COST BENEFIT ANALYSIS OF A DIABETES PREVENTION PROGRAM IN RURAL KENYA

by

ANNE WANGUI KANGETHE

(Under the Direction of Duska Franic)

ABSTRACT

Diabetes with a prevalence rate as high as 2.2% - 12.2% in Kenya, is similar to that of Western countries and can no longer be considered a "Western" disease. Diabetes and other non-communicable diseases (NCD) are leading causes of death worldwide. Therefore, early detection and prevention programs are imperative, although the focus by many decision makers is in communicable diseases in Sub-Sahara Africa. This study used cost benefit analysis to compare the benefits and costs of introducing a diabetes prevention program in rural Kenya. The willingness to pay (WTP), a non-market valuation technique, was used to assess the benefits of a five-year diabetes prevention program to the rural Kenyan residents, in monetary units. Program costs were obtained via interviews with Kenyan diabetes experts (2011$). Although the annual average WTP was US$ 6.86 per person, the program costs (US$94,526) exceeds the program benefits (US$32,939) resulting in a negative net social benefit (NSB) from the societal perspective. Health policy makers in Kenya may consider introducing such a program as part of a larger initiative on non-communicable disease prevention.

INDEX WORDS: Willingness to pay, net social benefit, cost benefit analysis, diabetes prevention, Kenya.

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TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

CHAPTER 1

INTRODUCTION

1.1 Diabetes

Diabetes mellitus is a disease characterized by chronic hyperglycemia due to defect in insulin secretion, insulin action or both. The prevalence of diabetes mellitus in Africa is increasing. This is attributed to urbanization, lifestyle changes, smoking, increased alcohol availability, increasing life expectancy and possibly, genetic predisposition (Gill, Mbanya et al. 2009). Diabetes will present a heavy burden on the health care systems in the years to come due to the high prevalence and acute long term complications (Sobngwi 2001). Treatment of diabetes is further compounded by the fact that health systems in Africa are heavily reliant on foreign aid which typically focuses on the big three health challenges, HIV/AIDS, tuberculosis and malaria control programs. In Kenya, tackling debates takes on a two sided approach; improving diabetes care and raising public awareness on diabetes and its risk factors (WDF 2009).

1.1.1 Prevalence

Diabetes and other non-communicable diseases prevalence is on the rise in sub-Saharan Africa. The International Diabetes Federation (IDF) estimated that 10.8 million people had diabetes in Sub-Saharan Africa in 2006 and that it would rise to 18.7 million by 2025, (Levitt 2008). In Kenya, the Ministry of Health (MOH) estimates the prevalence

of diabetes to be 10% or 3.5 million people (Jalang'o 2006; Ogwell 2008). A more recent study conducted in rural Kenyan populations found the prevalence to be 2.2% for the rural dwellers and 12.2% in the urban centers (Christensen, Friis et al. 2009). The prevalence of diabetes in Kenya is similar to that of Western countries and can no longer be considered a "Western" disease (WDF 2006). The American Diabetes Association (ADA) estimates that as of January 2011, 8.3% of the US population has type 2 diabetes with approximately one-fourth of these being classified as undiagnosed (ADA 2011).

1.1.2 Different Types of Diabetes in Sub-Sahara Africa

Gestational diabetes: This type of diabetes is defined as carbohydrate intolerance first detected in pregnancy and it reflects the incidence of type 2 diabetes mellitus in the background population. However, little is known about the prevalence of diabetes in pregnancy in the rural areas of East Africa (Zeck and McIntyre 2008).

Tropical diabetes: This rarely reported diabetes type results from malnutrition and fibrocalculous. Tropical diabetes is unique to certain climates including Africa, Asia and South America and was first reported in the 1960's and 1970's, but is rarely reported today (Levitt 2008).

Type 1 diabetes: This type of diabetes is characterized by destruction of pancreatic beta cells that produce insulin. Typically, type 1 diabetes is diagnosed in early childhood and adolescence although it is not uncommon for adults to present with type 1 diabetes. Patients presenting with this form of diabetes are unable to produce insulin. Estimated prevalence is less than 1/1000 but due to scarcity of information of its natural

history and complications, this data should be interpreted with caution (Levitt 2008; Majaliwa, Elusiyan et al. 2008).

Type 2 diabetes: This is a heterogeneous disease with multiple causes revolving around beta cell dysfunction, insulin resistance and enhanced glucose output (Otieno, Huho et al. 2008). Type 2 diabetes is the predominant form of diabetes in Africa accounting for over 90% of the cases (Kengne, Amoah et al. 2005; Levitt 2008). Given the rising prevalence of type 2 diabetes in Sub-Sahara Africa, this study will focus on this subtype.

1.1.3 Risk Factors

Diabetes risk factors can be divided into non-modifiable and modifiable factors. Non-modifiable risk factors include; increasing age, race & ethnicity, gender and family history (Sobngwi 2001; Levitt 2008; ADA 2011). The modifiable risk factors can be attributed to two issues; there is increased adoption of Western lifestyles and cultures with the abandonment of the traditional African cultures and the improvement on socio-economic conditions leading to life expectancy increases (Mbanya 1997). Life style changes have given rise to urbanization and an increase of modifiable risk factors in Sub-Sahara Africa including; obesity, high blood glucose, hypertension, physical inactivity, and smoking (Levitt 2008; ADA 2011). The current proposal will analyze age, gender, family history, obesity, hyperglycemia, hypertension and smoking as the non-modifiable and modifiable factors affecting respondents decisions concerning diabetes prevention.

1.1.4 Burden of Diabetes

a. Clinical Impact of Diabetes

In early symptomatic hyperglycemia, polyuria and consequent polydypsia result in dehydration. Blurry vision, fatigue, nausea and various fungal and bacterial infections may persist for weeks before medical attention is sought (Beers and Berkow 1999).

Late complications present several years after poorly controlled hyperglycemia. Macrovascular disease may lead to coronary artery disease, claudication, skin breakdown and infections. Retinopathy alters vision and can lead to blindness. Diabetic nephropathy may be asymptomatic until end-stage renal disease develops. Neuropathy may cause numbness, tingling and paresthesias in the extremities (Beers and Berkow 1999).

b. Cost of Diabetes

Diabetes presents significant costs to the individual and society, although data for economic cost of diabetes in Sub-Saharan Africa are sparse (Mbanya, Motala et al. 2010). In most sub-Sahara countries, medical health insurance and free health services are unavailable. Therefore most diagnosed patients have to pay for all parts of medical care.

A recent World Health Organization (WHO) report estimated the cost of diabetes case per year at $2144.3 for low income countries in Africa including Kenya (Kirigia, Sambo et al. 2009). According to the World Bank, Kenya's gross national income (GNI) for 2009 was $760. The GNI reflects the average income of its country's citizens (The Word Bank Group 2011). Clearly a diagnosis of diabetes presents an economic burden to the patients and their families.

Individuals seeking diabetes counseling must consult general practitioners often at prohibitive costs. For example, a visit to Kenyatta National Hospital, a tertiary referral hospital in Kenya, for a medical specialist visit such as an endocrinologist, will cost the patient KSh 500-1000 (US$ 6.25-13) (KNH 2011).

c. Morbidity/Mortality

Due to the challenges in the delivery of diabetes care, infections and acute metabolic complications have been reported as the most common causes of death in diabetic populations (Azevedo and Alla 2008). Acute complications of diabetic ketoacidosis, hyperosmolar non-ketotic coma and hypoglycemia commonly occur in Africa and have a worse prognosis than in developed countries (Gill, Mbanya et al. 2009). Microvascular complications are highly present as a result of poor glycemic and blood pressure control (Levitt 2008). Cardiovascular disease is the most significant cause of death in the diabetic population (Azevedo and Alla 2008). Diabetic retinopathy is the leading cause of adult blindness due to cataracts and open angle glaucoma. Diabetic neuropathy results in significant morbidity caused by pain, sensory loss, weakness and amputations. Nephropathy attributed to diabetes poses a challenge due to the inaccessible treatment options such as dialysis and organ transplants in Africa (Azevedo and Alla 2008).

Despite the burden that diabetes poses, health-care systems in most African countries are state-funded and priority is given to the unfinished agenda of communicable diseases (Mbanya, Motala et al. 2010).

1.1.5 Obstacles to Delivery of Care

There are several problems plaguing the delivery of diabetes care in Sub-Saharan Africa; scarcity of diabetes specialists and lack of healthcare facilities in rural areas, poor public awareness and health beliefs, poor treatment adherence, lack of reliable affordable supply of medications and monitoring equipment and lack of good epidemiologic data (Mbanya 1997).

In Kenya, there are challenges to preventing and treating diabetes although there is increasing attention by the Ministry of Health (Personal communication with Scholastica Owondo, program officer, Ministry of Public Health and Sanitation, April 2010). Health professionals do not consider diabetes as a health priority. Priority is given to communicable diseases such as HIV/AIDS, malaria and tuberculosis. This is compounded by unsettling political situations, illiteracy, lack of access to healthcare professionals and cultural perceptions of body size. In Kenya, being overweight is considered as an elite status symbol and is desirable (Levitt 2008; McFerran 2008).

1.1.6 Proposed Solutions for Kenya

Several solutions have been proposed to counter the progression of diabetes in Kenya through prevention. These can be divided into three categories; primary, secondary and tertiary prevention. In primary prevention, disease is stopped before it starts often by eliminating the risk factors (Beers and Berkow 1999). The primary prevention of type 2 diabetes involves reducing the modifiable risk factors by promoting regular exercise, healthy balanced diet, avoiding obesity, discontinuing smoking, glycemic level monitoring and diabetes education. The World Diabetes Foundation

(WDF), Ministry of Health (MOH) and the Kenya Diabetes Management and Information Center (DMI) are embarking on education programs that target the general public, high risk individuals and patients through events such as youth camps, and diabetes education seminars. Although sporadic, DMI also conducts health screenings with follow up and referrals as well as field data collection. Such an event was conducted in April 2010 at Safaricom, a telecommunication organization, in Nairobi (personal communication Vincent Mbugua of DMI April 2010).

In secondary prevention disease is detected and treated early often before symptoms are present thereby minimizing adverse outcomes (Beers and Berkow 1999). In diabetes, the aim of secondary prevention is to reduce the short-term and long-term complications of diabetes through appropriate drug therapy and monitoring. Tertiary prevention in chronic diseases helps alleviate further functional loss (Beers and Berkow 1999). Tertiary prevention in diabetes focuses on tight control of glycemic levels along with supportive and rehabilitative services to maximize quality of life and prevent disability and death.

There are concerted efforts to improve diabetes care for secondary and tertiary prevention in Kenya through establishing and/or equipping diabetes clinics in public district hospitals and establishing mini-clinics in dispensaries and health centers in rural Kenya (WDF 2009). The International Diabetes Federation (IDF) is working on diabetes training programs for healthcare workers in African countries including Kenya (Azevedo and Alla 2008).

The economic burden of diabetes estimated at $2144.3 per diabetes case per year, is prohibitive for most households in Kenya whose average annual household income is

$760 (Kirigia, Sambo et al. 2009; The Word Bank Group 2011). Therefore, primary prevention of diabetes is recommended as it can reduce the prevalence and incidence of type 2 diabetes (WHO 2010; Nikolic, Stanciole et al. 2011; Smith 2011). Currently, there are no formal diabetes primary prevention programs in Kenya.

1.1.7 Primary Prevention Programs in Diabetes: Other Countries

Studies involving primary prevention of diabetes have been conducted recently in Canada and Finland. In Alberta Canada, the Mobile Diabetes Screening Initiative (MDSI) transports diagnostic equipment and a team of healthcare professionals to provide diabetes counseling to rural areas. The program offers screening services for diabetes, diabetes and cardiovascular risks and eventually provides individualized diet counseling to participants (Ralph-Campbell, Oster et al. 2011). A total of 809 adults (180 diabetics and 629 without known diabetes) had repeat visits at 1 year. Of the known diabetic patients, there was significant improvements in body mass index, blood pressure, total cholesterol, and Hemoglobin A1c. Those without diabetes had improvements in blood pressure (Ralph-Campbell, Oster et al. 2011).

The Diabetes Prevention Study conducted in Finland reported that lifestyle intervention in people at high risk for type 2 diabetes resulted in sustained lifestyle changes and a reduction in diabetes incidence (Lindström, Ilanne-Parikka et al. 2006). Overweight men (n=172) and women (n=350) with impaired glucose tolerance (IGT) considered as high risk individuals were randomized to an intensive lifestyle intervention and a control groups. The lifestyle intervention group provided individuals with counseling focusing on body weight and physical activity as well as diet counseling. At

approximately 7 years of total follow up, there was a 43% reduction in relative risk while the absolute difference in diabetes risk between the intervention and control groups was 15% during the initial trial period and remained the same post-intervention follow-up (Lindström, Ilanne-Parikka et al. 2006).

A larger randomized study, the Diabetes Prevention Program, conducted with 3234 US adults aged at least 25 years with IGT compared lifestyle intervention versus drug intervention (metformin) and a placebo control group. The intensive lifestyle intervention group received 16-lesson curriculum covering diet exercise and behavior modification to encourage participant to maintain a weight reduction of 7% of initial body weight. Individuals were followed for approximately 2.8 years. The incidence of diabetes was reduced by 58% with the lifestyle intervention and by 31% with the metformin as compared with placebo in both interventions. In addition, lifestyle intervention was more effective in preventing type 2 diabetes in older adults and individuals in this groups tended to have a lower mortality rate than metformin intervention group (Knowler, Barrett-Connor et al. 2002).

These studies have successfully shown the advantages of lifestyle intervention in decreasing the incidence of diabetes. The authors of the Finnish study demonstrated that public health projects that employ lifestyle interventions lasting for a limited time can yield long term benefits in reducing the risk of type 2 diabetes (Lindström, Ilanne-Parikka et al. 2006).

1.2 Statement of problem

As the prevalence of diabetes in Kenya continues to increase, there are efforts by the Ministry of Health and non-government diabetes organizations to establish programs that

have the aim of tackling diabetes. Several approaches that target the primary, secondary and tertiary levels of prevention and care have been proposed (personal communication with Scholastica Owondo, program officer, Ministry of Public Health and Sanitation, April 2010). In particular, there is concerted effort to provide primary prevention programs to rural Kenya where traditionally, healthcare facilities have been scarce. For this population "...the emphasis must be on prevention – because the Western model of emphasizing treatment is unaffordable and unachievable when health workers are in short supply" (Smith 2011; UnitedHealth 2011). This approach prevents people from transitioning into patients (i.e. secondary and tertiary care models) that is often the case in Western healthcare.

Due to the scarcity of healthcare facilities in the rural areas, residents are faced with the dilemma of frequenting urban area facilities at prohibitive costs including travel or avoid seeking treatments until advanced stages of disease. Therefore, primary prevention of diabetes is appropriate for this population since the annual cost of the disease outweighs the annual income (Suri, Tschirley et al. 2008).

The Kenyan public rates healthcare among the top five priority areas for the government to address (Abiola, Gonzales et al. 2011). It is unknown if rural residents perceive such a program as being beneficial. This proposal's primary objective is to determine if rural Kenyan residents view a primary prevention program in type 2 diabetes as beneficial. The prevention program would entail diabetes education, screening and referral of at risk individuals consistent with the World Health Organization guidelines (WHO 2010) .

Unlike secondary and tertiary prevention programs that target patients with diabetes, primary prevention programs are currently unavailable in the Kenyan market place. Determination of their value cannot be approached using market goods valuation techniques such as purchase price evaluation. Valuation of such a program in this proposal will involve non-market techniques of cost benefit analysis.

1.2.1 Study Perspective

Programs can be analyzed from various view points; societal, ministry of health, government, agency providing the program, target group and from individuals. An analytic view point may look significantly better from one view point than from another (Drummond, Sculper et al. 2005). This study will take the societal perspective. Analysis of prevention programs such as the one proposed in this study typically take on the societal perspective (Haddix, Teutsch et al. 2003). In general, global or societal viewpoint is appropriate for public policy decision making as it is assumed that public resources will be utilized for realization of the programs (Torrance 1986).

1.3 Cost Benefit Analysis

This proposal is an evaluation of a program aimed at the primary prevention of type 2 diabetes. In program evaluation, researchers use social research methods to systematically investigate the effectiveness of social intervention programs in ways that are adapted to their political and organizational environment and redesigned to inform social action to improve social conditions (Rossi, Lipsey et al. 2004).

Several categories of economic evaluations exist. Outcome description, cost description, and cost-outcome description provide analyses of single services or programs. Efficacy study, cost analysis and full economic evaluation compare and contrasts two or more health services or programs (Ngorsuraches 2008). Cost benefit analysis fall under the full economic evaluation category where both costs and outcomes are examined. Examination of both costs and outcomes makes the full economic evaluation appropriate for policy decision making (Ngorsuraches 2008).

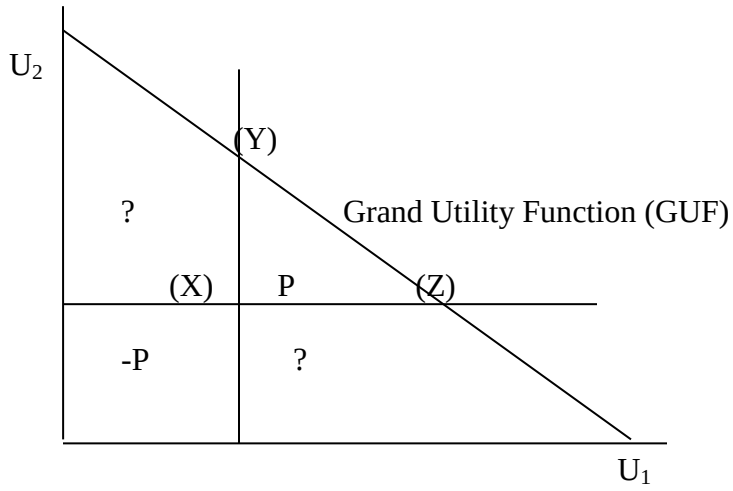
The analysis of the diabetes education and screening program, which is not readily available in the rural market place, will be based on the cost benefit framework. Cost benefit analysis is an analytical procedure expressed as the relationship between costs and outcomes measured in monetary terms (Rossi, Lipsey et al. 2004). Its framework is based on welfare economic theoretical foundations. This conceptual framework helps identify the explanatory variables in the study model.

The philosophical foundation of CBA is based on welfare economics. Welfare economics is a branch of economics that addresses normative questions (as opposed to positive predictions) based on two fundamental postulates (Drummond, Sculper et al. 2005);

1. Social welfare comprises of individuals' welfare (utilities). Utility is viewed as some measurable form of satisfaction that a consumer gets from consuming a good (Binger and Hoffman 1988). The social value of a project is the sum of the values of the project to the individual members of the society (Sassone and Schaffer 1978).
2. Individuals are the best judges of their own welfare (sovereignty)

The relevant source of monetary values for program outcomes is the individual. Welfare economics assumes that resource allocation is in equilibrium and that income distribution is appropriate therefore forming the basis of Pareto principles (Drummond, Sculper et al. 2005; Boardman, Greenberg et al. 2006).

The *Pareto criterion* is a technique that compares or ranks alternative programs. It stipulates that a policy change is socially desirable if, by the change, everyone can be made better off, or at least some are made better off, while no one is made worse off (Just, Hueth et al. 2004) (p14). Therefore if it possible to make at least one person better off when moving from point X to points Y or Z without making anyone else worse off, any point on triangle XYZ is ranked higher in society than point X. This movement represents *Pareto improvemen*t (Figure 1.1). Once it is not possible to make one person better off without making someone else worse off then the situation can be described as *Pareto efficient* or *Pareto optimal* (Binger and Hoffman 1988; Boardman, Greenberg et al. 2006).



The utility functions of individual 1 and 2 are recorded on the two axes. The line U_2U_1 also known as GUF, describes the maximum possible combinations of utilities which can be achieved by individuals 1 and 2. Suppose the economy is at point X, movement into the triangle XYZ is *Pareto improvement*. Any movement into rectangle –Ps is *Pareto deterioration*. Any movement south-east or north-west of X involves *Pareto non-comparability* (Dasgupta and Pearce 1986). That is, one person is made better off and the other is left worse off.

Figure 1.1: Grand Utility Function (GUF) - Pareto Criterion (Dasgupta and Pearce, 1986, p56-57)

Pareto improvement depends critically on initial income distribution. Therefore policy change must account for widely differing income distributions. To assist in the selection of alternative policies, the compensation principle (Kaldor-Hicks compensation) was developed that stipulated that a program is preferred if by implementing it, the gainers can compensate the losers such that at least one person is better off and no one is worse off (Just, Hueth et al. 2004). Actual compensation does not have to take place. This is basis for the *potential Pareto efficiency* rule or the *net benefits criterion* which is more feasible than the *Pareto efficient* rule. Analysis of program efficiency, in practice, depends on whether the program represents *potential Pareto improvement* (Boardman, Greenberg et al. 2006).

CBA uses the decision criteria of *potential Pareto improvement (PPI)*. The criterion labels a project superior if those who gain from the project could compensate those who lose so that none would be worse off with the project (Sassone and Schaffer 1978). Once all program costs and benefits are considered and as long as the net benefits are positive, such a program then maximizes aggregate wealth and indirectly helps those that are worse off in society through redistribution (Boardman, Greenberg et al. 2006). This proposal will be testing PPI which does not actually require the gainers from the program to compensate the losers. This compensation is hypothetical (Mitchell and Carson 1989).

1.3.1 Formatting of CBA Studies

a. Temporal perspective

Program evaluation must take into account whether or not the program currently exists or not. There are two major types of cost benefit analysis (CBA). Ex ante CBA, which is conducted while a project or policy is under consideration and ex-post CBA conducted at the end of a project or assumes the project already exists (Boardman, Greenberg et al. 2006). The cost benefit analysis of diabetes prevention program will be conducted using the ex-ante approach. Considering that the project is unavailable in the rural setting, the ex-ante approach is appropriate. This is represented by "Project A" on Table 1.1. This is most useful for deciding whether scarce resources should be allocated to the program.

b. Gain and loss of utility

Not all Kenyan residents will be better off or see an increase in utility from the introduction of the diabetes prevention program. Introduction of such a program may mean less funding for other projects. Considering the economic burden of diabetes, the aim of the introduction of the diabetes prevention program is to provide ready access at affordable costs to rural residents. Therefore, from a rural resident perspective, introduction of the program will cause a change in status quo and result in consumer gain. Therefore this proposal will assume a gain in "Project A" (Table 1.1).

c. Direction of measurement

To determine whether the overall balance of program introduction is positive or negative, the gainers (targeted rural residents) in contingent valuation study must be asked the maximum amount of money they would be willing to pay (WTP) for the project to be introduced. WTP is the maximum amount that an individual would be willing to pay to purchase the health improvement itself, everything else being equal, and if it were available on the market (Drummond 2005). If the project had represented a loss to the residents, they would have been asked how much they would be willing to accept (WTA) in compensation for their loss.

Theoretically, WTP and WTA should yield similar results. However, in practice WTA typically exceeds WTP (Shogren, Shin et al. 1994). This difference cannot be explained merely by the hypothetical nature of measurement, but instead can be attributed to income constraints and substitution effect (O'Brien and Gafni 1996). WTP decisions are made based on individuals' budgets while WTA is not. Therefore, individuals maybe WTA higher amounts than WTP. When the substitution for evaluated

project is unavailable, then individuals are more averse to the loss of programs than they are attracted to the gain. This results in higher WTA values stemming from the perceived higher loses (Shogren, Shin et al. 1994).

WTP technique is recommended by National Oceanic and Atmospheric Administration (NOAA) over WTA as it yields more conservative results (Arrow, Solow et al. 1993 In this proposal the WTP will be used.

d. Compensating and Equivalent Variation

CBA studies use the utility concept of either compensating or equivalent variation depending on whether a program is being introduced or removed and depending individual rights to prior or post program (O'Brien and Gafni 1996; Drummond, Sculper et al. 2005). In compensating variation (CV), the status quo condition of the participant changes with the introduction of the program. As a result of the change, participants are asked if they would be willing to pay for the program if it results in a gain (WTP) or how much they would be willing to accept in compensation if it results in a loss (WTA). Alternatively, in equivalent variation (EV), the status quo of the respondent does not change with introduction of a new program. Similarly, respondents are asked how much they would be willing to pay to forgo a loss (WTP) or how much they would need to be compensated to forgo a gain (WTA) (Bayoumi 2004).

The diabetes prevention program is currently unavailable in rural Kenya. DMI conducts education and screening exercises funded by private organizations interested in employee health. From Table 1.1, program introduction with consumer gain is represented by cell A_1. This is in tandem with majority of other health care contingent

valuation studies (O'Brien and Gafni 1996). For example, when Diener et al (1998) evaluated CVM studies in healthcare, WTP was used to measure utility in 95% of the studies.

Table 1.1: Use of Willingness-to-Pay and Willingness-to-Accept in the Context of Compensating Variation and Equivalent Variation (Drummond, Sculper et al. 2005)

Temporal perspective and Program status		Does this consumer gain or lose in utility from before-after change	**Compensating Variation (CV)** +/- required *after* the change to make utility the same as before the change	**Equivalent Variation (EV)** +/- required *before* the change to make utility the same as before the change
Before	After			
Project A: Introduction of a Program				
No program	Program	Gain	A_1 WTP: maximum amount that must be taken from the gainer to maintain at current (before) level of utility	A_3 WTA: minimum amount that must be paid to potential gainers to forgo the gain and make utility equal to what it would have been after the change
		Loss	A_2 WTA: minimum amount that must be paid to loser to maintain at the current (before) level of utility	A_1 WTP: maximum amount that must be taken from the potential loser to forgo the loss and make utility level equal to what it would have been after change
Project B: Removal of a Program				
Program	No program	Loss	B_1 WTA: minimum amount that must be paid to loser to maintain at current (before) level of utility	B_3 WTP: maximum amount that must be taken from potential loser to forgo the loss and make utility level equal to what it would have been after the change

		Gain	B_2 WTP: maximum amount that must be taken from gainer to maintain at current (before) level of utility	B_4 WTA: minimum amount that must be paid to potential gainers to forgo the gain and make utility equal to what it would have been after the change

The monetary measure of utility change for rural residents experiencing a change in status quo due to diabetes prevention program introduction is compensating variation (CV). CV assumes that individuals have rights to the original level of welfare. Therefore a sum of money must be received from the individual to leave them at the original level of welfare in form of willingness to pay (WTP) (O'Brien and Gafni 1996).

1.3.2. Utility Model

A state of the world (S) is a specific distribution of utility (some measurable form of satisfaction that a consumer gets from consuming a good) among members of society with (N) members such that;

Eq 1.1: $S = (U^1, U^2, \ldots U^N)$ (Sassone and Schaffer 1978)

A community member's utility (U) is maximized subject to income (Y) and price of commodities (P). For a bundle of goods (X=market goods, Q=non-market goods) the utility function assigns a single number:

Eq 1.2: Maximum U (X, Q) such that $P.X \leq Y$ (Champ 2003)

For each market good (X), there is an optimal demand function(X^*) that depends on price (P), level of non-market good (Q) and level of income (Y).

Eq 1.3: $X^* = X(P, Q, Y)$ (Champ 2003)

Therefore, the indirect demand utility function can be represented as:

Eq 1.4: $U(X^*, Q) = v(P, Q, Y)$ (Champ 2003)

From Table 1.1 introduction of a diabetes prevention program should leave the rural community residents at the original utility level before program introduction. An amount of money, compensating variation (CV), must be taken away from the residents to restore the residents back to original utility level results in the following indirect utility function:

Eq 1.5: $V(P^0, Q^0, Y^0) = V(P^1, Q^1, Y^1\text{-}CV)$ (Champ 2003)

Where superscript 0 denotes the initial status quo condition and superscript 1 denotes the subsequent level after the program introduction.

There are three general approaches to assigning money values to non-market goods such as health outcomes: (1) Human capital, (2) Revealed preference and (3) Stated preference. The human capital approach places monetary weights on healthy time using market wage rates and the program is assessed in terms of the present value of future earnings. This method has been criticized due to its lack of consistency with the tenets of welfare economics by restricting impacts to labor productivity (Drummond, Sculper et al. 2005).

Revealed preference places value of non-market goods from actual real world decision. This method poses a challenge such that markets may not be readily available and estimates from this method tend to vary widely due to the large number of confounders that affect consumer purchasing decisions (Drummond, Sculper et al. 2005).

In stated preference method, respondents are asked to think about a product or service contingent upon an actual market (contingent valuation). For the health program or service respondents are asked to state the maximum amount of money they would be willing to pay for the benefit (Drummond, Sculper et al. 2005). Referring to the above equation, WTP replaces CV such that

Eq 1.6: $V(P^0, Q^0, Y^0) = V(P^1, Q^1, Y^1 - WTP)$

Although hypothetical, WTP attempts to replace missing markets and the aggregation of the consumer surplus is the basis for cost benefit calculations.

1.3.3 Willingness to Pay as a Random Variable

Individual true willingness to pay is unknown to the researcher. Therefore it can be treated as a random variable (Aadland and Caplan 2003).

EQ 1.7: $WTP = \alpha + \beta Z + \varepsilon$

Where ε = random nonsystematic error

Z = vector of variables that are arguments that explain variation in responses to the valuation question

β = vector of coefficients to be estimated

α = constant

The random error term "e" is assumed to be normally distributed with a zero mean and constant variance (Alvarez-Farizo, Hanley et al. 1999). Therefore, the mean of e = 0. This forms the linear model

Eq 1.8: Mean $WTP = \alpha + \beta$ (mean Z)

1.3.4 Measuring Benefits:

Contingent valuation studies in healthcare have been conducted in Africa using various valuation methods including: open ended (OE), dichotomous choice (DC), bidding game (BG) payment card (PC) stochastic payment card (SPC) and structured haggling (SH) (Mitchell and Carson 1989; Onwujekwe 2004; Wang and Whittington 2005) .

An open ended questionnaire asks the respondent directly his or her maximum WTP value. For example, in Kenya, for a tsetse fly control program, respondents were asked "What would be the maximum amount of money (number of Kenya shillings) per month that your household would be willing to contribute to the purchase of materials during the first year of the program?" (Echessah, Swallow et al. 1997). OE is advantageous because it is easy to administer and small sample sizes are required for WTP estimation. However, the results are considered unreliable and the format can be cognitively burdensome to respondents and therefore not recommended (Arrow, Solow et al. 1993; Champ and Bishop 2006).

Dichotomous choice (also referred to as close ended, discrete choice, referendum, binary or take-it-or-leave it) presents respondents with a single WTP value which they either accept or reject (Smith 2000). For example, in valuation of an AIDS vaccine in Uganda, respondents were asked "Suppose that the price for this HIV/AIDS vaccine was 5000 Ugandan schilling (US$ 2.86), would you be willing to pay for the vaccine yourself?" The respondents were asked to choose one of three responses: Yes, No, or Yes if I had the money (Bishai, Pariyo et al. 2004). The DC method while easily administered suffers from the need of a large sample size, difficulty in choosing

appropriate offer amounts, and potentially higher bids due to yea-saying when using this method (Mitchell and Carson 1989; Champ and Bishop 2006).

In the bidding game, respondents are offered an initial WTP amount which they either accept or reject. According to the acceptance or the rejection of the initial amount, they either bid up or down in increments until their maximum WTP values are reached (Smith 2000). An example of the BG technique was used to elicit WTP for community-based health insurance in Nigeria (Onwujekwe, Okereke et al. 2009). The authors used the following template to elicit WTP values (in italics):

> The bidding game iteration for eliciting WTP for the individual was:
>
> *1. The price of a monthly insurance premium (contribution) per person is 600 Naira1; are you willing to pay? [ ]*
> *1 = Yes (Q2); 0 = No (Q3) Do not know (Q4)*
> *2. What if the premium is 700 Naira, will you be willing to pay? [ ]*
> *1 = yes (Q4); 0 = No (Q4)*
> *3. What if the premium is 500 Naira, will you be willing to pay? [ ]*
> *1 = yes (Q4); 0 = No (Q4)*
> *4. What really is the maximum amount you are willing to pay for CBHI? [ ]*

The bidding game imitates an auction and therefore it is likely to be familiar with the respondents. However, it is prone to starting point bias that occurs when the respondent's WTP amount is influenced by the starting offer amount and requires face to face interviews (Mitchell and Carson 1989).

A payment card questionnaire presents the respondent with a specified range of values. They are then asked to indicate which values they would pay (Donaldson, Shackley et al. 1995; Smith 2000). For example, in assessing WTP for voluntary HIV counseling and testing in Kenya, respondents were presented with a card listing 18 amounts to choose from ranging from KSh 0 to KSh 25,000 (US$ 0 to $360).

Respondents were then asked for the maximum they would be willing to pay for the service and the response was recorded by check marking one of the 18 options. Respondents were also given the option of stating an amount beyond what was provided on the card (Forsythe, Arthur et al. 2002).

Payment card is advantageous in that it offers the respondent more of a context for the bid (Mitchell and Carson 1989). It mimics real life where respondents "shop around" for the value closest to their maximum WTP (Ryan, Scott et al. 2004). Payment card techniques are well suited for small contingent valuation studies (Bayoumi 2004). However, the format is prone to range bias: when the information presented on the payment card influences the respondents' WTP amount (Smith 2000; Whynes 2004). Reports for range bias are variable: there are some studies that report no problem with the method (Rowe, Schulze et al. 1996; Brouwer and Spaninks 1999).

Stochastic payment card (SPC) is a new technique that offers respondents a list of prices to choose from and also an associated numeric likelihood matrix to choose from describing the likelihood of agreement to pay the various prices offered (Wang 1997). For example, the SPC technique was used when estimating the WTP for community health insurance in Rural Nigeria (Ataguba, Ichoku et al. 2008). Respondents were presented with the card (in italics below) and asked for each of the prices offered to circle the probability that they would pay the offered price.

Now consider your monthly income and your expenditure before you vote for a particular price. If the price you are going to choose will re-arrange your expenditure pattern, probably by increasing it, how probable are you to pay each of the following prices quarterly in order to obtain the benefits of the scheme in the community?

Quarterly cost In Naira	***Definitely no***	***Probably no***	***Not sure***	***Probably yes***	***Definitely yes***
0	*0%*	*25%*	*50%*	*75%*	*100%*
200	*0%*	*25%*	*50%*	*75%*	*100%*
400	*0%*	*25%*	*50%*	*75%*	*100%*
600	*0%*	*25%*	*50%*	*75%*	*100%*
800	*0%*	*25%*	*50%*	*75%*	*100%*
1000	*0%*	*25%*	*50%*	*75%*	*100%*

SPC is similar to the PC method and as such it prone to the same range bias when the information presented on the payment card influences the respondents' WTP amount. It also requires a large sample size (Wang and Whittington 2005).

Bidding game has been criticized in Sub-Sahara Africa due to its underlying philosophy of bidding up once the respondent has agreed to a bid which is inconsistent with purchasing transactions in this culture (Onwujekwe 2004). In the rural African market place, similar to a flea market transaction, once a price is agreed upon, it is considered unacceptable for the seller to haggle the price upwards. An alternative approach addressing this criticism is a new technique, structured haggling (SH), proposed by Onwujekwe (2004). SH is designed to closely mirror how transactions take place in the rural Sub-Sahara African marketplace. This new technique is similar to the bidding game, however, unlike the bidding game, the offer amount is not allowed to "bid up." In the following example of SH, Onwujekwe (2004) used the technique to determine the willingness to pay for insecticide treated mosquito nets in rural southeast Nigeria. Respondents were asked the following questions:

1. The price of a net is 550; are you willing to pay?
1=Yes (Q7), 0=No (Q2) Do not know (Q2)
2. What is the maximum amount you are willing to pay? (Interviewer: if more or equal to 450 Naira go to Q3, but if less than 450 Naira, go to Q4)
3. What if the price is 540 Naira, will you be willing to pay? 1=yes, 0=No (Interviewer: no matter the answer, go to Q7).
4. What if the price is 490 Naira, will you be willing to pay? 1=Yes (Q7), 0=No (Q5)
5. What really is the maximum amount you are willing to pay for a net? (Interviewer: If more or equal to
450 Naira go to Q7, but if less than 450 Naira go to Q6)
6. The amount that you have quoted is too low, and cannot cover the cost of the net, and so you will have to increase the amount if you really want to buy the net. So what is the final maximum amount you are willing to pay for a net? (Interviewer: No matter the answer, go to Q7)
7. If due to inflation or other uncertainties, the price of the net increases, what is the maximum amount you are very certain to pay?

In summary, there is no consensus on the best contingent valuation elicitation method in healthcare. Different WTP techniques may yield different WTP values. Smith (2000) went as far as to conclude that "there is no conclusive theoretical or empirical justification for considering one [technique] to be more valid than the other." Additionally, he recommended that researchers compare all types of elicitation formats with real choices. While this is regarded as the ideal, in practice this may not be feasible for most researchers with limited resources.

Researchers interested in conducting WTP studies can analyze previously published studies and make inferences based on such an analysis. The analysis can give insight into the valuation formats that have been used and how they have been used in the target population and disease state or condition of interest (see preliminary studies I and II). Although the methods have been extensively used in Western populations, their validity is impacted by culture since different markets use different transaction methods. Once the format is selected and applied, the results of the proposed study will be analyzed for examination of how well the format fits the proposed theory.

1.3.5 Measuring Costs

Cost data are essential for the calculation of net benefits. An analysis of a disease prevention program such as the one undertaken in this proposal must take on a societal perspective analyzing all benefits and "all costs of a program (no matter who pays for them)" (Haddix, Corso et al. 2003). There are several classifications of cost data used in a program evaluation: Direct medical costs, direct non-medical costs, indirect costs and intangible costs.

Direct medical costs are costs incurred to secure medical treatment by the patient, costs accrued by the health system and resources consumed by the prevention program (Haddix, Corso et al. 2003; Drummond, Sculper et al. 2005). *Direct non-medical costs* are costs incurred in connection with the health outcome but not classified under medical costs such as transportation to and from the facility incurred by the patient (Haddix, Corso et al. 2003). *Indirect costs* are a measure of resources forgone (opportunity costs) by the patient such as work time to participate in an intervention and seek care. These costs also include time lost due to morbidity and mortality (Haddix, Corso et al. 2003; Drummond, Sculper et al. 2005). *Intangible costs* are welfare losses due to physical and psychological pain and suffering. These are difficult to measure and value directly (Drummond, Sculper et al. 2005; Kirigia, Sambo et al. 2009).

Evaluation of direct medical, direct non-medical and indirect costs of the burden diabetes in Sub-Sahara Africa has already been undertaken by the World Health Organization (WHO) regional office for Africa (Kirigia, Sambo et al. 2009). Due to information scarcity, the objective of that study was to estimate the economic burden of diabetes in countries of the WHO African region. The region was divided into three

regions based on Gross National Income (GNI) per capita: group one (≥$8000), group two ($2000-$7999) and group three (<$2000). Kenya belongs to region three with an average GNI of $820 (The Word Bank Group 2011) (Table 1.2 reports 2005 international dollars, Int $[1]).

The total costs per diabetes case per year for a group 3 country like Kenya was estimated at $2,144.3 (Table 1.2). This study has some limitations that make this figure a conservative estimate. The study did not capture intangible costs referred to welfare loses due to physical and psychological distress. Additionally, the usual diabetic complications due to retinopathy, nephropathy, macrovascular and peripheral vascular disease were not included in the analysis due to the scarcity of information from this region. Therefore, this figure can be regarded as a conservative estimate of diabetes costs

[1] An international dollar has the same purchasing power as the U.S. dollar has in the United States (WHO).

Table 1.2: Average Annual Costs per Person with Diabetes in Sub-Sahara Africa (Int $ 2005)

	Cost per diabetes patient (Int$*)		
Itemized costs	GROUP 1	GROUP 2	GROUP 3
Direct Medical and non-medical			
(1). Insulin	309.7	403.9	687.4
(2). Syringes	56.5	40.5	69.0
(3). reagent strips	81.4	58.4	99.3
(4). glucose meters	1.0	0.7	1.2
(5). oral drugs	13.2	23.6	44.1
(6). Outpatient Department consultations	159.8	147.0	20.0
(7). Hospitalization	124.1	141.0	23.3
(8). Other related tests	84.6	90.1	188.1
(9). Monetary cost borne by households **	45.7	70.9	88.3
Subtotal	**876.0**	**976.1**	**1,220.6**
Indirect Costs			
(10). Permanent disability	9,297.2	3,342.1	813.5
(11). Temporary disability	111.9	40.2	9.8
(12). Premature deaths among the productive	1,024.7	368.3	89.7
(13). Productivity loss for care givers	121.8	43.8	10.7
Subtotal	**10,555.6**	**3,794.5**	**923.6**
GRAND TOTAL COST	**11,431.6**	**4,770.6**	**2,144.3**

Adapted from Kirigia, Sambo et al. 2009 pg. 10

* An international dollar has the same purchasing power as the U.S. dollar has in the United States

** Monetary costs borne by households include all out of pocket expenses related to seeking treatment such as transportation.

1.3.6 Net Social Benefit

Cost benefit analysis (CBA) determines the net social benefit (NSB) of health programs. Program benefits are valued based on compensation test (Pareto) and welfare principles (Drummond, Sculper et al. 2005). If the aggregate net benefits measured by WTP of all affected individuals are positive then there exists sets of contributions and payments that would make the policy a potential Pareto improvement over status quo (Boardman, Greenberg et al. 2006).

The decision rules based on CBA is simply to implement programs with net social benefit greater than 0 (NSB>0). This gives CBA an advantage over other economic appraisal techniques as a decision can be made on a single program and disparate effects in the same or different programs can be compared (Torrance 1986). This is especially useful for analysis of the diabetes prevention program whereby no other economic evaluations have been conducted on chronic health conditions in Kenya and as such, policy decisions can be made based on single program appraisals.

CBA is a calculation and determination of the net social benefit as determined by the following equation (Drummond, Sculper et al. 2005; Whitehead and Blomquist 2006)

Eq 1.9: $$NSB = \sum_{t=1}^{n} \frac{b(t) - c(t)}{(1+r)^{t-1}}$$

NSB = net social benefit
b(t) = benefits in money terms derived in year t (aggregated WTP)
c(t) = cost in money terms in year t
1/(1+r) = discount factor at annual interest rates
n = projects lifetime

In determining the choice of discount rate, analysts have relied on two methods; publicly announced discount rates for public sector projects in countries such as UK and relying on commonly published rates. This project will use 3% rate that is commonly used for program evaluation from a societal perspective and has been recommended for differential timing of costs and consequences (Drummond, Sculper et al. 2005). Discounting reflects the time preference of money demonstrated by individuals and opportunity costs of a healthcare program. The opportunity cost for implementing the program is the forgone returns from investing in other programs under consideration (Krahn and Gafni 1993). The project's lifetime will be five years. This reflects the election cycle in Kenya which in turn influences public policy projects.

1.4 Preliminary Study I -Willingness to Pay Studies in Sub-Sahara Africa (Kangethe and Franic 2011)

Introduction

A number of healthcare contingent valuation method (CVM) studies in Sub-Sahara Africa have been published such as (Frick, Lynch et al. 2003; Muko, Ngwa et al. 2004; Uzochukwu, Onwujekwe et al. 2010) among others. However, these studies have not been evaluated to assess trends and current practices of CVM studies in Sub-Sahara Africa. Although a similar study had been conducted of studies published from Western populations (Diener, O'Brien et al. 1998), the results obtained cannot be generalized to Sub-Sahara Africa due to the cultural differences between the two populations. Therefore, this evaluation is important because it aims to fill this gap.

The primary objective of this study was to review, classify and provide a critical appraisal of CVM healthcare studies conducted in Sub-Sahara Africa based on criteria provided by O'Brien and Gafni (1996). The results obtained would also serve as a comparison of trends and practices between the Western and Sub-Sahara African populations.

Methods

Article Search Criteria: Comprehensive literature search was conducted using EconoLit, Web of Science, ScienceDirect, Medline, Pubmed and Google Scholar in addition to article reference lists. Searches included terms "Contingent Valuation," "Willingness to Pay" and "Willingness to Accept" cross referenced with "Africa," "Health" and "Healthcare."

Inclusion Criteria: Peer reviewed publications and reports in the English language between 1984 and 2010 reporting CVM studies, willingness to pay (WTP) or willingness to accept (WTA), in Sub-Sahara African healthcare setting. Studies were evaluated using this time horizon because prior to 1984 very few health care CVM studies were published in the Western population (Diener, O'Brien et al. 1998) and none in sub-Sahara Africa

Exclusion Criteria: Studies that did not contain WTP or WTA empirical data, reviews, and publications duplicating empirical data were excluded.

Article Characteristics: Studies obtained were initially analyzed according to type of CVM valuation format and health condition/program evaluated. The critical appraisal was based on a conceptual framework of five questions to classify and critically appraise CVM studies (O'Brien and Gafni 1996; Diener, O'Brien et al. 1998). These questions are:

1. What question do we want to answer?
2. What type of measure can we use?
3. What do we need to ask of whom?
4. What characteristics of the program are important for determining how it is valued?
5. What question formats minimize bias and increase precision?

Results

Type of CVM Valuation Format

Of the 28 included studies, none were published prior to 1996, 14%(4) were published between 1991-2000, while 86%(24) were published between 2001-2010.

Majority of the studies provided estimates of WTP values using a single valuation format (Figure 1.2). Bidding game format was used most frequently in 36% (10/28) of the studies (Asenso-Okyere, Osei-Akoto et al. 1997; Onwujekwe, Shu et al. 1998; Asafu-Adjaye and Dzator 2003; Frick, Lynch et al. 2003; Binam, Nkama et al. 2004; Muko, Ngwa et al. 2004; Lwambo, Siza et al. 2005; Wiseman, Onwujekwe et al. 2005; Onwujekwe, Okereke et al. 2009; Uzochukwu, Onwujekwe et al. 2010), followed by the dichotomous choice format in 29% (8/28) of the studies (Weaver, Ndamobissi et al. 1996; Whittington, Pinheiro et al. 2003; Asfaw and Braun 2004; Bishai, Pariyo et al. 2004; Mujinja, Makwaya et al. 2004; Habbani, Groot et al. 2006; Saulo, Forsberg et al. 2008; Chase, Sicuri et al. 2009), then the open ended format (11%, 3/28 studies) (Echessah, Swallow et al. 1997; Lewallen, Geneau et al. 2006; Ataguba 2008), and the payment card method (11%, 3/28 studies) (Forsythe, Arthur et al. 2002; Masiye and Rehnberg 2005; Udezi, Usifoh et al. 2010).

Four of the 28 papers compared different elicitation formats; binary with follow up and bidding game (Onwujekwe, 2001), take it or leave it with bidding game (Dong, Kouyate et al., 2003), structured haggling technique with bidding game and binary with follow up (Onwujekwe, 2004), and dichotomous choice with follow up and stochastic payment card (Ataguba, Ichoku et al., 2008). Appendix 1 is a classification of all the retrieved papers by elicitation format included in this study.

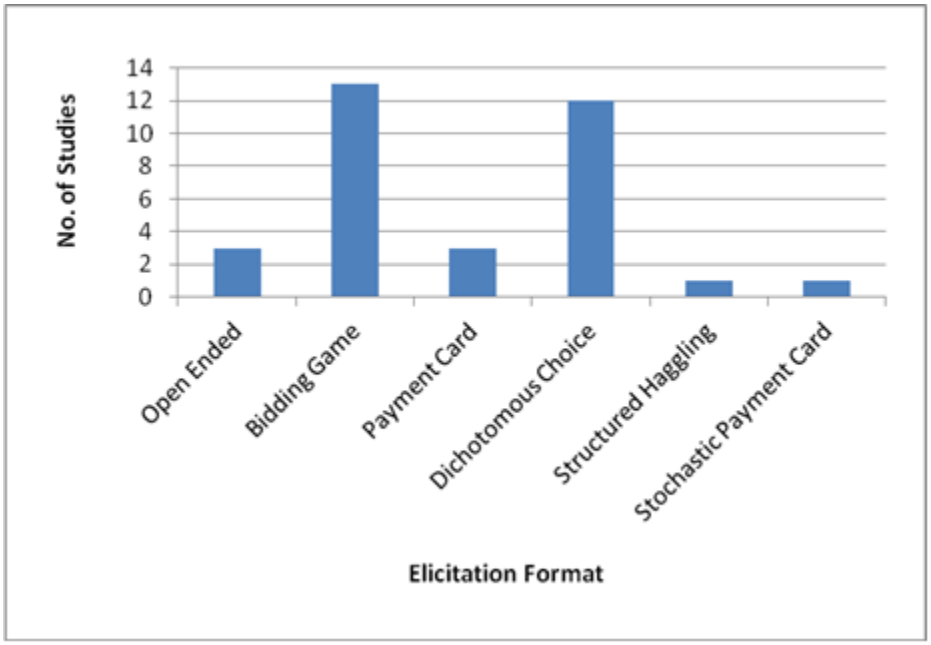


Figure 1.2: Summary of WTP Elicitation Formats in Healthcare used in Sub-Sahara African Countries

Health Conditions

The diseases evaluated were dominated by prevention and treatment of malaria 11 (39%). HIV/AIDS prevention, testing and treatment followed with 3 (11%) studies published. Other disease states evaluated were trypanosomiasis, cataract surgery, schistosomiasis and helminthiasis, trachoma blindness and onchocerciasis each with one study each. Remaining 9 (32%) studies evaluated community health insurance programs and public health improvements. Figure 1.3 is a summary of the content areas of the retrieved studies.

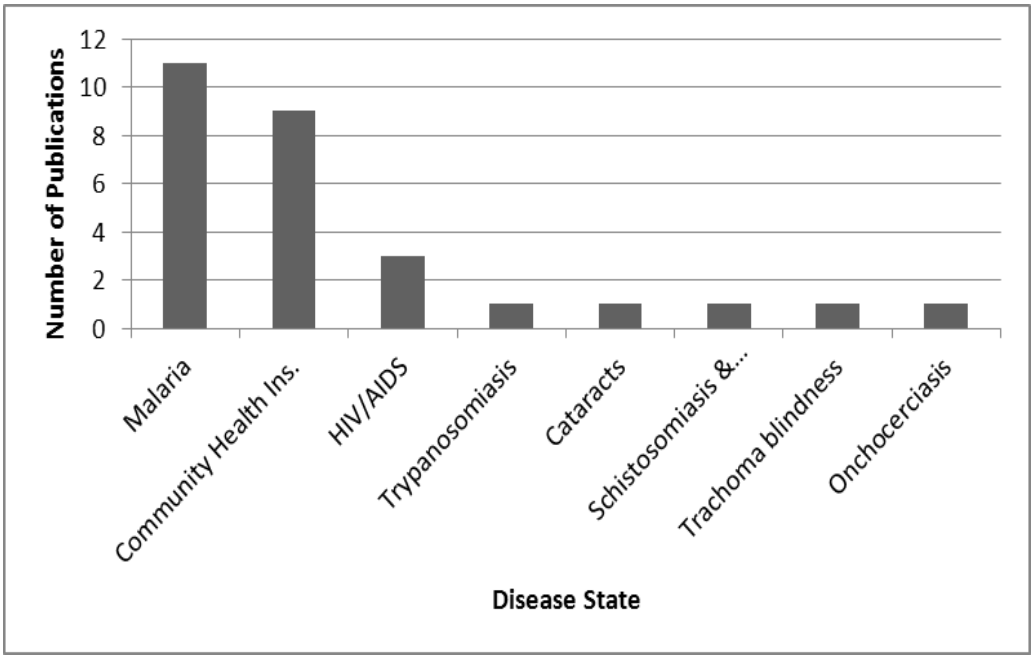


Figure 1.3: Content area of Retrieved Contingent Valuation Method Studies

Secondary Evaluation

1. What question do we want to answer?

Willingness to pay (WTP) studies that provide monetary valuation of healthcare can be used to determine consumer demand or value. All but one of the studies analyzed were concerned with pricing and demand: Forsyth et al (2002) conducted an economic evaluation of voluntary counseling and testing services for HIV/AIDS in Kenya.

Majority of the retrieved studies (54%) evaluated program introduction. The balance (46%) were concerned with programs or products already in existence but financed by other mechanisms such as governments or donors. None of the studies investigated program removal and by inference, none of the studies evaluated respondents' disutility.

2. What type of measure can we use?

All the studies evaluated utility changes using compensating variation. Since all the studies were concerned with gains in utility with program introduction or improvements, all studies employed the WTP method and none considered WTA

3. What do we need to ask of whom?

Different populations are surveyed during contingent valuation depending on authors' objectives. Majority of the studies involved surveying the general population. Approximately 72% of the studies were ex-ante insurance based because the study populations did not have the condition and were assumed to be at risk, while only five studies (17%) surveyed populations that were currently diseased or current users of the programs. In one study, the intervention was ex-ante user based. Lewallen at al interviewed patients requiring cataract surgery in rural Tanzania (Lewallen, Geneau et al. 2006).

In another study, the authors conducted a study involving both the general population and patients diagnosed with malaria in south east Nigeria. For the general population, the study was ex-ante insurance based while the diagnosed patients were classified as ex-post (Uzochukwu, Onwujekwe et al. 2010).

4. What characteristics of the program are important for determining how it is valued?

Consumption of healthcare as a commodity produces outcomes that are uncertain (O'Brien and Gafni 1996). Majority of the studies (82%) valued programs with uncertain outcomes. The remaining studies (18%) evaluated certain outcomes such as guaranteed access to malaria treatment facilities (Masiye and Rehnberg 2005); malaria vaccine that

would prevent malaria for one year (Whittington, Pinheiro et al. 2003); undergoing cataract surgery (Lewallen, Geneau et al. 2006); provision of a school based worm treatment program (Lwambo, Siza et al. 2005); and rapid diagnostic testing for malaria treatment (Uzochukwu, Onwujekwe et al. 2010).

All the studies evaluated the programs using the private goods market. None of the studies used the political market such as taxation or increased utility bills as payment vehicle.

5. What question formats minimize bias and increase precision?

The scenarios in CVM studies can be evaluated as holistic or as decomposed (O'Brien and Gafni 1996). Of the retrieved studies, 89% evaluated holistic scenarios. Three studies (11%) evaluated decomposed outcomes. In Uganda, respondents were asked to value hypothetical HIV vaccines with differing efficiencies and costs (Bishai, Pariyo et al. 2004); seven health services quality improvements in Central African Republic (Weaver, Ndamobissi et al. 1996); and three hypothetical Malaria vaccines in Nigeria (Udezi, Usifoh et al. 2010).

Of the 28 retrieved CVM studies conducted in Sub-Sahara Africa, all employed face-to-face interviews. Table 1.3 is a summary of the results of this review.

Table 1.3: Results of the Review and Classification of Contingent Valuation Method Studies in Sub-Sahara Africa

Question and Consideration	**No. of Studies**	**%**
1. What Question do we want to Answer?		
a. Problem definition		
i. Pricing and demand studies	27	96
ii. Project appraisal for resource allocation	1	4
b. Current Status of the program		
i. Program currently exists	13	46
ii. Program introduction	15	54
iii. Program removal	0	0
c. Utility/disutility of the program		
i. Gain in utility from program	28	100
ii. Loss in utility from program	0	0
2. What type of measure can we use?		
a. Money measure of utility change		
i. Compensating variation (CV)	28	100
ii. Equivalent variation (EV)	0	0
b. Valuation method employed		
i. Willingness to pay (WTP)	28	100
ii. Willingness to accept (WTA	0	0
3. What do we need to ask of whom?		
a. Externality and option value		
i. Currently diseased	5	17
ii. At future risk	0	0
iii. Not at future risk	0	0
iv. General population	24	83
b. Framing of program consumption and payment		
i. Ex-post user based	5	17
ii. Ex-ante user based	3	11
iii. Ex-ante insurance based	21	72
4. What characteristics of the program are important for determining how it is valued?		
a. Program outcome description		
i. Certain Outcomes	5	18
ii. Uncertain outcomes (probability)	23	82
b. Nature of the market for valuation		
i. Private goods market	28	100
ii. Public market	0	0

Table 1.3 Continued

Question and Consideration	No. of Studies	%
5. What question formats minimize bias and increase precision?		
a. Valuation scenario		
i. Holistic	25	89
ii. Decomposed	3	11
b. Valuation elicitation method		
i. Open Ended	3	9
ii. Bidding Game	13	39
iii. Payment Card	3	9
iv. Dichotomous Choice	12	36
v. Structured Haggling	1	3
vi. Stochastic Payment Card	1	3
c. Survey method		
i. Face-to-face	28	100
ii. telephone	0	0
iii. Mail	0	0
iv. internet	0	0

Discussion

In this review, the majority of CVM studies analyzed were valuations of communicable disease in pricing and demand studies to determine factors that affect the uptake of the proposed programs. This is probably not surprising given that malaria is a leading cause of morbidity followed by other acute infections in Sub-Sahara African countries. This is in contrast to a similar review of CVM studies conducted over 10 years ago focusing on chronic conditions or non-communicable diseases (NCDs) for resource allocation in non-Sub-Saharan African countries (Diener et al., 1998).

Community health insurance and public health improvements were the second most commonly evaluated services. Perhaps this was in response to the Bamako initiative (BI) adopted in 1987 by African countries (UNICEF, 1990). BI promoted health sector financing reform in response to decreased donor funding. Resulting research and policy debates have focused on WTP for essential services.

All reviewed studies used WTP as opposed to WTA. This is consistent with the Blue Panel of the National Oceanic and Atmospheric Administration (NOAA) recommendations (Arrow et al., 1993) and familiarity with how most individuals make decisions.

Another notable absence was the lack of political markets. The hypothetical market may be modeled as either a private goods or political market (Mitchell and Carson 1989). All the studies in this review were structured as a private goods market. This may be explained by socialized health care programs being a relatively new concept and therefore not integrated into hypothetical scenarios. This may also be a reflection of

political mistrust that can be attributed to the turmoil and strife in recent Sub-Sahara African history.

CVM elicitation formats were dominated by the bidding game. This may be a reflection of the African market places where discussion concerning item prices takes place. The new technique, structured haggling, proposed by Onwujekwe (2004) reflects more closely the African market place. Unlike the bidding game, the offer amount is not allowed to "bid up".

Conclusion and Relevance to Current Study

During the development of the SH technique, Onwujekwe (2004) compared the new novel method to the bidding game and binary with follow-up. However, this new technique was not compared to the open ended (OE) or the payment card (PC) method.

The open ended method will not be used in the study. In previous studies, the results provided using the open ended technique were "..so poor that other methods had to be developed" due to the unreliability of the responses (Smith 2000) (pg. 194). In a comparison between OE and PC techniques, there were fewer zero values in PC responses, which is beneficial because it indicates less protest bids, and therefore is more likely to elicit true consumer surplus (Donaldson, Thomas et al. 1997).

In Western countries, the PC method has been widely used in healthcare studies involving non-communicable diseases including diabetes (Hammerschmidt, Zeitler et al. 2003), gout(Khanna, Ahmed et al. 2008), rheumatoid arthritis (Fautrel, Clarke et al. 2007), colorectal cancer screening (Frew, Wolstenholme et al. 2001) and hearing loss (Grutters, Anteunis et al. 2009). The PC has been recommended in small CVM studies

(Bayoumi 2004). Considering the disadvantages of OE (unreliable results, cognitively challenging) the merits of PC (contextual reference and mimicking real life purchasing experiences) (Mitchell and Carson 1989; Ryan, Scott et al. 2004) and its wide usage in valuing non-communicable diseases, this proposal will compare structured haggling to the payment card method in eliciting WTP values for a primary diabetes type 2 prevention program in rural Kenya.

WTP values can be collected via face-to-face interviews, mail, telephone or through the internet (Rascati 2008). A 1993 report by the National Oceanic and Atmospheric Administration (NOAA) recommended the use of personal interviews in eliciting WTP values as they were the most reliable (Arrow, Solow et al. 1993). All the CVM studies in Sub-Sahara used face-to-face interactions. Additionally, the structured haggling technique requires in-person interaction. Consequently, this current proposal will use structured face-to-face interviews comparing SH and PC using the WTP format.

The majority of the studies reviewed analyzed valuation of communicable diseases. This proposal is uniquely different in that the analysis will be conducted for a non-communicable disease, type 2 diabetes in rural Kenya.

1.5 Preliminary Study II – Pilot Testing

Introduction

Pretesting evaluates in advance whether a questionnaire causes problems for interviewers and/or respondents. There are several methods of pretesting; conventional, conventional with supplements and cognitive interviews (Presser, Couper et al. 2004). For the purpose of this study, the conventional pretesting method was used with cognitive debriefing. In conventional pretesting, the questionnaire is administered as planned for the actual study. Responses are tallied and interviewer relates the experience with the questions and offer views about the questionnaire problems. There is remarkable confidence that using 20-50 cases is usually sufficient to discover major flaws in a questionnaire (Presser, Couper et al. 2004).

Methods

Participants

A cross-sectional descriptive study design was used. Potential study participants were invited to participate in the study through the University of Georgia International Students Life listserv. An invitation was emailed to all international students on the listserv inviting requesting Kenyan students and their Kenyan friends to participate. All men and women of Kenyan origin aged 18 years and older were invited to participate in the study.

Survey Development

The survey was divided into four sections: background information, WTP elicitation, respondent information (sociodemographics and respondents familiarity with diabetes), and interview completion.

a. Background Information

Section 1 presented background information on diabetes to participants to ensure that they understood the scenario presented. The background information was presented using a holistic scenario approach where a complete description of the program is presented, as recommended in CVM studies because it is likely to provide unbiased estimates (O'Brien and Gafni 1996).

The background section on diabetes included information on its prevalence, risk factors, problems, and a primary diabetes prevention program. Diabetes prevalence for rural Kenyan residents was estimated at 2.2%. (Christensen et al, 2009). The risk factors for diabetes (increasing age, gender, family history, obesity, hyperglycemia, hypertension, smoking) and the consequences of untreated diabetes (heart disease, visual difficulties, kidney/nerve damage) were obtained from various publications (Beers and Berkow 1999; Gan 2010; IDF 2010; ADA 2011). The benefit of a diabetes education, screening and referral program to rural residents proposed in the study is to prevent residents from developing type 2 diabetes. Similar studies that had been conducted had seen the risk of developing diabetes reduced by approximately 43% (Knowler, Barrett-Connor et al. 2002; Lindström, Ilanne-Parikka et al. 2006).

b. WTP Elicitation

In section two, willingness to pay amounts to be used in the SH and PC elicitation formats were obtained through consultations with Vincent Mbugua, a diabetes educator in Kenya Diabetes Management and Information Centre (April 2010). The maximum amount on the PC and SH (Ksh 600) was obtained from charges that a diabetic patient

would incur for a medical specialist visit such as an endocrinologist at the Kenyatta National Hospital, a tertiary referral hospital in Kenya (KNH 2011). The lowest amount was zero to capture the full range of values including no perceived value for the program represented by "zero bids."

The template for the SH technique was adopted from Onwujekwe et al's (2008) study comparing three WTP methods (SH, the bidding game and dichotomous choice) in Nigeria. In his study, Nigerian Naira (i.e. Nigerian currency) was used to elicit WTP prices. The present proposal replaced Nigerian Naira with Kenya Shilling (Ksh) to reflect the market place transaction in rural Kenya and removed the term "price" so as to obtain respondent perceived value and avoid relational bias. Relational bias occurs when the scenario also includes related information to other public or private commodities that in turn may influence or anchor the respondents' elicited WTP amount (Mitchell and Carson 1989). The template for the PC was adopted from Donaldson et al (1995) and included an additional follow-up question that asked the respondents for their maximum willingness to pay. The PC with follow-up question has been recommended in small CVM studies (Bayoumi 2004).

The PC and SH items are formatted to ask how much respondents would be WTP annually. This approach was taken because the diabetes prevention program mimics the annual physical examination procedure supported by clinicians in Western healthcare settings (Prochazka, Lundahl et al. 2005). Payment for health services in Kenya is expected at point of care in form of "user fees" (Chuma, Musimbi et al. 2009). Therefore, requiring annual payments for annual participation is consistent with how Kenyan participants would utilize a health service.

c. Respondent information

Sociodemographics: Items selected for socio-demographic questions were adapted from a previous WTP study conducted in Sub-Sahara Africa (Onwujekwe, Fox-Rushby et al. 2008). These items are similar to CVM studies completed in Western populations except for the use of a proxy metric for income. Authors included income proxies (measures of economic wellbeing) of car ownership and monthly expenditures. This approach was taken because in previous studies conducted in Sub-Sarah Africa (Kenya and in Nigeria), most participants refused to divulge information regarding income because this was regarded as an extremely personal question. Therefore, the authors used the proxies such as monthly expenditures and car ownership for WTP analysis (Onwujekwe 2001; Forsythe, Arthur et al. 2002). In the present study, similar to Onwujekwe et al (2008) car ownership will be used as a proxy to income.

Diabetes knowledge: Diabetes predisposing factors that potentially would affect WTP values increasing age, gender, family history, obesity, hyperglycemia, hypertension and smoking (Beers and Berkow 1999). These were adapted from previous studies that had assessed respondents' awareness of diabetes risk factors (Mokdad, Ford et al. 2003; Mukhopadhyay 2010) as well as information provided by DMI (personal communication with Vincent Mbugua April 2010).

d. Interview completion

The final section addressed how confident respondents were with their responses and if the interview was successfully completed. This is important because it assesses

respondents' comprehension of the interview process and feasibility of the interview by recording survey response rate. Additionally, WTP is more strongly related to plausible explanatory variables for respondents who express confidence in their responses (Hammitt and Graham 1999).

Validity

Measures used for economic analysis should be both valid (measuring what it intended to measure) and reliable (measure something in a consistent fashion). The validity of the instrument used in an evaluation based on economics stems from the validity of the theory which the instrument is derived. Under the welfarist approach, the measured outcome must accurately reflect individual preference (Gafni and Birch 1995). Methods of eliciting willingness to pay are considered valid based on theory, therefore by extension, they are considered reliable (Gafni and Birch 1995).

Content validity is the extent to which a measurement reflects the structure of the market and description of the amenity to be valued (Mitchell and Carson 1989). In this study content validity was addressed by review of the CVM survey by an expert panel prior to its administration. The questionnaire was developed with input from 4 University of Georgia faculty members, one of them being a pharmacy clinician with experience in diabetes education. The two faculty members have experience in public health and pharmacy while the fourth, Dr. John C. Bergstrom professor of Agricultural and Applied Economics, is an expert in contingent valuation studies. The questionnaire (appendix 2 and 3) was sent to 2 clinical officers for review at the Nairobi Audiology

Center in Kenya for input. These clinicians were selected due to their experience working with Kenyan patients from both rural and urban Kenyan population.

Reliability

Hypothetical bias is a threat to reliability and arises due to the nature of CVM studies in which hypothetical questions are asked in lieu of actual markets. The respondent has no incentive to provide accurate answers which reflect their true preferences (Mitchell and Carson 1989). In this study hypothetical bias was addressed by review of the CVM scenarios (PC and SH surveys) by the expert panel to ensure that they were realistic and neutral in addition to the use of "cheap talk" prior to elicitation the final WTP bid (Cummings and Taylor 1999). Cheap talk minimizes hypothetical bias by reminding respondents to think through their responses carefully to prevent misstating their values (Aadland and Caplan 2003). The following "cheap talk" text was added to both PC and SH surveys as recommended by Cummings and Taylor (1999).

"In studies such as this one, past research shows that people sometimes are reluctant to say how much they really value a health program. To help us learn how much the proposed diabetes prevention program is worth to people, could you please think again and tell us the absolute maximum amount you are willing to pay per year to participate in the program?"

Practicality and Feasibility

Practicality of an interview instrument can be assessed by how well the respondents accept and respond to the questionnaire. This can be achieved through

assessment of the response rate, completion rate as well as how long an instrument takes to complete. A brief instrument is ideal. The length of time it takes for administration of the instrument has implications for the feasibility of the study such that lengthy instruments are costly and may cause respondent fatigue (Brazier and Deverill 1999). In this study a brief survey is considered to take less than 15 minutes to complete (McHorney and Tarlov 1995).

Data Collection

Data was collected via face to face structured interviews with each respondent as recommended by Arrow et al (1993). Prior to the interview respondents were randomly assigned to one of two willingness to pay (WTP) techniques: payment card (PC) or structured haggling (SH). During the interview respondents were asked to complete the first 3 sections of the survey while section 4 was completed by the PI.

In section 1, the respondents were given background information regarding diabetes and the potential benefits of a diabetes prevention program.

In section 2, the respondent was asked to give a WTP amount for a program aimed at preventing diabetes in rural Kenya. Half the respondents (n=15) were randomly assigned the PC technique while the other half the SH technique. In the PC methods respondents were asked to identify in two to three questions the maximum amount they would be willing to pay for access to the program from a card listing several monetary options. In the SH method respondents were asked to respond to up to six questions to determine what is the maximum they would be willing to pay for the program (Appendix 2 and 3).

In section 3 respondents were asked to respond to socio-demographic questions and questions regarding their familiarity and experiences with diabetes. Cognitive debriefing was conducted at the end of the survey by asking respondents to provide comments regarding the questionnaire. This was an open ended question. Participants received $10 as an incentive for their participation. The study was approved by the UGA's Institutional Review Board prior to initiation.

Analysis

Responses were recorded on paper questionnaires and tabulated using Microsoft Excel® spreadsheet and SPSS 18.0. Analysis of the data included frequency plots to determine distribution and detect any problems with the survey. Percentages were reported for nominal data, and for interval data means and standard error of the means (SEM) were reported.

Results:

Participants

Thirty respondents completed the survey. There were no dropouts or incomplete surveys. Majority of the participants were male (60%), average age 36.73 (SD 9.42), married (70%), graduated from college (90%), and were employed or self-employed (86.7). The mean number of household members per respondent was 3.2. Nearly all of the respondents owned cars (96.7%), and the average household monthly expenditure was $2,113 (SD 1,264.2). When questioned about the confidence in the answers they

gave during the structured interview, most were very confident (96.7) (Table 1.4). The questionnaire took approximately 12 minutes to complete. During the cognitive debriefing process, most of the respondents commented that the questions were easy to understand and easy for them to provide responses.

Table 1.4: Pilot Sociodemographic Summary Statistics (n=30)

Respondent Characteristics	**No. (%)**
1. Gender	
Female	12 (40)
Male	18 (60)
2. Education Level	
High school/Secondary education	1 (3.3)
Post-secondary Education	2 (6.7)
College graduate	15 (50)
Post-graduate education	12(40)
3. Marital Status	
Single	8 (26.7)
Widowed	1(3.3)
Married	21(70)
Cohabit	0 (0)
4. Employment status	
Employed	20 (66.7)
Self employed	6 (20)
Not employed	0
Student	4(13.3)
5. Household monthly expenditure	
Mean (SEM)	$ 2,385 (243.3)
Range	$600-6000
6. Car Ownership	
Yes	29 (96.7)
No	1 (3.3)
7. Number of Family Members	
Mean	3.2
Range	1-6
8. Average Age	
Mean (SEM)	42.23 (1.81)
Range	18-58
9. Confidence in answers	
Very confident	29 (96.7)
Somewhat confident	1 (3.3)

Not too confident Not at all confident	0 0

Diabetes familiarity and pre-disposing factors

All participants reported having heard about diabetes. Approximately three-quarters had relatives with diabetes (73%) and two of the participants had type 2 diabetes. When asked about other diabetes predisposing factors, none of the respondents reported smoking, three had high blood pressure and eleven reported being obese or overweight (Table 1.5).

Table 1.5: Diabetes Familiarity and Predisposing Factors

Factor	**N (%)**
1. Familiarity with diabetes	
Yes	30 (100)
No	0
2. Participants that have diabetes	
Yes	2 (6.7)
No	28 (93.3)
3. Relatives with diabetes	
Yes	22 (73.3)
No	8 (26.7)
4. Participants with high blood pressure	
Yes	3(10)
No	27(90)
5. Smoker	
Yes	0
No	30 (100)
6. Obese or Overweight	
Yes	11(36.7)
No	19 (63.3)

Willingness to pay

WTP responses were available for all 30 respondents (Table 1.6). Mean (SEM) bids for SH and PC were US$19.1 (6.72) and US$14.9 (5.72), respectively. Almost 90% of the respondents that were interviewed using the SH technique quoted maximum bids beyond the presented maximum structured haggling amount of Ksh 600 (Figure 1.1). This is in contrast to the participants that responded using the PC technique where majority of the participants (64.2%) quoted maximum bids less that the presented maximum amount of Ksh 600. None of the respondents reported zero bids.

Table 1.6: Pilot study SH and PC willingness to pay summary

Characteristics	**Structured Haggling US$ 2011 (Ksh**) N=16**	**Payment Card US$ 2011 (Ksh**) N=14**
Range	0.12 (10) – 125 (10,000)	1.17(100) – 70.26 (6,000)
Mean	19.1 (1,629)	14.9 (1,275)
SEM	6.72 (574)	5.72 (488)
Median	11.7 (1,000)	6.44 (550)

** Based on May 2011 Currency Exchange rate (1 US$=85.4 Ksh) (Central Bank of Kenya 2011)

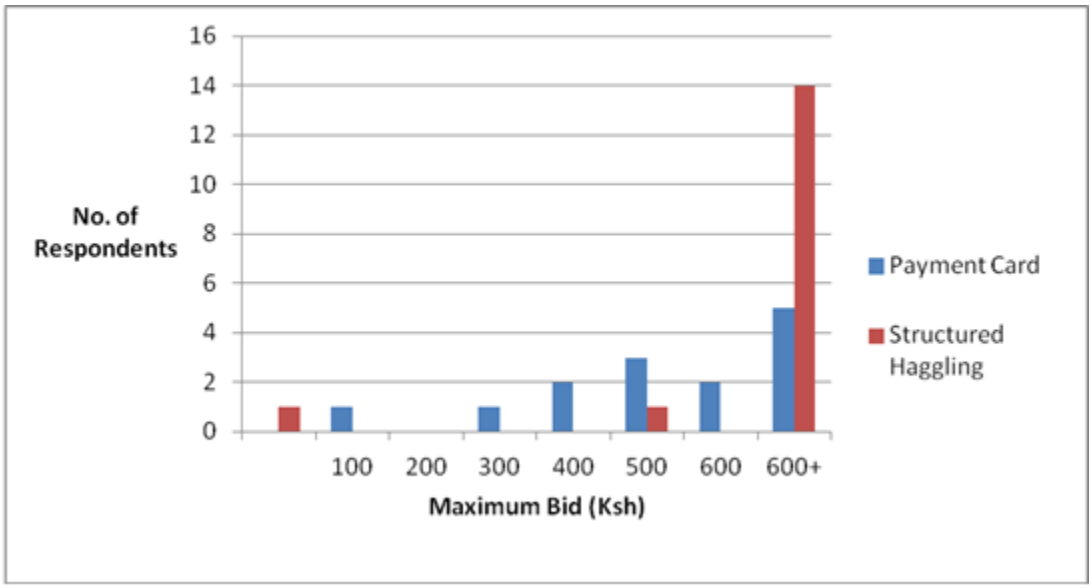


Figure 1.4: Payment Card and Structured Haggling Maximum Bid Distribution

Discussion and Implications for the Current Study:

The purpose of this pilot study was to evaluate the questionnaire for any potential problems that may be encountered during the structured face to face interview process. From the results, there was 100% completion rate: all respondents provided responses to all the items, and there were no dropouts. Surveys were completed in an average of 12 minutes meeting the requirement of practicality (McHorney and Tarlov 1995). This implies that the proposed study is both practical and feasible.

There were no significant problems reported with the survey. Although the participants using the SH and PC technique quoted maximum bids beyond the presented amounts, the current proposal will not change the WTP values as the targeted Kenyan rural population will have lower social economic status compared to the pilot study respondents (Kenyan students and their friends residing in Georgia).

Based on the results of the pilot study, there will be a few minor changes to some questions that assess the respondents' predisposing factors to diabetes. Dichotomous item responses (i.e., "yes" or a "no" answers) regarding respondents' familiarity with diabetes and smoking habits (Table 1.5 item 1 and 5) demonstrated ceiling and floor effects. These item responses will be expanded to provide more response options to capture more data points and prevent floor and ceiling effects. The item responses regarding relatives with diabetes (Table 1.5 item 3) will also be expanded to differentiate between a diagnosis of diabetes in immediate family versus distant relatives. The dichotomous question that asked if respondents considered themselves as obese or overweight (Table 1.5 item 6) will also be expanded to more response options. This question will now ask about the respondent' perception of their own weight status whether overweight, underweight or about right weight. This proposal will have an additional item that asks respondents to assess their perceived risk of developing diabetes on a semantic differential scale that was not included in the pilot study. (Please see Appendix 4 for these item changes). .

1.6 Study Hypotheses

This study's specific objectives are to determine the willingness to pay (WTP) for a diabetes education, screening and referral programs in rural Kenya and use the estimates to determine the net social benefit of the program. The project will be utilizing two different methods of soliciting willingness to pay values; structured haggling (SH) and payment card (PC). Based on these objectives, the hypotheses are:

$H0_1$: Willingness to pay values for a diabetes education, screening and referral program in rural Kenya using the payment card technique will equal zero ($WTP_{PC} = 0$)

HA_1: Willingness to pay values for a diabetes education, screening and referral program in rural Kenya using the payment card technique will be greater than zero ($WTP_{PC} > 0$)

and

$H0_2$: Willingness to pay values for a diabetes education, screening and referral program in rural Kenya using the structured haggling technique will equal zero ($WTP_{SH} = 0$)

HA_2: Willingness to pay values for a diabetes education, screening and referral program in rural Kenya using the structured haggling technique will be greater than zero ($WTP_{SH} > 0$)

Willingness to pay surveys using different solicitation formats typically yield different results. This study will investigate this phenomenon by employing the new

Structured Haggling (SH) and the widely used Payment Card (PC) techniques to value the diabetes prevention program in rural Kenya. A comparison of elicitation formats will sufficiently yield valuable estimates to inform policy makers. Therefore:

$H0_3$: There is no significant difference in the WTP values for a diabetes education, screening and referral program in rural Kenya obtained using structured haggling and payment card methods. ($WTP_{SH} = WTP_{PC}$)

HA_3: There is a significant difference in the WTP values for a diabetes education, screening and referral program in rural Kenya obtained using structured haggling and payment card methods. ($WTP_{SH} \neq WTP_{PC}$)

Several confounders may affect responses to the WTP question. The current proposal will analyze how confounders such as income influence WTP responses. Additionally, individuals' perceptions of risk factors related to diabetes also affect their WTP for a diabetes prevention program. The current proposal will also analyze how individuals self-assessed diabetes risk factors influence their WTP responses.

$H0_4$: Economic wellbeing, diabetes risk factors and self-assessed risk of developing diabetes have no influence on WTP values of a diabetes education, screening and referral program in rural Kenya

HA_4: Economic wellbeing, diabetes risk factors and self-assessed risk of developing diabetes have a significant positive influence on WTP values of a diabetes education, screening and referral program in rural Kenya

The primary goal of CBA studies is to identify projects where the net social benefit is greater than zero. Projects favored for implementation typically have positive values (Drummond, Sculper et al. 2005). The value of the program to rural residents in Kenya is unknown. Therefore:

$H0_5$: Net social benefit of a diabetes education, screening and referral program in rural Kenya will be equal zero compared to the status quo ("do nothing"). (NSB = 0)

HA_5: Net social benefit of a diabetes education, screening and referral program in rural Kenya will not equal zero compared to the status quo ("do nothing"). (NSB $\neq$ 0)

CHAPTER 2

METHODS

This chapter describes the participants, materials and procedures to be used in the proposed study. This study's primary objective is to answer the question of whether or not the residents of rural Kenya view a diabetes primary prevention program that offers education, screening and referrals as beneficial.

2.1 Study design

This project is a cross-sectional descriptive study using face to face interviews designed to value a diabetes prevention program in rural Kenya using the contingent valuation method. Specifically, participants in rural Kenya will be asked how much they would be willingness to pay (WTP) for a diabetes prevention program. For projects answering questions related to "what" or "how much," a cross-sectional non-experimental design is appropriate (Schafermeyer and Hurd 1998).

2.2 Target Population

The target population for this proposal is adult residents residing in Kiambu, a county located in central Kenya with an adult population of 1.1 million (KNBS 2009; KODP 2011) on the northern border with Nairobi, the capital and largest city of Kenya. This county has been selected due to its proximity to Nairobi which predisposes the county to rising prevalence of diabetes among its residents. Kiambu is predominantly

rural although its urban population is increasing. Unfortunately, this is regarded as a serious problem given the lack of access to resources in rural areas in Sub-Sahara Africa. (Personal communication with Vincent Mbugua, diabetes educator at Kenya Diabetes Management and Information Centre, April 2010). Diabetes prevalence in this county area is estimated to be 2.2% (Mbanya, Motala et al. 2010). This may be an underestimation due to the number of cases that go unreported. These rural residents are facing increasing diabetes prevalence and lack of adequate health facilities to cope with the demand. Therefore, a diabetes prevention program is suitable in this county.

2.3 Participants

Study participants will be recruited using convenience sampling of rural residents of Kiambu County in Kenya. Study inclusion criteria are all male and female adult residents of Kiambu County in rural Kenya aged 18 and older, that are able to communicate in the English language. English is the language of instruction in Kenyan schools (Michieka 2005). The percentage of the rural population above 15 years of age that can read and write English is 82% (CIA 2011; KIHBS 2011). For this proposal, individuals unable to communicate in English will be excluded.

2.4 Instrument Development

Items selected for questionnaire inclusion were based on the pilot study conducted earlier (Chapter 1, Section 1.5). The survey was divided into four sections; background information, WTP elicitation, respondent information and interview completion.

2.4.1 Introduction

Section 1 presented background information on diabetes to ensure respondents understood the scenario presented. The background information was presented using a holistic scenario approach in which a complete description of the program was presented, as recommended in CVM studies because it is likely to provide unbiased estimates (O'Brien and Gafni 1996).

The background section on diabetes included information on its prevalence, risk factors, problems, and a primary diabetes prevention program. Diabetes prevalence for rural Kenyan residents was estimated at 2.2%. (Christensen et al, 2009). The risk factors for diabetes (increasing age, gender, family history, obesity, hyperglycemia, hypertension, smoking) and the consequences of untreated diabetes (heart disease, visual difficulties, kidney/nerve damage) were obtained from various publications (Beers and Berkow 1999; Gan 2010; IDF 2010; ADA 2011). The benefit of a diabetes education, screening and referral program to rural residents proposed in the study is to prevent residents from developing type 2 diabetes. In Alberta Canada, the Mobile Diabetes Screening Initiative (MDSI) that transports diagnostic equipment and a team of healthcare professionals to provide diabetes counseling to rural areas once a year is similar to the program proposed in this study. On the second visit, of the diabetic patients, there were significant improvements in body mass index, blood pressure, total cholesterol, and Hemoglobin A1c. Those without diabetes had improvements in blood pressure (Ralph-Campbell, Oster et al. 2011). In a UK study, a prospective cohort of 24,155 participants have been followed (mean 4.6 years) in the EPIC-Norfolk study and the authors determined that if the participants were able to meet one more goal (decreased Body mass index, fat intake, saturated fat intake, increase fiber intake and physical

activity) the incidence of diabetes would be predicted to fall by 20% (Simmons, Harding et al. 2006).

The WTP scenarios risk information (prevalence) as well as benefits of the program will be presented with these examples from similar programs. (please see appendices 5 and 6). .

2.4.2 WTP Elicitation

In section two, willingness to pay amounts used in the SH and PC elicitation formats were obtained through consultations with Vincent Mbugua, a diabetes educator in Kenya Diabetes Management and Information Centre (April 2010). The maximum amount on the PC and SH (KSh 600) was obtained from charges that a diabetic patient would incur for a medical specialist visit such as an endocrinologist at the Kenyatta National Hospital, a tertiary referral hospital in Kenya (KNH 2011). The lowest amount was zero to capture the full range of values including no value for the program represented by "zero bids."

The template for the SH technique was adopted from Onwujekwe et al (2008) study comparing three WTP methods (SH, the bidding game and dichotomous choice) in Nigeria. In his study, Nigerian Naira (i.e. Nigerian currency) was used to elicit WTP prices. The present proposal replaced Nigerian Naira with Kenya Shilling (KSh) to reflect the market place transaction in rural Kenya and removed the term "price" so as to obtain respondent perceived value and avoid relational bias that occurs when the scenario presents includes value information about similar goods which may bias or anchor respondents WTP bid amounts (Mitchell and Carson 1989) .

The template for the PC was adopted from Donaldson et al (1995) and included an additional follow-up question that asked the respondents for the maximum willingness to pay. The PC with follow-up question has been recommended in small CVM studies (Bayoumi 2004).

The PC and SH items were formatted to ask how much respondents would be WTP annually. This approach was taken because the diabetes prevention program mimics the annual physical examination procedure supported by clinicians in Western healthcare settings (Prochazka, Lundahl et al. 2005). Payment for health services in Kenya is expected at point of care in form of "user fees" (Chuma, Musimbi et al. 2009). Therefore, requiring annual participation payments is consistent with how Kenyan participants would utilize a health service.

Although the majority of the respondents in the pilot study reported WTP values greater than the bids provided on questionnaire, these values will not be modified because pilot study participants residing in the United States are expected to have a higher socio-economic status compared to the target population in rural Kenya.

2.4.3. Respondent information

Sociodemographic: Items selected for socio-demographic questions were adapted from a previous WTP study conducted in Sub-Sahara Africa (Onwujekwe, Fox-Rushby et al. 2008). These items are similar to CVM studies completed in Western populations except for the use of a proxy metrics for income. Authors included the income proxies of car ownership and monthly expenditures. This approach was taken because in previous studies conducted in Sub-Sarah Africa (Kenya and in Nigeria), most participants refused

to divulge information regarding income because this was regarded as an extremely personal question. Therefore, the authors used the proxies to measure economic wellbeing such as monthly expenditures and car ownership for WTP analysis (Onwujekwe 2001; Forsythe, Arthur et al. 2002). In the present study, similar to Onwujekwe et al (2008) car ownership will be used as a proxy to income.

Several questions on economic wellbeing and diabetes knowledge will be modified based on the pilot study results (Appendix 4). Car ownership will be assessed from a household level and not the individual level. In most rural households, the head of the household may own the vehicle but it may be utilized by other family members (Peters 2010). It is expected that these family members will have a higher socio economic status than their counterparts in households without a car.

Diabetes knowledge: Diabetes predisposing factors that potentially would affect WTP values increasing age, gender, family history, obesity, hyperglycemia, hypertension and smoking (Beers and Berkow 1999). These were adapted from previous studies that had assessed respondents' awareness of diabetes risk factors (Mokdad, Ford et al. 2003; Mukhopadhyay 2010) as well as information provided by DMI (personal communication with Vincent Mbugua April 2010).

From the pilot results, several questions in this section will also be modified (Appendix 4). The question that asked respondents whether or not they had heard about diabetes will be modified from a dichotomous response option to reflect other studies that address varying levels of familiarity with health conditions (Nutting, Baier et al. 2001), i.e. a 5-point scale from 'not at all familiar' to 'very familiar'. For example, a person

with a relative that had diabetes will have heard about the disease but will have a different experience compared to an individual that had heard about diabetes through media outlets only.

The dichotomous questions assessing respondent smoking habit (Table 2.1 item 15) will be modified to provide three response options (Vartiainen, Seppala et al. 2002). The question regarding relatives with diabetes will be split into two, each with 3 response options (Table 2.1 Items 12 and 13). (Baptiste-Roberts, Gary et al. 2007). The dichotomous question that asked if respondents considered themselves obese or overweight will now ask the respondents' perception of their own weight status whether overweight, underweight or about right weight (Table 2.1 Item 16) (CDC 2009). This proposal will have an additional question that asks respondents to assess their own perceived risk on a 10-point semantic differential scale (Table 2.1 item 10 and 11) (Please see Appendix 4 for these item changes).

2.4.4. Interview completion

The final section addresses how confident respondents were with their responses and if the interview was successfully completed. This is important because it assesses respondents' comprehension of the interview process and analyses survey response rate. Additionally, WTP is more strongly related to plausible explanatory variables for respondents who express confidence in their responses (Hammitt and Graham 1999).

Practicality and feasibility

A brief survey instrument is ideal as this has implications for practicality and feasibility of the proposed study. Practicality and feasibility were assessed in the pilot study (Chapter 1 Section 1.5) by evaluating the completion rate as well as time to complete (Olsen and Donaldson 1998; Brazier and Deverill 1999) . This proposal will also asses the response rate, completion rate and how long an instrument takes to complete for the validation of the practicality and feasibility of the study.

The literacy level in Kenya is 85.1% with English as one of the official languages (WBG 2011). Although predominantly rural, the county is expected to have high literacy rate (Macharia, Kimani et al. 2007). Therefore, the current survey will be conducted in English.

Validity and reliability

Measures used for economic analysis should be both valid (measuring what it intended to measure) and reliable (measure something in a consistent fashion). The validity of the instrument used in an evaluation based on economics stems from the validity of the theory which the instrument is derived. Under the welfarist approach, the measured outcome must accurately reflect individual preference (Gafni and Birch 1995). Methods of eliciting willingness to pay are considered valid based on theory, therefore by extension, they are considered reliable (Gafni and Birch 1995).

A scaling method is valid if it measures accurately what it is intended to measure and is generally thought to be of three types: content, criterion and construct (Froberg and

Kane 1989). Content validity (face validity) is achieved qualitatively by careful selection of attributes investigated.

Content validity is the extent to which a measurement reflects the structure of the market and description of the amenity to be valued (Mitchell and Carson 1989). The pilot questionnaire was developed with input from 4 University of Georgia faculty members, one of them being a pharmacy clinician with experience in diabetes education. The two faculty members have experience in public health and pharmacy while the fourth, Dr. John C. Bergstrom professor of Agricultural and Applied Economics, is an expert in contingent valuation studies. The questionnaire was sent to 2 clinical officers for review at the Nairobi Audiology Center in Kenya for input. These clinicians were selected due to their experience working with Kenyan patients from both rural and urban Kenyan population. The instrument was also piloted with 30 respondents (n=30) with no drop outs or missing items showing that the instrument was interpreted as intended therefore, supporting face/content validity (Please see Chapter 1, Section 1.5). Through this rigorous process, the content validity of the questionnaire was established.

Criterion validity is concerned with whether the measure of the construct is related to other measures which may be regarded as criteria. Suitable criteria are not always available to validate WTP amounts (Froberg and Kane 1989; Mitchell and Carson 1989). Such a criterion would entail the presence of an actual market to compare resulting prices with values obtained from the hypothetical scenario presented for this study.

Construct validity involves the degree to which a measure relates to other measures predicted by theory (Mitchell and Carson 1989). This can be measured through

convergent and theoretical validity. Convergent validity measures the fit between two separate but equal measures of the same construct. Theoretical validity is the degree to which the findings of a study are consistent with theoretical expectations (Mitchell and Carson 1989). The current study will focus on theoretical validity by testing predictions. The results of this study will be used to inform policy makers the value of a diabetes prevention program in rural Kenya. When such a purpose is important, Mitchell and Carson (1989 pg. 207) offer the following suggestion:

> *"Whenever CVM studies are designed with the intent of gathering data to be used for policy purposes it is highly desirable that they take into account the need to produce theoretical based regression equations and that these be presented as a standard part of every CVM study report."*

Theoretical validity will be measured in this study by regressing the WTP amounts on a group of independent variables that theoretically affect WTP and assessing whether the estimated coefficients are consistent with theory based on their sign and significance. The current proposal will regress WTP values onto the following independent variables: socio-demographic characteristics, diabetes knowledge and self-perceived risk of diabetes. Table 2.1 summarizes independent variables to be included in the study, coding, and the expected relationship between the explanatory variables and the WTP values.

Table 2.1 Independent Variables Affecting WTP values

Variable	**Coding**	**Hypothesis (Expected relationship with WTP)**
1. Gender	0=Male 1=female	Males will have higher WTP values because they control the household incomes (Onwujekwe, Fox-Rushby et al. 2008).
2. Education Level	1.No formal Education 2.Adult Education 3.Primary Education 1-4 4.Primary Education 5-8 5.High school/Secondary education 6.Post-secondary education 7.College graduate 8.Post-graduate education	Education increases the level of health awareness. As education level increases the higher the WTP value (Onwujekwe, Fox-Rushby et al. 2008).
3. Marital Status	1.Single 2.Widowed 3.Married 4.Cohabit	Widowed, married and cohabiting individuals will have higher WTP values as they would like to protect their families (Onwujekwe, Fox-Rushby et al. 2008).
4. Employment Status	1.Employed salaried wage earner 2.Self employed i. Farmer ii. Artisan and small scale trading iii. Professional and business people iv. Other ____ 3.Not employed	Employed and self-employed individuals will have higher WTP values reflecting their higher SES status (Onwujekwe, Fox-Rushby et al. 2008).
5. Household Monthly Expenditure	Continuous measure in KSh	This is a proxy for income. The greater the expenditure, the higher the WTP (Forsythe, Arthur et al. 2002).
6. Household car Ownership	1=respondent household owns a car 0=otherwise	This shows enhanced SES and will lead to increased WTP (Onwujekwe, Fox-Rushby et al. 2008).
7. Number of Household residents	Continuous quantitative measure	The greater the number of residents, the higher the WTP value. Members of the household can pull their resources together (Onwujekwe, Fox-Rushby et al.

		2008).
8. assessment of current health status	1. Excellent 2. Very good 3. Good 4. Fair 5. Poor	That the strongest predictor of WTP values for a health status measured is the participants' value of their own current health. Better current health has been associated with higher values. (King, Tsevat et al. 2004)
9. Familiarity with diabetes	1 (not at all familiar) 2 3 4 5 (very familiar)	Individuals that are familiar with diabetes are more likely to have higher WTP values. Adapted from Onwujekwe et al (2008) and Baptiste-Roberts et al (2007).
10a. Diabetes status 10b. In your opinion, how likely are you to develop diabetes?	1=yes 0=no 1 means not at all likely to 10 means very likely.	Individuals who have diabetes are more likely to have higher WTP values. Adapted from Onwujekwe et al (2008), Mokdad et al (2003) and Mukhopadhyay (2010).
11 How serious do you think type 2 diabetes is	1 means not at all serious to 10 means very serious	Adapted from Corso et al 2002
12. Immediate relatives with diabetes	1.yes 2. no 3 (don't know)	Individuals who have immediate relatives with diabetes are more likely to have higher WTP values. Adapted from Onwujekwe et al (2008) and Baptiste-Roberts et al (2007).
13. Distant relative with diabetes	1.yes 2. no 3 (don't know)	Individuals who have relatives with diabetes are more likely to have higher WTP values. Adapted from Onwujekwe et al (2008) and Baptiste-Roberts et al (2007).
14. High Blood Pressure status	1=yes 0=no	Individuals who have diabetes risk factors are more likely to have higher WTP values. Adapted from Onwujekwe et al (2008), Mokdad et al (2003) and Mukhopadhyay (2010).
15. Smoking Status	1. regularly 2. occasionally 3. not at all	Individuals who have diabetes risk factors are more likely to have higher WTP values. adapted from Onwujekwe et al (2008) and

		Vartiainen et al (2002).
16. Perceived Weight	1 overweight 2 underweight 3 about the right weight 4 Refused 5 don't know	Individuals who have diabetes risk factors are more likely to have higher WTP values. Adapted from Onwujekwe et al (2008), Mokdad et al (2003) and Mukhopadhyay (2010).
17. Age	Continuous measure in years	As age increases, there is greater chance of having diabetes type 2. Hence the older population will have higher WTP. Adapted from Onwujekwe et al (2008), Mokdad et al (2003) and Mukhopadhyay (2010).
18. Confidence in responses	1.Very confident 2.Somewhat confident 3.Not too confident 4.Not at all confident	WTP is more strongly related to plausible explanatory variables for respondents who express confidence in their responses (Hammitt and Graham 1999).

2.5 Data Collection

2.5.1 Willingness to Pay

An invitational flyer (Appendix 9) will be posted on public notice boards available in the open air market places and local churches in Kiambu County, Kenya to recruit respondents. These notice boards are freely available to post flyers in the community. Flyers will also be handed out in the open air markets to interested individuals. This is regarded as an effective recruiting strategy because these are places that most rural residents frequent as part of the social fabric. In addition, this approach is inexpensive. Permission has been granted to post flyers for two churches, a local marketplace, and a dispensary/public health facility (Appendix 10a-10d).

Once the respondent agrees to participate and meets the inclusion criteria, all the tasks will be completed in one face-to-face interview conducted at a quiet location convenient to the respondent. To ensure that interviews can be conducted in private, there will be a tent stall (including 2 chairs and a table) set up in the marketplace. After a brief introduction, the participant will first complete an informed consent process including having all procedures explained and being given the opportunity to ask any questions before reading and signing the informed consent form.

Prior to the interview respondents will be randomly assigned to one of two willingness to pay (WTP) techniques: payment card (PC) or structured haggling (SH). As with the pilot study, the interview will be divided into 4 sections (Appendix 5 and 6). The study will be approved by the UGA's Institutional Review Board and the Kenya National Council for Science and Technology prior to initiation.

This current proposal will use fully structured face-to-face interviews to elicit WTP values from each respondent as recommended by the National Oceanic and Atmospheric Administration (NOAA) (Arrow, Solow et al. 1993). Additionally, this proposal will use the process of structured haggling, a practice that requires face to face encounters. In the earlier analysis of the 28 retrieved CVM studies conducted in Sub-Sahara Africa all the authors employed the face-to-face interview method for this population (Kangethe and Franic 2011). Other modes of administration such as internet, telephone and mail are considered unreliable for this rural population due to the unreliability of these services (Enakrire and Onyenania 2007; WHO 2011).

2.5.2 Costs

The costs included in this study are program costs over the five year analysis time frame, from the societal perspective.

Program Costs: The proposed diabetes education, screening and referral program would be delivered to rural residents of Kiambu County once a year for five years. The program providers would travel to pre-determined focal points close to the residents such as markets and churches. The program would then provide the residents diabetes education sessions and health screening and referral services for the target county. The number and location of sessions, and specific operating costs required to be itemized will be determined based on input from interviews with diabetes educators at the Kenya Diabetes Management and Information Centre based in Nairobi, Kenya building on program costs tabulated by Gorsky (1996), Kirigia (2009) and Haddix et al (2006)

(Appendix 7a, 7b and 8). Additional cost information will be obtained from the World health Organization's Choosing Interventions that are Cost Effective (WHO-CHOICE)(WHO 2011). This will be supplemented with information from local goods and services providers.

Operating costs of a health program can be divided into fixed costs and variable costs. *Fixed costs* remain constant regardless of the change in volume of the planned activity, for example, personnel and facility cost. Capital costs are considered fixed costs that typically occur at the beginning of the project. These can include vehicles, furniture and computers. *Variable costs* change as the level of activity changes and these can include diabetes testing supplies as well as education and referral materials (Haddix, Corso et al. 2003; Kirigia 2009).

The economic costs of using capital inputs consist of opportunity costs of making the investment and the rate at which the capital is used up (depreciation) (Kirigia 2009). For this project, vehicles, furniture and computers will be considered capital costs. Annuitizing determines the constant annual value of a capital item that is expected to be in use over the project's life. Annuity factor (AF) can be obtained from annutization factor tables. This project will use an annuity factor of 4.5797 that reflects a 5 year project life and a 3% discount rate that will be used for the net social benefit calculation (Haddix, Teutsch et al. 2003) (Appendix G pg 243). The following equation will be used to complete the capital costs table (Appendix 8) for annual costs calculation:

Eq 2.1 $$C = \left[P - S \frac{1}{(1+r)^t} \right] (AF)^{-1}$$

C = annual cost of the unit
P = cost of purchasing the unit
S = Resale value of the unit (after 5 years of service)
r = discount rate (3%) = 0.03
AF = annuity factor = $(1-[1/(1+ r)^t)]^{r-1}$ = 4.5797 (Haddix, Teutsch et al. 2003) pg. 243

2.6 Sample Size

The statistical power is the probability that a statistical test will correctly reject a null hypothesis. It is determined by the significance criterion (type 1 error rate), the precision of the sample estimates (sample size) and effect size (magnitude or strength of relationship among two or more variables) (Sawyer and Ball 1981; Cohen 1988). Power tables developed by Cohen were used for sample size estimation (Cohen 1988). In this proposal conventional significance level of 0.05 ($\alpha = 0.05$), at least 80% power ($\beta = 0.80$) will be assumed (Sawyer and Ball 1981). The variable WTP for a program involving non-communicable diseases has not been previously studied in this population. The conventional definitions of effect size (ES)for mean comparisons are small (ES=0.20), medium (ES=0.50) and large (ES=0.80) (Cohen 1988). Cohen suggests making assumptions regarding the effect size when there is not a good idea of the relationship between the dependent and independent variables. A researcher may "straddle the fence" and select a medium effect size of 0.5 (Cohen 1988 pg. 25). However, this study anticipates a smaller effect size of 0.3 similar to Onwujukwe et al (2008) when he compared structured haggling to bidding game and dichotomous choice.

Cohen's table 2.4.1 results in a sample size estimation of 175 per group (175 for PC and SH groups) (Cohen 1988, Table 2.4.1). The total sample size estimated will be 350. To account for possible incomplete/unusable survey responses of approximately 10%, 36 more respondents will be added to a final sample size of 386.

2.7 Data Analysis

Initial descriptive analysis of the data will include frequency plots to determine distributions such that any potential problems can be detected with the survey early in the study. Percentages will be reported for nominal data. Additionally, Chi Square analyses for nominal data will be performed. Means and standard errors of means will be conducted for interval data. All statistical tests will be conducted in SPSS 19.0 at the 0.05 level consistent with convention

2.7.1 Hypothesis Testing

The one sample one tailed student's t-test will be used to evaluate hypotheses 1 and 2 because this will test whether the diabetes program has any value to the respondents.

The null and alternative hypotheses are:

$H0_1$: Willingness to pay values for a diabetes education, screening and referral program in rural Kenya using the payment card technique will be equal to zero ($WTP_{PC} = 0$)

HA_1: Willingness to pay values for a diabetes education, screening and referral program in rural Kenya using the payment card technique will be greater than zero ($WTP_{PC} > 0$)

and

$H0_2$: Willingness to pay values for a diabetes education, screening and referral program in rural Kenya using the structured haggling technique will be equal to zero ($WTP_{SH} = 0$)

HA_2: Willingness to pay values for a diabetes education, screening and referral program in rural Kenya using the structured haggling technique will be greater than zero HA_2: ($WTP_{SH} > 0$).

Independent two-sample t-test will be used to test whether there is a difference between the mean WTP values elicited using the new structured haggling (SH) and the widely used payment card (PC) for a two tailed test. In the case where the two randomized groups differ in sociodemographic characteristics (Table 3.1) or perceptions of diabetes (Table 3.2) a regression analysis will also be conducted to assess the effect of potential confounders on the WTP values. The null and alternative statements are:

$H0_3$: There is no significant difference in the WTP values for a diabetes education, screening and referral program in rural Kenya obtained using structured haggling and payment card methods. ($WTP_{SH} = WTP_{PC}$)

HA_3: There is a significant difference in the WTP values for a diabetes education, screening and referral program in rural Kenya obtained using structured haggling and payment card methods ($WTP_{SH} \neq WTP_{PC}$)

Several variables may affect responses to the WTP question. A correlation matrix will determine the variables that significantly correlate with the dependent variable WTP. The significant variables will then be used as independent variables in the subsequent

regression analysis for hypothesis 4. Correlations (r) of 0.1, 0.3 and 0.5 will be considered small, medium and large respectively (Cohen 1988). Generalized linear models (GLM) will be used for regression analysis to investigate the extent of the influence of anticipated predictors education level, age, income proxies (car ownership and monthly expenditures) diabetes knowledge and experiences on willingness to pay. This will test the theoretical validity of the elicitation methods. Due to anticipated violation of normality (skewness of WTP estimates) (Franic, Pathak et al. 2005), the GLM regression has been selected as this model accommodates a wide variety of non-normal and non-interval measured outcome variables as well as ease in interpretation of the results (Gill 2000; Moran, Solomon et al. 2007).

GLM regression is performed in two steps which require establishing the "link function" and a "family." The link function specifies the relationship between the *mean* or the expectation of y given x variables, .i.e. $(E(y/x))$, and the linear specification of the covariates, i.e., $(X\beta)$. Examples of links include identity link, log link and power links. (Glick, Doshi et al. 2007). The use of a log link, for example, models the *log of the mean* or log of the expectation of y given x variables, i.e., $(\ln(E(y/x)) = (X\beta)$ GLM differs from OLS regression in its log transformation, as OLS models the *mean log of y or* expectation of the log of y given x variables, i.e., $E(\ln(y)/x) = (X\beta)$.

Interpretations of the results from the coefficients with log transformed OLS model require an extra step of back transformation of the beta weights, which is not needed in GLM procedure. The type of back transformation in OLS is dependent on the nature of the combination of the error terms in the model. Failure to carry out this transformation correctly leads to biased estimates of the average effects of the

explanatory variables(Manning 1998). Therefore, an example of the GLM with log link is more desirable than the OLS with log transformation model because inferences can be made directly about the population mean, with GLM without sophisticated back-transformation methods as opposed to the geometric mean with OLS (Barber and Thompson 2004). This leads to ease of interpretation of the results of the coefficients in GLM analysis.

A linear regression assumes the random variable is made up of the predictable part (explanatory variables) and an unpredictable part (the random error ε)(Ott and Longnecker 2001). Homoskedasticity assumes that the variance of the error terms in the regression model are constant while in heteroskedasticity the variance of the error term given the explanatory variables is not constant (Wooldridge 2009). Heteroskedasticity reduces the efficiency of the estimates and produces misleading or biased estimates of the impact of the covariates on the dependent variable (Manning 1998).

OLS assumes that the data is normally distributed and homoskedastic. Violations of these assumptions may mean that the inferences and predictions from such models are potentially misleading (Barber and Thompson 2004). GLM on the other hand allows for violations of normality and heteroskedasticity through a variance structure relating to the variance of the mean (Glick, Doshi et al. 2007). The second step in GLM regression involves specifying the family: distribution reflecting the mean-variance relationship. The Gaussian family indicates the variance is constant, the Poisson family indicates that the variance is proportional to the mean, Gamma family assumes the variance is proportional to the square of the mean, and the inverse Gaussian or Wald family assumes variance is proportional to the cube of the mean.

Models that use the GLM procedure require identifying (1) the structure of the "link" function and (2) the "family" of error terms. To identify the link function, the Pregibon link test is performed to determine the feasibility of the assumed link (Pregibon 1980). A non-significant p-value indicates a correct link assumption. The "family" of error terms is identified through the Modified Park test. The test regresses the residual square on log (y) to test for the coefficient of log ($\hat{y}$) i.e. $(y_i-\hat{y}_i) = \lambda_0 + \lambda_1 \ln(\hat{y}_i)$ (Manning and Mullahy 2001). The coefficient of $\ln(\hat{y}_i)$, λ_1, provides the GLM family. If the value of λ_1 is equal to 0, 1 or 2, then Gaussian-, Poisson-, Gamma-, and Inverse Gaussian- or Wald- family is assumed, respectively (Glick, Doshi et al. 2007). An additional test, the Modified Hosmer Lemeshow test is used to determine systematic bias pattern in the model (Hosmer and Lemeshow 2000). A non-significant p-value indicates an unbiased model. This proposal will test the most commonly assumed link function, log link and the most commonly assumed family distribution, gamma. STATA software will be used to determine link functions and family distribution for GLM regression analysis.

Using GLM this project will test the null and alternative hypotheses:

$H0_4$: Economic wellbeing, diabetes risk factors and self-assessed risk of developing diabetes have no influence on WTP values of a diabetes education, screening and referral program in rural Kenya

HA_4: Economic wellbeing, diabetes risk factors and self-assessed risk of developing diabetes have a significant positive influence on WTP or values of a diabetes education, screening and referral program in rural Kenya

The primary goal of CBA studies is to identify projects where the net social benefit is greater than zero. The social benefit of a diabetes prevention program in rural Kenya will be obtained through aggregation of the WTP values obtained through PC and SH methods. Net social benefits of such a program will be calculated by aggregating the benefits obtained and subtracting estimated costs for the program costs. The value obtained will be used to test the null and alternative hypotheses

$H0_5$: Net social benefit of a diabetes education, screening and referral program in rural Kenya will be equal to zero compared to the status quo (do nothing). (NSB = 0)

HA_5: Net social benefit of a diabetes education, screening and referral program in rural Kenya will not equal zero compared to the status quo (do nothing). (NSB $\neq$ 0)

2.7.2 Protest Responses

Often times, researchers conducting contingent valuation studies encounter respondents that refuse to pay any amount for a public good because of an underlying cause such as dissension to the process itself. This is known as a protest bid (Jorgensen, Syme et al. 1999). For this project, the respondents that refuse to provide a WTP amount will be asked to provide a reason (Appendix 5 and 6). Those that refuse to pay because they do not value the diabetes program will not be treated as protest bids and will be included in the analysis, while those that descent due to the process itself for example they believe that the government should pay, will not be included in the analysis. The dissension in the latter group does not reflect the respondents true value or preference of

the diabetes prevention program (Hoevenagel and van der Linden 1993; Jorgensen, Syme et al. 1999).

2.7.3 Sensitivity analyses

The process of a cost benefit analysis is based on estimates and assumptions that are influenced by several uncertain factors. Sensitivity analyses will identify which assumptions have the greatest influence on the analysis. Sensitivity analysis can be done by varying one variable (one-way or univariate sensitivity analysis) or several variables simultaneously (multi-way or multivariate sensitivity analysis) (Goldie and Corso 2003). The common variables tested with sensitivity analyses are the discount rate, benefits of the program and costs of the prevention program.

Discount Rate: An example of a univariate sensitivity analysis is the choice of discount rates that greatly influences the net social benefit calculation (Messonnier and Meltzer 2003). The current proposal adopts the 3% social discount rate that has been recommended for differential timing of costs and consequences. The social discount rate of 3% has been recommended by the panel on Cost-Effectiveness in Health and Medicine (Weinstein, Siegel et al. 1996). Sensitivity analysis will be conducted by varying the discount rate between 0% and 5% as recommended (Drummond, Sculper et al. 2005).

Benefits: One way sensitivity analysis of benefits will be determined through analysis of lower and upper bounds WTP values obtained from the SH and PC elicitation methods.

Costs: Program costs that consist of fixed and variable costs will be determined in this proposal through interviews with diabetes educators from DMI in Kenya. Sensitivity

analysis of costs will be conducted using lower and upper bounds for program costs determined through the interviews with the diabetes educators (Lawson, Fenwick et al. 2010). These will be used for the threshold analysis that will identify the critical values above or below which the conclusion of the study (net social benefit) changes (Briggs 1994).

Sensitivity analysis of CBA studies of public health interventions such as the diabetes prevention program in this proposal requires a multivariate sensitivity analysis because such programs usually are influenced by multiple variables (Messonnier and Meltzer 2003). This proposal will use Excel for one-way and multivariate sensitivity analysis. Also included will be threshold analysis of the NSB value to determine the required assumptions needed for the decision to change (Rascati 2008). This will be presented in form of alternatives to the proposed program.

Time horizon: The project's lifetime will be five years. This reflects the election cycle in Kenya which in turn influences public policy projects. However, sensitivity analyses will be conducted to assume different time horizons assuming shorter time horizons of 3 years and longer time periods of benefits expected from the program (Knowler, Barrett-Connor et al. 2002; Lindström, Ilanne-Parikka et al. 2006).

CHAPTER 3

RESULTS

This section describes the overall demographic characteristics of the study participants; the equivalence between the measured groups; validity of the measurements; and the results of the hypotheses tested in this proposal.

3.1 Sample characteristics

Participants

The description of the sample provides the following information: sociodemographic information, health related information and familiarity with diabetes. Of the 400 participants interviewed for the study between December 2011 and February 2012, 398 were included in the analysis. One participant was excluded because his WTP bid appeared excessive: it was the highest bid reported (Ksh 5,000 or US$ 59) and twice as high as the next highest bid, and equal to his overall monthly expenditures. This bid was also considered an outlier based on Cook's distance analysis (D = 0.278, mean = 0.03 SD = 0.015). Also, the respondent did not appear to understand the WTP exercise at all. He considered the exercise as valuing a higher education program even after it was clarified by the interviewer (AK) that it was for diabetes education and prevention. The other excluded participant only partially completed the questionnaire. After 40 minutes of discussion, he was unable to focus on the task at hand and veered off the discussion on several occasions.

Of the 400 respondents, 198 completed the payment card (PC) questionnaire while 200 completed the structured haggling (SH) questionnaire resulting in 99% completion rate. The survey took approximately 12 minutes to complete (range 5-35 min). None of the interviewees skipped any willingness to pay items. In addition to validity addressed in section 2.4.4, content validity is supported by the high completion rate and completion of all WTP items.

Table 3.1 shows no significant difference in respondent characteristics between the PC and the SH groups ($p > 0.05$). The characteristics shared by both groups were that there were slightly more male than female respondents with an average age of 40 years. Respondents reported being in good health with three quarters (74.8%) assessing their own health as excellent, very good or good.

Two thirds were married and self-employed (Table 3.1). Of the self-employed group, approximately half (48%) were farmers, 26 % were artisans and small scale traders while 23% were professionals or business professionals. The mean monthly household expenditure was KSh 10,898 (US$ 127.66). On average, the number of family members was 4.7 with a range of 1 to 15

Table 3.1: Sociodemographic Summary Statistics for Study Participants (n=398)

Respondent Characteristics	**PC**	**SH**	**Total n (%)**	**Statistic**	***P* value**
Gender					
Female	96	97	193 (48.5)	$X^2(1)=0.000$	0.998
Male	102	103	205 (51.5)		
Age					
Mean (SEM)	40.45(1.053)	40.55(1.033)	40.50 (0.74)	$t_{(396)}=-0.065$	0.948
Range	18-90	18-91	18-91		
Education Level					
Adult and Primary	57	57	114 (28.7)	$X^2(2)=0.013$	0.993
High school/Secondary	85	87	172 (43.2)		
Post-secondary and college	56	56	112 (28.1)		
Marital Status					
Single or Widowed	61	77	138 (37.4)	$X^2(1)=2.597$	0.107
Married or Cohabit	137	123	260 (65.3)		
Employment status					
Employed salaried	25	29	54 (14)	$X^2(3)=0.779$	0.855
Self employed	130	123	253 (64)		
Not employed	15	16	31 (8)		
Student	28	32	60 (15)		
Household monthly expenditures KSh*					
Mean (SEM)	10,666 (705)	11,127 (915)	10,898 (577)	$t_{(396)}=-0.398$	0.691
Range	200 – 80,000	350–100,000	200– 100,000		
Household Car Ownership					
Yes	34	28	62 (15.6)	$X^2(1)=0.762$	0.383
No	164	172	336 (84.4)		
Number of Family Members					
Mean (SEM)	4.7 (0.145)	4.7 (0.144)	4.7 (0.102)	$t_{(396)}=-0.060$	0.952
Range	1-12	1-15	1-15		

*** Mean household expenditures exchange rate (1 US$ = KSh 85.37)**

Diabetes Prevalence, Familiarity and Predisposing Factors

Table 3.2 shows no significant difference in self-reported diabetes prevalence familiarity and predisposing factors ($p > 0.05$) between the PC and the SH groups except in likelihood of developing diabetes and smoking status. Of the participants interviewed, 5.5% reported having been diagnosed with diabetes and 14% with high blood pressure by a health professional.

When asked how familiar the respondents were with type 2 diabetes on scale of 1 to 5 (1 = not at all familiar and 5 = very familiar) their mean response was 3.59 indicating that the respondents were somewhat familiar with the disease. Of those that did not have diabetes, when asked how likely they were to develop type 2 diabetes on a scale of 1 to 10 (1 = not at all likely and 10 = very likely) the mean rating was 4.93 indicating that on average respondents did not view themselves as likely to develop the disease. However, this mean was higher in the structured haggling group than in the payment card group and the difference was significant. When respondents were asked to consider the seriousness of type 2 diabetes on a scale of 1 to 10 (1 = not at all serious to 10 = very serious), their mean rating was 7.86, much greater than the score median of 5, indicating that they considered the disease to be serious.

Table 3.2: Self Report of Diabetes Prevalence, Familiarity and Predisposing Factors n=398

Factor	PC	SH	Total	Statistic	P Value
Current health status (1=verygood,5=poor) Mean (SEM)	2.87 (0.067)	2.89 (0.066)	2.88 (0.047)	$t_{(396)}$=-0.021	p= 0.094
Self-report of diabetes n(%)					
Yes	13	9	22 (5.5)	$X^2(1)$=0.813	p= 0.367
No	185	191	376 (94.5)		
Familiarity with diabetes (1=not at all familiar, 5=very familiar)					
Mean (SEM)	3.57 (0.117)	3.61 (0.118)	3.59 (0.083)	$t_{(396)}$=-0.267	p = 0.790
Likelihood of developing diabetes (n=376)*(1=not at all likely, 10=very likely)					
Mean (SEM)	4.41 (0.218)	5.43 (0.238)	4.93 (0.163)	$t_{(374)}$=-3.156	p = 0.002**
seriousness of type 2 diabetes (1=not at all serious, 10=very serious)					
Mean (SEM)	7.95 (0.202)	7.77 (0.216)	7.86 (0.148)	$t_{(396)}$= 0.623	p = 0.534
Immediate relatives with diabetes n (%)					
Yes	50	69	119 (29.9)	$X^2(2)$=4.184	p= 0.123
No	133	116	249 (62.6)		
Don't know	15	15	30 (7.5)		
Distant relative with diabetes n (%)					
Yes	78	76	154 (38.7)	$X^2(2)$=2.207	p= 0.332
No	94	87	181 (45.5)		
Don't know	26	37	63 (15.8)		
High blood pressure n (%)					
Yes	30	26	56 (14)	$X^2(1)$=0.381	p= 0.537
No	168	174	342 (86)		
Smoking status regularly or					

occasionally	36	19	55 (14)	$X^2(1)=6.297$	$p= 0.012$**
not at all	162	181	343 (86)		
Perceived Weight					
overweight	14	17	31 (8)	$X^2(3)=3.733$	$p= 0.292$
about the right weight	166	164	330 (83)		
underweight	13	8	21 (5)		
don't know	5	11	16 (4)		

* Non-diabetic respondents only
** P-value < 0.05

PC and SH Willingness to Pay Summary

Table 3.3 shows that more than 95% of the respondents in each group were willing to pay something (WTP>0) for the program. The remaining 17 respondents were not willing to pay any amount for the program. The predominant reasons (n=14) provided were lack of money due lack of steady income, student status or lack of funds due to other commitments such as recent payments of their children school fees. The remaining individuals that gave WTP value of zero did so for various reasons including they did not have the disease therefore should not pay, diabetic victims only should pay, religious belief that did not allow for medical care and being a healthcare provider.

At interview completion, respondents were asked how confident they were in their responses. Majority (83%) said they were very confident in their answers. Both groups had WTP values that were skewed to the right (Skewness 1.708 PC and 1.018 SH) (Figure 3.1).

Table 3.3: PC and SH Willingness to Pay Summary in KSh*

Characteristics	**Payment Card n=198**	**Structured Haggling n=200**
Mean (SEM)	533.59 (30.9)	637.55 (28.0)
Median	500	600
Range	0 – 2,500	0 - 2,500
t (df)	17.27 (197)	22.77 (199)
P value	<0.001	<0.001
95 % CI	472.65, 594.52	582.34, 692.76
n (%) WTP = 0	9 (4.5%)	8 (4%)

*Currency Exchange rate (1 US$ = Ksh 85.37) (Central Bank of Kenya 2011)

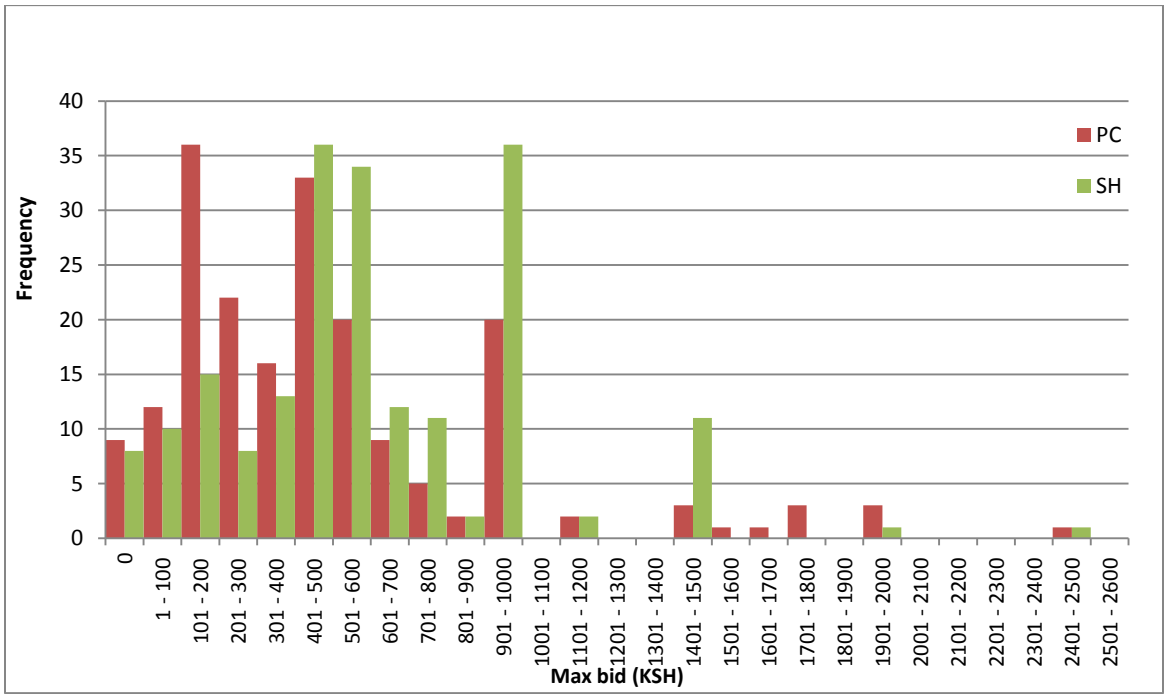


Figure 3.1: Payment Card and Structured Haggling Willingness to Pay maximum bid distribution (n=398)

WTP Given Participant Characteristics

Theoretical validity of the WTP measure was assessed using two measures of income proxies: household monthly expenditures and car ownership. The first independent sample t-test was conducted comparing households with low monthly expenditures (<= KSh 7999 or US$ 93.69) and high monthly expenditures (> KSh 8000 or US$ 93.70). This analysis revealed a significant difference between the two groups, $t(396) = -2.89$; $p < 0.01$. As expected, those in the high expenditure groups (half the respondents) reported a higher mean WTP value (KSh 645.93 or US$ 7.57) compared to the low expenditure group mean WTP value (KSh 525.73 or US$ 6.15).

The second independent t-test was conducted for car ownership comparing those households that owned a vehicle and those that did not, also revealed a significant difference between the groups, $t(396) = -3.81$; $p < 0.01$. As expected, those in households that owned a vehicle had a higher mean WTP value (KSh 768.87or US$ 9.00) compared to those in households without a car (KSh 552.05 or US$ 6.48).

An additional t-test comparing WTP values for patients with type 2 diabetes and those respondents without indicated that WTP values for the diabetics was significantly higher (KSh 977.27 or US$ 11.44) than those without diabetes (KSh 562.93 or US$ 6.59) $t(396) = -3.63$; $p < 0.01$.

3.2 Hypothesis Testing

3.2.1 Hypothesis 1 and 2

The one sample one tailed student's t-test was used to evaluate hypotheses 1 and 2. The null and alternative hypotheses were:

$H0_1$: Willingness to pay values for a diabetes education, screening and referral program in rural Kenya using the payment card technique will be equal to zero ($WTP_{PC} = 0$)

HA_1: Willingness to pay values for a diabetes education, screening and referral program in rural Kenya using the payment card technique will be greater than zero ($WTP_{PC} > 0$)

And

$H0_2$: Willingness to pay values for a diabetes education, screening and referral program in rural Kenya using the structured haggling technique will be equal to zero ($WTP_{SH} = 0$)

HA_2: Willingness to pay values for a diabetes education, screening and referral program in rural Kenya using the structured haggling technique will be greater than zero HA_2: ($WTP_{SH} > 0$).

The mean WTP for the full sample is KSh 585.83 (US$ 6.86), for PC is KSh 533.59 (US$ 6.25) and for SH is KSh 637.55 (US$7.46). One sample t test (with test value = 0) showed that the mean WTP_{PC} and mean WTP_{SH} were significantly different from zero $t_{(197)} = 17.27$, $p<0.001$ and $t_{(199)} = 22.77$, $p<0.001$. This test confirms rejection of the null hypotheses that mean willingness to pay values for a diabetes education, screening and referral program in rural Kenya using the payment card and structured haggling

techniques will be equal zero. Study results showed that the diabetes prevention program has value to the respondents.

3.2.2 Hypothesis 3

Independent two-sample t-test was used to test whether there is a difference between the mean WTP values elicited using the new structured haggling (SH) and the widely used payment card (PC). The null and alternative statements were:

$H0_3$: There is no significant difference in the WTP values for a diabetes education, screening and referral program in rural Kenya obtained using structured haggling and payment card methods. ($WTP_{SH} = WTP_{PC}$)

HA_3: There is a significant difference in the WTP values for a diabetes education, screening and referral program in rural Kenya obtained using structured haggling and payment card methods ($WTP_{SH} \neq WTP_{PC}$)

On examining the WTP distribution, Levene's test for equality of variance between the PC and SH groups revealed a p value-=0.642, therefore, for the t-test, the assumption is that the variances are equal. The distribution has a skewness of 1.342 and kurtosis value of 2.721. Compared to a normal distribution, this data is skewed to the right (positive skew) and is leptokurtic (positive kurtosis)(Schapira, Nattinger et al. 2001). A normal distribution is required for independent sample t tests. However, if the sample sizes are large (greater than n=30) then results using t tests are approximately correct (Ott and Longnecker 2001; Philip 2012). The mean WTP_{PC} (Ksh 533.59) and the mean WTP_{SH} (Ksh 637.55) values differ by Ksh 103.96, $t_{(396)} = 2.494$, p value = 0.013.

(Table 3.3). Therefore, this confirms rejection of the null hypothesis: that there is no significant difference in the WTP values for a diabetes education, screening and referral program in rural Kenya obtained using structured haggling and payment card methods ($WTP_{SH} = WTP_{PC}$).

Although the two groups, PC and SH were formed using randomization, tables 3.1 and 3.2 indicates that the two groups differed on two of these 18 items in the questionnaire ($p<.05$): (1) the likelihood of developing diabetes in which SH group had a higher score than the PC group and (2) smoking status of the respondents in which PC had more individuals that smoked regularly or occasionally than the SH group (Table 3.2). These differences were significant and the next section examines the potential for confounding of the WTP differences in the two groups.

Correlation

The bivariate correlation matrix between willingness to pay and independent variables revealed 10 significant variables at $p<0.05$: elicitation method ($r=0.124$), diabetes status ($r=0.227$), gender ($r=0.118$), education level ($r=0.166$), employment status ($r=0.184$), car ownership ($r=0.188$), familiarity with diabetes ($r=0.187$), seriousness of diabetes ($r=0.138$), smoking status ($r=0.108$), and age ($r=0.111$). These correlations were in the predicted direction (Appendix 11).

Additional significant correlations observed were employment and gender ($r=0.19$), car ownership and education level, ($r=0.224$), diabetes familiarity and diabetes status ($r=0.18$), seriousness of diabetes and employment status ($r=0.103$), seriousness of diabetes and diabetes familiarity with diabetes ($r=0.316$), smoking status with elicitation

method, (r=0.126), gender and smoking status, (r=-0.316), smoking status and seriousness of diabetes (r=-0.106), age and diabetic status (r=0.303), age and gender (r=0.126), age and education (r=0.446), age and diabetes familiarity (r=0.150), age and seriousness of diabetes (0.200). However, these correlations were not high (all are less than r=0.5) (Cohen 1988) and the correlated variables were included in the regression model.

Regression

Using multiple generalized linear modeling (GLM) the WTP values were regressed on the linear combination of the predictors from the significant bivariate correlations. In this step, the likelihood of developing diabetes is included thought not significantly correlated with willingness to pay. This will test for confounding identified earlier from table 3.2.

The first step in GLM is identifying the family of error terms through performing the Modified Park Test. The second step of GLM is identifying the link function using the Pregibon link test and Modified Hosmer Lemeshow tests. The most commonly assumed family structure is the gamma distribution and the most commonly assumed link is the log link. The results for steps 1 and 2 of the GLM regression are presented in Table 3.4 with these assumptions. (Please see Appendix 20 for STATA code).

Table 3.4: Results for the Modified Park Test, Pregibon Link test and the Modified Hosmer-Lemeshow test for the Gamma distribution (confounding test)

No. of Observation = 376
Deviance = 142.307
Pearson = 168.960
Variance Function = V(u) = U^2 [gamma]
Link function = g(u) = ln(u) [log]

Max bid	Estimate	Std Error	Z P>Z	95 % confidence interval
SH/PC	.2153145	.072281	2.98 0.003	.0736463 .3569827
Diabetes	.0	omitted	omitted	omitted
Gender	.1400685	.0772937	1.81 0.070	-.0114244 .2915615
Education	.2606675	.0845813	3.08 0.002	.0948912 .4264438
Employment	.3022696	.0961617	3.14 0.002	.1137961 .4907432
Car own	.1596182	.1014783	1.57 0.116	-.0392756 .358512
Familiarity with diabetes	.0565084	.022996	2.46 0.014	.0114371 .1015797
Seriousness of diabetes	.0251934	.0138368	1.82 0.069	-.0019263 .0523131
Smoking	.2736486	.1098428	2.49 0.013	.0583608 .4889365
Age	.0006842	.003176	0.22 0.829	-.0055406 .006909
Likelihood of developing Diabetes	-.0183379	.012764	-1.44 0.151	-.0433549 .006679
constant	5.217236	.1865515	27.97 0.000	4.851602 5.582871

Modified Park Test – Fitted model: link = log; family = Gamma
Test for Family; Coefficient = 0.809468 (poisson)
Test for link
Pearson Correlation test = 0.6019
Pregibon link test = 0.4491
Modified Hosmer and Lemeshow = 0.9765

The slope coefficient estimate from the Modified Park test was 0.809. Since this coefficient was close to 1, Poisson like regression with log link was indicated. The Pregibon link test is not significant (p=0.4491) and the Modified Hosmer and Lemeshow

test was also non-significant indicating that the log link assumption was appropriate for the distribution and the model was unbiased. The next step was to run the model with Poisson family and log link as recommended by the Modified Park test and Modified Hosmer and Lemeshow test results. The STATA printout of results assuming Poisson like distribution and log link function are presented in Table 3.5.

Table 3.5: GLM regressing linear combination of predictors on WTP assuming Poisson like distribution and log link function (with confounders)

No. of Observation = 376
Deviance = 85386.9
Pearson = 86686.4584
Variance Function = V(u) = U [poisson]
Link function = g(u) = ln(u) [log]

Max bid	Estimate	Std Error	Z P>Z	95 % confidence interval
SH/PC	.226496	.069442	3.26 0.001	.0903921 .3625999
Diabetes	0	omitted	omitted	omitted
Gender	.1251209	.0717362	1.74 0.081	-.0154794 .2657212
Education	.2396054	.0763609	3.14 0.002	.0899407 .3892701
Employment	.2870755	.097884	2.93 0.003	.0952264 .4789246
Car own	.1947734	.0886213	2.20 0.028	.0210788 .3684679
Familiarity with diabetes	.0532161	.0221111	2.41 0.016	.0098791 .096553
Seriousness of diabetes	.0267708	.0132297	2.02 0.043	.000841 .0527006
Smoking	.213454	.1095173	1.95 0.051	-.0011959 .428104
Age	.0001758	.002871	0.06 0.951	-.0054512 .0058029
Likelihood of developing Diabetes	-.0199986	.0117477	-1.70 0.089	-.0430238 .0030265
constant	5.311778	.186809	28.43 0.000	4.945639 5.677917

Modified Park Test – Fitted model: link = log; family = poisson
Test for Family; Coefficient = 0.792946 (poisson)
Test for link
Pearson Correlation test = 0.8881
Pregibon link test = 0.4344
Modified Hosmer and Lemeshow = 0.9729

Table 3.6: GLM regressing linear combination of predictors on WTP assuming Poisson like distribution and log link function (without confounders)

No. of Observation = 376
Deviance = 142.307
Pearson = 168.960
Variance Function = V(u) = U^2 [gamma]
Link function = g(u) = ln(u) [log]

Max bid	Estimate	Std Error	Z	P>Z	95 % conf interval	
SH/PC	.2061555	.0661283	3.12	0.002	.0765464	.3357647
Diabetes	.4855144	.1250333	3.88	0.000	.2404536	.7305751
Gender	.0818684	.0677058	1.21	0.227	-.0508327	.2145694
Education	.242331	.0760768	3.19	0.001	.0932233	.3914388
Employment	.3244397	.0968884	3.35	0.001	.1345419	.5143376
Car own	.229628	.0856533	2.68	0.007	.0617506	.3975054
Familiarity with diabetes	.0472776	.0223372	2.12	0.034	.0034975	.0910576
Seriousness of diabetes	.0219804	.012705	1.73	0.084	-.002921	.0468818
Smoking	omitted					
Age	-.001300	.0028047	-0.46	0.643	-.0067973	.0041969
Likelihood of developing diabetes	omitted					
constant	5.5136	.156429	35.25	0.00	5.207005	5.820195

Modified Park Test – Fitted model: link = log; family = Poisson
Test for Family; Coefficient = 0.860578 (poisson)
Test for link
Pearson Correlation test = 0.9067
Pregibon link test = 0.7037
Modified Hosmer and Lemeshow = 0.1173

Tables 3.5 and 3.6 shows that the inclusion of the confounders (smoking status and likelihood of developing diabetes) does not have a significant effect on the willingness to pay outcomes in the PC and the SH groups. With confounders, the beta estimates for the elicitation method SH/PC is 0.23 (Table 3.5) and without confounders the beta is 0.21 (Table 3.6), i.e. varying only by 0.02, indicating that these two variables did not have an important influence on estimation method. (Normand, Sykora et al. 2005; Rochon, Gurwits et al. 2005). Also, the p values for the confounders were not significant at 0.051 and 0.089, respectively. (Table 3.5)

3.2.3 Hypothesis 4

Several variables may affect responses to the WTP question. Regression analysis was used to investigate the extent of the influence of education level, age, income proxies (car ownership and monthly expenditures) diabetes knowledge and experiences on willingness to pay. This tested the theoretical validity of the elicitation methods. Due to anticipated violation of normality (skewness of WTP estimates) the generalized linear model (GLM) was selected as it accommodates a wide variety of non-normal and non-interval measured outcome variables. The null and alternative hypotheses are

$H0_4$: Economic wellbeing, diabetes risk factors and self-assessed risk of developing diabetes have no influence on WTP values of a diabetes education, screening and referral program in rural Kenya

HA_4: Economic wellbeing, diabetes risk factors and self-assessed risk of developing diabetes have a significant positive influence on WTP or values of a diabetes education, screening and referral program in rural Kenya

Regression

Using multiple generalized linear modeling (GLM) the WTP values were regressed on the linear combination of the predictors from the significant bivariate correlations. The first step in GLM is identifying the family of error terms through performing the Modified Park Test. The second step of GLM is identifying the link function using the Pregibon link test and Modified Hosmer Lemeshow tests. The most commonly assumed family structure is the gamma distribution and the most commonly

assumed link is the log link. The results for steps 1 and 2 of the GLM regression are presented in Table 3.7 with these assumptions. (Please see Appendix 20 for STATA code).

Table 3.7: Results for the Modified Park Test, Pregibon Link test and the Modified Hosmer-Lemeshow test for the Gamma distribution

No. of Observation = 398
Deviance = 151.317
Pearson = 181.005
Variance Function = V(u) = U^2 [gamma]
Link function = g(u) = ln(u) [log]

Max bid	Estimate	Std Error	Z	P>Z	95 % confidence interval	
SH/PC	.1876571	.069798	2.69	0.007	.0508555	.3244586
Diabetes	.4154551	.1608237	2.58	0.010	.1002464	.7306637
Gender	.1343072	.0753234	1.78	0.075	-.0133238	.2819383
Education	.2541464	.0840444	3.02	0.002	.0894225	.4188704
Employment	.3461498	.0941647	3.68	0.000	.1615904	.5307092
Car own	.1841825	.0983678	1.87	0.061	-.0086149	.3769799
Familiarity with diabetes	.0520748	.0227371	2.29	0.022	.0075109	.0966388
Seriousness of diabetes	.0246037	.013183	1.87	0.062	-.0012346	.0504419
Smoking	.291308	.1097805	2.65	0.008	.0761422	.5064737
Age	-.0011463	.0030596	-0.37	0.708	-.0071431	.0048505
constant	5.187142	.1835753	28.26	0.000	4.827341	5.546942

Modified Park Test – Fitted model: link = log; family = Gamma
Test for Family; Coefficient = 0.957 (poisson)
Test for link
Pearson Correlation test = 0.6281
Pregibon link test = 0.5420
Modified Hosmer and Lemeshow = 0.7376

The slope coefficient estimate from the Modified Park test was 0.957. Since this coefficient was close to 1, Poisson like regression with log link was indicated. The Pregibon link test is not significant (p=0.5420) and the Modified Hosmer and Lemeshow test was also non-significant indicating that the log link assumption was appropriate for the distribution and the model was unbiased. The next step was to run the model with Poisson family and log link as recommended by the Modified Park test and Modified Hosmer and Lemeshow test results. The STATA printout of results assuming Poisson like distribution and log link function are presented in Table 3.8 and appendix 18.

Table 3.8: GLM regressing linear combination of predictors on WTP assuming Poisson like distribution and log link function

No. of Observation = 398
Deviance = 93101.94
Pearson = 95677.4834
Variance Function = V(u) = U [poisson]
Link function = g(u) = ln(u) [log]

Max bid	Estimate	Std Error	Z P>Z	95 % confidence interval
SH/PC	.1856814	.0042141	44.06 0.000	.177422 .1939408
Diabetes	.4512071	.0079439	56.80 0.000	.4356373 .4667769
Gender	.127696	.0044598	28.63 0.000	.118955 .1364371
Education	.2233663	.0048396	46.15 0.000	.2138807 .2328518
Employment	.3293678	.0061296	53.73 0.000	.3173539 .3413817
Car own	.2206035	.0054109	40.77 0.000	.2099984 .2312086
Familiarity with diabetes	.0482258	.0014121	34.15 0.000	.0454581 .0509934
Seriousness of diabetes	.0248828	.0008069	30.84 0.000	.0233014 .0264642
Smoking	.2367459	.0070565	33.55 0.000	.2229154 .2505765
Age	-.0018355	.0001779	-10.32 0.000	-.0021842 -.0014868
constant	5.293777	.0118764	445.74 0.000	5.2705 5.317055

Modified Park Test – Fitted model: link = log; family = poisson
Test for Family; Coefficient = 0.967(poisson)
Test for link
Pearson Correlation test = 0.8633
Pregibon link test = 0.4652
Modified Hosmer and Lemeshow = 0.2941

To check for model assumptions, i.e. a Poisson distribution, the Modified Park test was performed and the resulting coefficient of λ=0.967 is still close to 1, therefore, Poisson like regression with log link was indicated. The Pregibon link test is not significant (p=0.4652) again indicating that the log link assumption was appropriate for the distribution and the non-significant Modified Hosmer and Lemeshow test indicates that the model is unbiased. However, the results on Table 3.5 (and appendix 17) indicate that the model is over-dispersed. The five-percent critical value for a chi-squared with 387 d.f. is 433.87 and the deviance (93,101) and Pearson's chi-squared (95,677) are both in the 90,000s, therefore the model is over-dispersed. As a result, the "scale" option was used (i.e. a STATA code) to scale the standard errors using the square root of the Pearson chi-square dispersion. This is a recommended procedure that asks for the estimate of the dispersion parameter and adjusts the standard errors based on the parameter (Hoffmann 2004).

Table 3.9: Poisson Model (with Pearson χ^2-based dispersion)

No. of Observation = 398
Deviance = 93101.94
Pearson = 95677.4834
Variance Function = V(u) = U [poisson]
Link function = g(u) = ln(u) [log]

Max bid	Estimate	Std Error	Z P>Z	95 % confidence interval
SH/PC	.1856814	.0662597	2.80 0.005	.0558148 .3155481
Diabetes	.4512071	.1249063	3.61 0.000	.2063952 .696019
Gender	.127696	.0701237	1.82 0.069	-.0097439 .265136
Education	.2233663	.0760961	2.94 0.003	.0742205 .372512
Employment	.3293678	.0963795	3.42 0.001	.1404674 .5182682
Car own	.2206035	.0850776	2.59 0.010	.0538544 .3873526
Familiarity with diabetes	.0482258	.0222029	2.17 0.030	.0047089 .0917426
Seriousness of diabetes	.0248828	.0126868	1.96 0.050	.0000172 .0497484
Smoking	.2367459	.1109534	2.13 0.033	.0192812 .4542107
Age	-.0018355	.0027977	-0.66 0.512	-.0073188 .0036478
constant	5.293777	.186739	28.35 0.000	4.927776 5.659779

(Standard errors scaled using square root of Pearson X2-based dispersion.)

Modified Park Test – Fitted model: link = log; family = poisson
Test for Family; Coefficient = 0.967(poisson)
Test for link
Pearson Correlation test = 0.8633
Pregibon link test = 0.4652
Modified Hosmer and Lemeshow = 0.2941

The resulting analysis including scaling of errors results in coefficients that are identical to the previous analysis but the standard errors are adjusted to compensate for the over-dispersion in the Poisson distribution (Table 3.9). In summary, using the GLM Poisson like distribution and the log link function (Table 3.9), show as expected,

consistent with economic theory that aspects of economic wellbeing (education, employment, car ownership), diabetes risk factors (smoking), familiarity with diabetes and seriousness of diabetes all had a significant positive impact on WTP values. Therefore, this confirms the rejection of the null hypothesis that economic wellbeing, diabetes risk factors and self-assessed risk of developing diabetes have no influence on WTP or values of a diabetes education, screening and referral program in rural Kenya.

3.2.4 Hypothesis 5

The primary goal of CBA studies is to identify projects where the net social benefit is greater than zero. The social benefit of a diabetes prevention program in rural Kenya were obtained through aggregation of the WTP values obtained through PC and SH methods. Net social benefits of such a program were calculated by aggregating the benefits obtained and subtracting estimated costs for the program costs. The value obtained were used to test the null and alternative hypotheses

$H0_5$: Net social benefit of a diabetes education, screening and referral program in rural Kenya will be equal to zero compared to the status quo (do nothing). (NSB = 0)

HA_5: Net social benefit of a diabetes education, screening and referral program in rural Kenya will not equal zero compared to the status quo (do nothing). (NSB $\neq$ 0)

To address Hypothesis 5, the following sections will describe the estimation of costs, benefits and then followed by the NSB calculation**.** This chapter concludes with one- and multi- way sensitivity analyses for NSB calculations.

a. Estimation of Costs

The cost estimates were obtained through interviews with diabetes educators Vincent Mbugua and Joseph M Ndungu from the Kenya Diabetes Management and Information Centre (DMI) as described in Section 2.5.2. Each of the interviews took approximately 1 hour to complete. The cost estimates were also reviewed by Ms Beatrice Magiya, a nutritionist working with diabetic patients at Kiambu District Hospital, who also concurred with the cost estimates provided. These costs were classified as fixed costs and variable costs (Please see Section 2.5.2). Table 3.9 presents the itemized summary of all program costs. All costs and benefits are presented in 2011KSh (or 2011US$).

Fixed Costs: According to the diabetes educators, a diabetes educator at DMI, such a program would realistically expect to reach 100 participants per week on an ongoing basis with an expected number totaling 4800 participants per year (100 participants per week x 4 weeks per month x 12 months) to be seen at 48 locations throughout Kiambu county, Kenya, i.e. each program visit each week will be at a different location (4 weeks per month x 12 months = 48). *Personnel:* An administrator, a Diabetes educator, two social workers and five nurses would be would be required for the program bringing the total personnel costs to KSh 4,881,541 (US$ 57,181) yearly (Please see Table 3.8 for itemization of personnel costs. WHO-CHOICE and DMI were used as a source for personnel salaries because these are considered the most reliable sources. *Facility costs:* Knight Frank a commercial property manager and Safaricom the largest telecommunications provider in Kenya provided estimates for the office facilities totaling

KSh 1,266,296 (US$14,833). Office Mart and MECOL are computer and office furniture suppliers in Kenya. They provided estimates for the computers and required furniture while WHO-CHOICE provides estimates on office supplies (appendix 12). Joseph Ndungu provided the estimates for the rest of the diabetic supplies. These costs were annuitized (Haddix, Corso et al. 2003 Appendix G p243 AF=4.5797) (Table 3.7) bringing the total for supplies and equipment to KSh 206,115 (US$ 14,601). *Other costs:* Other costs considered were vehicle (annuitized) and program advertising through advertising vehicle speaker systems (48 weeks). The diabetes educator mentioned gratuity to village elder/sub-chiefs required for each weekly visit of KSh 1000 (US$ 11.71). This brings the total of other miscellaneous costs to KSh 1,246,510 (US$ 14,601)

Variable Costs: The costs of diabetic supplies education material/flyers and target venue fees (e.g. market place) were provided by Mr. Joseph Ndungu. These would target 4800 participants per year at 48 locations. WHO-CHOICE estimates that vehicle operation and maintenance requires approximately 0.09$ per kilometer travelled. The target areas are located on average 70 kilometers from the program location and the program providers would require travel to these areas once weekly (US$ 0.09 x 140 km x 4 trips/month x 12 months = $605). The variable costs add up to KSh 469,232 (US$ 5,496).

Table 3.10: Estimated capital program costs for a 5 year period: Annuity Calculation

Item	**No. of items**	**Purchase Cost in year 1**		**Expected scrap value**	**PV of scrap value PV(3%,5yr) =0.8626**	**Equivalent Annual Cost A(3%,5yr)=4.5797**	
		KSh	**US$**	**KSh**	**KSh**	**KSh**	**US$**
Vehicle	1	1,732,352	20,292	742,000	640,049	238,510	2,794
Office Drawers	2	11,450	134	5,725	4,938	1,422	17
Office Desks	2	12,044	141	6,022	5,195	1,496	18
Office Chairs	2	13,834	162	6,917	5,967	1,718	20
Visitor Chairs	4	15,760	185	7,880	6,797	1,957	23
Reading lamp	2	5,313	62	2,657	2,292	660	8
Calculators	2	6,856	80	3,428	2,957	851	10
Printers/copier	1	30,000	351	15,000	12,939	3,725	44
Desk top computers	2	130,000	1,523	0	0	28,386	333
Glucometer	5	15,000	176	0	0	3,275	38
Weigh scales	2	10,000	117	0	0	2,184	26
Blood pressure machines	2	10,000	117	0	0	2,184	26
Tape Measure	2	1,000	12	0	0	218	3
Total		**1,993,609**	**23,353**	**789,629**	**681,134**	**286,585**	**3,357**

Productivity Losses

Participants that are expected to take part in the program incur productivity losses including time taken to travel to participate in the program and wages lost due to participation in the program. It is assumed that participants would walk to the program location which would be held locally; therefore no travel costs were considered. Additionally, respondents were not told whether or not to consider loss of income due to time taken off work to participate in the program. Therefore the most conservative approach would be to assume that respondents did consider their productivity losses when providing their WTP estimates. As a result, inclusion of these costs (productivity losses) in the 'cost' estimates would result in double counting given that they are assumed to be included in the 'benefits' of the program (Currie, Donaldson et al. 2002).

Table 3.11: Annual Program Costs (based on 100 participants per week)

Resource	Quantity per year (A)	Cost/unit (KSh) (B)	Cost/unit (US$) (C)	Total costs (KSh) (AxB)	Total costs (US$) (AxC)	Source
FIXED COSTS						
Personnel						
Administrator	1 FT	1,048,770	12,285	1,048,770	12,285	WHO-CHOICE
Diabetes Educator	1 FT	1,048,770	12,285	1,048,770	12,285	WHO-CHOICE
Social Worker	2 FT	192,000	2,249	384,000	4,498	DMI
Nurse	5 PT	480,000	5,623	2,400,000	28,113	DMI
Subtotal				**4,881,541**	**57,181**	
Facilities						
Rent + maintenance	1 Yr.	918,136	10,755	918,136	10,755	Knight Frank
Car-Park (2 cars)	1 Yr.	220,000	2,577	220,000	2,577	Knight Frank
Electricity	1 Yr.	56,400	661	56,400	661	Knight Frank
Phone service	1 Yr.	30,000	351	30,000	351	Safaricom
Internet	1 Yr.	41,760	489	41,760	489	Safaricom
Subtotal				**1,266,296**	**14,833**	
Supplies and Equip						
Office supplies	20 items	7,978	93	159,552	1,869	WHO-CHOICE
Desk top Computer	2	14,214	167	28,386	333	Office Mart
Office furniture	10 pieces	657	8	6,592	77	MECOL
Printer/Copier	1	3,756	44	3,725	44	Office Mart
Glucometers	5	649	8	3,275	38	DMI

Weigh Scales	2	1,110	13	2,184	26	DMI
Blood pressure machine	2	1,110	13	2,184	26	DMI
Tape Measures	2	128	2	218	3	DMI
Subtotal				**206,116**	**2,414**	
Other						
Fleet Vehicles	1	238,510	2,794	238,510	2,794	WHO-CHOICE
Public announcement (mobile advertising)	48 weeks	20,000	234	960,000	11,245	DMI
Village Elder / sub-chief (gratuity)	1yr	1,000	12	48,000	562	DMI
Fixed Costs Subtotal				**1,246,510**	**14,601**	
VARIABLE COSTS						
Education materials	4800 Units	5	0.06	24,000	281	DMI
Diabetes screening materials (test strips,)	4800 Units	32	0.37	153,600	1,799	DMI
Target facility fees	48 locations	5,000	59	240,000	2,811	DMI
Vehicle operation	6720 km	(Ksh 7.68/km)	(0.09$/km)	51,632	605	WHO
Variable Costs Subtotal				**469,232**	**5,496**	
TOTAL COSTS				**8,069,694**	**94,526**	

Key: FT, Full time is assumed to be a 40 hr. week. PT, Full time is assumed to be a 20 hr. week. DMI Kenya Diabetes Management and Information Centre, WHO-CHOICE World Health organization's Choosing Interventions that are Cost Effective, Frank Knight residential and commercial property managers, MECOL is the largest manufacturer of steel/wood Office and Institutional furniture, Office Mart, a large retail outlets of office products and services, Safaricom an integrated communications company

b. Estimation of Benefits

Aggregate willingness to pay was used to estimate the benefits. The mean annual WTP for all respondents (both PC and SH groups) was KSh 585.83, SEM=20.975 (Mean WTP US$6.86, SEM=0.246). The total annual mean perceived benefits (WTP) based on aggregated WTP of 4800 participants per year is KSh 2811,984 (KSh 585.83 x 4800 participants per year) or US$ 32,939.

c. Net Social Benefit

The Net Social Benefit (NSB) calculation for the 5 year program was subsequently obtained through classifying aggregated WTP results as (mean WTPSH and WTPPC) benefits against the costs (Table 3.12).

Table 3.12: Program Net Social Benefit Calculation

	KSh/Year	**US$/Year**
No. of participants/year	4800	4800
Yearly Benefits (B)		
Mean WTP (PC+SH)	585.83	6.862
Total WTP (based on 4800 participants)	2,811,984	32,939
Yearly Costs (C)		
Program Costs per year (Table 3.8)	8,069,694	94,526
NSB Estimation		
Year 1 (B-C)*.9709	-5,104,711	-59,795
Year 2 (B-C)*.9426	-4,955,918	-58,052
Year 3 (B-C)*.9151	-4,811,331	-56,359
Year 4 (B-C)*.8885	-4,671,476	-54,720
Year 5 (B-C)*.8626	-4,535,301	-53,125
NSB	**-24,078,736**	**-282,051**

At the end of 5 years of program provision from a societal perspective, the NSB is KSh -24,078,736 (US$ -282,051). The results confirm the rejection of the null hypothesis that the NSB would equal zero. Although the respondents had a positive WTP value for the program, the program costs surpass the perceived benefits resulting in a negative NSB.

3.3 Sensitivity analyses

One way: Sensitivity analysis was conducted by varying the discount rate between 0% and 5%. The mean WTP for all respondents, KSh585.83(US$6.86), was first used for the first one-way sensitivity analyses. The lower bound sensitivity analysis used the lower mean WTP from the pc group KSh533.59(US$6.25) while the upper bound was based on the higher mean WTP from the SH group KSh637.55(US$7.47) (Table 3.13). Please see appendices 14a-14c for detailed calculation of the estimates).

Table 3.13 One Way sensitivity analyses with varying discount rates

Variable	NSB KSh/Year	NSB US$/year
WTPPC+SH=KSh585.83(US$6.86)		
Mean WTP PC+SH 0%	-26,288,552	-307,937
Mean WTP PC+SH 3%	-24,078,736	-282,051
Mean WTP PC+SH 5%	-22,762,731	-266,636
Lower bound KSh533.59(US$6.25)		
Mean WTP PC 0%	-27,542,312	-322,623
Mean WTP PC 3%	-25,227,105	-295,503
Mean WTP PC 5%	-23,848,337	-279,353
Upper Bound KSh637.55(US$7.47)		
Mean WTP SH 0%	-25,047,272	-293,397
Mean WTP SH 3%	-22,941,798	-268,734
Mean WTP SH 5%	-21,687,932	-254,046

The second one-way sensitivity analysis varied the total annual program costs of Ksh 8,069,694 (US$ 94,526) by +/-20% participants, as these were considered consistent with possible viable changes in the number of program participants. The results are presented in Table 3.14. (Please see Appendices 13, 15a & 15b for detailed calculations of the estimates).

Table 3.14 One way sensitivity analyses of varying program cost participants± 20%, assuming a 3% discount rate (KSh and US$)

Variable	**KSh/Year**	**US$/year**
± 20% participants per week		
Costs		
80/week (-20%)	-8,034,174	-94,110
120/week (+20%)	-8,105,214	-94,942
NSB/year		
80/week (-20%)	-26,491,674	-310,316
120/week (+20%)	-21,665,798	-253,787

From both tables 3.13 and 3.14, the sensitivity analyses do not provide a positive NSB value above which the conclusion of this study will change. All the parameters obtained provided a negative NSB.

Table 3.15 Multi-way sensitivity analyses of NSB varying costs and benefits ± 20%, assuming a 3% discount rate (US$)

Variable		NSB US$/year
± 20% participants per week (Table 3.14)		
80/week (-20%)		-310,316
120/week (+20%)		-253,787
	NSB Change	56,529
WTP upper and lower bound (Table 3.13)		
Mean WTP PC		-295,503
Mean WTP SH		-268,734
	NSB Change	26,769

Two-way: Table 3.15 indicates that a modest variation in the number of participants per week by ±20% has a greater influence on NSB than varying WTP amounts based on the mean WTP from the payment card and the structured haggling techniques while the social discount rate is held constant at the recommended 3%.

Threshold analysis: Threshold analysis showed that a cost reduction by 2/3 or ¾ alone still resulted in a negative NSB of Ksh -3,209,156 (US$ -37591) and -573,458 (US$ -6717), respectively. In a previous study, cost was varied between 50% and 200% of the base value (Wang, Middleton et al. 2003). However, for the current study, similar to a typical mobile health screening clinic in the United States, the services provided would be shared 3 or 4 ways with other services such as depression, vision and cholesterol screenings (Oriol, Cote et al. 2009). This would reduce the costs of the program by either 2/3 or 3/4. However, when these cost reductions were combined with increases in the number of participants the NSB switches to positive. When 1/3 cost cuts were combined with an increase of 26.5% participants per week the resulting NSB is Ksh

101 (US$ 1.2). When costs were reduced by 1/4 and participants increased by 4.8% per week then the NSB is also positive at Ksh 21 (US$ 0.2). From discussions with Kenyan diabetes educators, increasing participants by 4.8% is feasible while increasing by 26.5% is optimistic. See appendix 16 for a detailed calculation.

Time horizon: With smaller time horizons e.g. 3 years, all the program costs would be absorbed within the shorter time period making present value costs larger and the resultant NSB smaller (more negative) than the current analysis. However, if the study time horizon was longer, e.g., a lifetime, the capital costs would be absorbed over a longer time period reducing the overall present value costs and increasing the NSB value. Although in this latter case the benefits (WTP) would result much in the future, the present value of the benefits would also be significantly reduced. The expected result, again would be a negative NSB, but less negative than the present study.

CHAPTER 4

DISCUSSION AND CONCLUSIONS

This chapter presents a summary of the major findings of the current study and their significance. In addition, the implications, limitation and direction for future research are presents here.

4.1 Sample

In this study sample, there were more male respondents (51.5%) than female respondents (48.5%). This sample had a higher male respondent percentage than the actual population in Kiambu county which has more female residents (51%) than male (49%) (KODP 2011). In rural Kenya, there is a gender difference in terms of how income is earned. Men tend to earn large sums irregularly while women earn small steady income. Men also tend to make claims on women's incomes (Johnson 2004). It would have been expected that having more males in the sample would have significantly, i.e. positively influenced the WTP values. However, from the GLM results, gender was not a significant influencing factor on WTP values. This can be explained by several reasons. Firstly, Kenya has a large number of informal savings and credit groups with primarily women as members (Owen 2007). This has allowed women to be more autonomous in household financial decision making. Secondly, in the present study, there are more unmarried/widowed women (46%) compared to the Kenyan national census of women aged 15-49 (41%) (KNBS 2010). Therefore, these women are

able to make autonomous financial decisions making gender a non-significant variable in WTP values

The mean monthly household expenditure of KSh 10,898 (US$ 127.66) was three times higher than the rural Kenyan estimated poverty line of mean monthly expenditure KSh 3,579[b] (US$ 41.92) (Okwi, Ndeng'e et al. 2007). This is also higher than a previous study conducted in rural Kenya where the estimated monthly expenditures were US$ 50 (Forsythe, Arthur et al. 2002).

On average, the number of family members in the study sample was 4.7, which is slightly higher than the average Kenyan household size of 4.4 (KODP 2011). The high range of 1 to 15 indicates that some respondents may have considered extended family members living in the same household, which would not be considered unusual in Kenya. This is further supported by the fact that "the distinction between nuclear and extended family in East Africa is blurred" (Khavul, Bruton et al. 2009). The large average number of household members was expected to result in higher WTP bids as individuals are expected to pool resources together (Onwujekwe, Fox-Rushby et al. 2008). However, from bivariate correlations this variable was not significantly correlated with WTP in this study (Appendix 11). The non-significance of the variable can be explained considering 2 phenomena. Large families may be composed of dependents such as children and other dependent relatives causing a strain on financial resources. It is expected that these families would have low WTP values for health improvements. On the other hand if the family is composed of individuals that can pool resources as suggested by Onwujekwe (2008) then these families would have higher WTP values. Therefore, this variable can

[b]Kenya's poverty line in 1997 was Ksh 1,239(Okwi, Ndeng'e et al. 2007). This value has been converted to 2011 values using Kenya's consumer price index accessed from the Kenya National Bureau of Statistics - http://www.knbs.or.ke/consumerpriceindex.php.

either increase or decrease WTP depending on the composition of the family structure and therefore has no effect on the study's current WTP values.

The results indicate that self-reported diabetes prevalence was higher at 5.5% in the present study than the reported rural averages in Kenya of 2.2% and in the capital of Nairobi the rate is anticipated to be 12.2%, however no data is available for Kiambu (Christensen, Friis et al. 2009; Maina, Ndegwa et al. 2010). Given the proximity of Kiambu to Nairobi, the capital of Kenya, a prevalence higher than 2.2% was anticipated. The self-reported hypertension was lower at 14% compared to the age-standardized prevalence reported in rural Kenya of 23.7% (Hendriks, Wit et al. 2012). This can be explained by the fliers specifically mentioning diabetes and attracting respondents with a diagnosis of diabetes versus other comorbidities.

4.2 Validity

The different factors assessing validity i.e., assessed content validity, high completion rate and theoretical validity indicate that questions were interpreted as intended. Theoretical validity is the degree to which the findings of a study are consistent with theoretical expectations (Mitchell and Carson 1989). There are various ways to test this. Theoretical validity was supported in this study by the results of t tests, correlations and GLM regression results discussed in the following section.

T tests

In this study, validity analysis using t-tests revealed that those respondents with a higher level of expenditures have higher WTP values. This is expected because higher expenditures are a proxy measure for higher discretionary income. Additionally, In the

context of theoretical validity one would expect those with the condition in question are expected to have higher WTP bids then those without or as disease severity increases, people have higher WTP values for relief of symptoms (Kleinman Leah 2002). T-tests revealed that those that had diabetes had significantly higher WTP value than those without.

Correlation

Significant positive correlations of WTP with income support theoretical validity (Klose 1999). In this study, WTP had significant positive correlations with education level, employment status and car ownership, as expected (Appendix 11). These factors assess the economic wellbeing of the participants and were hypothesized to influence WTP values. Similarly, Onwujekwe et al (2008) in assessing WTP values for insecticide treated nets using SH found a positive and significant correlation between income proxies (food costs) and WTP (Onwujekwe, Fox-Rushby et al. 2008).

GLM Regression

In this study, from the GLM analysis, the income proxy, car ownership, was a significant positive predictor of WTP. This result is similar to a previous studies in Sub-Saharan Africa in which income or income proxies were significant positive predictors of WTP using the PC method (Masiye and Rehnberg 2005; Udezi, Usifoh et al. 2010) and using the SH method (Onwujekwe, Uzochukwu et al. 2004). Validity of the PC method using income has also been established in other settings including Western countries (Donaldson, Thomas et al. 1997; Gyldmark and Morrison 2001; Smith 2006; Martín-

Fernández, Gómez-Gascón et al. 2010) and developing countries (Afroz, Hassan et al. 2006).

In a separate study, Onwujekwe et al (2008) using OLS analysis assessing SH did not find significance in income proxy variable and other variable hypothesized a priori to influence WTP values though there were significant bivariate relationship. This current study employed the GLM method and the results indicate that several of the hypothesized variables were significant and had signs that were as expected (Table 3.6). However, no significance was observed with age and gender, two variables with significant bivariate correlations. This indicates that GLM that is a viable option in analyzing WTP values that are skewed and heteroskedastic.

In summary, from the t tests, correlations and regression analyses in this study, support that the SH and PC methods were valid measures of WTP for rural residents in Kenya.

4.3 Willingness to pay: Structured Haggling and Payment Card

This study showed that Kenyan residents valued the diabetes prevention program: over 95% of participants were willing to pay more than zero KSh for program access. Both PC and SH surveys were completed successfully in this study. No WTP items were omitted in either group indicating the feasibility of both methods in rural Kenya.

The mean payment card WTP was KSh 533.59 (US$ 6.25) and the mean structured haggling WTP was KSh 637.55 (US$ 7.47). Although these are modest values in terms of US dollars, it is important to consider the low income for this rural region. The mean annual income (2008) for rural Kenya was US$ 820 versus US$ 47,3420 for

the USA (Suri, Tschirley et al. 2008; The Word Bank Group 2011) . Therefore, present study WTP bids were substantial when compared to Kenyan annual incomes. Additionally, the bids are substantial when compared to prices of staple food commodities in Kenya. For example, in 2011, the price of a kilogram of maize was KSh 42 (US$ 0.5), 2 kilograms of maize flour KSh 121.80 (US$ 1.42) and 2 kilograms of rice KSh 367.30 (US$4.30) (NCPB 2011).

The WTP values reported in this study are higher than another study conducted in Kenya in which 50% of the respondents were willing to pay US$6 for HIV counseling and testing services (Forsythe, Arthur et al. 2002). Compared to diabetes, HIV patients have access to free care provided in government hospitals (Zachariah, Van Engelgem et al. 2008). However, patients with diabetes face obstacles including unavailable essential drugs resulting in the following respondent quotes "diabetes is a killer disease" and "I would rather have HIV than diabetes." In other words, in Kenya, type 2 diabetes unlike HIV in the US, a non-communicable disease, is regarded as a death sentence due to the lack of access to care.

When comparing WTP values of PC with SH, SH values were significantly greater than PC. This result is consistent with Onwujekwe (2004) findings of SH being greater than binary with follow-up and bidding game. And can be attributed to the success of the 'haggling' process in the market place, and why this transaction mode is the most prevalent way of conducting business in rural areas.

There is no actual market for the diabetes prevention program to enable comparisons of the elicited WTP value and the true program value in Kenya. However, SH has been used in rural markets in Sub-Sahara Africa. Onwujekwe (2004) showed SH

WTP values were very close to true market value (i.e. what residents actually paid) for mosquito nets in rural Nigeria.

The results of this study do not imply that SH is appropriate for every setting in Kenya. These study results showed its use was practical and convenient to administer in a rural setting in Kenya, which is dominated by haggling-type market place transactions. As a result, SH may have value in other rural market place settings where culturally, haggling takes place.

When choosing between the SH and PC elicitation methods, available research resources must be considered. SH requires face to face interactions as in a haggling process. This would require substantial resources. However, with limited resources, PC can be administered without the requirement of interviewers resulting in cost savings (Mitchell and Carson 1989). In rural areas where mailing systems are a challenge, questionnaires can be hand delivered and picked up (Arthur Jr, Woehr et al. 1995).

4.4 Cost Benefit Analysis

The number of WTP studies is rising although very few of these are complete CBA studies (Diener et al., 1998; Sach et al., 2007). This can be attributed to difficulty in monetizing outcomes. However, the lack of studies that combine WTP values and costs of interventions raises the question of using these studies for resource allocation (Sach 2007). This study is the first full CBA study of a diabetes prevention program in Kenya, thereby providing policy makers with a direct means to transparently weigh the benefits and the costs of the program.

Study WTP bids showed that respondents valued the program independent of measurement method (Table 3.3). However, a recent study in Kenya indicated that only 27.2% of community members had good knowledge of diabetes (Maina, Ndegwa et al. 2010). There is a need for a diabetes education and prevention program in rural Kenya. However, in terms of NSB, the cost of providing the new program was higher than the population's perceived benefits resulting in a negative value. This analysis assumes a stand-alone facility would be used to implement the program. Forsythe et al (2002) in a CBA study assessing the value of HIV counseling and testing in Kenya showed costs of the service can be significantly reduced if the service was integrated to existing health centers as opposed to stand-alone facilities. Therefore, similarly, the costs of this program could also be reduced by integrating care using community facilities.

Another possible contributing factor to the low WTP value and consequently the negative NSB was the presentation of the benefits of the program to the respondents. Mortality reduction information as a result of the program was not presented to the respondents and this may have resulted in the conservative WTP values provided. Similarly, mortality risk reductions were also not presented in the HIV study by Forsythe et al (2002) also possibly resulting in low WTP values.

There are several program alternatives that can provide positive NSB. Combining cost reductions by 2/3 and 3/4 and participant increases by 26.5% and 4.8 % results in positive NSB. One way of cutting costs would be integrating such a program into other disease prevention programs where the overhead costs can be shared between the programs. Consequently, this may have the added effect of increasing participants who

while not particularly interested in the program, my take the opportunity to participate due to convenience.

For the current study, similar to a typical mobile health screening clinic in the United States, the services provided would be shared 3 or 4-way with other services such as depression, vision and cholesterol screenings (Oriol, Cote et al. 2009). Mobile health clinics are available in Kenya where the focus is on prevention of communicable diseases such as sleeping sickness, malaria and HIV (SHARE 2013). The diabetes prevention program evaluated in this project can be incorporated as part of such a mobile clinic already in existence. Such a program is not only feasible but already underway in a rural South Africa where the focus is on non-communicable diseases such as diabetes, asthma, hypertension and epilepsy (Coleman, Gill et al. 1998).

From discussions with Kenyan diabetes educators, increasing participants by 4.8% is feasible while increasing by 26.5% is optimistic. Sharing costs with other mobile disease prevention programs and reducing the current costs to 1/4 while increasing participants by 4.8% is a more feasible and realistic recommendation that produces a positive NSB. Therefore, the recommendation is to incorporate the diabetes prevention program into other currently available disease prevention programs as part of a larger disease prevention initiative.

This study assumed an analytical time period of five years that reflects political voting cycle and expected policy changes. Adjusting the study time horizon to a shorter time period with of approximately 3 years, that reflects the length of typical diabetes prevention programs, all the program costs would be absorbed within the short time period making the present value of costs larger and the resultant NSB smaller than the

current analysis (Knowler, Barrett-Connor et al. 2002). However, if the time period is longer e.g., a lifetime projection, the capital costs would be absorbed over a longer time period reducing the overall present value of costs and increasing the NSB value; more positive NSB than the present study. This is similar to a previous study in which net benefits of implementing electronic medical record systems in primary care increase with time (Wang, Middleton et al. 2003).

Alternative approaches to measure benefits: The benefits of a healthcare program can be viewed as an investment in a person's human capital. An alternative approach to the WTP method to measuring benefits in a CBA is using the human capital approach (HCA). The human capital method places monetary value on healthy time using market wage rates and the value of the program is assessed in terms of the present value of future earnings (Drummond, Sculper et al. 2005). If in the present study the HCA was used as an alternative to the WTP approach to measure benefits then the following assumptions could be made (Appendix 21). The result would be a substantial increase in the assessment of benefits using the HCA over the WTP using present study assumptions, i.e., US$ 200,581 vs $94,526. However, if a more pessimistic view of the success of the program was taken a much more modest measure of benefits would result using HCA, which is analogous to the sensitivity analysis for the present study. This result greater benefits measured using HCA over WTP is similar to a Taiwan study of a chicken pox vaccine in which the benefits using HCA were greater than benefits measured by WTP method (Hsu, Lin et al. 2003). Typically, WTP values are expected to be higher than HCA values (Alberini and Krupnick 2000; Fautrel, Clarke et al. 2007). However, Kenya is a low income country therefore; the HCA values are greater than WTP, as WTP values

are constrained by low income. Income constraints on WTP values have been previously discussed, but in short, WTP is limited by discretionary income (O'Brien and Gafni 1996).

Though commonly used, the HCA has been criticized for various reasons. Of note is that the method is not consistent with the tenets of welfare economics as benefits are restricted to impacts on labor productivity (Drummond 1981). The method has the potential to value high wage earners more highly than low wage earners. Consequently, it discriminates against people not in the labor force (Blumenschein and Johannesson 1996). Due to its lack of consistency with the tenets of welfare economics required for CBA analysis, WTP was used as opposed to the HCA in the current project.

4.5 Future Research

A future recommendation from this project is to perform a CBA assuming that the program is integrated into established health facilities to determine its NSB. Currently, the World Health Organization is emphasizing the control of four non-communicable diseases cardiovascular diseases, diabetes, cancers and chronic respiratory diseases that share common risk factors of tobacco use, physical inactivity, unhealthy diets and the harmful use of alcohol (WHO 2009) . Integrating the diabetes education and prevention program evaluated here into an overall non-communicable disease prevention program as recommended by WHO may increase the NSB by sharing the overhead capital costs with other prevention and treatment programs. This type of approach has been reported previously by Forsythe et al (2002) who concluded that integrating voluntary HIV

counseling and testing in Kenya into existing health centers can reduce the costs of voluntary and counseling testing services.

4.6 Limitations

This study has potential limitations, consistent with all contingent valuation method studies including hypothetical, information and interviewer biases. CVM studies ask respondents their willingness to pay for hypothetical scenarios. They are asked to state what they would pay for the program but are not required to actually pay for it. Hypothetical bias arises due to the nature of CVM studies in which hypothetical questions are asked in lieu of actual markets. The respondent may provide higher or lower WTP bids resulting in greater variability in WTP bids (Mitchell and Carson 1989). This study addressed hypothetical bias by employing "cheap talk" in the PC and SH surveys prior to elicitation the final WTP bid (Cummings and Taylor 1999) (please see section 2.4.2). Additionally, this proposal provides accurate introduction information from in-depth literature searches and consultation with diabetes educators Dr. Robin Southwood (US) and Vincent Mbugua (Kenya) as well as conducting a pilot test (see Preliminary study II) to ensure that scenarios are as consistent with real life as possible.

Information bias occurs when how the information is presented in the CVM scenario influences valuations in a significant manner (Bergstrom, Stoll et al. 1989) while interviewer bias occurs when the respondent gives a WTP amount that differs from the true value in an attempt to please the interviewer (Mitchell and Carson 1989). This proposal addresses these biases by: utilizing structured interview formats (Appendix 5 and 6) to ensure that the interviewer provides the same information consistently, having

all interview materials reviewed by an expert panel knowledgeable about diabetes and survey methods to ensure information is brief yet complete and neutral, and piloting the survey in a sample of Kenyans.

Other potential biases include range bias with the payment card and starting point bias with the structured haggling technique. Range bias occurs when the information presented on the payment card influences the respondents' WTP amount (Smith 2000; Whynes 2004). Reports for range bias are variable: there are some studies that report no problem with the method (Rowe, Schulze et al. 1996, Brouwer and Spaninks 1999). Similar to the bidding game structured haggling may suffer from starting point bias that occurs when the respondent's WTP amount is influenced by the starting offer amount (Mitchell and Carson 1989). Starting point bias has not been investigated with the structured haggling technique and this may form a basis for future studies with this technique.

Morbidity presentation and lack of mortality information in the scenario may have resulted in amenity misspecification bias specifically benefit part-whole bias. This bias occurs where a respondent includes a narrower or broader range of benefits in valuing the program than intended by the researcher (Mitchell and Carson 1989). Mortality reduction as a result of the diabetes prevention program was not presented to the respondents. Therefore, this may have resulted in undervaluing of the program and consequent low bids.

Another potential limitation of this study is the generalizability of these results. The project evaluated is concerned with providing a diabetes prevention program to adult

residents of rural Kenya. Results of this study cannot be generalized to urban residents with higher incomes and ready access to health care facilities.

4.7 Conclusions

This study has compared the commonly used payment card (PC) and the newly developed structured haggling (SH) willingness to pay elicitation method. This study shows that both methods were feasible in a rural setting with SH bids exceeding PC bids. Until these methods are compared to actual markets, the debate as to which elicitation method is best will continue (Smith 2000).

Diabetes prevention programs have been shown to be effective in other countries (Lindström, Ilanne-Parikka et al. 2006). Based on willingness to pay (benefit) data, rural residents valued the diabetes education, screening and referral program in rural Kenya. However, from a societal perspective, the costs for implementing the program outweighed the benefits. The evaluated program is a stand-alone project. Policy makers may consider a number of options that can reduce the operating costs of the program including, implementation of the program as part of established diabetes clinics, or administering the services to already gathered groups such as at religious functions: such an approach may result in a positive net social benefit.

Appendix 1: Classification of the studies by elicitation format

Open Ended
Echessah, Swallow et al. 1997
Lewallen, Geneau et al. 2006
Ataguba 2008

Bidding Game
Binam, Nkama et al. 2004
Asenso-Okyere, Osei-Akoto et al. 1997
Asafu-Adjaye and Dzator 2003
Wiseman, Onwujekwe et al. 2005
Onwujekwe, Okereke et al. 2009
Lwambo, Siza et al. 2005
Uzochukwu, Onwujekwe et al. 2010
Frick, Lynch et al. 2003
Onwujekwe, Shu et al. 1998
Muko, Ngwa et al. 2004

Payment Card

Masiye and Rehnberg 2005
Forsythe, Arthur et al. 2002
Udezi, Usifoh et al. 2010

Dichotomous choice (Take it or leave it, Referendum, Binary)
Saulo, Forsberg et al. 2008
Whittington, Pinheiro et al. 2003
Asfaw and Braun 2004
Bishai, Pariyo et al. 2004
Weaver, Ndamobissi et al. 1996
Chase, Sicuri et al. 2009
Mujinja, Makwaya et al. 2004
Habbani, Groot et al. 2006

Mixed methods
Dong, Kouyate et al. 2003
Ataguba, Ichoku et al. 2008
Onwujekwe 2001
Onwujekwe, Fox-Rushby et al. 2008

Appendix 2 (pilot study)

FACE-TO-FACE
INTERVIEW

STRUCTRED HAGGLING
WILLINGNESS TO PAY

ID#: _____

Date of interview: _____

Time Started: _____am/pm

Time Ended: _____am/pm

Section 1: Background

In Kenya, approximately 3 out of every 100 people have adult onset diabetes also know as type 2 diabetes. The risk factors for diabetes can be due to little physical exercise, obesity, genetics, becoming older and high blood pressure. If not detected and treated, diabetes can cause many problems. Such problems include:

- Heart disease leading to heart attacks and heart failure
- Difficulty in vision and eye problems leading to blindness;
- Kidney problems, leading to kidney failure;
- Nerve damage primarily leading to problems of the foot but also to problems such as diarrhea, constipation, nausea, vomiting etc arising from damage to nerves in other parts of the body. Amputation may result.

Many people are unaware that they have diabetes or that they have the risk factors. Suppose that there is a program that can educate rural residents to reduce the risk of developing diabetes. In this program, trained diabetic educators can raise awareness of the risks, conduct screenings and provide referrals for further checkups if needed. In some countries, where such programs exist, individuals that were identified to be at risk were offered individualized counseling on lifestyle modification such as proper diet and physical activity. They were followed for seven years and their risk of developing diabetes was reduced by approximately 43%. That means that instead of 3 out of every 100 people developing diabetes, the number is reduced to 2 out of every 100 people developing diabetes.

Now I want you to think about how this program could help prevent you from having problems and expenses caused by undetected diabetes. Considering all your other expenses such as food, rent, school fees etc, how much are you willing to pay annually for participation in such a program to prevent the problems and expenses from undetected diabetes? The program is not covered by insurance nor the government and it cannot be provided free of charge.

There are no right or wrong answers and the purpose of the questions is only to find the value of such a program to you.

Section 2: Willingness to Pay (SH)

Now I'm going to ask you 3-6 questions about how much you are willing to pay to participate in the program. Remember, the program will reduce your risk of developing diabetes by 43%.

1. Would you be willing to pay **KSh 600** per year to participate in the program?

   Yes *[go to Q5]*
   No *[go to Q2]*
   Do not know *[go to Q2]*

2. What is the maximum amount you are willing to pay per year? _____

   [> KSh 500 go to Q5]
   [Between KSh 400-499 go to Q3]
   [< KSh 400 go to Q4]

3. Would you be willing to pay **KSh 500** per year to participate in the program?

   Yes
   No
   [No matter the answer, go to Q5]

4. Would you be willing to pay **KSh 450** per year to participate in the program?

   Yes *[go to Q6]*
   No *[go to Q5]*

5. In studies such as this one, past research shows that people sometimes are reluctant to say how much they really value a health program. To help us learn how much the proposed diabetes prevention program is worth to people, could you please think again and tell us the absolute maximum amount you are willing to pay per year to participate in the program? KSh _____

   [No matter the answer, go to Q6]

6. If due to inflation or other uncertainties, the cost of the program increases, would you be willing to pay more for the program than what you stated in Question 5 above?

   Yes
   What is the maximum amount per year you would be willing to pay to participate in the program?
   KSh _____

No *[record the amount given in question 5]*
KSh _____

[If KSh 0 is given], Can you please tell me why?

_____

Appendix 3 (pilot study)

FACE-TO-FACE
INTERVIEW

PAYMENT CARD
WILLINGNESS TO PAY

[interviewer completed]

ID#: _____

Date of interview: _____

Time Started: _____am/pm

Time Ended: _____am/pm

Section 1: Background

In Kenya, approximately 3 out of every 100 people have adult onset diabetes also know as type 2 diabetes. The risk factors for diabetes can be due to little physical exercise, obesity, genetics, becoming older and high blood pressure. If not detected and treated, diabetes can cause many problems. Such problems include:

- Heart disease leading to heart attacks and heart failure
- Difficulty in vision and eye problems leading to blindness;
- Kidney problems, leading to kidney failure;
- Nerve damage primarily leading to problems of the foot but also to problems such as diarrhea, constipation, nausea, vomiting etc arising from damage to nerves in other parts of the body. Amputation may result.

Many people are unaware that they have diabetes or that they have the risk factors. Suppose that there is a program that can educate rural residents to reduce the risk of developing diabetes. In this program, trained diabetic educators can raise awareness of the risks, conduct screenings and provide referrals for further checkups if needed. In some countries, where such programs exist, individuals that were identified to be at risk were offered individualized counseling on lifestyle modification such as proper diet and physical activity. They were followed for seven years and their risk of developing diabetes was reduced by approximately 43%. That means that instead of 6 out of every 200 people developing diabetes, the number is reduced to 4 out of every 200 people developing diabetes.

Now I want you to think about how this program could help prevent you from having problems and expenses caused by undetected diabetes. Considering all your other expenses such as food, rent, school fees etc, how much are you willing to pay annually for participation in such a program to prevent the problems and expenses from undetected diabetes? The program is not covered by insurance nor the government and it cannot be provided free of charge.

There are no right or wrong answers and the purpose of the questions is only to find the value of such a program to you.

Section 2: WTP (PC)

Now I'm going to ask you 2-3 questions about how much you are willing to pay to participate in the program. Remember, the program will reduce your risk of developing diabetes by 43%.

1. Please tell me the maximum you are willing to pay per year to access the program.

Please put a *(✓)* next to all the amounts you are willing to pay	KSh 0
	KSh 100
Put an *(X)* next to the amount that you are sure you would not pay	KSh 200
	KSh 300
	KSh 400
Put a circle around the maximum amount you would be prepared to pay	KSh 500
	KSh 600
	Other KSh _____

(If more than KshKSh 600 please ask for a specific amount)

2. In studies such as this one, past research shows that people sometimes are reluctant to say how much they really value a health program. To help us learn how much the proposed diabetes prevention program is worth to people, could you please think again and tell us the absolute maximum amount you are willing to pay per year to participate in the program? KSh _____

3. If due to inflation or other uncertainties, the cost of the program increases, would you be willing to pay more for the program than what you stated in question 2?

   Yes

   What is the maximum amount per year you would be willing to pay to participate in the program?
   KSh _____

   No *[record the amount given in question 2]*
   KSh _____

[If KSh 0 is given], Can you please tell me why?

_____

Section 3: Demographics

This is the last part of this interview. Now I'm going to ask you some questions about yourself.

1. What is your gender
   a. Female
   b. Male

2. What is the highest level of education level that you have attained?
   a. No formal Education
   b. Adult Education
   c. Primary Education 1-4
   d. Primary Education 5-8
   e. High school/Secondary education
   f. Post-secondary education
   g. College graduate
   h. Post-graduate education

3. What is your marital status?
   a. Single
   b. Widowed
   c. Married
   d. Cohabit

4. What is your employment status?
   a. Employed salaried wage earner
   b. Self employed
      i. Farmer
      ii. Artisan and small scale trading
      iii. Professional and business people
      iv. Other _____
   c. Not employed
   d. Student

5. What are your household monthly expenditures? _____

6. Do you own a car
   a. Yes
   b. No

7. How many family members live in your home including you?
   _____

8. Have you heard about diabetes?
   a. Yes

b. No

9. Do you have diabetes?
    a. Yes
        i. How long have you had diabetes? _____
        ii. What problems have you experienced with diabetes?
        _____
        _____
    b. No

10. Do you have relatives with diabetes?
    1. Yes
    2. no

11. Do you have high blood pressure?
    a. Yes
    b. No

12. Do you smoke?
    a. Yes
    b. No

13. Do you consider yourself to be overweight or obese?
    a. Yes
    b. No

14. What year were you born? _____

15. How confident are you in your answers?
    a. Very confident
    b. Somewhat confident
    c. Not too confident
    d. Not at all confident

Finally, do you have any other comments about diabetes or this research?

_____

_____

Appendix 4: Modification to the demographic information for proposed study

Pilot study		Proposed Study	
Do you own a car	1 =respondent owns a car 0=otherwise	Does your household own a car	1=yes 0=no
Have you heard about Diabetes	1=yes 0=no	How familiar are you with diabetes	1 (not at all familiar) 2 3 4 5 (very familiar)
Do you have relatives with diabetes	1=yes 0=no	Do any of your immediate family members (mother, father, sister, brother) have diabetes Do any of your other relatives (grandparent, cousin, uncle, aunt) have diabetes	1.yes 2. no 3 (don't know) 1.yes 2. no 3 (don't know)
Do you smoke	1=yes 0=no	Do you now Smoke?	1. regularly 2. occasionally 3. not at all
Do you consider yourself to be overweight or obese	1=yes 0=no	Do you consider yourself now to be …	1 overweight 2 about the right weight 3 underweight 4. don't know
		In your opinion, how likely are you to develop diabetes? (1 means not at all likely and 10 means very likely)	(Not at all likely) 1 2 3 4 5 6 7 8 9 10 (Very likely)
		How serious do you think type 2 diabetes is? (1 means not at all serious and 10 means very serious)	(Not at all serious) 1 2 3 4 5 6 7 8 9 10 (Very serious)
		In general, would you say your health is:	Excellent Very good Good Fair Poor

Appendix 5 *[NON DIABETIC RESPONDENTS ONLY]*

DIABETES SCREENING

[If a respondent meets the inclusion criteria proceed with the diabetes screening process]

Have you ever been told by a doctor, nurse or other health professional that you have diabetes?

a. Yes

[If a respondent answers YES to the question, proceed with the diabetic questionnaire]

b. No

[If a respondent answers NO to the question, proceed with the non-diabetic questionnaire]

FACE-TO-FACE
INTERVIEW

STRUCTRED HAGGLING
WILLINGNESS TO PAY

ID#: _____

Date of interview: _____

Time Started: _____am/pm

[NON DIABETIC RESPONDENTS ONLY]

Section 1 Background

Diabetes is a disease that causes blood sugar to be too high. When adults develop diabetes it is called adult onset or type 2 diabetes. In rural Kenya, approximately 3 out of 100 people have diabetes. Many people are unaware that they have diabetes because in the early stages they can have no symptoms, so it's possible to have diabetes and not know it. But if not detected and treated, diabetes can cause many short-term and long term problems. Such problems include:

- Frequent infections, and wounds that are slow to heal
- Increased thirst, frequent urination, extreme hunger, rapid weight loss
- Extreme fatigue and irritability, dizziness
- Stomach problems such as nausea and vomiting
- Heart disease leading to heart attacks and heart failure
- Blurred vision, and eye problems leading to blindness
- Kidney problems, leading to kidney failure
- Tingling and numbness in the feet, and possibly amputation.

Your lifestyle choices can completely prevent type 2 diabetes or at least delay it. You can't do anything about your age or your genetics. On the other hand you can do something about your lifestyle choices, factors that predispose you to diabetes such as being overweight, too little physical exercise, eating habits, high blood pressure, and smoking are up to you.

Now suppose that there is a diabetes education and screening program that can reduce your risk of developing diabetes. In this program, trained diabetes educators travel to a location near you, provide diabetes education including healthy eating choices and exercise programs, conduct screenings and provide referrals for further checkups if needed. The program would be offered once a year in your area.

Now I want you to think about how this program could help prevent you from having problems and expenses caused by undetected diabetes. One study has successfully shown that if you ate more healthy or increased your physical activity you could reduce your chances of developing diabetes by 20%.

Considering all your other expenses such as food, rent, school fees etc, how much are you willing to pay <u>annually</u> for participation in such a program? The program is not covered by insurance nor the government, you cannot borrow to pay for it, and it cannot be provided free of charge.

There are no right or wrong answers and the purpose of the questions is only to find the value of such a program to you.

Section 2: Willingness to Pay (SH)

Now I'm going to ask you 3-6 questions about how much you are willing to pay to participate in the program.

1. Would you be willing to pay **KSh 600** per year to participate in the program?

   Yes *[go to Q5]*
   No *[go to Q2]*
   Do not know *[go to Q2]*

2. What is the maximum amount you are willing to pay per year? _____

   [> KSh 500 go to Q5]
   [Between KSh 400-499 go to Q3]
   [< KSh 400 go to Q4]

3. Would you be willing to pay **KSh 500** per year to participate in the program?

   Yes
   No
   [No matter the answer, go to Q5]

4. Would you be willing to pay **KSh 450** per year to participate in the program?

   Yes *[go to Q6]*
   No *[go to Q5]*

5. In studies such as this one, past research shows that people sometimes are reluctant to say how much they really value a health program. To help us learn how much the proposed diabetes prevention program is worth to people, could you please think again and tell us the absolute maximum amount you are willing to pay per year to participate in the program? KSh _____

   [No matter the answer, go to Q6]

6. If due to inflation or other uncertainties, the cost of the program increases, would you be willing to pay more for the program than what you stated in Question 5 above?

   Yes

   What is the maximum amount per year you would be willing to pay to participate in the program?
   KSh _____

No *[record the amount given in question 5]*
KSh _____

[If KSh 0 is given], Can you please tell me why?

_____

Section 3: Demographics

This is the last part of this interview. Now I'm going to ask you some questions about yourself.

1. What is your gender
   c. Female
   d. Male

2. What is the highest level of education level that you have attained?
   a. No formal Education
   b. Adult Education
   c. Primary Education 1-4
   d. Primary Education 5-8
   e. High school/Secondary education
   f. Post-secondary education
   g. College graduate
   h. Post-graduate education

3. What is your marital status?
   a. Single
   b. Widowed
   c. Married
   d. Cohabit

4. What is your employment status?
   a. Employed salaried wage earner
   b. Self employed
      i. Farmer
      ii. Artisan and small scale trading
      iii. Professional and business people
      iv. Other _____
   c. Not employed
   d. Student

5. What are your household monthly expenditures? _____

6. Is there a car in your household?
   a. Yes
   b. No

7. How many family members live in your home including you?
   _____

8. In general, would you say your health is:

Excellent Very good Good Fair Poor

9. How familiar are you with diabetes

1 not at all familiar
2
3
4
5 very familiar

10. In your opinion, how likely are you to develop diabetes?

(1 means not at all likely and 10 means very likely)

Not at all likely 1 2 3 4 5 6 7 8 9 10 Very likely

11. How serious do you think type 2 diabetes is?

(1 means not at all serious and 10 means very serious)

Not at all serious 1 2 3 4 5 6 7 8 9 10 Very serious

12. Do any of your immediate family members (mother, father, sister, brother) have diabetes

a. Yes
b. no
c. don't know

13. Do any of your other relatives (grandparent, cousin, uncle, aunt) have diabetes?
a. Yes
b. no
c. don't know

14. Do you have high blood pressure?
a. Yes
b. No

15. Do you smoke?
a. Regularly
b. Occasionally

c. Not at all

16. Do you consider yourself to be……?
    a. overweight
    b. about the right weight
    c. underweight
    d. don't know

17. What year were you born? _____

18. How confident are you in your answers?
    a. Very confident
    b. Somewhat confident
    c. Not too confident
    d. Not at all confident

Finally, do you have any other comments about diabetes or this research?

_____

_____

That completes all the questions for the interview. Thank you for giving us your time and help. We appreciate your assistance very much.

Section 4: Interviewer's Evaluation
[Interviewer completed]

Time Ended: _____am/pm

Status if Interview

1. Completed
2. Subject ineligible
3. Broken off
4. Refused

If ineligible, broken off or refused, why?
_____

How well did the respondent understand what she/he was asked to do in the WTP questions?

1. Understood completely
2. Understood somewhat
3. Did not understand very much
4. Did not understand at all
5. Other (specify) _____

Which of the following description best describes the degree of effort that the respondent made to arrive at the value for the WTP scenarios?

1. Gave the questions prolonged consideration in an effort to arrive at the best possible value
2. Gave the questions careful consideration but the effort was not prolonged
3. Gave the questions some consideration
4. Gave the question very little consideration
5. Other (specify) _____

FACE-TO-FACE
INTERVIEW

PAYMENT CARD
WILLINGNESS TO PAY

[Interviewer completed]

ID#: _____

Date of interview: _____

Time Started: _____am/pm

[NON DIABETIC RESPONDENTS ONLY]

Section 1 Background

Diabetes is a disease that causes blood sugar to be too high. When adults develop diabetes it is called adult onset or type 2 diabetes. In rural Kenya, approximately 3 out of 100 people have diabetes. Many people are unaware that they have diabetes because in the early stages they can have no symptoms, so it's possible to have diabetes and not know it. But if not detected and treated, diabetes can cause many short-term and long term problems. Such problems include:

- Frequent infections, and wounds that are slow to heal
- Increased thirst, frequent urination, extreme hunger, rapid weight loss
- Extreme fatigue and irritability, dizziness
- Stomach problems such as nausea and vomiting
- Heart disease leading to heart attacks and heart failure
- Blurred vision, and eye problems leading to blindness
- Kidney problems, leading to kidney failure
- Tingling and numbness in the feet, and possibly amputation.

Your lifestyle choices can completely prevent type 2 diabetes or at least delay it. You can't do anything about your age or your genetics. On the other hand you can do something about your lifestyle choices, factors that predispose you to diabetes such as being overweight, too little physical exercise, eating habits, high blood pressure, and smoking are up to you.

Now suppose that there is a diabetes education and screening program that can reduce your risk of developing diabetes. In this program, trained diabetes educators travel to a location near you, provide diabetes education including healthy eating choices and exercise programs, conduct screenings and provide referrals for further checkups if needed. The program would be offered once a year in your area.

Now I want you to think about how this program could help prevent you from having problems and expenses caused by undetected diabetes. One study has successfully shown that if you ate more healthy or increased your physical activity you could reduce your chances of developing diabetes by 20%.

Considering all your other expenses such as food, rent, school fees etc, how much are you willing to pay annually for participation in such a program? The program is not covered by insurance nor the government, you cannot borrow to pay for it, and it cannot be provided free of charge.

There are no right or wrong answers and the purpose of the questions is only to find the value of such a program to you.

Section 2: WTP (PC)

Now I'm going to ask you 2-3 questions about how much you are willing to pay to participate in the program.

1. Please tell me the maximum you are willing to pay per year to access the program.

   Please put a *(✓)* next to all the amounts you are willing to pay

   Put an *(X)* next to the amount that you are sure you would not pay

   Put a circle around the maximum amount you would be prepared to pay

   Ksh 0
   Ksh 100
   Ksh 200
   Ksh 300
   Ksh 400
   Ksh 500
   Ksh 600

   Other Ksh _____

   (If more than Ksh 600 please ask for a specific amount)

2. In studies such as this one, past research shows that people sometimes are reluctant to say how much they really value a health program. To help us learn how much the proposed diabetes prevention program is worth to people, could you please think again and tell us the absolute maximum amount you are willing to pay per year to participate in the program? Ksh _____

3. If due to inflation or other uncertainties, the cost of the program increases, would you be willing to pay more for the program than what you stated in question 2?

   Yes
   What is the maximum amount per year you would be willing to pay to participate in the program?
   Ksh _____

   No *[record the amount given in question 2]*
   Ksh _____

[If Ksh 0 is given], Can you please tell me why?

_____

Section 3: Demographics

This is the last part of this interview. Now I'm going to ask you some questions about yourself.

1.What is your gender
   a. Female
   b. Male

2.What is the highest level of education level that you have attained?
   a. No formal Education
   b. Adult Education
   c. Primary Education 1-4
   d. Primary Education 5-8
   e. High school/Secondary education
   f. Post-secondary education
   g. College graduate
   h. Post-graduate education

3.What is your marital status?
   a. Single
   b. Widowed
   c. Married
   d. Cohabit

4.What is your employment status?
   a. Employed salaried wage earner
   b. Self employed
      i. Farmer
      ii. Artisan and small scale trading
      iii. Professional and business people
      iv. Other _____
   c. Not employed
   d. Student

5.What are your household monthly expenditures? _____

6. Is there a car in your household?
   a. Yes
   b. No

7. How many family members live in your home including you? _____

8. In general, would you say your health is

Excellent Very good Good Fair Poor

9. How familiar are you with diabetes

   1 not at all familiar
   2
   3
   4
   5 very familiar

10. In your opinion, how likely are you to develop diabetes?

    (1 means not at all likely and 10 means very likely)

    Not at all likely 1 2 3 4 5 6 7 8 9 10 Very likely

11. How serious do you think type 2 diabetes is?

    (1 means not at all serious and 10 means very serious)

    Not at all serious 1 2 3 4 5 6 7 8 9 10 Very serious

12. Do any of your immediate family members (mother, father, sister, brother) have diabetes

    a. Yes
    b. no
    c. don't know

13. Do any of your other relatives (grandparent, cousin, uncle, aunt) have diabetes?
    a. Yes
    b. no
    c. don't know

14. Do you have high blood pressure?
    a. Yes
    b. No

15. Do you smoke?
    a. Regularly
    b. Occasionally
    c. Not at all

16. Do you consider yourself to be……?
    a. overweight
    b. about the right weight
    c. underweight
    d. don't know

17. What year were you born? _____

18. How confident are you in your answers?
    a. Very confident
    b. Somewhat confident
    c. Not too confident
    d. Not at all confident

Finally, do you have any other comments about diabetes or this research?

_____

_____

That completes all the questions for the interview. Thank you for giving us your time and help. We appreciate your assistance very much.

Section 4: Interviewer's Evaluation

[Interviewer completed]

Time Ended: _____am/pm

Status if Interview

1. Completed
2. Subject ineligible
3. Broken off
4. Refused

If ineligible, broken off or refused, why?

_____

How well did the respondent understand what she/he was asked to do in the WTP questions?

1. Understood completely
2. Understood somewhat
3. Did not understand very much
4. Did not understand at all
5. Other (specify) _____

Which of the following description best describes the degree of effort that the respondent made to arrive at the value for the WTP scenarios?

1. Gave the questions prolonged consideration in an effort to arrive at the best possible value
2. Gave the questions careful consideration but the effort was not prolonged
3. Gave the questions some consideration
4. Gave the question very little consideration
5. Other (specify) _____

Appendix 6 [*DIABETIC RESPONDENTS ONLY]*

DIABETES SCREENING

[If a respondent meets the inclusion criteria proceed with the diabetes screening process]

Have you ever been told by a doctor, nurse or other health professional that you have diabetes?

a. Yes

[If a respondent answers YES to the question, proceed with the diabetic questionnaire]

b. No

[If a respondent answers NO to the question, proceed with the non-diabetic questionnaire]

FACE-TO-FACE
INTERVIEW

STRUCTRED HAGGLING
WILLINGNESS TO PAY

ID#: _____

Date of interview: _____

Time Started: _____am/pm

[DIABETIC RESPONDENTS ONLY]

Section 1 Background

Diabetes is a disease that causes blood sugar to be too high. When adults develop diabetes it is called adult onset or type 2 diabetes. In rural Kenya, approximately 3 out of 100 people have diabetes. Many people are unaware that they have diabetes because in the early stages they can have no symptoms, so it's possible to have diabetes and not know it. But if not detected and treated, diabetes can cause many short-term and long term problems. Such problems include:

- Frequent infections, and wounds that are slow to heal
- Increased thirst, frequent urination, extreme hunger, rapid weight loss
- Extreme fatigue and irritability, dizziness
- Stomach problems such as nausea and vomiting
- Heart disease leading to heart attacks and heart failure
- Blurred vision, and eye problems leading to blindness
- Kidney problems, leading to kidney failure
- Tingling and numbness in the feet, and possibly amputation.

Your lifestyle choices can completely prevent type 2 diabetes or at least delay it. You can't do anything about your age or your genetics. On the other hand you can do something about your lifestyle choices, factors that predispose you to diabetes such as being overweight, too little physical exercise, eating habits, high blood pressure, and smoking are up to you.

Now suppose that there is a diabetes education and screening program. In this program, trained diabetes educators travel to a location near you, provide diabetes education including healthy eating choices and exercise programs, conduct screenings and provide referrals for further checkups if needed. The program would be offered once a year in your area.

Now I want you to think about how this program could help prevent you from having problems and expenses caused by diabetes. Even though you already have diabetes this program would be useful to you because you would learn more about skills on how best to manage your diabetes.
One study has shown that such a program has successfully improved weight loss, blood pressure and blood sugar levels.

Considering all your other expenses such as food, rent, school fees etc, how much are you willing to pay <u>annually</u> for participation in such a program? The program is not covered

by insurance nor the government, you cannot borrow to pay for it, and it cannot be provided free of charge.

There are no right or wrong answers and the purpose of the questions is only to find the value of such a program to you.

Section 2: Willingness to Pay (SH)

Now I'm going to ask you 3-6 questions about how much you are willing to pay to participate in the program.

1. Would you be willing to pay **Ksh 600** per year to participate in the program?

   Yes *[go to Q5]*
   No *[go to Q2]*
   Do not know *[go to Q2]*

2. What is the maximum amount you are willing to pay per year? _____

   [> Ksh 500 go to Q5]
   [Between Ksh 400-499 go to Q3]
   [< Ksh 400 go to Q4]

3. Would you be willing to pay **Ksh 500** per year to participate in the program?

   Yes
   No
   [No matter the answer, go to Q5]

4. Would you be willing to pay **Ksh 450** per year to participate in the program?

   Yes *[go to Q6]*
   No *[go to Q5]*

5. In studies such as this one, past research shows that people sometimes are reluctant to say how much they really value a health program. To help us learn how much the proposed diabetes prevention program is worth to people, could you please think again and tell us the absolute maximum amount you are willing to pay per year to participate in the program? Ksh _____

   [No matter the answer, go to Q6]

6. If due to inflation or other uncertainties, the cost of the program increases, would you be willing to pay more for the program than what you stated in Question 5 above?

   Yes
   What is the maximum amount per year you would be willing to pay to participate in the program?
   Ksh _____

No *[record the amount given in question 5]*
Ksh _____

[If Ksh 0 is given], Can you please tell me why?

_____

Section 3: Demographics

This is the last part of this interview. Now I'm going to ask you some questions about yourself.

1. What is your gender
   c. Female
   d. Male

2. What is the highest level of education level that you have attained?
   a. No formal Education
   b. Adult Education
   c. Primary Education 1-4
   d. Primary Education 5-8
   e. High school/Secondary education
   f. Post-secondary education
   g. College graduate
   h. Post-graduate education

3. What is your marital status?
   a. Single
   b. Widowed
   c. Married
   d. Cohabit

4. What is your employment status?
   a. Employed salaried wage earner
   b. Self employed
      i. Farmer
      ii. Artisan and small scale trading
      iii. Professional and business people
      iv. Other _____
   c. Not employed
   d. Student

5. What are your household monthly expenditures? _____

6. Is there a car in your household?
   a. Yes
   b. No

7. How many family members live in your home including you?
   _____

8. In general, would you say your health is:

Excellent Very good Good Fair Poor

9. How familiar are you with diabetes

1 not at all familiar
2
3
4
5 very familiar

10. You mentioned that you have diabetes
    a. How long have you had diabetes? _____years
    b. Can you please tell me what problems have you had with diabetes?
       _____
       _____

11. How serious do you think type 2 diabetes is?

(1 means not at all serious and 10 means very serious)

Not at all serious 1 2 3 4 5 6 7 8 9 10 Very serious

12. Do any of your immediate family members (mother, father, sister, brother) have diabetes

    d. Yes
    e. no
    f. don't know

13. Do any of your other relatives (grandparent, cousin, uncle, aunt) have diabetes?
    d. Yes
    e. no
    f. don't know

14. Do you have high blood pressure?
    a. Yes
    b. No

15. Do you smoke?
    a. Regularly
    b. Occasionally
    c. Not at all

16. Do you consider yourself to be……?
    a. overweight
    b. about the right weight
    c. underweight
    d. don't know

17. What year were you born? _____

18. How confident are you in your answers?
    a. Very confident
    b. Somewhat confident
    c. Not too confident
    d. Not at all confident

Finally, do you have any other comments about diabetes or this research?

_____

_____

That completes all the questions for the interview. Thank you for giving us your time and help. We appreciate your assistance very much.

Section 4: Interviewer's Evaluation
[Interviewer completed]

Time Ended: _____am/pm

Status if Interview

1. Completed
2. Subject ineligible
3. Broken off
4. Refused

If ineligible, broken off or refused, why?
_____

How well did the respondent understand what she/he was asked to do in the WTP questions?

1. Understood completely
2. Understood somewhat
3. Did not understand very much
4. Did not understand at all
5. Other (specify) _____

Which of the following description best describes the degree of effort that the respondent made to arrive at the value for the WTP scenarios?

1. Gave the questions prolonged consideration in an effort to arrive at the best possible value
2. Gave the questions careful consideration but the effort was not prolonged
3. Gave the questions some consideration
4. Gave the question very little consideration
5. Other (specify) _____

FACE-TO-FACE
INTERVIEW

PAYMENT CARD
WILLINGNESS TO PAY

[Interviewer completed]

ID#: _____

Date of interview: _____

Time Started: _____am/pm

[DIABETIC RESPONDENTS ONLY]

Section 1 Background

Diabetes is a disease that causes blood sugar to be too high. When adults develop diabetes it is called adult onset or type 2 diabetes. In rural Kenya, approximately 3 out 100 people have diabetes. Many people are unaware that they have diabetes because in the early stages they can have no symptoms, so it's possible to have diabetes and not know it. But if not detected and treated, diabetes can cause many short-term and long term problems. Such problems include:

- Frequent infections, and wounds that are slow to heal
- Increased thirst, frequent urination, extreme hunger, rapid weight loss
- Extreme fatigue and irritability, dizziness
- Stomach problems such as nausea and vomiting
- Heart disease leading to heart attacks and heart failure
- Blurred vision, and eye problems leading to blindness
- Kidney problems, leading to kidney failure
- Tingling and numbness in the feet, and possibly amputation.

Your lifestyle choices can completely prevent type 2 diabetes or at least delay it. You can't do anything about your age or your genetics. On the other hand you can do something about your lifestyle choices, factors that predispose you to diabetes such as being overweight, too little physical exercise, eating habits, high blood pressure, and smoking are up to you.

Now suppose that there is a diabetes education and screening program. In this program, trained diabetes educators travel to a location near you, provide diabetes education including healthy eating choices and exercise programs, conduct screenings and provide referrals for further checkups if needed. The program would be offered once a year in your area.

Now I want you to think about how this program could help prevent you from having problems and expenses caused by diabetes. Even though you already have diabetes this program would be useful to you because you would learn more about skills on how best to manage your diabetes.
One study has shown that such a program has successfully improved weight loss, blood pressure and blood sugar levels.

Considering all your other expenses such as food, rent, school fees etc, how much are you willing to pay annually for participation in such a program? The program is not covered

by insurance nor the government, you cannot borrow to pay for it, and it cannot be provided free of charge.

There are no right or wrong answers and the purpose of the questions is only to find the value of such a program to you.

Section 2: WTP (PC)

Now I'm going to ask you 2-3 questions about how much you are willing to pay to participate in the program.

Please tell me the maximum you are willing to pay per year to access the program.

Please put a *(✓)* next to all the amounts you are willing to pay

Put an *(X)* next to the amount that you are sure you would not pay

Put a circle around the maximum amount you would be prepared to pay

Ksh 0

Ksh 100

Ksh 200

Ksh 300

Ksh 400

Ksh 500

Ksh 600

Other Ksh _____

(If more than Ksh 600 please ask for a specific amount)

In studies such as this one, past research shows that people sometimes are reluctant to say how much they really value a health program. To help us learn how much the proposed diabetes prevention program is worth to people, could you please think again and tell us the absolute maximum amount you are willing to pay per year to participate in the program? Ksh _____

4. If due to inflation or other uncertainties, the cost of the program increases, would you be willing to pay more for the program than what you stated in question 2?

   Yes

   What is the maximum amount per year you would be willing to pay to participate in the program?
   Ksh _____

   No *[record the amount given in question 2]*
   Ksh _____

[If Ksh 0 is given], Can you please tell me why?

_____

Section 3: Demographics

This is the last part of this interview. Now I'm going to ask you some questions about yourself.

1. What is your gender
    a. Female
    b. Male

2.What is the highest level of education level that you have attained?
    a. No formal Education
    b. Adult Education
    c. Primary Education 1-4
    d. Primary Education 5-8
    e. High school/Secondary education
    f. Post-secondary education
    g. College graduate
    h. Post-graduate education

3.What is your marital status?
    a. Single
    b. Widowed
    c. Married
    d. Cohabit

4.What is your employment status?
    a. Employed salaried wage earner
    b. Self employed
        i. Farmer
        ii. Artisan and small scale trading
        iii. Professional and business people
        iv. Other _____
    c. Not employed
    d. Student

5.What are your household monthly expenditures? _____

6. Is there a car in your household?
    a. Yes
    b. No

7. How many family members live in your home including you? _____

8.In general, would you say your health is:

Excellent Very good Good Fair Poor

9. How familiar are you with diabetes

   1 not at all familiar
   2
   3
   4
   5 very familiar

10. You mentioned that you have diabetes
    How long have you had diabetes? _____years
    Can you please tell me what problems have you had with diabetes?
    _____
    _____

11. How serious do you think type 2 diabetes is?

    (1 means not at all serious and 10 means very serious)

    Not at all serious 1 2 3 4 5 6 7 8 9 10 Very serious

12. Do any of your immediate family members (mother, father, sister, brother) have diabetes

    d. Yes
    e. no
    f. don't know

13. Do any of your other relatives (grandparent, cousin, uncle, aunt) have diabetes?
    d. Yes
    e. no
    f. don't know

14. Do you have high blood pressure?
    a. Yes
    b. No

15. Do you smoke?
    a. Regularly
    b. Occasionally
    c. Not at all

16. Do you consider yourself to be……?
    a. overweight
    b. about the right weight
    c. underweight
    d. don't know

17. What year were you born? _____

18. How confident are you in your answers?
    a. Very confident
    b. Somewhat confident
    c. Not too confident
    d. Not at all confident

Finally, do you have any other comments about diabetes or this research?

_____

_____

That completes all the questions for the interview. Thank you for giving us your time and help. We appreciate your assistance very much.

Section 4: Interviewer's Evaluation

[Interviewer completed]

Time Ended: _____am/pm

Status if Interview

1. Completed
2. Subject ineligible
3. Broken off
4. Refused

If ineligible, broken off or refused, why?

_____

How well did the respondent understand what she/he was asked to do in the WTP questions?

1. Understood completely
2. Understood somewhat
3. Did not understand very much
4. Did not understand at all
5. Other (specify) _____

Which of the following description best describes the degree of effort that the respondent made to arrive at the value for the WTP scenarios?

1. Gave the questions prolonged consideration in an effort to arrive at the best possible value
2. Gave the questions careful consideration but the effort was not prolonged
3. Gave the questions some consideration
4. Gave the question very little consideration
5. Other (specify) _____

Appendix 7 Annual Program Costs

a. Template: Annual Program Costs

Resource	**Quantity per year (A)**	**Cost/unit (B)**	**Total costs (A x B)**
FIXED COSTS			
Personnel			
Administrator			
Clerical worker			
Diabetes Educator			
Dietician			
Nurse			
Driver			
Facilities			
Rent			
Maintenance			
Water			
Electricity			
Phone			
Internet			
Supplies and Equip			
Office supplies			
Computer			
Office furniture			
Glucometers			
Weigh Scales			
Tape Measures			
Fleet Vehicles			
Advertising			
Other			
Other			
Subtotal			
VARIABLE COSTS			
Client Education materials			
Diabetes screening materials (test strips,)			
Target facility fees			
Travel (petrol)			
Other			
Other			
Subtotal			
TOTAL COSTS			

.

b. Productivity Losses

	Quantity per year (A)	**Cost/unit (B)**	**Total costs (A x B)**
Participant Travel Time			
Time Taken to Participate			
Other			
Other			
TOTAL			

Appendix 8: Annuity Calculation for Capital Costs

Item	**Number of items**	**Purchase/ unit**	**Expected Scrap Value after 5 years**	**Annuity Factor (3% for 5 years)** (Haddix, Teutsch et al. 2003) pg. 241	**Annualized Costs**
Vehicle				4.5797	
Furniture				4.5797	
Computer				4.5797	
Other				4.5797	

Appendix 9: INVITATION FLYER

DIABETES PREVENTION PROGRAM SURVEY

Please take 20 minutes of your time to complete this survey

This information will help us support diabetes prevention in the community

Are you 18 years of age or older?

If so, contact

Anne Kangethe, PhD Candidate

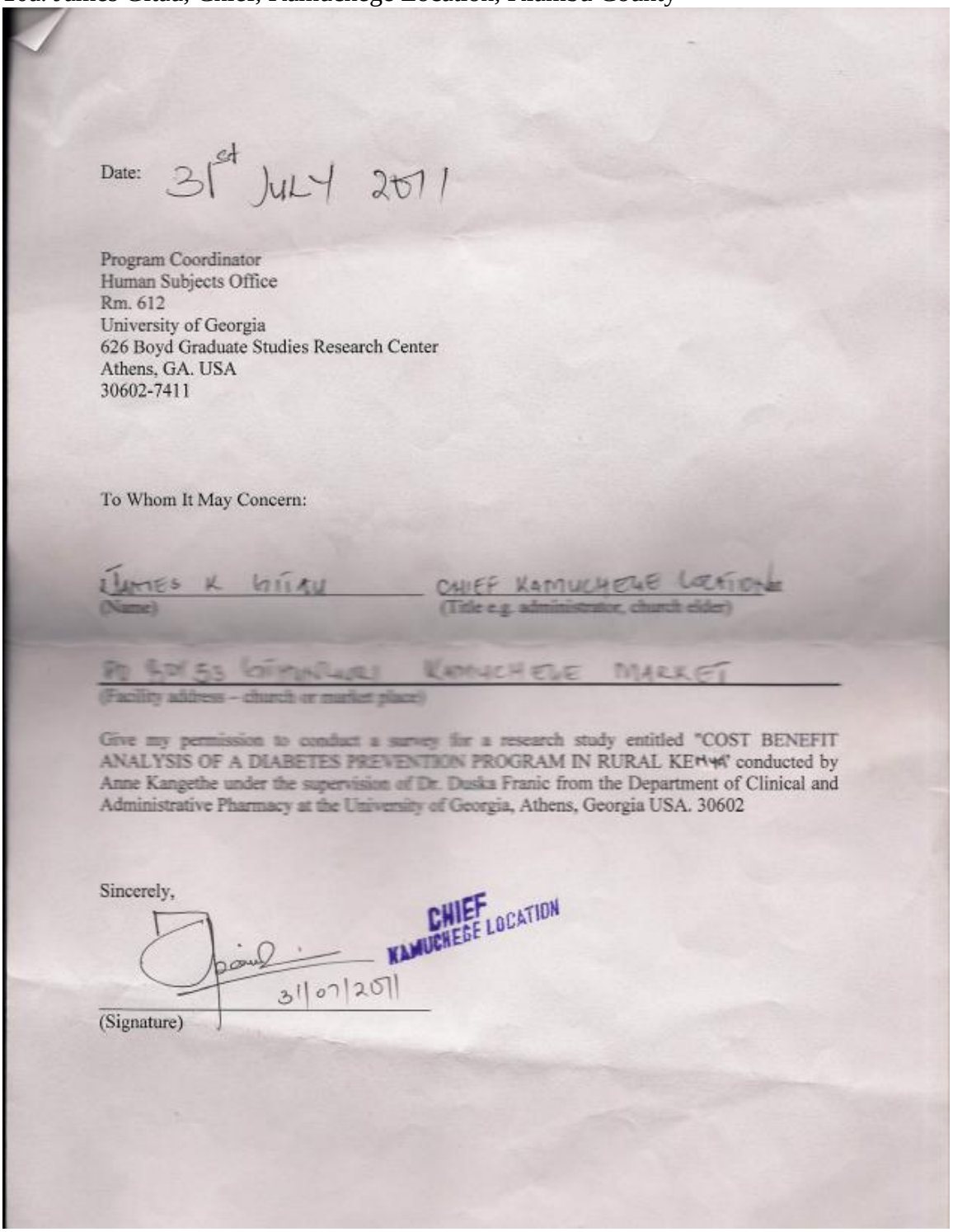
University of Georgia, Athens, GA. USA

at 20-782156

NB: The phone number listed in the flyer is a local phone number in Kiambu Kenya (which has 8 digits).

Appendix 10a-10d: SIGNED PERMISSION LETTERS

10a. James Gitau, Chief, Kamuchege Location, Kiambu County



Date: 31st JULY 2011

Program Coordinator
Human Subjects Office
Rm. 612
University of Georgia
626 Boyd Graduate Studies Research Center
Athens, GA. USA
30602-7411

To Whom It May Concern:

JAMES K GITAU — CHIEF KAMUCHEGE LOCATION
(Name) (Title e.g. administrator, church elder)

P.O BOX 53 GITHUNGURI — KAMUCHEGE MARKET
(Facility address – church or market place)

Give my permission to conduct a survey for a research study entitled "COST BENEFIT ANALYSIS OF A DIABETES PREVENTION PROGRAM IN RURAL KE[illegible]" conducted by Anne Kangethe under the supervision of Dr. Duska Franic from the Department of Clinical and Administrative Pharmacy at the University of Georgia, Athens, Georgia USA. 30602

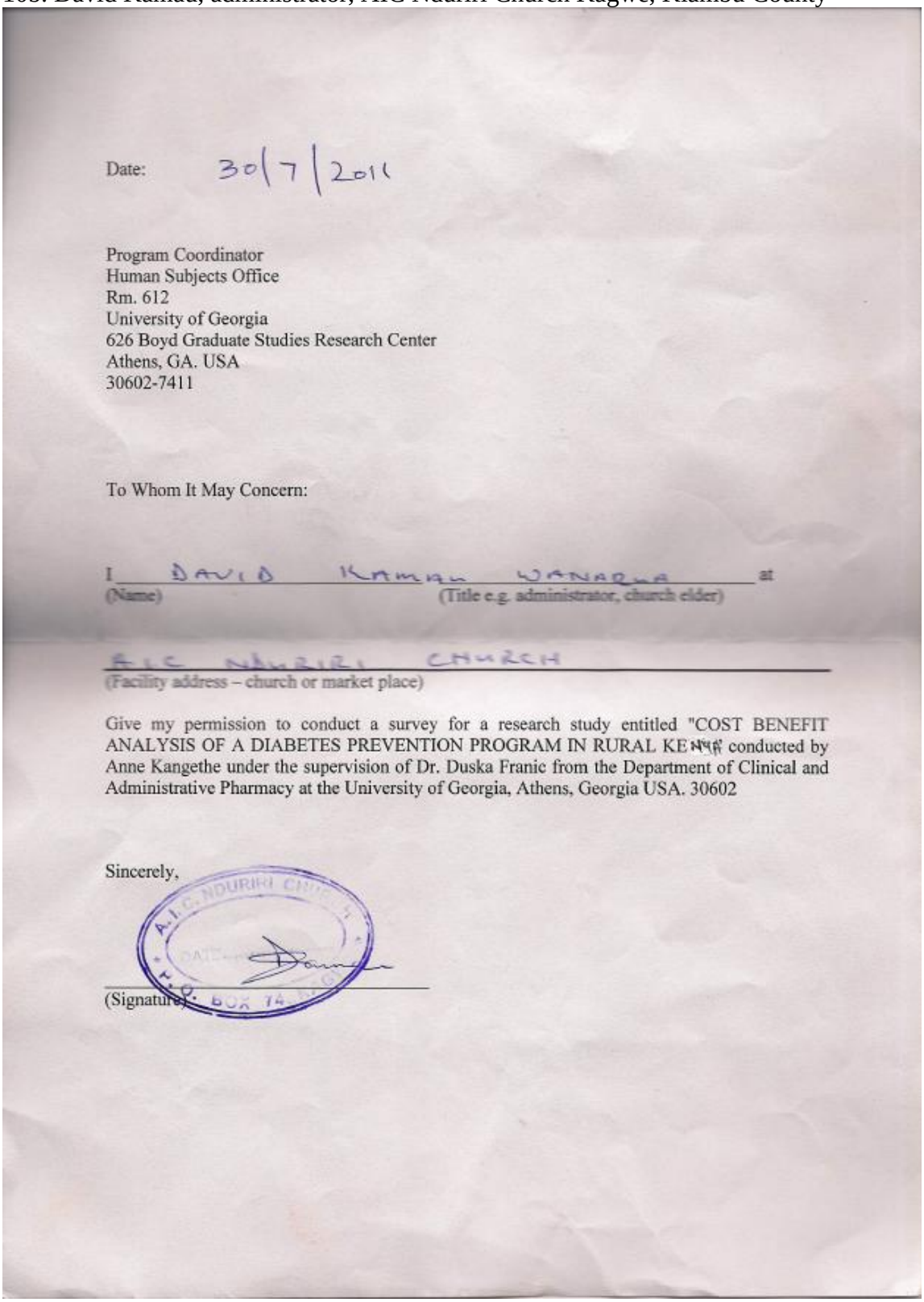
Sincerely,

CHIEF KAMUCHEGE LOCATION

31/07/2011

(Signature)

10b. David Kamau, administrator, AIC Nduriri Church Kagwe, Kiambu County



Date: 30/7/2011

Program Coordinator
Human Subjects Office
Rm. 612
University of Georgia
626 Boyd Graduate Studies Research Center
Athens, GA. USA
30602-7411

To Whom It May Concern:

I DAVID KAMAU WANARUA at
(Name) (Title e.g. administrator, church elder)

A.I.C NDURIRI CHURCH
(Facility address – church or market place)

Give my permission to conduct a survey for a research study entitled "COST BENEFIT ANALYSIS OF A DIABETES PREVENTION PROGRAM IN RURAL KE[illegible] conducted by Anne Kangethe under the supervision of Dr. Duska Franic from the Department of Clinical and Administrative Pharmacy at the University of Georgia, Athens, Georgia USA. 30602

Sincerely,

A.I.C. NDURIRI CHURCH
P.O. BOX 74

(Signature)

10c. Joseph Kiarie, Chairman, AIC Nduriri Dispensary, Kagwe, Kiambu County

Date: 30th July 2011

Program Coordinator
Human Subjects Office
Rm. 612
University of Georgia
626 Boyd Graduate Studies Research Center
Athens, GA. USA
30602-7411

To Whom It May Concern:

I JOSEPH KIARIE KURIA CHAIRMAN at
(Name) (Title e.g. administrator, church elder)

A.I.C. NDURIRI
(Facility address – church or market place)

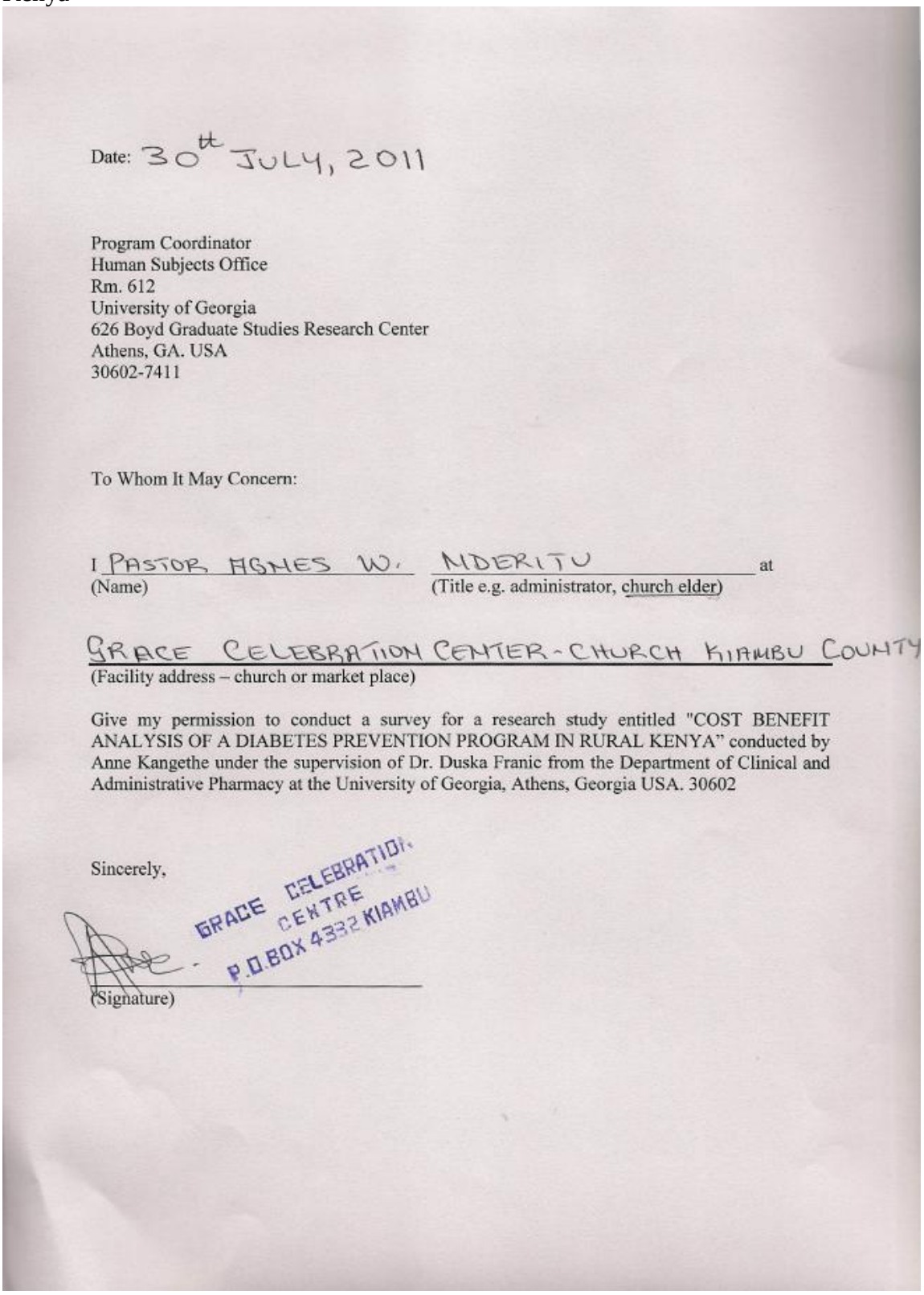
Give my permission to conduct a survey for a research study entitled "COST BENEFIT ANALYSIS OF A DIABETES PREVENTION PROGRAM IN RURAL KENYA" conducted by Anne Kangethe under the supervision of Dr. Duska Franic from the Department of Clinical and Administrative Pharmacy at the University of Georgia, Athens, Georgia USA. 30602

Sincerely,

A.I.C. NDURIRI DISPENSARY
P. O. BOX 74
KAGWE

(Signature)

10d. Pastor Agnes Nderitu, Church elder, Grace Celebration Center, Kiambu County, Kenya



Date: 30th JULY, 2011

Program Coordinator
Human Subjects Office
Rm. 612
University of Georgia
626 Boyd Graduate Studies Research Center
Athens, GA. USA
30602-7411

To Whom It May Concern:

I PASTOR AGNES W. NDERITU at
(Name) (Title e.g. administrator, church elder)

GRACE CELEBRATION CENTER - CHURCH KIAMBU COUNTY
(Facility address – church or market place)

Give my permission to conduct a survey for a research study entitled "COST BENEFIT ANALYSIS OF A DIABETES PREVENTION PROGRAM IN RURAL KENYA" conducted by Anne Kangethe under the supervision of Dr. Duska Franic from the Department of Clinical and Administrative Pharmacy at the University of Georgia, Athens, Georgia USA. 30602

Sincerely,

GRACE CELEBRATION CENTRE
P.O.BOX 4332 KIAMBU

(Signature)

Appendix 11: Correlation matrix

	maxbid	PC/SH	Diabetic	Gender	EDU	Marital	Eployd	EXP	Car Own	No in Fam	Hlth rating	Diab familiar	likely to get diab	serious of diab	Imm Rel	Dist Rel	HBP	Smoker	Weight	Age	Confidence
maxbidksh	1																				
PC/SH	0.124	1																			
	0.013																				
Diabetic	0.227	-0.045	1																		
	0.000	0.369																			
Gender	0.118	0.000	0.037	1																	
	0.019	0.998	0.465																		
EDU	0.166	-0.003	-0.078	0.026	1																
	0.001	0.950	0.120	0.607																	
Marital	0.079	-0.081	0.038	0.233	-0.155	1															
	0.117	0.108	0.454	0.000	0.002																
Eployd	0.184	-0.027	0.053	0.190	-0.138	0.458	1														
	0.000	0.589	0.290	0.000	0.006	0.000															
EXP	0.070	0.020	-0.046	0.055	0.210	0.112	0.209	1													
	0.166	0.691	0.359	0.272	0.000	0.026	0.000														
Car Own	0.188	-0.044	0.048	0.056	0.224	0.007	0.036	0.301	1												
	0.000	0.384	0.343	0.262	0.000	0.886	0.475	0.000													
No in Fam	-0.049	-0.003	0.028	-0.094	-0.058	0.091	-0.064	0.054	-0.018	1											
	0.327	0.952	0.572	0.062	0.246	0.071	0.201	0.281	0.714												
Hlth rating	-0.069	0.011	0.161	-0.147	-0.099	0.138	0.109	-0.065	-0.063	0.067	1										
	0.169	0.820	0.001	0.003	0.049	0.006	0.029	0.198	0.208	0.184											
Diab familia	0.187	0.013	0.180	0.044	0.011	0.112	0.096	0.096	0.015	-0.018	-0.132	1									
	0.000	0.790	0.000	0.381	0.832	0.025	0.056	0.055	0.768	0.726	0.009										
likely to get	-0.018	0.161	.	0.050	-0.089	0.110	0.057	-0.021	-0.068	0.040	0.140	0.239	1								
	0.726	0.002	.	0.332	0.084	0.033	0.270	0.684	0.190	0.434	0.007	0.000									
serious of d	0.138	-0.031	0.053	0.065	0.019	0.135	0.103	0.026	-0.017	0.053	-0.015	0.316	0.311	1							
	0.006	0.534	0.294	0.193	0.705	0.007	0.039	0.606	0.739	0.294	0.773	0.000	0.000								
Imm Rel	0.083	0.101	0.082	-0.047	-0.006	0.084	0.094	0.003	-0.008	0.051	0.220	0.216	0.211	0.080	1						
	0.097	0.044	0.102	0.348	0.906	0.095	0.060	0.946	0.871	0.313	0.000	0.000	0.000	0.111							
Dist Rel	0.094	-0.014	0.056	-0.107	0.076	0.026	0.076	-0.038	0.014	0.012	0.153	0.083	0.070	0.067	0.394	1					
	0.061	0.776	0.264	0.034	0.128	0.605	0.129	0.446	0.775	0.812	0.002	0.100	0.177	0.185	0.000						
HBP	0.049	-0.031	0.218	-0.027	-0.141	0.128	0.066	-0.028	-0.034	0.081	0.238	0.184	0.198	0.132	0.209	0.064	1				
	0.328	0.538	0.000	0.596	0.005	0.011	0.193	0.580	0.495	0.105	0.000	0.000	0.000	0.008	0.000	0.201					
Smoker	0.108	0.126	0.097	-0.316	0.089	-0.062	-0.062	0.022	0.052	0.052	0.003	-0.016	-0.074	-0.106	0.023	0.049	0.099	1			
	0.031	0.012	0.054	0.000	0.077	0.215	0.217	0.657	0.305	0.305	0.955	0.748	0.154	0.035	0.648	0.329	0.048				
Weight	-0.041	0.024	0.036	-0.027	-0.091	-0.020	0.056	0.072	0.026	0.080	0.130	0.040	0.033	0.065	0.112	0.078	0.162	-0.070	1		
	0.411	0.627	0.471	0.591	0.070	0.692	0.262	0.152	0.606	0.112	0.009	0.421	0.527	0.195	0.026	0.120	0.001	0.165			
Age	0.111	0.003	0.303	0.126	-0.277	0.393	0.446	0.166	0.023	0.069	0.229	0.150	0.188	0.200	0.176	0.039	0.244	0.014	0.077	1	
	0.027	0.948	0.000	0.012	0.000	0.000	0.000	0.001	0.646	0.169	0.000	0.003	0.000	0.000	0.000	0.439	0.000	0.778	0.126		
Confidence	0.095	0.096	0.081	0.027	0.106	0.062	0.007	-0.035	-0.063	-0.008	-0.116	0.170	0.005	0.112	0.136	0.087	0.049	0.070	-0.078	-0.070	1
	0.060	0.056	0.108	0.591	0.035	0.217	0.886	0.485	0.212	0.880	0.021	0.001	0.926	0.026	0.007	0.085	0.327	0.165	0.122	0.166	

Appendix 12: Office Supplies costs (WHO-CHOICE)

ITEM	Cost US$/MONTH	Cost KSH/MONTH	Cost US$/Year	Cost (KSh)/Year
Paper (plain)	14.44	1,232.74	173.28	14,793
Pencils	0.07	5.98	0.84	72
Pens	0.81	69.15	9.72	830
Pencil erasers	0.54	46.10	6.48	553
Envelopes (small)	0.06	5.12	0.72	61
Envelopes (medium)	0.21	17.93	2.52	215
Envelopes (manila)	0.23	19.64	2.76	236
Notebook (100 Pages)	4.35	371.36	52.20	4,456
Stapler	10.89	929.68	130.68	11,156
Staples	1.65	140.86	19.80	1,690
Folders	0.42	35.86	5.04	430
Document Trays	3.61	308.19	43.32	3,698
Black ink printer cartridge	112.80	9,629.74	1,353.60	115,557
Clips (butterfly-style)	0.38	32.44	4.56	389
Glue	0.01	0.85	0.12	10
Liquid paper	2.42	206.60	29.04	2,479
Reading Lamp *(annuitized)	0.64	54.98	7.73	660
Postage	0.36	30.73	4.32	369
Filing folders	1.02	87.08	12.24	1,045
Calculator *(annuitized)	0.08	70.95	0.96	851
TOTAL			**1,869**	**159,552**

Appendix 13: Program Cost Calculation for ± 20% Participants

Resource	100 participants Cost per year (KSh)	100 participants US$/year (1$=Ksh 85.37)	80 participants KSh/year	80 participants US$/year (1$=KSh 85.37)	120 participants KSh/yr	120 participants US$/year (1$=KSh 85.37)	Source
FIXED COSTS							
Personnel							
Office Administrator	1,048,770	12,285	1,048,770	12,285	1,048,770	12,285	WHO-CHOICE
Diabetes Educator	1,048,770	12,285	1,048,770	12,285	1,048,770	12,285	WHO-CHOICE
Social Worker	384,000	4,498	384,000	4,498	384,000	4,498	DMI
Nurses	2,400,000	28,113	2,400,000	28,113	2,400,000	28,113	DMI
Subtotal	**4,881,541**	**57,181**	**4,881,541**	**57,181**	**4,881,541**	**57,181**	
Facilities							
Rent or mortgage + water	918,136	10,755	918,136	10,755	918,136	10,755	Knight Frank
Car park	220,000	2,577	220,000	2,577	220,000	2,577	Knight Frank
electricity	56,400	661	56,400	661	56,400	661	Knight Frank
Phone	30,000	351	30,000	351	30,000	351	Safaricom
Internet	41,760	489	41,760	489	41,760	489	Safaricom
Subtotal	**1,266,296**	**14,833**	**1,266,296**	**14,833**	**1,266,296**	**14,833**	
Supplies and Equip							
Office supplies	159,552	1,869	159,552	1,869	159,552	1,869	WHO-CHOICE
Desk top Computer	28,386	333	28,386	333	28,386	333	Office Mart
Office Furniture	6,592	77	6,592	77	6,592	77	MECOL
printer copier	3,725	44	3,725	44	3,725	44	Office Mart
Glucometer	3,275	38	3,275	38	3,275	38	DMI

Weigh scales	2,184	26	2,184	26	2,184	26	DMI
Blood pressure machines	2,184	26	2,184	26	2,184	26	DMI
Tape Measure	218	3	218	3	218	3	DMI
Subtotal	**206,116**	**2,414**	**206,116**	**2,414**	**206,116**	**2,414**	
Other							
Fleet Vehicle	238,510	2,794	238,510	2,794	238,510	2,794	WHO-CHOICE
Public announcement advertising	960,000	11,245	960,000	11,245	960,000	11,245	DMI
Village elder/sub-chief (gratuity)	48,000	562	48,000	562	48,000	562	DMI
Subtotal	**1,246,510**	**14,601**	**1,246,510**	**14,601**	**1,246,510**	**14,601**	
VARIABLE COSTS							
Diabetes screening materials	153,600	1,799	*122,880	*1,439	**184,320	**2,159	DMI
Education materials	24,000	281	*19,200	*225	**28,800	**337	DMI
Target venue charges	240,000	2,811	240,000	2,811	240,000	2,811	DMI
Vehicle operation (0.09$/km)	51,632	605	51,632	605	51,632	605	WHO
Variable Costs Sub Total	**469,232**	**5,496**	**433,712**	**5,080**	**504,752**	**5,913**	
GRAND TOTAL	**8,069,694**	**94,526**	**8,034,174**	**94,110**	**8,105,214**	**94,942**	

Key: DMI Kenya Diabetes Management and Information Centre, WHO-CHOICE World Health organization's Choosing Interventions that are Cost Effective, Frank Knight residential and commercial property managers, MECOL is the largest manufacturer of steel/wood Office and Institutional furniture, Office Mart, a large retail outlets of office products and services, Safaricom an integrated communications company (*) 80% of the costs (**) 120% of the costs

Appendix 14a: NSB Sensitivity Calculation with Discount Rates 0%, 3%, 5%

PC + SH mean WTP		(KSH)/yr	US$/yr
	No of participants per year (100/week)	4,800	4,800
	Mean WTP SH+PC	585.83	6.862
	Total WTP ($6.862 per client)	2,811,984	32,939
	Program Costs per year ($)	8,069,694	94,526

3% **(B-C)*.9709+ (B-C)*.9426+(B-C)*.9151+(B-C)*.8885+(B-C)*.8626**

	Ksh/yr	US$/yr
cost	8,069,694	94,526
benefit	2,811,984	32,939

End year		**CBA** Ksh/program	**CBA** US$/program
	Y1	-5,104,711	-59,795
	Y2	-4,955,918	-58,052
	Y3	-4,811,331	-56,359
	Y4	-4,671,476	-54,720
	Y5	-4,535,301	-53,125
SUM	NSB=	**-24,078,736**	**-282,051**

5% **(B-C)*.9524+ (B-C)*.9070+(B-C)*.8638+(B-C)*.8227+(B-C)*.7835**

End year		**CBA** Ksh/program	**CBA** US$/program
	Y1	-5,007,443	-58,656
	Y2	-4,768,743	-55,860
	Y3	-4,541,610	-53,199
	Y4	-4,325,518	-50,668
	Y5	-4,119,416	-48,254
SUM	NSB=	**-22,762,731**	**-266,636**

0% **(B-C)+ (B-C)+(B-C)+(B-C)+(B-C)**

End year		**CBA** Ksh/program	**CBA** US$/program
	Y1	-5,257,710	-61,587
	Y2	-5,257,710	-61,587
	Y3	-5,257,710	-61,587
	Y4	-5,257,710	-61,587
	Y5	-5,257,710	-61,587
SUM	NSB=	**-26,288,552**	**-307,937**

Appendix 14b: Lower Bound NSB Sensitivity Calculation with Discount Rates 0%, 3%, 5%

PC mean WTP		(KSH)/yr	US$/yr
	No of participants per year (100/week)	4,800	4,800
	Mean WTP PC	533.59	6.250
	Total WTP	2,561,232	30,002
	Program Costs per year ($)	8,069,694	94,526

3% **(B-C)*.9709+ (B-C)*.9426+(B-C)*.9151+(B-C)*.8885+(B-C)*.8626**

	Ksh/yr	US$/yr
cost	8,069,694	94,526
benefit	2,561,232	30,002

End year		**CBA** Ksh/program	**CBA** US$/program
	Y1	-5,348,166	-62,647
	Y2	-5,192,277	-60,821
	Y3	-5,040,794	-59,046
	Y4	-4,894,269	-57,330
	Y5	-4,751,600	-55,659
SUM	NSB=	**-25,227,105**	**-295,503**

5% **(B-C)*.9524+ (B-C)*.9070+(B-C)*.8638+(B-C)*.8227+(B-C)*.7835**

End year		**CBA** Ksh/program	**CBA** US$/program
	Y1	-5,246,260	-61,453
	Y2	-4,996,175	-58,524
	Y3	-4,758,210	-55,736
	Y4	-4,531,812	-53,084
	Y5	-4,315,880	-50,555
SUM	NSB=	**-23,848,337**	**-279,353**

0% **(B-C)+ (B-C)+(B-C)+(B-C)+(B-C)**

End year		**CBA** Ksh/program	**CBA** US$/program
	Y1	-5,508,462	-64,525
	Y2	-5,508,462	-64,525
	Y3	-5,508,462	-64,525
	Y4	-5,508,462	-64,525
	Y5	-5,508,462	-64,525
SUM	NSB=	**-27,542,312**	**-322,623**

Appendix 14c: Upper Bound NSB Sensitivity Calculation with Discount Rates 0%, 3%, 5%

SH mean WTP		(KSH)/yr	US$/yr
	No of participants per year (100/week)	4,800	4,800
	Mean WTP SH	637.55	7.468
	Total WTP	3,060,240	35,847
	Program Costs per year ($)	8,069,694	94,526

3% **(B-C)*.9709+ (B-C)*.9426+(B-C)*.9151+(B-C)*.8885+(B-C)*.8626**

	Ksh/yr	US$/yr
cost	8,069,694	94,526
benefit	3,060,240	35,847

End year		**CBA** Ksh/program	**CBA** US$/program
	Y1	-4,863,679	-56,972
	Y2	-4,721,912	-55,311
	Y3	-4,584,152	-53,697
	Y4	-4,450,900	-52,137
	Y5	-4,321,155	-50,617
SUM	NSB=	**-22,941,798**	**-268,734**

5% **(B-C)*.9524+ (B-C)*.9070+(B-C)*.8638+(B-C)*.8227+(B-C)*.7835**

End year		**CBA** Ksh/program	**CBA** US$/program
	Y1	-4,771,004	-55,886
	Y2	-4,543,575	-53,222
	Y3	-4,327,167	-50,687
	Y4	-4,121,278	-48,275
	Y5	-3,924,907	-45,975
SUM	NSB=	**-21,687,932**	**-254,046**

0% **(B-C)+ (B-C)+(B-C)+(B-C)+(B-C)**

End year		**CBA** Ksh/program	**CBA** US$/program
	Y1	-5,009,454	-58,679
	Y2	-5,009,454	-58,679
	Y3	-5,009,454	-58,679
	Y4	-5,009,454	-58,679
	Y5	-5,009,454	-58,679
SUM	NSB=	**-25,047,272**	**-293,397**

Appendix 15a: NSB Sensitivity Calculation with Discount Rates 0%, 3%, 5% with (-) 20% participants

80 participants		(KSH)/yr	US$/yr
	No of participants per year (80/week)	3,840	3,840
	Mean WTP SH+PC	585.83	6.862
	Total WTP ($6.862 per client)	2,249,587	26,351
	Program Costs per year ($)	8,034,174	94,110

(B-C)*.9709+ (B-C)*.9426+(B-C)*.9151+(B-C)*.8885+(B-C)*.8626

	Ksh/yr	US$/yr
cost	8,034,174	94,110
benefit	2,249,587	26,351

End year		**CBA** Ksh/program	**CBA** US$/program
	Y1	-5,616,256	-65,787
	Y2	-5,452,552	-63,870
	Y3	-5,293,476	-62,006
	Y4	-5,139,606	-60,204
	Y5	-4,989,785	-58,449
SUM	NSB=	**-26,491,674**	**-310,316**

5% **(B-C)*.9524+ (B-C)*.9070+(B-C)*.8638+(B-C)*.8227+(B-C)*.7835**

End year		**CBA** Ksh/program	**CBA** US$/program
	Y1	-5,509,241	-64,534
	Y2	-5,509,241	-64,534
	Y3	-5,509,241	-64,534
	Y4	-5,509,241	-64,534
	Y5	-5,509,241	-64,534
SUM	NSB=	**-27,546,204**	**-322,668**

0% **(B-C)+ (B-C)+(B-C)+(B-C)+(B-C)**

End year		**CBA** Ksh/program	**CBA** US$/program
	Y1	-5,784,587	-67,759
	Y2	-5,784,587	-67,759
	Y3	-5,784,587	-67,759
	Y4	-5,784,587	-67,759
	Y5	-5,784,587	-67,759
SUM	NSB=	**-28,922,936**	**-338,795**

Appendix 15b: NSB Sensitivity Calculation with Discount Rates 0%, 3%, 5% with (+) 20% participants

120 participants		(KSH)/yr	US$/yr
	No of participants per year (120/week)	5,760	5,760
	Mean WTP SH+PC	585.83	6.862
	Total WTP ($6.862 per client)	3,374,381	39,527
	Program Costs per year ($)	8,105,214	94,942

(B-C)*.9709+ (B-C)*.9426+(B-C)*.9151+(B-C)*.8885+(B-C)*.8626

	Ksh/yr	US$/yr		
cost	8,105,214	94,942		
benefit	3,374,381	39,527	alt. calc for NSB=	**-21,665,798**

End year		**CBA** Ksh/program	**CBA** US$/program
	Y1	-4,593,166	-53,803
	Y2	-4,459,284	-52,235
	Y3	-4,329,186	-50,711
	Y4	-4,203,346	-49,237
	Y5	-4,080,817	-47,802
SUM	NSB=	**-21,665,798**	**-253,787**

5% **(B-C)*.9524+ (B-C)*.9070+(B-C)*.8638+(B-C)*.8227+(B-C)*.7835**

End year		**CBA** Ksh/program	**CBA** US$/program
	Y1	-4,505,646	-52,778
	Y2	-5,509,241	-64,534
	Y3	-5,509,241	-64,534
	Y4	-5,509,241	-64,534
	Y5	-5,509,241	-64,534
SUM	NSB=	**-26,542,609**	**-310,913**

0% **(B-C)+ (B-C)+(B-C)+(B-C)+(B-C)**

End year		**CBA** Ksh/program	**CBA** US$/program
	Y1	-4,730,834	-55,416
	Y2	-5,784,587	-67,759
	Y3	-5,784,587	-67,759
	Y4	-5,784,587	-67,759
	Y5	-5,784,587	-67,759
SUM	NSB=	**-27,869,182**	**-326,452**

Appendix 16a: Annual Program Costs with 1/3 and 1/4 cost sharing alternatives

Resource	Quantity per 100 clients (ksh)	Cost per year(Ksh)	US$/year (1$=Ksh 85.37 2012)	1/3 Cost sharing per year(Ksh) + 1.265x patients	1/3 cost US$/year (1$=Ksh 85.37 2012)	1/4 Cost sharing per year(Ksh) + 1.048x patients	1/4 cost US$/year (1$=Ksh 85.37 2012)
FIXED COSTS							
Personnel							
Office Administrator	1	1,048,770	12,285	349,590	4,095	262,193	3,071
Diabetes Educator	1	1,048,770	12,285	1,048,770	12,285	1,048,770	12,285
Social Worker	2	384,000	4,498	128,000	1,499	96,000	1,125
Nurses	5	2,400,000	28,113	800,000	9,371	600,000	7,028
Subtotal		4,881,541	57,181	2,326,361	27,250	2,006,963	23,509
Facilities							
Rent or mortgage + water	1 yr	918,136	10,755	306,045	3,585	229,534	2,689
Car park	1 yr	220,000	2,577	73,333	859	55,000	644
electricity	1 yr	56,400	661	18,800	220	14,100	165
Phone	1 yr	30,000	351	10,000	117	7,500	88
Internet	1 yr	41,760	489	13,920	163	10,440	122
Subtotal		1,266,296	14,833	422,099	4,944	316,574	3,708
Supplies and Equip							
Office supplies	20 items	159,552	1,869	53,184	623	39,888	467
Desk top Computer	2	28,386	333	9,462	111	7,097	83
Office Furniture	10 pieces	6,592	77	2,197	26	1,648	19
printer copier	1	3,725	44	1,242	15	931	11
Glucometer	5	3,275	38	3,275	38	819	10
Weigh scales	2	2,184	26	2,184	26	546	6

Blood pressure machines	2	2,184	26	2,184	26	546	6
Tape Measure	2	218	3	218	3	55	1
Subtotal		206,116	2,414	73,946	866	51,529	604
Other							
Fleet Vehicle	1	238,510	2,794	79,503	931	59,628	698
Public announcement advertising	1 yr	960,000	11,245	320,000	3,748	240,000	2,811
Village elder/sub-chief (gratuity)	1 yr	48,000	562	16,000	562	12,000	141
Fixed Costs Sub total		1,246,510	14,601	415,503	5,242	311,628	3,650
VARIABLE COSTS							
Test strips + Lancets	100	153,600	1,799	193,536	2,267	160,819	1,884
Education materials and flyers	100	24,000	281	30,240	354	25,128	294
Target venue fees		240,000	2,811	80,000	937	60,000	703
Vehicle Operation		51,632	605	17,211	202	12,908	151
Variable Costs Sub Total		469,232	5,496	320,987	3,760	258,855	3,032
Grand Total		**8,069,694**	**94,526**	**3,558,895**	**41,688**	**2,945,549**	**34,503**

Key: FT, Full time is assumed to be a 40 hr. week. PT, Full time is assumed to be a 20 hr. week.

Appendix 16b: NSB with 1/3 cost sharing

		(KSH)/yr	US$/yr
	No of participants per year (100/week)	4,800	4,800
	Mean WTP SH+PC	585.83	6.862
	Total WTP ($6.862 per client)	2,811,984	32,939
	Program Costs per year ($)	3,512,719	41,147

(B-C)*.9709+ (B-C)*.9426+(B-C)*.9151+(B-C)*.8885+(B-C)*.8626

	Ksh/yr	**US$/yr**
cost	3,512,719	41,147
benefit	2,811,984	32,939

		CBA	**CBA**
3%		Ksh/program	US$/program
	Y1	-680,344	-7,969
	Y2	-660,513	-7,737
	Y3	-641,243	-7,511
	Y4	-622,603	-7,293
	Y5	-604,454	-7,080
	NSB=	**-3,209,156**	**-37,591**

Appendix 16c: NSB with 1/3 cost sharing +26.5% participant increase

		(KSH)/yr	US$/yr
	No of participants per year (~127/week)	6,075	6,075
	Mean WTP SH+PC	585.83	6.862
	Total WTP ($6.862 per client)	3,558,917	41,688
	Program Costs per year ($)	3,558,895	41,688

(B-C)*.9709+ (B-C)*.9426+(B-C)*.9151+(B-C)*.8885+(B-C)*.8626

	Ksh/yr	**US$/yr**
cost	3,558,895	41,688
benefit	3,558,917	41,688

		CBA	**CBA**
3%		Ksh/program	US$/program
	Y1	22	0.3
	Y2	21	0.2
	Y3	20	0.2
	Y4	20	0.2
	Y5	19	0.2
	NSB=	**101**	**1.2**

Appendix 16d: NSB with 1/4 cost sharing

		(KSH)/yr	US$/yr
	No of participants per year (100/week)	4,800	4,800
	Mean WTP SH+PC	585.83	6.862
	Total WTP ($6.862 per client)	2,811,984	32,939
	Program Costs per year ($)	2,937,201	34,406

(B-C)*.9709+ (B-C)*.9426+(B-C)*.9151+(B-C)*.8885+(B-C)*.8626

	Ksh/yr	**US$/yr**	
cost	2,937,201	34,406	
benefit	2,811,984	32,939	
		CBA	**CBA**
3%		Ksh/program	US$/program
	Y1	-121,574	-1,424
	Y2	-118,030	-1,383
	Y3	-114,586	-1,342
	Y4	-111,256	-1,303
	Y5	-108,013	-1,265
	NSB=	**-573,458**	**-6,717**

Appendix 16e: NSB with 1/4 cost sharing +4.8% participant increase

		(KSH)/yr	US$/yr
	No of participants per year (~105/week)	5,028	5,028
	Mean WTP SH+PC	585.83	6.862
	Total WTP ($6.862 per client)	2,945,553	34,503
	Program Costs per year ($)	2,945,549	34,503

(B-C)*.9709+ (B-C)*.9426+(B-C)*.9151+(B-C)*.8885+(B-C)*.8626

	Ksh/yr	**US$/yr**	
cost	2,945,549	34,503	
benefit	2,945,553	34,503	
		CBA	**CBA**
		Ksh/program	US$/program
3%	Y1	4.5	0.1
	Y2	4.3	0.1
	Y3	4.2	0.0
	Y4	4.1	0.0
	Y5	4.0	0.0
	NSB=	**21**	**0.2**

Appendix 17: STATA printout for the Modified Park Test, Pregibon Link test and the Modified Hosmer-Lemeshow test for the Gamma distribution

```
Generalized linear models                         No. of obs      =       398
Optimization     : ML                             Residual df     =       387
                                                  Scale parameter =  .4677138
Deviance         =  151.3171644                   (1/df) Deviance =  .3910004
Pearson          =  181.0052475                   (1/df) Pearson  =  .4677138

Variance function: V(u) = u^2                     [Gamma]
Link function    : g(u) = ln(u)                   [Log]

                                                  AIC             =  14.70642
Log likelihood   = -2915.577351                   BIC             =  -2165.44
```

maxbidksh	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
shpc2coded	.1876571	.069798	2.69	0.007	.0508555	.3244586
diab2coded	.4154551	.1608237	2.58	0.010	.1002464	.7306637
gender2coded	.1343072	.0753234	1.78	0.075	-.0133238	.2819383
edu	.2541464	.0840444	3.02	0.002	.0894225	.4188704
emp1coded	.3461498	.0941647	3.68	0.000	.1615904	.5307092
car2coded	.1841825	.0983678	1.87	0.061	-.0086149	.3769799
familiar diab	.0520748	.0227371	2.29	0.022	.0075109	.0966388
seriousnessof	.0246037	.013183	1.87	0.062	-.0012346	.0504419
smoke2coded	.291308	.1097805	2.65	0.008	.0761422	.5064737
gecalculated	-.0011463	.0030596	-0.37	0.708	-.0071431	.0048505
_cons	5.187142	.1835753	28.26	0.000	4.827341	5.546942

Codebook

Maxbidksh: WTP bid in KSh
Shpc2coded (WTP Method): 0=PC 1=SH
diab2coded (Diabetes diagnosis): 0=non diabetic 1=diabetic
gender2coded (Gender): 0=female 1=male
EDU (Education): 0=No formal Education Adult Education Primary Education High school/Secondary education 1=No secondary education College graduate Post-graduate
emp1coded (Employment): 0 =Not employed + Student 1=Employed salaried wage earner + Self employed
car2own (Car ownership): 0=no, 1=yes
familiar diab (familiarity with diabetes): Scale (1=not at all familiar, 5=very familiar)
seriousnessof (seriousness of diabetes): Scale (1=not at all serious, 10=very serious)
smoke2coded (smoker): 0=not at all 1=regular + occasional
agecalculated (age): continuous variable

Modified Park Test

```
  FITTED MODEL:  Link = Log ; Family =  Gamma

  Results, Modified Park Test (for Family)

     Coefficient:   .957067

     Family, Chi2, and p-value in descending order of likelihood

       Family                              Chi2        P-value

       Poisson:                          0.0154         0.9012
       Gaussian NLLS:                    7.6643         0.0056
       Gamma:                            9.1013         0.0026
       Inverse Gaussian or Wald:        34.9218         0.0000

  Results of tests of GLM Log  link

       Pearson Correlation Test:                        0.6281
       Pregibon Link Test:                              0.5420
       Modified Hosmer and Lemeshow:                    0.7376
```

Appendix 18: STATA printout for the Modified Park Test, Pregibon Link test and the Modified Hosmer-Lemeshow test for the Poisson distribution

```
Generalized linear models                         No. of obs      =       398
Optimization     : ML                             Residual df     =       387
                                                  Scale parameter =         1
Deviance         =  93101.94083                   (1/df) Deviance =  240.5735
Pearson          =   95677.4834                   (1/df) Pearson  =  247.2286

Variance function: V(u) = u                       [Poisson]
Link function    : g(u) = ln(u)                   [Log]

                                                  AIC             =  241.6592
Log likelihood   = -48079.18894                   BIC             =  90785.18
```

maxbidksh	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
shpc2coded	.1856814	.0042141	44.06	0.000	.177422	.1939408
diab2coded	.4512071	.0079439	56.80	0.000	.4356373	.4667769
gender2coded	.127696	.0044598	28.63	0.000	.118955	.1364371
edu	.2233663	.0048396	46.15	0.000	.2138807	.2328518
emp1coded	.3293678	.0061296	53.73	0.000	.3173539	.3413817
car2coded	.2206035	.0054109	40.77	0.000	.2099984	.2312086
familiar diab	.0482258	.0014121	34.15	0.000	.0454581	.0509934
seriousnessof	.0248828	.0008069	30.84	0.000	.0233014	.0264642
smoke2coded	.2367459	.0070565	33.55	0.000	.2229154	.2505765
gecalculated	-.0018355	.0001779	-10.32	0.000	-.0021842	-.0014868
constant	5.293777	.0118764	445.74	0.000	5.2705	5.317055

Codebook

Maxbidksh: WTP bid in KSh
Shpc2coded (WTP Method): 0=PC 1=SH
diab2coded (Diabetes diagnosis): 0=non diabetic 1=diabetic
gender2coded (Gender): 0=female 1=male
EDU (Education): 0=No formal Education Adult Education Primary Education High school/Secondary education 1=No secondary education College graduate Post-graduate
emp1coded (Employment): 0 =Not employed + Student 1=Employed salaried wage earner + Self employed
car2own (Car ownership): 0=no, 1=yes
familiar diab (familiarity with diabetes): Scale (1=not at all familiar, 5=very familiar)
seriousnessof (seriousness of diabetes): Scale (1=not at all serious, 10=very serious)
smoke2coded (smoker): 0=not at all 1=regular + occasional
agecalculated (age): continuous variable

Modified Park Test

```
FITTED MODEL:  Link = Log ; Family =  Poisson

Results, Modified Park Test (for Family)

   Coefficient:   .966911

   Family, Chi2, and p-value in descending order of likelihood

     Family                              Chi2        P-value

     Poisson:                          0.0088         0.9254
     Gaussian NLLS:                    7.4922         0.0062
     Gamma:                            8.5528         0.0034
     Inverse Gaussian or Wald:        33.1243         0.0000

Results of tests of GLM Log  link

     Pearson Correlation Test:                       0.8633
     Pregibon Link Test:                             0.4652
     Modified Hosmer and Lemeshow:                   0.2941
```

Appendix 19: Poisson Model (with Pearson χ^2-based dispersion)

```
Generalized linear models                         No. of obs      =       398
Optimization     : ML                             Residual df     =       387
                                                  Scale parameter =         1
Deviance         =  93101.94083                   (1/df) Deviance =  240.5735
Pearson          =   95677.4834                   (1/df) Pearson  =  247.2286

Variance function: V(u) = u                       [Poisson]
Link function    : g(u) = ln(u)                   [Log]

                                                  AIC             =  241.6592
Log likelihood   = -48079.18894                   BIC             =  90785.18
```

maxbidksh	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
shpc2coded	.1856814	.0662597	2.80	0.005	.0558148	.3155481
diab2coded	.4512071	.1249063	3.61	0.000	.2063952	.696019
gender2coded	.127696	.0701237	1.82	0.069	-.0097439	.265136
edu	.2233663	.0760961	2.94	0.003	.0742205	.372512
emp1coded	.3293678	.0963795	3.42	0.001	.1404674	.5182682
car2coded	.2206035	.0850776	2.59	0.010	.0538544	.3873526
familiaryoub	.0482258	.0222029	2.17	0.030	.0047089	.0917426
seriousnessof	.0248828	.0126868	1.96	0.050	.0000172	.0497484
smoke2coded	.2367459	.1109534	2.13	0.033	.0192812	.4542107
agecalculated	-.0018355	.0027977	-0.66	0.512	-.0073188	.0036478
_cons	5.293777	.186739	28.35	0.000	4.927776	5.659779

(Standard errors scaled using square root of Pearson X2-based dispersion.)

Codebook

Maxbidksh: WTP bid in KSh
Shpc2coded (WTP Method): 0=Payment card 1=structured haggling
diab2coded (Diabetes diagnosis): 0=non diabetic 1=diabetic
gender2coded (Gender): 0=female 1=male
EDU (Education): 0=No formal Education Adult Education Primary Education High school/Secondary education 1=No secondary education College graduate Post-graduate
emp1coded (Employment): 0 =Not employed + Student 1=Employed salaried wage earner + Self employed
car2own (Car ownership): 0=no, 1=yes
familiar diab (familiarity with diabetes): Scale (1=not at all familiar, 5=very familiar)
seriousnessof (seriousness of diabetes): Scale (1=not at all serious, 10=very serious)
smoke2coded (smoker): 0=not at all 1=regular + occasional
agecalculated (age): continuous variable

Appendix 20: STATA syntax

destring likelihoodofdevelopingdiab , replace ignore(#NULL!)

Correlations

pwcorr maxbidksh shpc2coded diab2coded gender2coded edu mar2coded emp1coded exp car2coded nooffamilymembersinhouse healthrating howfamiliarareyouwithdiab likelihoodofdevelopingdiab seriousnessofdiabets immrel2coded distrel2coded hbp2coded smoke2coded wgt2coded agecalculated conf2coded, sig print (0.05)

Modified Park Test, Pregibon Link test and the Modified Hosmer-Lemeshow test for the Poisson distribution

glm maxbidksh shpc2coded diab2coded gender2coded edu mar2coded emp1coded exp car2coded nooffamilymembersinhouse healthrating howfamiliarareyouwithdiab seriousnessofdiabets immrel2coded distrel2coded hbp2coded smoke2coded wgt2coded agecalculated conf2coded, link(log) family (gamma)

glmdiag

Modified Park Test, Pregibon Link test and the Modified Hosmer-Lemeshow test for the Poisson distribution

glm maxbidksh shpc2coded diab2coded gender2coded edu mar2coded emp1coded exp car2coded nooffamilymembersinhouse healthrating howfamiliarareyouwithdiab seriousnessofdiabets immrel2coded distrel2coded hbp2coded smoke2coded wgt2coded agecalculated conf2coded, link(log) family (poisson)

glmdiag

Disperssion

glm maxbidksh shpc2coded diab2coded gender2coded edu emp1coded car2coded howfamiliarareyouwithdiab seriousnessofdiabets smoke2coded agecalculated, link(log) family (poisson) scale(x2)

Appendix 21: Benefits calculated using Human Capital approach: comparing conservative versus present study assumptions (US$2011)

	Conservative	**From current study**
Participants per year	4800	4800
Screening yield (a)	0.6%	5.5%
Diabetics positively identified (b) =(a)*4800	28.8	264
Benefits per patient per year2005 ($)	2,144.30	2,144.30
Benefits per patient per year 2011 ($)(c)	3,798.88	3,798.88
Assumed reduction in diabetes incidence	20%	20%
Resulting reduction in number of diabetics/yr (d)=(b)*20%	5.76	52.8
Benefits =(d) x(c)	**$21,881**	**$200,581**

Notes:

- (c) HCA 2011= CPI 2011/CPI 2005 x HCA 2005 ((Boardman, Greenberg et al. 2006) =130.09/73.43 x 2144.30=3.798.88 (CPI values from Central Bank of Kenya 2011)
- The economic burden of diabetes mellitus in Sub-Sahara Africa has been estimated at $2,144.3 (2005 international dollars) per case per year in low income countries such as Kenya (Kirigia, Sambo et al. 2009). This loss includes direct medical costs (drugs, reagents, hospitalizations) and productivity losses (disability, premature death, care givers).
- The diabetes education, screening and referral program in rural Kenya currently investigated is expected to reduce the incidence of diabetes by 20% (Simmons, Harding et al. 2006). If the screening yields are modest at 0.6% (Ealovega, Tabaei et al. 2004)(Ealovega, Tabaei et al. 2004) then the benefits from the program are modest at US$ 21,881. However, with an optimistic yield at 5.5% from the self-reported diabetes prevalence in the current study the yearly cost savings would be approximately US$ 200,581
- With a diabetes prevalence of between 2.2% - 12.2% in Kenya, the program yield is expected to be closer to 5.5%. This would result in these benefits (US$ 200,581) that are higher than the yearly costs of implementing the program (US$ 94,526).

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