*[(1.73-1)]+1}*100=13.94%

This means that 13.94% of TB cost be attributed to smoking.

Step 4: *Calculating the total health care costs for selected diseases that are attributable to smoking*

Ischemic Heart Diseases: US$1,658,608

Male 30 to 45 years old
Number of cases =117, cost per case=7,259, and SAF=0.667, therefore
The cost of treatment of IHD attributable to smoking tobacco for male 30 to 45 years old =117*7,259*0.667=US$566,485

Male 46+ years old
Number of cases =247, cost per case=7,259, and SAF=0.475, therefore
The cost of treatment of IHD attributable to smoking tobacco for male 46+ years old=247*7,259*0.475=US$851,662

Female 30 to 45 years old

[25] *Michael N. Bates, PhD; AsheenaKhalakdina, PhD; MadhukarPai, MD, Ph; Lisa Chang, MPH; Fernanda Lessa, MD, MPH; Kirk R. Smith, PhD, Risk of Tuberculosis From Exposure to Tobacco Smoke, A Systematic Review and Meta-analysis, 2007*

Number of cases =146, cost per case=7,259, and SAF=0.047, therefore

The cost of treatment of IHD attributable to smoking tobacco for female 30 to 45 years old =146*7,259*0.047=US$49,811

Female 46+ years old
Number of cases =268, cost per case=7,259, and SAF=0.098, therefore
The cost of treatment of IHD attributable to smoking tobacco for female 46+ years old =268*7,259*0.098=US$190,650

Lung Cancer: US$1,361,355

Male
Number of cases =214, cost per case=5,393, and SAF=0.9, therefore
The cost of treatment of lung cancer attributable to smoking tobacco or male=214*5,393*0.9=US$1,038,692

Female
Number of cases =193, cost per case=5,393, and SAF=0.31, therefore
The cost of treatment of lung cancer attributable to smoking for female=193*5,393*0.31=US$322,663

Stroke: US$5,897,634
Male 30 to 45 years old
Number of cases =407, cost per case=5,650, and SAF=0.39, therefore
The cost of treatment of stroke attributable to smoking for male 30 to 45 years old =407*5,650*0.39=US$896,825

Male 46+ years old
Number of cases =1425, cost per case=5,650, and SAF=0.485, therefore
The cost of treatment of stroke attributable to smoking for male aged 46+ years old =1425*5,650*0.485=US$3,904,856

Female 30 to 45 years old
Number of cases =534, cost per case=5,650, and SAF=0.044, therefore
The cost of treatment of stroke attributable to smoking tobacco for female aged 30 to 45 years old=534*5,650*0.044=US$132,752

Female 46+ years old
Number of cases =1,386, cost per case=5,650, and SAF=0.123, therefore
The cost of treatment of stroke attributable to smoking tobacco for female aged 46+ years old =1,386*5,650*0.123=US$963,201

COPD: US$1,777,745

Male
Number of cases =986, cost per case=1,661, and SAF=0.813, therefore
The cost of treatment of COPD attributable to smoking tobacco for male
=986*1,661*0.813=US$1,331,487

Female
Number of cases =878, cost per case=1,661, and SAF=0.306, therefore
The cost of treatment of COPD attributable to smoking tobacco for
female=878*1,661*0.306=US$446,258

TB: US$4,931,997

Number of case=12,896, cost per case=2,743.5, and SAF=0.1394 therefore
The cost of TB treatment attributable to smoking tobacco= 12,896*2,743.5*0.1394
=US$4,931,996.53

Table 7: Total variable health care costs attributable to smoking in Cambodia in 2013

Diseases	Attributable cost (USD)
Ischemic Heart Diseases	$1,658,608
Lung Cancer	$1,361,355
Stroke	$5,897,634
COPD	$1,777,745
TB	$4,931,997
Total	$15,627,339

Adding the smoking attributable costs of treatment for the all five health conditions (Lung Cancer, IHD, Stroke, COPD and TB) generates the total of US$15,627,339. This amount represents the variable cost of treating smoking-attributable diseases in Cambodia in year 2013.

Step 4: *Estimating the full cost of treatment by taking into account the depreciation and the fixed costs*

Total full treatment cost = the treatment cost /45.3*100
= US$15,627,339/45.3*100
=US$ 34,497,437

This means that the total health care costs in Cambodia that can be attributable to smoking based on the five diagnoses included in this study is US$ 34,497,437.

Phase 2: Estimating Productivity Loss

The productivity loss (also called indirect costs) consists of costs related to premature mortality and morbidity caused by smoking.

Step 1: Estimating productivity cost of premature mortality

The current smoker loses on average 12 years of life and there are 10,000 deaths per year in Cambodia. The GDP per capita is 1,007 USD. Therefore,

Mortality productivity cost = (12*10,000)*1,007= US$120,840,000

Step 2: Estimating productivity cost due to morbidity

Lung Cancer

Lung Cancer for male

A patient and a caregiver spent 10 days in a hospital and 10 months at home. We assumed 20 workdays per month. There were 214 cases of lung cancer for male in 2013 and SAF of Lung Cancer for male is 0.90. Therefore

The mortality-related cost for Lung Cancer of male=7*210*2*214*0.90= US$566,244

Lung Cancer for female

A patient and a caregiver spent 10 days in a hospital and 10 months at home. We assumed 20 workdays per month. There were 193 cases of lung cancer for female in 2013 and the SAF of Lung Cancer for female is 0.31. Therefore

The mortality-related cost for Lung Cancer of female=7*210*2*193*0.31= US$175,900.20

Total mortality-related cost of LUNG CANCER=US$742,144.20

IHD

IHD for male age 30-45 years old

A patient and a caregiver spent on average 8 days in a hospital and 10 days at home. There were 117 cases of male age 30-45 years old for IHD in 2013 and the SAF of IHD for male age 30-45 years old is 0.667. Therefore

The mortality-related costs for IHD of male age 30-45 years old
=7*18*2*117*0.667=US$19,665.83

IHD for male age 46-59 years old

A patient and a caregiver spent on average 8 days in a hospital and 10 days at home. There were 247 cases of male age 46-59 years old for IHD in 2013 and the SAF of IHD for male age 46-59 years old is 0.475. Therefore

The mortality-related costs for IHD of male age 46-59 years old
=7*18*2*247*0.475=US$29,565.90

IHD for female age 30-45 years old
A patient and a caregiver spent on average 8 days in a hospital and 10 days at home. There were 146 cases of female age 30-45 years old for IHD in 2013 and the SAF of IHD for female age 30-45 years old is 0.047. Therefore

The mortality-related costs for IHD of female age 30-45 years old
=7*18*2*146*0.047=US$1,729.22

IHD for female age 46-59 years old
A patient and a caregiver spent on average 8 days in a hospital and 10 days at home. There were 268 cases of female age 46-59 years old for IHD in 2013 and the SAF of IHD for female age 46-59 years old is 0.098. Therefore

The mortality-related costs for IHD of female age 46-59 years old
=7*18*2*268*0.098=US$6,618.53

Total mortality-related cost of IHD=US$57,579.48

Stroke
Stroke for male age 30-45 years old

A patient and a caregiver spent the total of 240 days in a hospital and recovering at home until they could resume work. There were 407 cases of stroke for male age 30-45 years old in 2013 and the SAF of Stroke for male age 30-45 years old is 0.39. Therefore

The mortality-related cost of Stroke for male age 30-45 years old =7*240*2*407*0.39= US$533,332.80

Stroke for male age 46-59 years old

A patient and a caregiver spent the total of 240 days in a hospital and recovering at home until they could resume work. There were 1,425 cases of stroke for male age 46-59 years old in 2013 and the SAF of Stroke for male age 46-59 years old is 0.485. Therefore

The mortality-related cost of stroke for male age 46-59 years old =7*240*2*1425*0.485= US$2,322,180

Stroke for female age 30-45 years old

A patient and a caregiver spent the total of 240 days in a hospital and recovering at home until they could resume work. There were 534 cases of stroke female age 30-45 years old in 2013 and the SAF of Stroke for female age 30-45 years old is 0.044. Therefore

The mortality-related cost of Stroke for female age 30-45 years old =7*240*2*534*0.044= US$78,946.56

Stroke for female age 46-59 years old

A patient and a caregiver spent the total of 240 days in a hospital and recovering at home until they could resume work. There were 1,386 cases of stroke for female age 46-59 years old in 2013 and the SAF of Stroke for female age 46-59 years old is 0.123. Therefore

The mortality-related cost of stroke for female age 46-59 years old =7*240*2*1386*0.123= US$572,806.08

Total mortality-related cost of STROKE=US$3,507,265.44

COPD

COPD for male

A patient and a caregiver spent 10 days in a hospital and 20 days at home. There were 986 cases of COPD for male in 2013 and the SAF of COPD for male is 0.813. Therefore

The mortality-related cost of COPD for male =7*30*2*986*0.813=US$336,679.56

COPD for female

A patient and a caregiver spent 10 days in a hospital and 20 days at home. There were 878 cases of COPD for female in 2013 and the SAF of COPD for female is 0.306. Therefore

The mortality-related cost of COPD for female =7*30*2*878*0.306=US$112,840.56

Total mortality-related cost of COPD=US$449,520.12

TB

A patient and a caregiver spent 105 days in hospital and at home. There were 12,896 cases of TB in 2013 and the SAF of TB is 0.1394. Therefore

The mortality-related cost =7*105*2*12,896*0.1394=US$2,642,622.53

Table 8: Productivity costs of smoking related morbidity

Diseases	Costs (USD)
IHD	$ 57,579.48
Lung Cancer	$ 742,144.20
Stroke	$ 3,507,265.44
COPD	$ 449,520.12
TB	$ 2,642,622.53
Sub-total	$ 7,399,131.77

Sum up the estimation Productivity Loss (Cost)

The total productivity loss for five diseases (IHD+ Lung Cancer+ stroke+ COPD+TB) in 2013 was US$120,840,000+US$7,399,131.77=US$128,239,131.77

Sum up the estimation of the total society costs attributable to smoking

The total society costs attributable to smoking including the health care costs and productivity loss are US$ **162,736,568.77**, which equal to 1.05% of Cambodia's 2013 GDP[26]. (Table 8)

Table 9: Estimation of the total costs attributable to smoking tobacco

Description	Cost (USD)
Total cost of treatments	$ 34,497,437.00
Total productivity cost	$ 128,239,131.77
Total costs of smoking	**$ 162,736,568.77**

Phase 3: Case Studies

Eight case studies were important part of the methodology, because they provided data on the number of days lost from work due to a specific illness and confirmed that people are seeking medical help outside the system of government hospitals. We interviewed three patients with IHD, two stroke patients, two COPD patients and one lung cancer patient.

This section describes the health seeking behavior of patients who suffer from tobacco related diseases, their health care cost related to the diagnosis, treatment and rehabilitation as well as their smoking history.

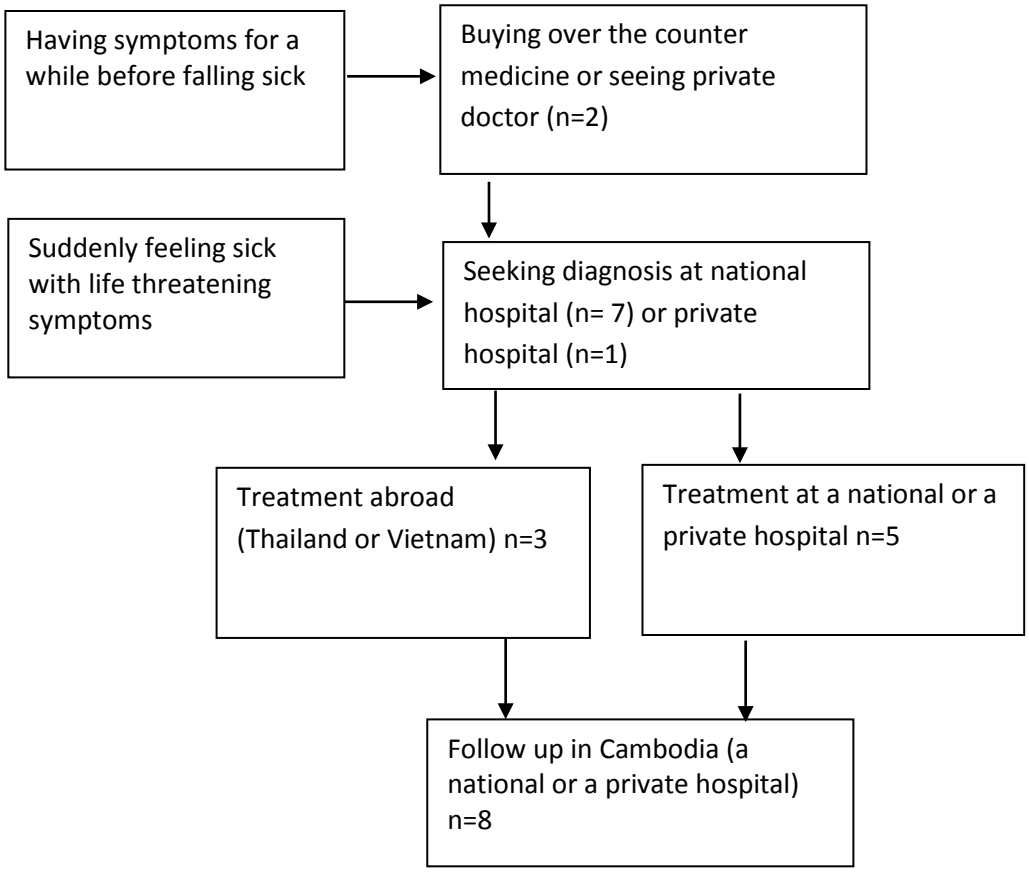
[26] http://data.worldbank.org/indicator/NY.GDP.MKTP.CD retrieved on 28 December 2015

Health seeking behavior of patients

Health seeking behavior may vary according to the socio-economic status of the family. Based on secondary data, by 2010, only 29% of patients sought care first in the public sector and 57% with private providers[27], which was consistent to the findings of qualitative study which was found that once experiencing disease symptoms, the patients usually buy over-the counter medicines or see a private doctor as the first step. When the symptoms become severe/life threatening, patients usually go to a national hospital operated by the government or to a private hospital. In some cases, the patients are not confident in the ability of local hospitals to handle their case and seek a second opinion and/or treatment abroad, most commonly in Thailand or in Vietnam. If diagnosed abroad, they either proceed with a treatment abroad or bring the diagnoses obtained abroad to Cambodia where they continue treatment in a local facility (either public or private) and purchase their mediations out of pocket. The majority of these choices are driven by available resources with the diagnoses/treatment abroad being the most expensive, followed by a private facility in Cambodia. A national hospital is still the cheapest option, but many patients struggle to pay for the care even in these facilities [28],[29].

[27] Peter Leslie Annear, Health Sector Analysis, Ministry of Health, Cambodia, 2014
[28] Cambodia Annual Health Financing report 2014
[29] Tracking Universal Health Coverage report, WHO, 2014

Figure 3: Pattern of Health Seeking Behaviour of Patients



Case Study 1: A stroke

Sophal, 52, married man, was an engineer working for the government, but also running his private business supervising construction sites. Sophal has been a heavy smoker for more than 20 years. He used to smoke one to two packs a day. He also drinks alcohol.

Before he got ill, he made approximately US$ 3,000 per month, this is a very high income according to Cambodia standard, where minimum wage is approximately US$ 150 per month. This income comes from his government salary at US$ 200 per month and his private work. In May 2015, Sophal started to feel dizzy, experienced headaches, tension in his head, neck and chest. He was admitted to Calmette hospital and was diagnosed with a stroke. His family decided in the same day to take him to Vietnam for further diagnosis and treatment. They travel to Vietnam in a private car and was hospitalized in a private hospital in Ho Chi Minh city for 14 days. After that he stayed in Vietnam for one more month for a follow-up. Upon his

return to Cambodia, he continued his follow-up at Calmette hospital. He had to visit Calmette hospital 3 times per week for rehabilitation (learning to walk and speak). He also needed to additional physiotherapy twice a day until presence (for 6 months until interview day). Sophal took medicines to speed up his recovery. Sophal and his family spent US$ 15,288 for the diagnosis, hospitalization, and treatment from the time he had stroke until 5 months after the event. His condition improved significantly, although his right hand and leg remained paralyzed. He could barely walk without help, and he could not speak. The doctors expected that he will be able to speak and walk in about a year that is within 1.5 years after the incident.

His wife is his main caregiver accompanying him to all his hospital visits while she struggles to take care of the rest of the family.,

The disease affected Sophal's family both economically and socially. The family used its savings to pay for the diagnosis and treatment. They are very concerned that Sophal will not be able to resume his work and earn regular income that the family depends on. This could push the family into the poverty. There are no particular benefits for sick person like Sophal, he continues to receive his monthly government salary although he is sick, but he does not have income from his private work, thus putting his family into a hard time to cover his treatment.

Before his illness, Sophal has never tried to quit smoking and was never concerned about the health damage smoking could cost. He quits smoking after he was diagnosed and informed that his illness was caused by smoking.

The case of Sophal demonstrates a typical health care seeking behavior among those relatively well off. Sophal was able to go to multiple health care providers. It is not uncommon that Cambodians seek health care abroad, especially in Vietnam due to lack of trust on the quality of health care provided by public hospital.

Case Study 2: COPD

Sokha, a married man, age 65, lives in Sihanouk Province, the coastal areas in the southwest of the country at the Gulf of Thailand. He is a farmer. His wife is a grocery seller. The family has only a modest income and supported by his brother who is an owner of the farm that he is working for. Sokha has four children who work in private sector.

Sokha has been a heavy smoker for more than 30 years consuming at least 2 cigarette packs per day.

Sokha had hypertension and has been coughing for about 10 years before he experienced

difficult breathing in December 2014 and was referred to Khmer-Russian hospital in Phnom Penh. He was diagnosed with Chronic Obstructive Pulmonary Disease (COPD) and admitted to the hospital for 18 days. At that time, he decided to quit smoking. Four months later after his discharge (Jan 2015), in April 2015 he got a flu, had difficulty breathing and even lost his conscious. He was admitted to the same hospital for the second time, this time he was hospitalized for 14 days. Following this hospitalization, he had to take prescribe medicines for one month that cost him US$ 120. After that he needed to return to the hospital every month for a follow-up for the first six month and had to continue using his medicines that cost him US$ 120 per month. Overall, his family spent close to US$ 13,000 over the course of two years to treat his illness. He used up all his savings and received support from his brother and children to cover the costs.

The case of Sokha demonstrates that the drain on family resources does not stop after the diagnoses and hospital treatment. Sokha's condition requires continued treatment with significant monthly expenses.

He continues to work at the farm owned by his brother, but he can only do light work and requires more rest. His wife always accompany him while he is sick at hospital or at home, she had to close her grocery story to help with the family farm since the productivity of her husband declined.

Case Study 3: Lung Cancer

Saroeun, age 51, married with three children and lives in Phnom Penh. Sarouen has been a heavy smoker. He began smoking when he was ten years old. He recalls smoking more during Pol Pot regime (1975-1979). As a teenager, he used to smoke hand-rolled cigarette consuming about half kilogram of dry tobacco leaf in a week. After the regime change in 1979, Saroeun smoked variety of brands, about two packs a day for about 20 years. Sarouen never thought that smoking could make him sick. He has heard about the harm of smoking and his wife and his children asked him to stop, but he never tried to quit.

Before he got sick, Saroeun was a police officer with a modest salary of about US$ 200 per month, which was supplemented by other income [they declines to report the source and amount of extra income].

Saroeun first felt sick in March 2014, when he started to cough blood. He sought treatment from a nearby pharmacy, because he thought that it was a severe flu. The bleeding did not stop and he went to Calmette hospital to diagnose the problem. The hospital did a CT scan and a biopsy of his lungs after a doctor found a tumor in his right lung. When the results of the biopsy

returned back from a lab in France, the doctor confirmed lung cancer.

Saroeun and his family were shocked. Saroeun has never been diagnosed with any health problems in the past. Saroeun and his family went to Bangkok to confirm the diagnosis and to begin treatment. At that point, Saroeun stopped smoking. The PhyaThai hospital in Bangkok confirmed stage 3 lung cancer and the local doctor suggested a surgery. Saroeun and his family refused the surgery and begin chemotherapy in the hospital. Saroeun stayed in the PhyaThai hospital for 20 days and spent about US$ 10,000 for the treatment. Running out of savings, Saroeun and his family requested to be discharged from the PayaThai hospital to the Rama government hospital where the treatment was cheaper. At Rama, Saroeun underwent 23 chemotherapy sessions. He stayed in Bangkok to get his first six chemotherapy sessions. Then he returned to Cambodia and travelled back and forth between Bangkok and Phnom Penh to receive the remaining treatment. At that point, the family has spent about US$ 90,000 for his treatment, travel and four months stay in Bangkok. At the end, the family decided to stop treatment in Thailand, because it could not afford it and Saroeun was not getting any better. Saroeun continues his treatment at Calmette hospital in Phnom Penh.

Saroeun spent at least 10 months in treatment. He stopped working completely, and his wife estimates that the couple spent approximately US$ 120,000 during these 10-months to cover the cost of treatment, travel, and their stay in Bangkok. So far, his wife said that she spent all her saving and sold jewelry to cover these costs.

Case Study 4: Ischemic Heart Disease **(IHD)**

Mr. Piseth, age 53, married with two children, is agriculture professional. He has been a heavy smoker for approximately ten years. Until May 2015 he has been a healthy man. In May he experienced a severe chest pain that did not respond to painkillers and his blood pressure skyrocketed.

His wife took him to a private hospital in Phnom Penh where a doctor found that his three coronary vessels were blocked. He was diagnosed with ischemic heart disease (IHD) and needed a surgery. He stopped smoking immediately. His one night stay at the private hospital that diagnosed his illness cost him US$ 800. The next day he flew to Bangkok with his wife for the surgery that cost US$ 20,000. Following the surgery in Bangkok he was hospitalized for seven days and then stayed in Bangkok for one more week after the hospitalization for the follow-up treatment. He and his wife stayed at a hotel and went to the hospital every day. Upon his return to Phnom Penh, he has to recover at home for one month, after which he resumed to work. But only part time, because he was still weak to work full time.

Piseth continues to take daily medication that cost around US$ 80-100 per month. He also needs to go to Bangkok every 6 months for a follow-up that costs US$ 1,500.

So far, the family spent approximately US$ 26,765, but this is not the final bill, since the medication needs to be taken and future follow-ups in Bangkok.

His wife was his main caregiver. She is a government officer and she missed many days from work during Piseth's hospitalization in Bangkok and during the follow-up treatment.

Health care cost

As discussed earlier the health care costs vary according to the capacity of a particular health care facility to treat certain health condition, but also by the ability of a patient to pay for the treatment. The health care costs in the Sophal's case (stroke) were mostly related to the hospital treatments, medications and transportation.

The costs reported by the lung cancer patient were much higher compared to those provided by the hospital experts, most likely due to some health care being provided in Thailand. The lung cancer diagnoses and treatment costs approximately US$ 5,393 in a national hospital, but Saroeun, the lung cancer patient paid approximately US$ 120,000 for his treatment abroad and in the country.

Similarly, the health care costs associated with other conditions were determined by the type and variety of health providers. For example, Piseth and his family spent US$ 26,765 for the treatment of his IHD (including a surgery) in Thailand. This cost was about triple the amount of US$ 7,259 estimated by a Cambodia government hospital (Calmette) inclusive of a surgery). On the other hand, Samnang who also suffered from IHD, spent approximately US$ 6,600 for his diagnosis and treatment that did not required a surgery. However, in case of Samnang, some costs (e.g. materials and equipment) were covered by humanitarian aid to Cambodia, because he was treated in a non-for-profit hospital that charges lower fees to the patient with financial difficulty.

Smoking Behavior of Patients Participating in the Case Studies

All case study participants were heavy smokers for more than ten years before their diagnoses. None of them considered smoking to be a health risks and they never tried to quit. After learning that their sickness is related to tobacco use, they all quit smoking and regretted that they have smoked.

I really regretted that I have been smoking for so many years. My wife and my children advised me to quit but I did not listen. Now I want to quit for good and I can do it, it just needs a commitment (Bunthan, 49, IHD)

Discussions

In this study we estimated the cost of smoking in Cambodia that is related to health care and the loss of productivity due to poor health.

The study applied relative risks (RRs) from CPS-II to calculate SAFs of health care costs. Similar approach has been previously applied in Vietnam and in other countries in the region. It has been argued that RRs from CPS-II provided the higher bound due to estimates based on Chinese data suggesting that the RRs could be lower. However, a recent study confirmed that using CPS-II as the base for RRs in Asia seems appropriate (Pham Thi, et al, 2014).

Though the cost per case of the five diseases is well estimated, we believe that the estimated total costs of smoking presented in this study represent the lower bound of these estimates due to the following factors:

- The study considered only five major health conditions, but there are as many as 40 diseases related to smoking. Furthermore, the study does not include the costs related to passive smoking, the costs related to fires caused by smoking, and cost of buying cigarettes among Cambodia tobacco user aged over than 15 years which was estimated to reach US$ 201,534,701 in year 2014[30].

- We relied on the number of cases per diseases from the national hospitals' records, which actually was lower than the reality. According Peter Annear, 2014, the use of public health facilities for hospitalisation reaches 60% of health service users, the use of public facilities for primary care remains low (apart from maternal and child health)[31]. However, we know thanks to our case studies and discussions with medical professionals during the course of the study that not all cases end up in the national hospitals. In recent years, the number of patients seeking health care from private facilities and/or in abroad has increased significantly. In addition, many patients do not go to national hospitals for treatment, because they cannot afford it[32].

- The costs presented in the study reflect hospital costs. Therefore it does not cover outpatient care and/or self-treatment. This further contributes to the underestimation

[30] National Adult Tobacco Survey of Cambodia, National Institute of Statistics, Ministry of Planning, 2014
[31] Peter Leslie Annear, Health Sector Analysis, Ministry of Health, Cambodia, 2014
[32] MoH's Annual Health Financing report 2015

of the total costs. According to study in Vietnam in 2012 the outpatient cost is 8.5% of total cost (smoking-attributable healthcare costs plus smoking attributable costs of mortality, and productivity lost due to morbidity for five smoking related diseases)[4]. This means that this cost should be under estimated by 8.5%.

- It was not possible to estimate the depreciation and the recurrent costs of hospital treatment due to the lack of data kept by the hospitals. In order to solve this problem, we assumed that these costs represent a similar percentage of the total costs (54.7%) as in Vietnam that has a similar health care system.

The study did not employ smoking-attributable DALYs to estimate the impact of smoking related mortality due to the fact that these estimates have been criticized due to their upward bias, which is particularly pronounced in countries with relatively low life expectancy such Cambodia. An alternative approach employed in this study involved an estimate of the annual number of deaths attributable to smoking and the average number of life-years lost per smoker estimated by WHO. We estimated the productivity by the GDP per capita and assumed that the annual GDP growth is equal the depreciation rate. The average GDP Annual Growth Rate in Cambodia averaged 7.68 percent from 1994 until 2014[33].

Despite these limitations, we found that smoking cost Cambodia at lease US$ 162,736,568.77 or about 1.05% of Cambodia's 2013 GDP[34]. This estimate is comparable to estimates in other countries. For example, the costs of smoking in Vietnam in 2012 accounted for 1.17% of its GDP[35], 1.40% of 2005 GDP in the US, and 0.7% of 2008 GDP in China[36].

In regard to cost of treatments of the diseases born by smoking, in Cambodia, the cost of treatment financed by three sources, government, donors and household out of pocket spending. Total Health Expenditure (THE) has substantially increased over the last five years, from US$ 564 Million in 2008 to US$ 763 Million in 2012, representing more than 5% of the GDP. In 2012, THE was approximately US$ 52 per capita, 24% of which comes from government spending, 15% from development partners, and the remaining 61% from out-of pocket spending (OOP) 37. Household health expenditure, via OOP, contributes the greatest part of the THE. Since 2008, OOP has increased from US$ 25 per capita in 2008 to US$ 32 per capita in 2012 or approximately US$ 459 billion, accounting for 61% of THE. According to MoH's Annual Health Financing report, 2012, the poor spend a higher share of their income than the non-poor to obtain the same treatment.

---

[33] http://www.tradingeconomics.com/cambodia/gdp-growth-annual retrieved on 11 January 2016
[34] World Bank, Cambodia's 2013 GDP was US$15.23 billion
[35] Hoang Anh et all, 2012 Health care cost attributed to smoking in Vietnam, 2012
[36] Lian Yang et all. Economic cost attributable to smoking in China: update and an 8-year comparison, 2000-2008. Tobacco Control 2011;20:266-272
[37] MoH's Annual Health Financing report 2012

Limitations

The study adapted the theoretical and conceptual framework employed in similar studies in other countries while facing some of the similar limitations. Only five of the known diseases to be caused by smoking were studied. Furthermore, morbidity associated with these diseases was probably underestimated; morbidity and mortality estimates did not include those for cigar smokers, passive smokers, pregnant women, and children; and minimum wage of garment factory was used to estimate productivity losses.

Due to the lack of data, we had to adjust our original plan to employ collected primary data directly from hospitals that have capacity to treat the four tobacco related diseases; the study faced some challenges: First, we were not able to include the costs of health care that some patients are obtaining abroad, and we do not know how many patients are seeking such treatment.

Second, the research team did not know how many patients did not seek a treatment in a health care facility due to the lack of their resources to cover the costs. As result, the number of cases in this study is likely to be a conservative estimate. In addition, data in this study captured only officially hospital fees, but did not include other fees paid by the patients such as the costs of medicines purchased outside the medical facility, transport, and food for the patients and caregivers during hospitalization. However, our case studies captured a broad array of costs incurred by the patients and their families.

We assume that the cost of treatment for smokers and non-smokers is identical. To the extent that the cost of treating a smoker is higher compared to a non-smoker due to the complications among smoking patients, we have underestimated the health care costs of smoking.

Conclusions and recommendations

This is the first study in Cambodia to estimate the costs of smoking. The results show that smoking imposes an enormous financial burden on Cambodia society in particular among the poor. The total costs of smoking related to the health care reached US$ 34,497,437 while the productivity loss amounted to US$ 128,239,131,77in 2013. The total costs of health damage reached **US$ 162,736,568.77**, which represents 1.05% of Cambodia's 2013 GDP.

Despite the study limitations, these estimates are useful for decision-makers and tobacco control partners as they advocate for strengthen in public policies to control tobacco use in Cambodia.

It is necessary to strengthen the health information system (HIS) under the leadership of the Department of Planning and Health Information System of the Cambodian Ministry of Health. The current system does not allow disintegrating information for the purpose of assessing the burden of Non Communicable Diseases at different levels of care (national, regional, provincial). An improvement in data collection and data management will allow calculating more refined estimates of the costs of smoking in the future.

The cost for treating tobacco related diseases and productivity loss due to active smoking was nearly 12 times higher than the total domestic tobacco tax revenue (US$ 13, 825,230 million) collected by General Department of Taxation in 2013[38].

Raising awareness among policy makers about this significant negative impact of smoking on Cambodia economy will be critical to ensure the adoption of stronger tobacco control policies in Cambodia. Raising awareness among the general population about the burden that tobacco use poses on their household financial security is also necessary to gain support on tobacco control program. Raising excise tobacco taxes has been proven to be the win-win approach to reduce tobacco consumption while raising government tax revenue. Currently tobacco tax in Cambodia remains low at around 19-26% of the retail price while WHO recommended that this rate should be from 66%-80% of the retail price.

[38] WHO's Global Report on Tobacco, 2015

Annex 1: Survey of costs for a standard diagnosis, the treatment and a follow up

The missing data in the table below means that the procedure is not performed in the relevant hospitals. It is evident, that the public hospitals offer more health care services compared to private hospitals. This is because private hospitals often refer a patient to a public hospital if the case is severe or if the patient cannot cover the costs of private health care. In case of Royal Ratanak hospital, a patient who can afford it is transferred to a Bangkok hospital in Thailand.

The figures in all tables refer to cost of the procedure indicated in the first column in different hospital (10 hospitals). The amount of money is in US$

Ischemic Heart Disease

Description	*Calmette*	*Khmer-Russia Friendship*	*PreahKosamak*	*PreahKetmealea*	*Kaldal RH*	*Battambang RH*	*Kampong Cham RH*	*Hope Center*	*Hope Jeremia*	*Royal RatanakRatanak*
1-Name of procedure for diagnosis										
Physical Examination	12	2.5						90	5	40
Blood test	50	5						30	30	700
X-ray	8	6						42	10.5	60
ECG	6	20							20	60
Scanner		150							88	120
MRI									145	200
Angiography	2100									
Sputum test										
EEG										

Anatomopathology (Anapath test)										
Others										
Bronchoscopy										
Cytology										
Radiothorax								10	10.5	
Echocardiaque	15							15	15	30
2-Name of procedure for treatment										
Physician visit	0	0							5	20
Nurse visit	0	0								2
Medication	80								70	400
Chemotherapy										
Surgery	4500									
Physiotherapy									10	20
Hospitalization (room fees and care)	315	35						1000	315	700
Others										
Ponction Pleural										
Chemotherapy side										
O2	10									2
3-Name of procedure for follow up to a year										
Out-patient visits	16	60							5	20
Medication	105								70	400
Physical therapy									10	20

Others										
X-Ray									10	
Scanner										
Echocardiography	30								15	30
ECG	12									30
Total	7259	278.5	0	0	0	0	0	1187	834	2854

Lung Cancer

Description	*Calmette*	*Khmer-Russia Friendship*	*PreahKosamak*	*PreahKetmeal ea*	*Kaldal RH*	*Battambang RH*	*Kampong Cham RH*	*Hope Center*	*Hope Jeremia*	*Royal Ratanak*	*Sain Marie*
1-Name of procedure for diagnosis											
Physical Examination	16	2.5	3								12
Blood test	90	6	1.25								67
X-ray	8	5	15								13
ECG	6	20									7
Scanner	160	150									170
MRI											200
Angiography											
Sputum test											30
EEG											
Anatomopathology (Anapath test)	50	70									70
Others											

Bronchoscopy	40		40								
Cytology		12	5								
Ultrasound											8
Anapath			12								
2-Name of procedure for treatment											
Physician visit	0	0	1.5								2
Nurse visit	0	0									1
Medication	900										50
Chemotherapy	2100										
Surgery	300										2000
Physiotherapy	150	40	2.5								60
Hospitalization (room fees and care)	432	50	2.5								450
Others											
Ponction Pleural	21										
Chemotherapy side											
Bronchoscopy		40									
Monitoring											10
Ponction Pleural											20
Chemotherapy side											3500
Radiation											380
3-Name of procedure for follow up to a year											
Out-patient visits	32	36									45

Medication	900										200
Physical therapy	20	48									80
Others											
X-Ray	8										13
Scanner	160										170
Ultrasound											8
Total	5393	479.5	82.75	0	0	0	0	0	0	0	7566

Stroke

Description	*Calmette*	*Khmer-Russia Friendship*	*PreahKosamak*	*PreahKetmealea*	*Kaldal RH*	*Battambang RH*	*Kampong Cham RH*	*Hope Center*	*Hope Jeremia*	*Royal Ratanak*	*Sain Marie*
1-Name of procedure for diagnosis											
Physical Examination	0	2.5					0		5	40	
Blood test	140	6					12		30	700	67
X-ray		5							10.5	60	13
ECG		20					1.25		10	60	7
Scanner		150					80		88	120	170
MRI									145	200	200
Angiography											
Sputum test											
EEG											
Anatomopathology (Anapath test)											

Others											
Bronchoscopy											
Cytology											
Physical Examination By a specialist doctor											20
Ultrasound											8
Echography									10	30	
2-Name of procedure for treatment											
Physician visit	0	0					0		5	20	2
Nurse visit	0	0					0			2	1
Medication	900						0		280	700	150
Chemotherapy											
Surgery											
Physiotherapy		40					10		10	20	20
Hospitalization (room fees and care)	4050	50					7.5		320	800	490
Others											
Oxygen											40
Ponction Pleural											
Chemotherapy side											
Kinesitherapie											20
Transfusion blood (donors)											40
Monitoring										80	10
Urinary catheter											5
Gastric tube											5

Sond Vesical											
Sond Nasogastric										50	
Strictbcatheter										20	
Catherter										80	
Oxygene										2	
3-Name of procedure for follow up to a year											
Out-patient visits	560	36							5	20	20
Medication									70	400	100
Physical therapy		48									20
Others											
X-Ray											
Scanner											
Total	5650	357.5	0	0	0	0	110.75	0	988.5	3404	1408

C O P D

Description	*Calmette*	*Khmer-Russia Friendship*	*PreahKosamak*	*PreahKetmealea*	*Kaldal RH*	*Battambang RH*	*Kampong Cham RH*	*Hope Center*	*Hope Jeremia*	*Royal Ratanak*
1-Name of procedure for diagnosis										
Physical Examination	0	2.5	3		0		0			
Blood test	30	12	1.5		2		32			
X-ray	16	10	5		5		10			

ECG	10	40					1.25			
Scanner	150	150								
MRI	170									
Angiography										
Sputum test	40	5					0			
EEG										
Anatomopathology (Anapath test)										
Others										
Bronchoscopy										
Cytology										
Ultrasound					2.5		2			
Spirometry			10							
2-Name of procedure for treatment										
Physician visit	0	0	1.5							
Nurse visit	0	0								
Medication	400									
Chemotherapy	50									
Surgery	50									
Physiotherapy	15	12	2.5							
Hospitalization (room fees and care)	400	50	2.5				11.25			
Others										

Bronchoscopy		40								
Ponction Pleural										
Chemotherapy side										
3-Name of procedure for follow up to a year										
Out-patient visits	60	30								
Medication	240									
Physical therapy	30	24								
Others										
X-Ray										
Scanner										
Total	$1,661.00	US$375.50	$26.00	US$0.00	US$9.50	US$0.00	US$56.50	US$0.00	US$0.00	US$0.00

Annex 2: Interview guide for case studies with patients suffered from tobacco related diseases

Objective:

To learn a pattern of health seeking behaviour that patients and family have undergone to seek care to treat tobacco related diseases and cost associated to treatment and other indirect costs. As patients in Cambodia usually seek care from private providers (in some cases outside the countries) the case studies will provide full picture of all treatment/services patients has sought care from and cost associated to that.

Interview guide

Themes	Main questions	Probe
Socio-demographic characteristics	1. What is your name? 2. Sex? 3. Age? 4. What is your marital status? 5. How many children do you have? 6. What is your main job? 7. What is your spouse main job? 8. Your income per month? 9. How is income of your family? 10. What is your address? (Village, Commune, district, province/city),and	

	phone number	
Pattern of health seeking behaviour that patients and family have undergone to seek care to treat tobacco related diseases and cost associated to treatment and other indirect costs	11. What is your health problem (Lung cancer, COPD, IHD, Stroke)?	12. What are the first symptoms/sign you experiences? 13. How long (years/months) have you encounter this health condition (disease)? 14. How did you know that health condition (disease)? or who tell you about your disease? OR Where did you get diagnosed with that particular disease? 15. What cost associated with the diagnosis?
	16. From the first time you got this symptom/sign, what did you do to relieve this health condition (symptom, or disease)? 17. What is cost associated with your care seeking before being diagnosed?	18. Later on, how did you try to treat this health condition? It is by your-self (buy medicine, take traditional herb, etc)? or seeking to consult with other people like traditional healers, local private health professionals, or public health facility in your community? public health facility far from your home (district, province, Phnom Penh capital city, abroad like in Vietnam/Thailand, etc)? 19. How often or how long did you try to treat your-self or try to use traditional

		medicine before experience with modern medicine?
	20. How often or how long did you were admitted to hospital for treating your disease after diagnosed?	21. And which hospitals? Please mention? 22. Do you currently have pain?
	23. During staying in hospital, who were your care givers (wife, children, friends, relative)?	24. Who were the full time care givers? And who were the part time care givers?
	25. How is this affect on your job and income?	26. How long have you lost your job? 27. How are your care giver job and income? Did any care givers lost job? And how long? 28. How is the economic status of your family after you suffer from this health condition?
	29. How is the feeling of your family toward you?	30. Did you have stigma and discrimination from your family members (wife, children, parent) and friends in regard to your chronic and serious health problem? If yes, to what extent is the stigma and discrimination are?
	31. How do you feel about your own health condition?	32. How do you feel (concern) about the future of your family?
	33. Do you still smoke during	34. If yes, how long have you

Smoking behaviour	last 30 day?	smoke? and how many cigarette do you usually smoke per day? 35. Do you smoke hand roll cigarettes or manufacture cigarettes
		36. If no, did you smoke in the past? And how long have you smoke before the day you quit? and how many cigarette did you usually smoke per day? 37. Did you smoke hand roll cigarettes or manufacture cigarettes 38. How long have you quit smoking?
	39. Do you have any words to say for the smokers?	40. Are you happy with the quality of care you have received so far? What would you change? What improvements can be made?

Thanks you very much for your kind participation!!