



**SCHOOL OF FINANCE AND APPLIED ECONOMICS**  
**CHRONIC DISEASE MANAGEMENT PROGRAMS ON HEALTH INSURANCE**  
**PROFITABILITY IN KENYA**

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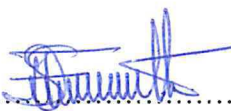
**DECLARATION**

I hereby declare that this Research Proposal is my original work. It has not been presented by any other person from any other institution known and unknown to me.

Signed..........

Date.....30/11/2016.....

This Research Proposal has been submitted for examination with my approval as the Supervisor.

Signed..........

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Date.....30/11/2016.....

## **ABSTRACT**

Chronic diseases have been a real problem in Kenya and in the entire world. Most of these diseases are non-communicable and affect the population towards old age. This chronic diseases if not well managed may lead to acute illnesses that are costly to cure and may lead to costly admission care. In the modern world where insurance is becoming popular, a lot of these costs are transferred to the health insurance providers. For the population that is receiving pension benefits. These costs end up reducing the expected utility for these funds received. This paper has been written in this light and is aimed at showing the significance of chronic disease management in increasing profitability for health insurance providers and improving pension's utility for beneficiaries. This has been done through predicting expected costs for chronic disease management programs for the expected population at risk by use of a predictive model. This hence enables health insurance providers and pension sponsors to load for justifiable risk amount in the premiums charged for the respective benefits. This is alongside helping pensioners appreciate their pension benefits more as they derive more utility from them.

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# 1 CHAPTER ONE: INTRODUCTION

## 1.1 Background to the Study

Chronic illnesses have become major problem in Africa hence eliciting a lot of research and aid programs on the chronic illnesses and their respective management with a view to improve the quality of life of the affected patients. It is for a fact the value of life of chronically ill individual is diminished as a consequence of the illness especially when not well managed. Numerous non-governmental foundations have been created with an agenda to cater for these chronic illnesses management. USAID for example has taken an initiative to manage HIV/Aids by distributing the antiretroviral medicine throughout developing countries.

The term chronic disease refers to terminal illnesses that are manageable but are hard to cure or rather have no cure at all as reported by Arney, (1984). Such diseases are characterized by protracted symptoms and therefore grueling treatment and management as found by Martin, (2009). Such diseases include diabetes, hypertension, cancer and HIV/Aids among others. These diseases are mostly triggered by the different patient's lifestyle. Some are infectious i.e. HIV whereas others are hereditary e.g. diabetes, hypertension as well as cancer.

There exists a strong relationship between poverty and poor health in Kenya. It has been shown severally that most Kenyan citizens living below the poverty line have a low life expectancy and high chances of contracting chronic diseases as shown by Steyn, (2001). This translates to the high mortality rates as well as unmanageable expenses to cater for health. The argument touted for the high prevalence of chronic diseases among the poor. The inability to visit health facilities for regular checkups or preventive care compared to the richer populace who can better afford treatment and checkup.

The number of Kenyans living in dire poverty is rapidly rising as a result of high unemployment as indicated by Wright, (2013). The social security fund exists to help

improve standards of living/maintain them especially after retirement. The fund is compulsory for a working citizen bound by the employment act earning a salary from as little as 7000 in 2013 which was to be revised to 10000 in the year 2016 as documented in the NSSF, (2013). These contributors are then liable to receive pension upon retirement. The fund's contributors are up to 60% of the low income earners with a net salary of KSHS. (10-30) thousand. Apart from the compulsory NSSF contributions, the same salary is liable for taxation as well as Health insurance premiums to the National Health Insurance Fund.

Given the existing poverty levels in Kenya, the number of people in private health arrangements is very few as found by Peters, (2008). The same applies for private pensions arrangements. However for the lucky population, that has the employer providing benefits in terms of defined benefit pension plans as well as health insurance covers well fit this classification.

Disease management refers to knowledge based on care strategy intended to continuously improve the value of health care delivery from the perspective of those who, receive, purchase, provide or evaluate it as discussed by Bodhemier, (2002). This study focuses on Diabetes type 2 as the main chronic diseases currently faced by the Kenyan population at large as found by Arzevedi, (2008). The management of these diseases and its impact on Health insurance profit margins as well as utility of the pension benefits being offered to the low class and middle class citizens.

### 1.2 Chronic disease management programs in Kenya

A few insurance companies have reported to have chronic disease management programs in place aimed at increasing their profitability. UAP health insurance is one of these companies. They have in place strategies such as case management, planned visits and self-care education systems.

The penetration of chronic illnesses on the other hand is rising very fast. Kenya is experiencing increase in diabetes, heart disease, cancer, chronic lung, neurological, psychiatric diseases. As a result of this the relevance of the CDMP's should be a part the health covers provided in order to avoid losses while providing health insurance. Health insurance providers have reported losses as a result of large unexpected single losses resulting from chronic illnesses such as cancer chemotherapy and diabetes hospitalization

At the moment, 61% of the total health spending in Kenya goes to another chronic disease – HIV For that level of spending, antiretroviral coverage for 61% of HIV positive people in need of treatment has been achieved; meaning that 39% of people in need of treatment are missing out. The commitment to provision of HIV treatment to those in need entails an expansion of services, and an increasing recurrent annual financial commitment that will not reduce in the near future. Indeed, given some of the evidence on antiretroviral resistance, one might imagine the cost will rather increase. Furthermore, the more successful one becomes at management, the greater the number of people under management, the longer they will live, and the greater the recurrent costs.

### 1.3 Problem statement

The importance of Health insurance all over the world and especially in third world countries is slowly dawning in. Increasingly, countries are encouraging the uptake of insurance by either holding such funds for their citizens or providing incentives to the employers to encourage provision. Pensions on the other hand have been long accepted as part what of most people comprised in the work force. Generally, most countries as well provide for their working citizens through social funds. In developed countries, benefits are of more variety as compared to developing countries.

The Kenyan economy is made of a struggling working class who interact with these forms of insurance by chance. The average citizen in Kenya relies on pension provision and (or) health insurance either from national funds or from their employers if lucky. The penetration of private arrangements for these benefits is blurry as found by Juting, (2005). Chronic diseases such as cancer and diabetes (to mention a few) have been a major problem on the Kenyan population. The people at risk are either working or retired mostly between the ages 35-75 following discussions by Baker, (1996). The treatment for these diseases is expensive and eats a lot into the insurance providers and (or) an individual's limited pension income.

Skimming through literature reveals limited studies on the significance of Chronic Disease Management Programs in Kenya. The current study seeks to establish the significance of the Chronic Disease Management Programs (CDMP's) in improving profitability for health insurance providers through substantially reducing related costs. The improvement of the utility arising from an individual's pension income would also be determined.

#### 1.4 Research objectives

This study aims to develop a model for the Chronic Disease Management Programs. The model is to be used in pricing health insurance products as well as pension contribution determination. Through this, the importance of chronic disease management programs (CDMP), on health insurance profitability as well as pension's utility is established.

#### 1.5 Research Questions

Why CDMP's are relevant to the health insurance providers in Kenya?

How CDMP's are a demonstrative way to improve pension's utility of the low income earners in Kenya?

### 1.6 Importance of the research

This research bears significance beyond doubt. It is intended to improve the field of insurance in various ways. This is by making the Health insurance providers desire to offer the policy more as compared to the current situation. This will be as a result of the increased profitability in these policies with the invention of these chronic disease management programs, without forgetting current pension's utility. This is also through the incorporation of these disease management programs.

### 1.7 Scope of the research

This research is to cover Kenyan population and the chronic diseases prone to affect them. The research also looks at local health insurance providers and pension sponsors that are based in Nairobi. These include both public and private schemes. Data to be used expected to be collected from the company's data set which will include financial statements.

## 2 CHAPTER TWO: LITERATURE REVIEW

Different studies by other researchers have been critically analyzed to help the researcher find grounds on her study

Chronic diseases are the main reasons of premature mortality in both developed and developing countries. The number of patients suffering from multiple chronic illnesses is alarming. A report from the World Health Organization estimates that chronic illnesses growth will increase from contributing to 57% of the annual deaths to 65% by the year 2030. The chronic illnesses not only affect the individual but they also impact on the families of the patients, their employer, the government and their health insurance providers if any. Each of the mentioned parties is affected in one way or another. These diseases require continuous close monitoring and prolonged health care that could last a life time. The chances of this chronic diseases developing into acute illness that could lead to death are with no doubt very high. Chronic health conditions comprise of several health conditions, some communicable i.e. HIV/AIDS and others are non-communicable such as diabetes, hypertension, coronary heart diseases. Others that fall in this bracket are mental illnesses that are long-term such as depression and schizophrenia as found by (Organization(WHO), (2008)

Current trends have seen a new wave of cancer diagnosis rising to very high rates. The number of cancer patients in east and central Africa is rapidly increasing. In Kenya the case is even worse. The problem gets worse as the necessary care and treatment for these deadly and burdening terminal illnesses such as cancer have not yet been fully developed. Increasing cases of obesity and factors such as increased ageing population and other global changes such as increased levels of global warming e worsened the situation. Some chronic illnesses however, such as HIV/aids and Tuberculosis that have been viewed to be under control are still the leading causes of increased mortality levels

in the country. These diseases have seen all sorts of aid coming to Africa ranging from the World Health Organization (WHO) to the United States aid (USAID) programs as shown by Gemmill, (2008)

While these diseases affect the wider global economy and countries in the West that are referred to as developed are equally affected, it has been a matter of concern globally. In Europe measures have been put in place to manage these diseases and encourage preventive measures. The intended implication is that much can be done to reduce the significant costs that chronic diseases are putting on the current health care systems and the economy at large. European countries have devised a variety of policy responses to extend improved required care to the chronic illnesses patients and reduce the overall economic burden. A lot of African countries losing the citizens (human resources) to these chronic illnesses should borrow this idea to solve the problem following findings by Thomas, (2003)

In the following paragraphs we shall review some of the strategies that have been used in developed countries in managing chronic diseases. This is alongside their effectiveness and the application of this or similar trends in Kenya. Australia is the representative of the developed countries in this section. They have had in practice several of these strategies in their health care system. These are; self-management education, clinical practice guidelines, physician education, health care teams, case health management, chronic disease registries, reminder systems, performance feedback and DM's

#### *Self-management education*

It could be in the form of either providing knowledge or providing technical skills required for handling a chronic disease (diseases). Training could not be for specific chronic conditions but for problem solving skills to assist in change in behavior. Most popular research on this strategy relates to diabetes. Review on self-management for different health conditions such as diabetes, asthma, arthritis among others showed that educating patients on the chronic conditions they are facing does not really have clinical

outcomes. , education in the disease coupled with training in problem solving skills could improve outcomes. For this strategy however, adding other practices such as practitioner visits could improve the self-management care strategy in general and make it more effective.

#### *Decision support*

This is structured in that; there are clinical practice guidelines alongside physician support. A review on this strategy of guidelines only shows that, provision of printed guidelines only for the physicians of medical education on chronic diseases is not of as much significance. , face to face interactive sessions with these physicians on the emerging trends on chronic disease care and patient wellness is far more effective.al educating avenues such as seminars for academic detailing improves professional performance for 9/10 physicians.

#### *Planned visits*

This may be individual or in groups and are done by physicians/nurses/pharmacists or just a team of caregivers. Researches on the various planned visits strategies have shown that they are very effective. This is especially for diabetic patients; it reduced hospital visits for diabetic related conditions. Planned visits by a group of caregivers have been shown to reduce HbA1c in most diabetic patients but not all. For some it did not work as expected.

#### *Case Management*

This strategy is done through intensive proactive efforts to reach out to high risk patients. This could be done via telephone calls as well as home regular clinic/home visits to check for symptoms, progress and health behavior change. This is also done for supervision of medication progress. A review on this strategy from case managements to manage chronic diseases such as heart failure and diabetes show that the management of these chronic illnesses is more effective through telephone conversations with patients as well

as these visits. Disadvantage however is that for the older patients aged age 75 and above this strategy seemed to be less effective.

#### *Primary care teams*

This is where a group of diverse clinical care givers participate and generally communicate on the treatment given to a group of patients. This strategy involves delegation of chronic care giving to other clinical officers that are included in the team. These are nurses and pharmacist that come together with the professional physician to give required care. This is done through visits (regular) to the team. A review on this strategy shows that compared to an individual physician being the sole care giver to the chronically ill, adding more members to come up with a team is more efficient.

#### *Clinical information systems.*

This strategy involves having registries that have records of the different patients with chronic diseases on the disease. These registries could feed reminder systems that prompt caregivers to give the required treatment or care to specific patients when due. This system allows patients to be contacted for care since all their important information is at hand. A review on this strategy

Bohemia's arguments, on the framework of a chronic disease management programs above is workable. , this framework describes traditional approaches in managing chronic illness. The above strategies have been used in Australia and the UK in the recent past. However, as much as Kenya is somewhat naïve with CDMP's, a more up-to-date framework should be borrowed.

#### 2.1 Predictive risk modelling for chronic diseases

Predictive risk models are used to predict such events as unplanned hospital visits, which may arise from acute chronic disease. These visits are undesirable, costly and potentially avoidable. These models have been shown to be superior to other case finding

approaches such as thresholds and clinical opinions. Factors to be considered when developing such models include, the cost of developing the model, accuracy, data on which the model is run, the software needed and its availability among other factors that apply generally when on is choosing any other model. These models should be seen as a major building block for developing a wider strategy for chronic disease management.

Different predictive models have different time horizons. The predictive risk models are useful in predicting events that follow the following criteria. The event needs to be undesirable to the patient, significant to the health service providers i.e. costly, preventable and recorded in routine administrative data. It is advisable to be clear on what one entails to predict and the risk conditions to be embedded within a coherent strategy for management of long-term conditions. The array of outcomes to be predicted are, unexpected admissions and readmissions of patients within a given period, Specialty-special admissions for say mental illness and nursing home admissions/intensive social care as discussed by Geriant, (2011).

Predictive models use healthcare claims information such as, demographics, prior costs and diagnoses. A number of predictive models that are well established are available for different medical care. Different models incorporate different data and techniques. By use of statistical techniques these models distinguish between conditions that are likely to be outlived and those that are likely to become chronic. Information that is available on prior diagnoses helps models to rank individual members of a population in terms of expected future cost risk and assign them into either high, medium or low risk categories. A few of these predictive models are listed below.

ACG-PM model is software that was developed at St. John's Hopkins University. IT predicts future health care costs by evaluating pharmacy expenses, diagnoses and demographics. A two stage process is used. First patients are sorted into clusters of age, sex and diagnoses combinations. Each cluster is then assigned a cost score based on the average cost of similar, previously evaluated patients. The second stage involves

statistical methods that are used to create risk scores. Past pharmacy costs can also be factored into the model.

CDPS model. This was developed at the University of California. It is available free of charge at <http://cdps.ucsd.edu/>. The model uses demographics and diagnostics data to predict costs based on the principle that an individual risk tends to increase with each additional condition that the individual has. In other words, the risk conditions are additive. , the software is disadvantaged in that there is no customer support and it's not updated regularly.

DCG model, Diagnostic cost Groups created by the Boston University researchers. It also uses assumptions of additive costs. Risk costs can be calculated separately for fee-for-service and managed care programs. A review shows that the ACG model is overall the best performer in all the three models. It is so in areas of sensitivity, specificity and positive predictive value for most of the cases.

In practical modelling of chronic diseases, Bayesian models could be used. Application of censoring knowledge depending on the information available is crucial in these models. Specialized software such as win BUGS could be used in implementing these models. In estimation of different parameters in the model the Markov Monte-Carlo simulation could be used. In a paper by Marjorie Rosenberg, the Bayesian models, with a lot of Monte-Carlo simulation for its parameters has been used. Data was recorded to follow a Poisson distribution Knowledge on Markov chains has been applied consistently as found by Farrell, (2008). A lot of these could be borrowed in modelling any other chronic disease with its characteristics known to the modeler.

### 3 METHODOLOGY

#### 3.1 Research design

This is a quantitative research based on secondary data. Data is obtained from pension funds that offer benefits to its employees and statistical reports on the Kenyan population from KNSBS. This research used simulations from Microsoft excel.

#### 3.2 Population and sampling

The population of this research will consist of the pension schemes offering different forms of benefits to its members as in findings by Mileviskey (2006). One pension scheme was chosen as a sample representative of the population. A non-probability method was used when selecting this sample. The sample was created on the basis of experienced schemes indicates Shermann, (2008).

#### 3.3 Data collection

The research uses secondary data for its quantitative research. The data is to be collected from specific firms' claim experience for a post-retirement medical care scheme. It is based on the sickness rates (morbidity tables) from U.K and S.A. The study is for the period 2006-2016 influenced by the high rates of diabetes type 2 diagnosis among pensioners in Kenya.

#### 3.4 Analysis of profitability

Profitability for any insurance company offering health insurance is determined on a profit testing basis. This involves considering the reserves less the net cash flows. The scheme's profitability will be analyzed including the predictive morbidity probabilities on one hand and excluding them on the other hand. This is by checking the reserves, and profit signatures on a before and after cohort analysis as discussed in ACTED, Core Technical 5, 2015) (2015).

### 3.5 Determination of the chronic illness (parameters) for the model

The chronic illness used in this study is Diabetes type 2. This disease is associated with increased risk of cardiovascular disease, premature mortality and leads to blindness and non-traumatic amputations resulting from micro vascular complications. Preventability or delay of onset diabetes is possible through lifestyle modification. These lifestyle modifications promote weight loss and pharmaceutical interventions which has prompted different countries to implement national diabetes programs and develop guidelines for diabetes prevention. An example in Kenya is the diabetes walk which is aimed at increasing the awareness of this disease and the lifestyle that can be adopted to prevent or delay it reports Buijsse, (2010).

Efficiency in these preventive measures could be attained through predictability. In the country risk analysis for the disease could be done through glucose fasting or oral glucose tolerance of a cohort. This helps us to come up with predictive probabilities (morbidity tables) to use in estimating costs for covering such a disease for a health insurer. Resulting risks scores could be based on different systematic reviews. One can choose a set of variables from the following; age, sex, gender, ethnicity, family history, systolic BP, geographical location and glucose fasting (glucose tolerance) as found by Schmidt, (2005) It is possible to have a general morbidity table as it is to have a specific table for different geographical regions in the country. This will all depend on the variables one will choose for their risk scores.

This study will use morbidity tables created by the researcher with reference from the existing morbidity tables from the U.K and S.A. The disease was chosen on the basis that Diabetes type 2 is the most expensive and one of the most popularly diagnosed chronic illnesses in the Kenyan middle aged population ranking. The population is comprised of both genders and ages between (35-75) years. This is because diabetes is a lifestyle disease affecting both genders within the mentioned age

### 3.6 Creation of a predictive pricing model

The pricing model significantly estimates the cost of covering a diabetes type 2 and incorporating it into the pricing formula. The model does this by incorporating the potential hazards other than age, in this case, chronic illnesses. This was determined by the predictive probabilities considering a specific illness i.e. Diabetes type 2 as explained above. The cost of preventing or delaying the disease using different practices such as self-care management programs, case studies or planned visits (dependent on the insurer's preference) is also estimated and incorporated into the formula to come up with a suitable price for the insurer which allows them to administer CDMP'S effectively and increase their profit margins significantly.

### 3.7 Statistical estimation

Age is the most used to determine the death/survival probabilities included in premium calculations. This study has considered chronic diseases specifically Diabetes type 2 as an additional parameter in determination of these specific probabilities. This will be included in the determination of the contribution required into the scheme.

The pricing formula would be;

$$EPV \text{ of premiums} = EPV \text{ of benefits} + \text{expenses} + \text{Profit loading} \dots\dots \text{(Equation 1)}$$

$$P\ddot{a}_{n-\overline{1}} = S\bar{A}_x + \text{expenses} + \text{Profit loading} \dots\dots \text{(Equation 2)}$$

n = No of years in employment (contribution).

x = exact age at which one falls ill after retirement. (Age at which one is eligible to receive benefits)

$$EPV \text{ of benefit} = (\text{amount} * \text{assurance P.V random variable}) * a_x \dots\dots \text{(Equation 3)}$$

$$\text{Where this equals } S\bar{A}_x = \sum_{k=1}^n V^{k+1} * k|q_x * \text{sum assured} \dots\dots \text{(Equation 4)}$$

The above formula applies for a whole life assurance from the time one is diagnosed with the

Illness after retirement. However, where the pensioner purchases an annuity from a private provider on a term assurance basis or critical illness cover basis. This could be calculated using the respective formulas for term assurance and critical illness respectively. The  $q_x$  here would represent the morbidity in this case. (Chen Tao)

The  $a_x$  multiplied by the benefit means that the sum assured is paid to the insured in terms of an annuity for his whole life and payments stop in the event of death. The  $q_x$  usually refers to the death probabilities. In this study we use the probabilities of the person falling ill in the event after retirement. These probabilities of illness are picked from morbidity tables in the IFOA.

As this pricing model strives to incorporate the risks of a chronic illness. The  $(q_x)$  would be a summation of all the  $(q_x)$  for the different chronic illnesses. This could be presented as

$$\sum q_x^w$$

Where 'w' represents the different withdrawal factors (chronic illnesses) at age 'x' with which, one falls ill, after retirement. (institute and faculty of actuaries, 1991,2005,2008)

### 3.8 Limitations of the study.

The research was only limited to diabetes as the chronic illness. This was due to the following matters;

Availability of data.

The researcher had a hard time finding this data specifically related to this study. This is due to few studies exist on this/ related to this study. Also most insurance companies classify their pricing models as confidential hence getting this kind of data was not easy. As a result the researcher had to rely mostly on secondary data in the form of government statistics done by national corporations for the government.

Time frame.

Adequacy of time was an issue as the study for each chronic illness was beyond the allocated time frame. This is what prompted specificity of one illness in the study.

## 4 DATA ANALYSIS, RESULTS AND DISCUSSIONS

### 4.1 Introduction

This chapter presents the analysis of study findings of the research on the Chronic disease management Programs and health insurance profitability in Kenya. In the study variables which were used are; Kenyan current population, Employment rates in Kenya and diabetes diagnosis rates. This chapter critically analyses the variables involved in the study and estimates of the model presented in the previous chapter.

### 4.2 Research Findings

This section aimed at establishing the major significance in using critical illness morbidity probability tables in pricing health insurance. In this specific research, key attention was paid to diabetes. The tables could be customized to fit any other critical illness that needs to be priced in the same procedural manner.

#### 4.2.1 Statistical Analysis

The employment rates used in this analysis are as at 2016 last quarter. This is according to the numerous statistical analyses done by the Kenya National Bureau of Statistics. The KNSBS, using relevant indicators such as the GDP, inflation rates, currency, imports and exports among others has documented the current unemployment rate to be at 25%. This automatically translates the employment rate as the difference i.e. 75%. This employment rate is what this study focuses on in coming up with actuarial morbidity tables. The forecasts have indicated a sharp increase in the unemployment rates followed by a decline as shown in the graph below.

#### 4.2.1 Forecasted unemployment rates

Year	2016	2017	2018	2019	2020
Unemployment rates in %	25-40%	24.7	25	46	24

*Table 1: This table shows the unemployment rates in Kenya currently and what they are forecasted to be in the next four years. The rates are given as a percentage of the total population.*

#### 4.2.1.1 Graphical presentation of the forecasted rates

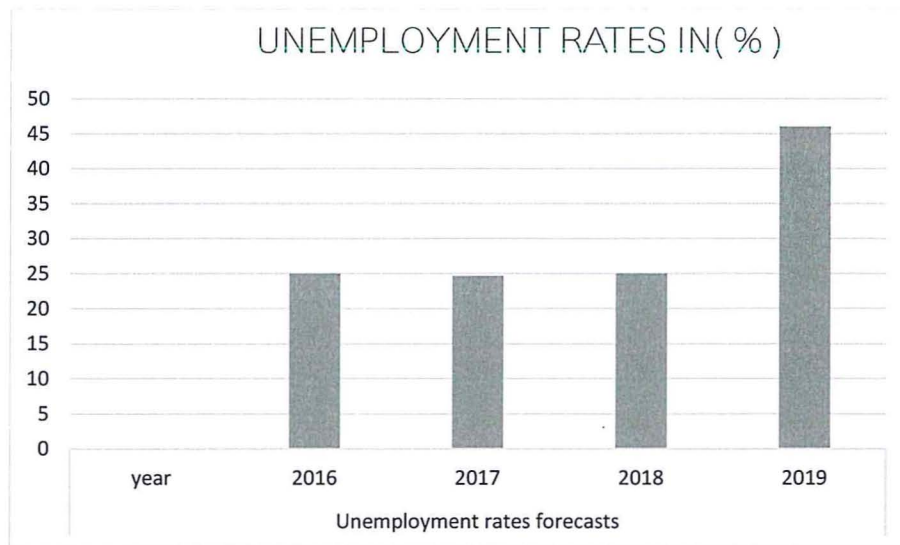


Figure I: This graph indicates the unemployment rates in Kenya currently and the forecasts for the next four years.

Studies as at the past one year have indicated a rise in diabetes diagnosis. In most cases the disease was diagnosed after events of hypertension attacks or diagnosis in the patients. Studies in the Kenyan demographics indicate a rise in the diagnosis of this critical illness. This could be as a result of the increasing awareness and availability of health facilities as well as changing lifestyles. These diagnoses however do not necessarily translate to the prevalence of the disease in Kenya. The researcher through simulations has however been able to forecast diagnosis rates and subsequent increases for the whole Kenyan population eligible for health insurance covers. The table below shows the rate of diabetes diagnosis in both Kenyan men and women.

#### 4.2.1.2 Diabetes diagnosis in Kenyan women

Age	Diabetes diagnosis in %	Total no. of women
15-19	0.5	2717
20-24	1.0	2691
25-29	1.4	2932
30-34	1.2	2162
35-39	1.3	1780
40-44	2.3	1292
45-49	2.6	1052

*Table 2: This are the diabetes diagnosis rates in the population that visited the hospitals in the year 2014. This are specific for women. Diabetes was mostly diagnosed hand in hand with hypertension.*

#### 4.2.1.3 Diabetes diagnosis in Kenyan men

Age	Diabetes diagnosis in %	Total no. of men
15-19	1.1	2540
20-24	1.8	2125
25-29	2.0	2104
30-34	4.9	1785
35-39	3.6	1483
40-44	4.9	1224
45-49	7.1	1800

*Table 3: This are the diagnosis rates for diabetes among the male population that visited the hospitals in the year 2014. These individuals were mostly diagnosed with diabetes alongside hypertension*

Given the whole employed Kenyan population versus diabetes diagnosis, the researcher found this rate to be at 0.01 at age 25. An increase of 0.001 was applied on each subsequent age as deduced from the above data. This are what the researcher calls  $q_x$  in the tables used to price. These refers to the probabilities of an individual aged  $x$  whether male or female falling ill with diabetes.

The probabilities are then simulated for each age in the tables beginning with age 25. It must be stated that in this research study the researcher came up with the following assumptions in building the tables that are the basis of the model used. (Kenya National Bureau of Statistics, 2015)

#### 4.2.2 Assumptions and Morbidity tables

##### **The radix;**

This refers to the initial population observed when building actuarial tables. In this research, this was reached after several assumptions and deductions of results obtained from sample population based studies. The study used was the one done by the KNSBS shown in the tables above.

The researcher opted to use employment rates to deduce this radix. This is because the table prices health insurance for pensioners/senior citizens. These are mostly the working population. These employed citizens are required to be belong to both National health and social security funds. The employment rates are deduced from the unemployment rates indicated in the findings above. This is by subtracting the unemployment rate from 1.

**The morbidity probabilities.**

This, as stated above refers to the probability of an individual aged( $x$ ), falling ill with diabetes in one year. Time (one year, two years...) is indicated on as a subscript on the left side of the letter( $q$ ). This is as  ${}_tq_x$ . This rate in the tables exists as just  $q_x$  for each age from age 25 all the way to age 101. The probability of an individual aged  $x$  falling ill within the next (2, 3, 4...) years could however be calculated from these tables. The  $q_x$  in the tables were deduced from the diabetes diagnosis rates. The most crucial age is the starting age, 25. This age was assumed to be the age at which most employment in Kenya begins. This is also a time that most people are financially informed and less naïve. The inception of insurance covers health mostly is at this age. The rate of diabetes diagnosis at this age was found to be 0.01. The radix multiplied by this rate gives us the number of people falling ill with diabetes from the cohort. This is then subtracted from the initial population to give us the number of survivors to the next period. Diabetes diagnosis tended to increase with an increase in age. The average increase deduced from the above tables and applied on the whole working population was found to be 0.001.

The rate of diabetes diagnosis at age 25 based on this radix is then obtained by  $\frac{\text{radix} * 0.01(\text{rate of diabetes diagnosis at initial age})}{\text{radix}}$ . This is the rate that is increased by 0.001 at each subsequent age, as shown below.

Rate of diabetes diagnosis in pension  
n scheme members - 0.01  
Radix - 22,590,000.00

**4.2.3 Morbidity tables extract.**

age	$l_x$	$diab(x)$	$q_x$
25	22,590,000	278,700.00	0.012491428
26	22,311,300	301,011.30	0.013491428

27	22,010,288	318,960.52	0.014491428
28	21,691,328	336,029.65	0.015491428
29	21,355,298	352,179.37	0.016491428
30	21,003,119	367,374.55	0.017491428
31	20,635,744	381,584.39	0.018491428
32	20,254,160	394,782.51	0.019491428

Table 4: this is an illustration of how the morbidity probabilities are calculated given the necessary data to present the radix and the diabetes diagnosis rates ( $diab_x$ )

The general trend of the  $(q_x)$ 's is demonstrated in the graph below. We could conclude that the rate  $(q_x)$  is an increasing function of the age  $(x)$ .

These could however change with a change in lifestyles which could lead to less diagnosis of the critical illness in the Kenyan population.

#### 4.2.4 Trend line for the morbidity probabilities against age

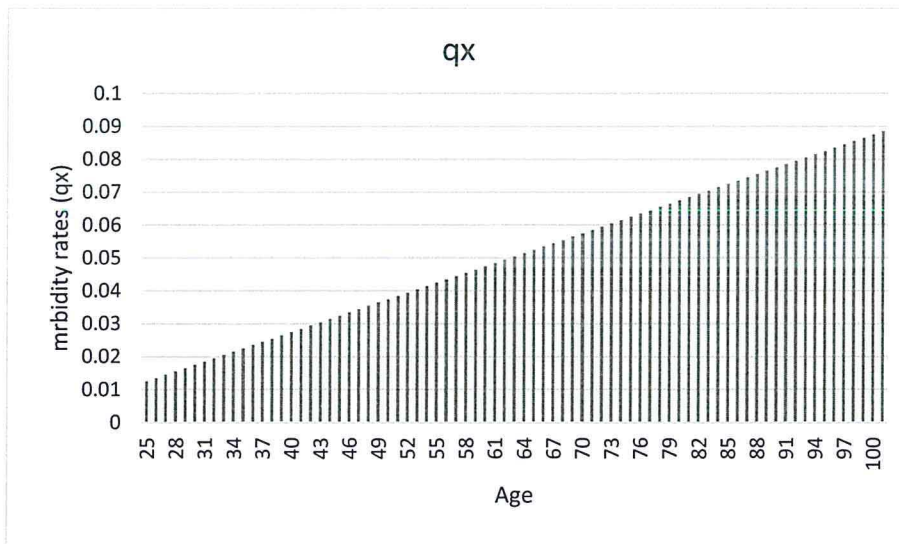


Figure II: This figure indicates the diabetes diagnosis rates and their trend as age increases.

#### 4.2.5 Pricing using Morbidity tables

This research is mostly about pricing health insurance for senior citizens whose exposure to critical illness is immense. Using these probabilities, of one falling ill with diabetes when pricing would give a much reasonable price. It would also help in estimating well the required benefits as well as the right amount of it to be received by an insured. Pricing was done using the formulas stated in the methodology. This pricing however was based on the following assumptions.

##### 4.2.5.1 Pricing assumptions.

Premium is payable on annual basis as well as monthly. Depending on the insured or insurer and their preferences. The researcher however presents the results using the annual premium.

The interest rates used to accumulate the premium and benefits payable range from 4%-6%. This is as per the actuarial tables. For prudence, the researcher's results are presented as at 6%. This is to avoid under estimation of reserves. Given the current consumer price index interest rate is at 10%. The insurer's actual returns exceed the assumed rate of return. This is good for business. To be more prudent the researcher would have gone for

the lowest interest rate as it is in the actuarial tables .Doing so would however be the highest level of under estimation that leads to a major reserve. This may be unreasonable given the current market rate. It could be considered fraudulent!

Using the CPI index, interest rate of 10% the reserve for the insurer as in the model is at KSHS. 198 million. Prudence in pricing requires you to moderate the interest rates in order to avoid ruin as a result of fluctuations of market interest rates which may cause the required reserve to suddenly shrink. By using 6%, the market reserve expands to KSHS. 3.2 billion. However shrinking the interest rate even more to 4% the reserve expands more to KSHS. 13.7 billion. The reserve increases as the interest rate decreases.

The age at entry is any age in the range of 25-55. This is because this is the age within which one has a right to employment. Past 55, is considered retirement age for most organizations in Kenya. Also around age 55 should be the age at which one is at a higher risk of facing the insurable peril. This beats the purpose for insurance. The researchers results are based on age 25 as age at entry.

The contribution years are 20. This is to provide sufficient amount in the insurance pool to cover individual claims as they fall due.

The sum assured is assumed to be 7 million. This could vary to be any value depending on the size of the scheme, Type of critical illness under consideration and number and type of persons under cover/targeted to be under cover. Most medical schemes in Kenya have a sum assured of 3 million. This research however considers a critical illness hence the 7 million sum assured.

The expenses in this type of cover are mostly as a result of the chronic disease management programs. Commissions are not a major expense as the product is assumed to be compulsory for the whole employed population. This is borrowed from the national health and social security funds' settings. The researcher however includes all kinds of expenses for prudence. This results are inclusive of commission expenses to agents of distributing the business. The initial expenses for both commission and CDMP's is high

at 25% and 15% respectively. This is because at inception of any new insurance policies initial expenses are usually high before the insurer recoups back his capital. These expenses are assumed to reduce in the subsequent years and remain constant over the subsequent renewal years. These renewal expenses are assumed to be 10% and 5% for commissions and CDMP's respectively.

#### 4.2.6 Pricing using the traditional method

The traditional method is a retrospective way of pricing compared to the above model pricing. This method requires the insurer to know/estimate the reserve beforehand. The premiums are then determined using this reserve. However some insurer's especially the civil servant schemes (which is what is used in this study) just decide on a percentage of the salary to deduct monthly. This is what will act as the premium payable and is automatically deducted from the salaries.

##### 4.2.6.1 Assumptions used for the traditional pricing.

The monthly premium as a percentage of the salary is 3%. This is what some organizations offering health cover to senior citizens were found to be using. The employed population is in 3 tiers. The first is for the minimum wage which is up to 50% of the population. The second tier is for the average wage which comprised of 30% of the population. The third tier is of the most population which comprises of 20% of the population. The average salary of the tier 1 population is at KSHS 15thousand. The average salary of the tier 2 population is at KSHS 35 thousand and that of the tier 3 population is at KSHS. 150000 thousand.

Expenses are expected to be 30% of the total premium for initial and renewal expenses. Other expenses that should be included in the existing traditional pricing model are the critical illness expenses. These have been estimated as 20% of the total premium by the researcher.

The premium contribution from the tier 1 population was estimated to be 5 billion, for tier 2 to be 7.1 billion and that of tier 3 was estimated to be 20.3 billion. These give a total

premium of 32.5 billion. Deducting the expected claims and required expenses from this total premium gives a deficit of (10.3 billion)

#### 4.3 Results and discussions

Having tested both methods comparatively. It is evident that for a health insurer to actually realize objective profits when pricing health insurance with the current level of exposure to different chronic illnesses, the way to go is using morbidity tables. This pricing method accounts for all probabilities of one getting ill and makes reserves as well as calculates benefits due to the insured while making valid assumptions based on the probability of the disease occurring and the costs to cover for the specific management programs.

As much as the research narrowed down to focus on one chronic illness which is diabetes, the insurer can easily customize the tables to their benefit. This means the insurer could use the tables to predict any other chronic illness using the same approach used by the researcher and the radix could remain the same for Kenya. The only thing they would require to change would be the rates used. The sum assured could change depending on the adversity of the chronic illness where an insurer is focusing on a specific but different chronic illness.

Using the traditional method on the other hand as we have seen would be futile for an insurer. Given the reserves indicated in the previous section, it beats the purpose of insurance since no insurer would like to report losses each year. This kind of deficits may lead to insured's benefits being compromised most of the time. This is so as the insurer would mostly treat an instance of chronic illness as an exclusion of the medical cover. Benefits would only be payable when one is ill with any other illness but not an expensive to treat chronic illness. This may lead to the dissatisfaction of the policyholder and the insurer may risk reputational loss. In most cases and especially in national health funds, no gains are realized and sometimes immense losses are reported leading to no benefits at all to any insured claiming.



## 5 .CONCLUSION AND RECOMMENDATIONS

### 5.1 Introduction

This chapter introduces the summary of findings; conclusion and recommendations. It also highlights limitations of the study and finally gives suggestions for future research studies.

### 5.2 Summary of findings

The statistical analysis has indicated that the relevance of the conditional probabilities used to price the medical cover for senior citizens. It has clearly indicated how this method leads to better reserves as compared to using the traditional method. This is because this method accounts for all relevant expenses resulting from chances of one falling ill and the expenses that come with offering management programs. This is done alongside pricing to give objective profitable pricing. A correlation analysis done on the reserves realized at each age 'x' and the conditional morbidity probabilities used to arrive at them is 0.8. This shows that reserves are directly influenced by the probabilities of the occurrence of the insured peril.

This accounting for uncertainty in the chances of claims leads to certainty in profitability. This is the major paradox surfacing in this research. The research is focusing on the major chronic illnesses with a specific example of diabetes. This is the most prudent approach for a health insurer to consider as it accounts for the worst case scenario when coming up with a health insurance product.

The same approach could be used to account for other little ailments but what is the point? It would be best to have a pool of medical policy holders paying for the price as modelled using morbidity tables. The pooled premiums would cover for the small less costly ailments and the probable chronic illness all alike. Narrowing down to create rates for each existing ailment could be hectic and time consuming for an insurer.

### 5.3 Conclusion

The main objective of this research study was to come up with a better way of offering medical covers profitably and satisfactory. This is by including package services in the chronic disease management programs and enhancing the pricing of the cover to best cater for this services. The suggested chronic disease management programs are; self-management seminars, planned visits, fitness facilities, free screening and counselling among others as discussed in chapter two. These could be offered alongside medical care and mostly for senior citizens who are the most likely to suffer from chronic illnesses. This research hence focused on pension-medical covers and how to price them profitably.

Looking at the traditional pricing that is widely used in Kenya by the few pension-medical providers as well as the normal medical providers, a lot is hanging. This is in terms of accountability for the fast arising chronic illnesses among the population. This is a major contributor of large losses as well as dissatisfying benefits payable to the insured. The statistical analysis indicates fast rising rates of the probability of chronic illness diagnosis which has not been accounted for in the traditional pricing method.

Using the traditional method led to deficits. This is demonstrated where an introduction of the chronic illness expense was introduced to their existing expenses. For a clearly defined sum assured the researcher was able to indicate an objective surplus as well as a satisfying service to its policy holders using the morbidity tables pricing.

### 5.4 Recommendations

On the basis of the results found in this study, the researcher recommends the incorporation of chronic disease management programs into health insurance products to improve health insurance profitability. This is by offering this package service and accounting for it in a well-defined pricing model. The results indicate profuse reserves that could be used by the insurer in so many ways.

The researcher also recommends the building of well-defined objective pricing models when pricing health insurance. Using this approach in offering medical insurance covers either to a general population or to senior citizens could lead to the insurer's increased

liquidity levels. This expands the insurer's freedom to expand the business or offer better services to its stakeholders. As a result the insurer could rank well reputation wise.

The researcher recommends mostly for the Kenyan government to adopt this approach in developing social funds. These are the National Health Insurance Fund (NHIF) and the National Social Security Fund (NSSF) in order to report more customer satisfaction as well as positive reserves required to better the funds.

The regular health insurers could also use a similar approach in coming up with their health products for the benefits discussed above. Since pension- medical is a new product in the market, most insurers would tend to move away from offering it to avoid 'burning their fingers'. This research has clearly demonstrated how these insurers could offer this product profitably and in a satisfactory manner on the part of the policy holder.

#### 5.5 Suggestions for further studies

The research was set to show the significance of Chronic Disease Management Programs and Health insurance. The variables used to demonstrate this were however not exhaustive. Future studies could look into other chronic diseases and the effect it would have on the profitability. This could involve modeling of these diseases' characteristics using mathematical methods such as Bayesian methods to generate the probabilities for a given population.

The scope of this research was to demonstrate the significance of CDMP's and health insurance profitability mainly focusing on senior citizens i.e. pension-medical. Other researchers may want to check for the significance of the pension medical covers in the Kenyan population.

## REFERENCES

- ACTED. (2015). *Core Technical 5*. London, U.K: Institute and Faculty Of Actuaries.
- ACTED. (2015-2016). *Core Technical 4 and 5*. London U.K: Institute and Faculty Of Actuaries.
- Arney, W. R. (1984). *Power and Visibility, the invention of teenage Pregnancies*. Social Science and medicine.
- Arzevedi, M. a. (2008). Diabetes in Sub-Saharan Africa,Mali, Kenya, Mozambique, Nigeria, South Africa and Zambia. *Review Article*, 101-102.
- Baker, L. &. (1996). HMO Penetration and the Cost of Health Care: Market Discipline or Market Segmentation? , 86(2), 389-394. Retrieved from <http://www.jstor.org/stable/2118158>. *The American Economic Review*.
- Bodhemier, T. M. (2002). Patient Self Management of Chronic Disease in Primary care. *Innovations in Primary Care*.
- Buijsse, B. S. (2010). *Risk assesment tools For identifying individuals at Risk of Developing Type two diabetes*. Nuthetal, Germany.
- Chen Tao, P. o. (n.d.). Pricing Private Health Insurance Products in China. *SouthWestern University of Finance and Economics No.55*.
- Farrell, M. A. (2008). Predictive modelling of Costs for achronic disease with acute-high cost episodes. *North American Actuarial jornal,volume 12 no. 1*.
- Gemmill, M. (2008). Chronic Disease Management in Europe. *London School of Economics and Political Science*.
- Geriant, I. N. (2011). Choosing A Predictive Risk Model. *Evidence for better healt Care*.
- institute and faculty of actuaries. (1991,2005,2008). *continous mortality investigation report*. IFOA.
- Juting, D. D. (2005). Private Health Insurance For the Poor in Developing countries. *Policy Insights No. 11*.

- Kenya National Bureau of Statistics, M. o. (2015). *Kenya Demographic and Health Survey*. Nairobi, Kenya.
- Martin, C. M. (2009). *The Social Construction of Ethnicity. The key to understanding Chronic care transformation*. *Journal of Evaluation in Clinical Practice*.
- Milevisky, M. A. (2006). *The Calculus of Retirement Income*. *Frontmatter*, United States of America.
- NSSF. (2013). *National security fund Act, Kenya*. NSSF Website.
- Organization (WHO), W. H. (2008). *Innovative Care for Chronic Conditions*.
- Peters, D. H. (2008). *Poverty and Access to Health Care In Developing Countries*. *Annals of the New York Academy Of Sciences*.
- Schmidt, M. D. (2005). *Identifying Individuals at high risk of Diabetes*.
- Sharad Weir, W. C. (n.d.). *Overview and Uses of predictive modelling*. *Centre For health Policy and Research*.
- Shermann, F. O. (2008). *The Economics of Health and Health Care*.
- Steyn, D. B. (2001). *Burden Of disease Research Unit*. Capetown: Medical Research Council.
- Thomas, B. (2003). *Interventions To Improve Chronic illnesses care: The effectiveness*. *Disease Management, Volume 6*.
- Wagner, J. (2012). *Chronic Disease Management, Reducing costs, improving outcomes*. *Issue of the Advocate's Forum, University of Chicago*.
- Wright, E. G. (2013). *The burden of Chronic Disease on Household in Tanzania and Kenya: Evidence from Health insurance Fund Operational Research*. *A study for USAID*.

## APPENDIX I

### Morbidity tables

Smallest number of members in a scheme-100,000

Largest number of members in a scheme-225900000

Radix		rate of diabetes diagnosis in pension scheme members	
22,590,000.00		0.01	
<i>Age</i>	<i>l<sub>x</sub></i>	<i>diab<sub>x</sub></i>	<i>q<sub>x</sub></i>
25	22,590,000	278,700	0.012491428
26	22,311,300	305,473	0.013691428
27	22,005,826	327,698	0.014891428
28	21,678,128	348,832	0.016091428
29	21,329,296	368,813	0.017291428
30	20,960,482	387,589	0.018491428
31	20,572,892	405,109	0.019691428
32	20,167,783	421,333	0.020891428
33	19,746,449	436,227	0.022091428
34	19,310,222	449,762	0.023291428
35	18,860,459	461,919	0.024491428
36	18,398,540	472,684	0.025691428
37	17,925,855	482,051	0.026891428
38	17,443,803	490,021	0.028091428
39	16,953,782	496,600	0.029291428
40	16,457,181	501,802	0.030491428
41	15,955,378	505,648	0.031691428
42	15,449,729	508,163	0.032891428
43	14,941,566	509,379	0.034091428
44	14,432,186	509,332	0.035291428
45	13,922,854	508,064	0.036491428
46	13,414,789	505,622	0.037691428
47	12,909,166	502,055	0.038891428
48	12,407,111	497,418	0.040091428
49	11,909,692	491,768	0.041291428
50	11,417,924	485,163	0.042491428

51	10,932,760	477,667	0.043691428
52	10,455,092	469,344	0.044891428
Age	$l_x$	$diab_x$	$q_x$
53	9,985,748	460,257	0.046091428
54	9,525,490	450,474	0.047291428
55	9,075,016	440,060	0.048491428
56	8,634,956	429,083	0.049691428
57	8,205,872	417,608	0.050891428
58	7,788,264	405,701	0.052091428
59	7,382,562	393,427	0.053291428
60	6,989,135	380,847	0.054491428
61	6,608,287	368,024	0.055691428
62	6,240,262	355,017	0.056891428
63	5,885,244	341,882	0.058091428
64	5,543,362	328,673	0.059291428
65	5,214,688	315,443	0.060491428
66	4,899,244	302,241	0.061691428
67	4,597,003	289,112	0.062891428
68	4,307,891	276,098	0.064091428
69	4,031,792	263,241	0.065291428
70	3,768,550	250,576	0.066491428
71	3,517,974	238,136	0.067691428
72	3,279,837	225,952	0.068891428
73	3,053,885	214,051	0.070091428
74	2,839,833	202,455	0.071291428
75	2,637,378	191,187	0.072491428
76	2,446,190	180,263	0.073691428
77	2,265,927	169,698	0.074891428
78	2,096,228	159,505	0.076091428
79	1,936,723	149,692	0.077291428
80	1,787,031	140,266	0.078491428
81	1,646,765	131,233	0.079691428
82	1,515,532	122,593	0.080891428
83	1,392,938	114,348	0.082091428
84	1,278,590	106,495	0.083291428
85	1,172,094	99,031	0.084491428
86	1,073,062	91,952	0.085691428
87	981,110	85,250	0.086891428
88	895,860	78,917	0.088091428
89	816,942	72,945	0.089291428
90	743,996	67,325	0.090491428
91	676,671	62,044	0.091691428
92	614,626	57,093	0.092891428

93	557,532	52,459	0.094091428
94	505,073	48,129	0.095291428
Age	$l_x$	$diab_x$	$q_x$
95	456,944	44,091	0.096491428
96	412,853	40,332	0.097691428
97	372,521	36,839	0.098891428
98	335,681	33,598	0.100091428
99	302,083	30,598	0.101291428
100	271,484	27,824	0.102491428
101	243,659	25,265	0.103691428

Table 5: All morbidity tables as calculated and used by the researcher in pricing the health insurance product. The same table could be developed for a different chronic illness.