ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCE

SCHOOL OF PUBLIC HEALTH/HEALTH ECONOMICS

COST EFFECTIVENESS ANALYSIS OF CERVICAL CANCER SCREENING METHODS AT FAMILY GUIDANCE ASSOCIATION, ADDIS ABABA,ETHIOPIA 2017

A Thesis submitted to Addis Ababa University College of Health Sciences School of Public Health in partial fulfillment of the requirements for the degree of Master of Public Health/Health Economics

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APPROVAL SHEET

I certify this research work titled “cost effectiveness analysis of cervical cancer screening methods” is my own work. The work has not been presented elsewhere for assessment. Where material has been used from other sources it has been properly referred.

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ACRONYMS

CC	Cervical cancer
CCS	Cervical cancer screening
CEA	Cost effectiveness analysis
CPI	Consumer price index
CSA	Central statistical agency
DALY	Disability adjusted life year
EV	Expected value
FGAE	Family guidance association Ethiopia
FMOH	Federal minster of health
GDP	Gross domestic product
HPV	Human Papilloma virus
HPV DNA	Human Papilloma virus Deoxyribonucleic Acid
ICER	Incremental cost effectiveness ratio
LEEP	Loop Electrosurgical Excision Procedure
LMIC	low and middle income countries
NMB	Net monetary benefit
PAP	Papanicolaou
PSA	Probabilistic sensitivity analysis
VIA	Visual inspection with acetic acid
VILI	Visual inspection with Lugol’s iodine
WHO	World health organization

ABSTRACT

Background: Cervical cancer is one of the most widespread and second leading cause of gynecological related mortality worldwide. In developing countries, the number of deaths and morbidities from the disease has been on the rise. Cervical cancer is usually detected in advanced stages in these countries due to the lack of effective preventive mechanisms. In Ethiopia only 1% of age eligible women receive effective screening for cervical cancer. Although organized cervical cancer screening has been proven to be effective in saving significant number of lives in developed world, there are a number of barriers to expand them into developing world such as competing health care needs, limited human and financial resources, poorly developed health care services, gender related barriers, political instability and widespread poverty.

Objectives: To evaluate the cost-effectiveness of cervical cancer screening methods, Addis Ababa, Ethiopia.

Methods: Institutional based cross sectional study design was used. The cost was from societal perspective. Sample size was determined using singe population mean formula and systematic random sampling techniques was used to include women for the interview and also the cost from provider perspective were collected from the three clinics. Full economics evaluation was done using Markova model to construct and simulate the natural history of HPV-induced cervical dysplasia to compare cost and effectiveness of Papanicolaou, Visual Inspection of cervix with Acetic acid and Human Papilloma virus Deoxyribonucleic Acid test. A micro-costing approach was used to measure and aggregate the cost of all resources used to provide cervical cancer screening at individual level. Cost-effectiveness analysis was used to determine the incremental cost-effectiveness ratio.

Results: Cost of VIA, PAP and HPV DNA test from societal perspective was found to be $14.23, $ 20.51and $19.06 respectively. Among the three screening strategies, Pap smear was not cost effective at any given willingness to pay threshold. VIA and HPV DNA test was cost effective at incremental cost effectiveness ratio $ 268.10 per disability adjusted life year averted.

Conclusion: Cervical cancer screening using VIA and HPV DNA test are cost-effective strategies.

CHAPTER 1: INTRODUCTION

1.1 Background

Cervical cancer is preventable and treatable form of cancer with combination of effective HPV vaccination, improved screening and treatment (1). The natural history of disease is well understood that cervical cancer is caused by persistent infection with oncogenic human papilloma virus (HPV) through sexual activity; that most HPV infections shed within one to two years and that a small number of persistent HPV infections progress to precancerous lesions which, if untreated, may become invasive. Understanding the natural history of HPV infection as a cause of cervical carcinogenesis has led to introduction of prophylactic HPV vaccines and use of different screening tests and the long precancerous stage provides an excellent opportunity for effective intervention measures (2, 3).

More than 140 HPV genotypes have been identified. They are classified into high-risk, probable high-risk and low-risk types. The Low-risk HPV infections usually clear up without any interventions within a few months. The high-risk HPV serotypes are more likely to persist and cause cancer. Approximately 50 of these genotypes are known to be oncogenic or high risk types, which cause cancer of the cervix (4-7). Of these, 50 high risk HPV genotypes: HPV-16, -18, -31, - 33, -35, -39, -45, -51, -52,-56, -58, -59, -68, - 73, and -82 cause more than 95% of all cases of cervical cancer (7, 8). HPV-16 is the type that is responsible for 50-60% of all cervical cancer worldwide and HPV-18 is followed by an incidence of 10-20%. Thus, HPV-16 and -18 are considered as the types responsible for approximately 70% of CC worldwide (9-11).

Cancer of the cervix can be prevented in three ways through vaccine that include two prophylactic vaccines (bivalent and quadrivalent vaccines) with high efficacy against HPV types 16 and 18, which cause 70% of cervical cancer cases globally (12) and a ninevalent vaccine against five additional oncogenic HPV types that together with HPV-16,18 cause up to 90% of cases and screening for precancerous lesions and providing early treatment to prevent progression to cancer (13, 14).

Even though due to limited infrastructure and health budgets, the technological advances that can prevent, detect, and treat oncogenic HPV infections are not generally available in low-and middle-income countries (LMICs), where 85% of cervical cancers occur (15, 16).

Cervical cancer is one of the most widespread gynecological cancers worldwide and remains the second leading cause of gynecological-related mortality with 530,232 new cases and an estimated 265,000 deaths reported each year. More than 85% of cases occur in developing countries where more than 95% of women have never been screened for the disease (17). It is the second most frequently diagnosed cancer (80,400) and the leading cause of cancer death (50,300) in African women. Rates vary substantially across regions, with the incidence and death rates in East Africa and West Africa as high as the rates in North Africa (18). In addition to being the most prevalent cancer among women, its societal importance is heightened due to the fact that in average it affects women at young age, often when they are still raising families (19).

Cervical cancer in Ethiopia was reported to be the second leading cancer diagnosis among adult women. According to the 2009 world health organization report, the age-adjusted incidence rate of cervical cancer in Ethiopia is 35.9 per 100,000 patients with 7619 annual number of new cases and 6081 deaths every year (20). A study done on 2,111 women attending hospitals and clinics in Addis Ababa has also reported the prevalence of invasive cancer to be 15.6/1000 of the studied population (21).Most of these Ethiopians often at an advanced stage by the time they seek screening services (22).

Screening is taken in to account optimal when the smallest amounts of resources are used to achieve the greatest benefit (23). Screening for cervical cancer typically aim to detect precancerous lesions before they reach to invasive cervical cancer. The illness takes 10-15 years to develop, screening at interval within this period allows for simple interventions to be carried out before cancerous and precancerous tumors progress to invasive cases (24). Since cervical cancer is rare before the age of 30, WHO recommends screening to start from 30 years and above. For high risk groups like HIV infected women, screening can be done earlier starting from 25 and above (25).

For two to three generation of women who are beyond vaccination age, screening remains the only form of prevention (26). Screening for cervical cancer precursors can be achieved through the use of cytology, HPV DNA testing, or VIA (27). Pap smear testing is the most common cervical cancer screening method worldwide for many decades (28) and is credited with reducing cervical cancer risk in developed countries (29), the procedure requires frequent screening, trained personnel, laboratory infrastructure, and diagnostic follow- up at higher level facilities that leads to poor screening outcomes in low-resource settings. An alternative screening method, visual inspection with acetic acid (VIA), is a low-cost test that requires few supplies and no laboratory infrastructure, but has moderate sensitivity and low specificity, result vary with practitioner performance and making quality control is a challenge. In LMIC screening coverage with Pap testing or VIA remains low (30, 31).To overcome these challenge the World Health Organization (WHO) recommends use of HPV DNA testing or VIA for cervical cancer screening in resource poor regions and countries that do not have screening program at place already (32).

Ethiopia in previous years, screening with Pap smear was the only mechanism employed and it was used in very few health care facilities usually located in urban areas. Even though, the few existing services were underutilized due to the lack of awareness of the public. In Ethiopian context Screening is believed to be the best mechanism. The FMOH developed guide line in 2015 supported WHO recommendation and recommended women to start cervical cancer screening at age of thirty five and above and screen at least once every three years. The “see and treat” strategy is being applied using Visual Inspection under Acetic acid (VIA) as screening method and cry therapy as a treatment option (33).

This study tries to show among available cervical screening methods which one is the most cost effective screening method in our country context. Three strategies VIA, cytology based on Pap smear and HPV DNA testing were compared in terms of cost and effectiveness for screening women who are above 30 years. The study is carried out from societal perspective and therefore costs associated with health sector as well as patient costs are compared for the three strategies. The outcome of Cost effectiveness analysis is number of DALYS averted. The cost effectiveness

is determined on basis of Incremental Cost Effectiveness Ratio (ICER), which can be defined as additional cost per DALYS averted for a given strategy as compared to next most costly strategy.

1.2 Statement of the problem

Cervical cancer is considered as the most preventable cancers. The determination of the explanation for cervical cancer, its slow progression coupled with the development of preventive and screening mechanism with precancerous treatment makes cervical cancer the most preventable cancer and one which will even be eradicated. Despite this fact however, wide mortality rates are being recorded, particularly in developing countries (34).

There is a large discrepancy in mortality and morbidity rates between developing and developed countries. The gaps are widened in recent decades as screening and effective preventive ways have led to a dramatic decline within the prevalence and mortality rates in developed countries. For example, with in the United States between 1955- 1992 the mortality rate for cervical cancer declined by nearly 70% and the rates have continuing to drop by 3% annually. Equally within the United Kingdom, the rates of cervical cancer were down by 70% in 2008 compared to 30 years ago (35).

On the contrary, in developing countries, the amount of deaths and morbidities from the disease has been on the rise. Cervical cancer is typically detected in advanced stages in these countries due to the lack of effective preventive mechanisms. An estimated 80% of all patients with cancer in developing countries are presented with advanced stages at their first consultation (20).

Moreover, in step with World Health Organization (WHO) estimate, the amount of mortalities from cervical cancer is predicted to rise from the current figure of 274,883 to 474,000 annually and over 95% of these deaths are expected to be from developing countries (35). The number of cervical cancer cases is expected to double in Sub- Saharan continent (36). The high prevalence of cervical cancer is additional evident within the case of Ethiopia.

In terms of effective coverage only 19% among women of aged 25-64 years in the developing world have been screened compared to 63% in developed countries. The reason for the low coverage was believed to be limited access to health services, limited or no screening programs, limited or non-existent awareness about cervical cancer screening among populations and health workers, limited or no access to diagnostics and laboratories, poor referral and follow up (37).

In Ethiopia only 1% of age eligible women receive effective screening for cervical cancer the coverage is 0.6 % in urban and 0.4% in rural Ethiopia (37). The major factors identified that influence screening utilization were lack of knowledge about the need for cervical screening, fatalistic attitudes about cervical cancer and other aspects of health, low perceived susceptibility, having many contending issues, financial constraint, and emotional barriers (38).

Although organized cervical cancer screening has been proven to be effective in saving significant number of lives in developed world those that are mentioned above are barriers to expand them into developing world. In 2010, cervical cancer accounted for over 7 million disability adjusted life years lost (39). If cervical cancer prevention programs had been implemented globally it has been estimated that between 10 and 230 million dollars and almost 1 trillion dollars in value of a statistical life (VSL) would have been saved (40, 41).

Health care costs are increasing and puts a strain on limited health care resources. Unavoidable choices and trade-offs have to be made since there always will be more available technology options that resources will allow. These choices are relevant for public decisions about allocation of resources. So being a developing country, the effective use of health care expenditure is an important issue and the decisions on the choices have to be made based on formal evaluations if the additional health benefits are worth the additional costs implied with new technology.

Cost-effective cervical cancer screening strategies implemented in low resource settings can reduce cervical cancer mortality. So to reduce the burden of cervical cancer in Ethiopia we need to have a cost effective cervical cancer screening strategies. As to my knowledge there are no published study done on cost effectiveness of cervical cancer screening methods, so these research will try to fill these gap by doing cost and cost effectiveness analysis of cervical

screening methods on women above age 30 years since cervical cancer is uncommon before the age of30 years, WHO recommends screening to start from 30 years and above. The study area Family Guidance Association is preferred because both screening methods are available and most public health facilities refer for Pap smear test to the family guidance association clinics.

1.3 Significance of the study

Cervical cancer is preventable and curable within the very early stages of the illness. Fortunately, it has a very well-known natural history characterized by a long premalignant phase which provides chance for preventive interventions. And among all gynecological cancers, cervical cancer offers the greatest potential for prevention, early detection and cure (42). Evidence from the developed world shows that the high incidences of cervical cancer in developing countries are due to lack of inadequate/inefficient existing screening programs (43).

So evidence is needed to make decision on cervical cancer screening test to make the coverage of cervical cancer high, service to be accessed easily and promote screening program to maximize health gain given these limited health budgets. So these cost effectiveness study will inform decision makers to choose cost effective cervical cancer screening method and be used as a base line for other potential cost effectiveness research. Coupled with this, the costing analysis will be expected to inform planning and budgeting decision for scaling up interventions.

CHAPTER 2: LITERATURE REVIEW

2.1 Over-view of cervical cancer

Human papillomavirus (HPV) is a DNA virus from the papillomavirus family that causes productive infections in the keratinocytes of the skin or mucous membranes (44). Most HPV infections are asymptomatic. However, non-oncogenic HPV infections (low risk (LR-HPV)) such as types 6 and 11 may cause benign papillomas, including warts or squamous cell papillomas, while infection with oncogenic HPV (high risk (HR-HPV)) can cause cancers of the cervix, vulva, vagina, penis, oropharynx and anus (45).

Cervical cancer is a slow growing cancer that arises from the epithelium covering the tip of the cervix and it is consider a sexually transmitted diseases. There are four major steps in the cervical cancer development: 1) Human Papillomavirus (HPV) infection of cervical epithelium, 2) viral persistence, 3) progression of persistently infected epithelium to cervical pre-cancer, and4) invasion through the basement membrane of the cervical epithelium (19).

2.2 Cervical cancer screening methods

Screening is a public health program used on a population at risk, or target population. Screening is not performed to diagnose a disease, but to identify individuals with a high probability of having or of developing a disease. Women those are targeted for screening cervical cancer may actually feel perfectly healthy and may see no reason to visit a health facility. The objective of screening program is to reduce morbidity and mortality, and to improve the quality of life in the population (46).

Cervical cancer takes more than 10 years from detection of CIN 2 or CIN3 to development into invasive cervical cancer, the screening gives ample time to detect and treat before it develops into invasive cancer (47).There are three common types of cervical cancer screening test methods.

1. Pap smear

In the Pap smear test, a sample of cells is taken from the transformation zone of the cervix using an extended-tip wooden spatula or brush; using a cotton swab is no longer recommended. The entire transformation zone should be sampled since this is where almost all high-grade lesions develop. The sample is then smeared onto a glass slide and right away fixed with a solution to protect the cells. The slide is sent to a cytology laboratory where it is discolored and examined using a microscope to determine whether the cells are normal and to classify them appropriately, using the Bethesda classification. The results of the Pap smear are then reported to the clinic where the specimen was taken. The Pap test takes less than 5 minutes to carry out, is not painful, and can be done in an outpatient examination room. An acceptable smear requires adequate numbers of well-preserved squamous epithelial cells and an adequate end cervical/transformation zone component. Each smear should be legibly labeled. The accuracy of cytological testing depends on the quality of the services, including sampling practices (taking and fixing the smears), and preparation and explanation of smears in the laboratory.

2. HPV DNA test

A cheap HPV test called care HPV which the test kit costs around USD $5 per test and ableto provide results (detecting 14 high risk HPV types) within2.5 hour, has been developed specifically for usage in low resource public-health settings to screen women 30 years of age and older.HPV testing also paves the way for analyzing self-collected sample from the vagina by the women using various methods such as tampon, swab, cytobrush, vaginal lavage or custom made device (48, 49).

3. Visual inspection with acetic acid

Sometimes referred to as direct visual inspection (DVI), precancerous lesions temporarily appear white after staining with acetic acid (vinegar). Like cervical cytology and HPV DNA testing, VIA involves a speculum examination and exposing the cervix. Swabbing the cervix with 3%–5%acetic acid using a cotton applicator, abnormal areas have a distinctive white appearance.

VIA can be implemented in a wide range of settings. No laboratory processing is necessary, the results are immediate, and treatment can be provided in the same visit. Due to the subjective nature of visual assessment, it is important to normalize definitions for positive and negative tests, and to give special attention to regular and reliable quality guarantee. While in most studies to date the sensitivity of VIA has been equivalent to or better than cytology, its specificity has been lower.

Screening policies differ widely among countries in terms of tests used; targeted age, screening interval and total number of scheduled screening examination.

In Ethiopia the cervical cancer prevention and control program screening guide line developed in January 2015 include the three components of prevention and control: primary prevention, secondary Prevention, and tertiary care. The target population for screening is women between the ages of 30and 49 years, unless HIV-positive. Aim to screen at least 80% of women in the target population over a defined period of time. The recommends screening interval by FMOH is every five years following normal results irrespective of HIV status. Following abnormal results and/or treatment, repeat screening in one year. If follow-up screening is normal, return to screening every five years (50).

2.3 Treatment of Cervical Cancer

To reduce morbidity and mortality, screening must be followed by treatment, either at the same or a following visit. Women who have precancerous lesions on the cervix are usually treated with 1 of the following methods. Cryotherapy and Loop electrosurgical excision procedure (LEEP) are usually used first options for intraepithelial lesions of the cervix. The choices will depend on the size of the lesion. Cryotherapy is a low cost and effective method, broadly used in low resource settings since it can be done without local anaesthesia or electricity, although it can lead to discharge during recovery and some possibility of infection. LEEP are accepted procedures used because it can be done as an outpatient with local anaesthesia and removes only small part of cervical stroma. But these procedures increases risk of early deliveries as shown by recent studies (19).

2.4 Sensitivity and specificity of cervical cancer screening test

Sensitivity is defined as proportion of persons with a given disease who are screened as positive. The screening result is true positive when the screening result is positive and the person has the disease. The screening result is false positive when the screening result is positive but the person does not have the disease (51).

Specificity is defined as the proportion of individuals without the disease who get a negative screening test result. The screening result is true negative when the screening test is negative and the person does not have the disease and, the screening test is false negative when the screening test is negative but the person has the condition (52). The strength of test depends on how high its sensitivity and specificity is (53).

In cervical screening testing methods there are several studies done on accuracy of test performance. The results in the studies indicate that cytology is a highly specific screening test, and it specificity is estimated to be in the range of 95–99%. VIA is at least as sensitive as conventional cytology in detecting high-grade lesions, but that its specificity is lower. Thus, VIA appears to be the most promising low-technology alternative to cytology (54). The result was consistent with study done in Sudan to Compare the performance of VIA and Pap in terms of sensitivity, specificity, positive and negative predictive values revealed that VIA was higher than Pap smear in sensitivity but there was no difference in specificity between the two tests. VIA had lower positive predictive value compared to Pap smear but it has higher negative predictive value than Pap smear (55). And also study in Pakistan done to determine the accuracy of visual inspection with acetic acid in comparison with Pap smear against colposcopy directed biopsy, for detection of pre-cancerous lesion reviled sensitivity of visual inspection was 78.5% vs 61.1% for Pap smear and the specificity of visual inspection was 99.3% vs 99.4% for cytology. Significantly higher sensitivity and specificity was found for the combined test than either of the two alone; 93.1% and 99.1% respectively. The positive predictive value of visual inspection vs pap was 84.6% vs 78.5% and negative predictive value was 98.6% vs 96.5%. Both values of combined test were significantly higher than either of the two tests alone (56).

In several large clinical studies, VIA has shown clinical sensitivity ranging from 41% to 92%, approaching that of standard colposcopy (57, 58). While the sensitivity of VIA/VILI is quite good, some studies have reported specificity as low as 49% .The Pap smear had a sensitivity of 0.65 and specificity of 0.88. The VIA test had a sensitivity of 0.68 and specificity of 0.85 (59).

In contrast a study that was done at an HIV treatment clinic in Kenya using across-sectional study design in which 498 women all received Pap, VIA, and HPV screening, found human papillomavirus testing with a Cervix brush in PreservCyt media (HPV) to be the most sensitive cervical cancer screening method among HIV infected women (81%) followed by Pap smear (74%) and visual inspection with acetic acid (VIA) (61%), while Pap smear was the most specific (98%) followed by VIA (63%) and HPV (55%) (60) these difference may be due to subjectivity of the result for pap and VIA.

A good quality and highly sensitive test is important in low resource settings because tests requiring frequently repeated screening is not affordable. From the patient's perspective as well, tests requiring several revisits for diagnostic evaluations and treatment can act as barrier for participation. Specificity of the tests needs to be high to control the chances of over treatment. Hence sustainable screening programs that targets high risk women for one or two screening with highly sensitive test with broad coverage are necessary to ensure cervical cancer incidence and mortality is reduced (47, 61).

2.5 Cost of cervical cancer screening

Costs implies value of the resources used in treatment or intervention, which should include health care resources and social care (62). Inclusion of range costs depends on the perspective taken during economic evaluation, such as patient perspective, health care perspective and societal perspective (63).

Different studies has been done on cost and cost effectiveness of cervical cancer screening methods from different perspective. A Study done in Tanzania to compare the institutional cost per person of screening and treatment between two groups of patients (study included 721

screened and 333 unscreened patients) and perform the cost effectiveness of screening program from provider perspective reviled that the average Screening cost per patient using VIA is US $1.45 and the average cryotherapy cost per patient is US $28.97(including staff time and supply) (64). In Thailand the cost benefit study of different cervical cancer screening strategies was done that compare no screening, VIA,PAP,HPV DNA testing and combined strategies using semi-Markova model that consider societal cost get cost of VIA, PAP and HPVDNA test(hybrid capture II) 2.05US$,9.38US$ and 31.88US$respectively (65). Even though it was from provider perspective the cost finding for VIA (3.67$) and pap (8.17$) was consistent with study in South Africa among HIV women (66).

In contrast to the above findings a cost effectiveness study in Kenya at HIV treatment clinic using quantity-and-price approach to estimate costs from societal perspective found cost of VIA $18, Pap $39 and $32 per screened women (60). Study done in rural Shanxi Province, China on Estimation of the costs of cervical cancer screening, diagnosis and treatment using a micro-costing approach from societal perspective show direct medical costs of screening were found to be $4.4, $4.84, $8.17 and $10.1 for VIA only, combined VIA/VILI, care HPV (self-sampling) and care HPV (clinician-sampling), respectively (67). In 2000 Goldie et al. compared the cost of different screening approaches in five developing countries found that the cost of providing VIA ranged between <US$5 in India to as high as $30 in South Africa. In each country VIA proved to be the most cost effective screening test (68). All the above studies cost of VIA were within the above rage but the cost difference between studies can be the perspective of the studies, year of study, costing approach and other factors.

2.6 Cost effectiveness of cervical cancer screening

Cost-effectiveness analysis (CEA) is a widely applied method used to identify which health care interventions deliver the best value for money. It identifies the most effective health care intervention strategy while accounting for the opportunity cost of other services foregone. A comprehensive CEA of cervical cancer prevention involves comparison of alternative prevention strategies, including various screening intensities and/or vaccination.

In cost effectiveness analysis (CEA), outcomes are measured in natural units such as life years saved, number of episode free days or number of cancer detected. CEA therefore compares alternatives in which costs related to a single common effect that may differ in magnitude. Result of CEA can be expressed in terms of cost per unit of effect or effect per unit cost. CEA is of most use in situation where decision is to be made from limited range of option in a given field under limited budget. It is mostly recommended to use final outcomes, such as life years saved, but in cases where intermediate outcomes are used, it is recommended that the link between final and intermediate outcome be established (63).

In low-resource settings, techniques such as visual inspection with acetic acid (VIA) or with Lugol's iodine (VILI) have been proposed as cost-effective alternatives to traditional Pap/cytology programs for cervical cancer screening. Such methods have enabled "see-and-treat" programs to be implemented, using cryotherapy for immediate ablation of any lesion appearing abnormal by VIA (32). A cost effectiveness analysis conducted in 5 developing countries that combine the 3 screening strategies pap, VIA and HPV DNA test shows that strategies that incorporate VIA or HPV DNA test enhance the linkage between screening and treatment in 1 or 2 visit are the most effective and cost-effective alternatives and reduce the life time risk of cancer by approximately 25 to 36% with cost less than $ 500 per year life saved (68) that was consistent with the study done in Tanzania which shows screening with VIA and treat with cryotherapy improves life-years gained and Kenya which show from screening strategies (VIA, care HPV and pap) with single visit approach VIA was most cost effective strategy with highest projected life expectancy (60, 64). These studies support the single visit approach strategy that is adopted by Ethiopia for cervical cancer screening.

And also in Thailand the cost benefit study of different cervical cancer screening strategies was done that compare no screening, VIA,PAP,HPV DNA tasting and combined strategies using semi-Markova model shows that Comparing no screening with all other strategies reduce incidence and mortality at costs ranging from $121 to $6720 per life-year saved and comparing the strategies with each other, they found that, under current conditions, the most cost-effective

strategy is VIA with immediate treatment ($517 per life-year saved for women aged 35–55 years) (65).

A study conducted on cost-effectiveness analysis of cervical cancer prevention based on a rapid human papillomavirus screening test in a high-risk region of China from societal perspective using micro- costing method. Screening strategies included in the study were conventional cytology (Pap smear and liquid based cytology) and HPV DNA testing (hc2 and care HPV test) differentiating by initial screening test, number of clinical visits, screening frequency in a lifetime, procedure locations and targeted ages. The study reviled that for all screening frequency rapid care HPV testing were cost effective compared with other strategies (69).

In contrast to the study that support VIA to be cost effective; a Randomized trial in India found that a single round of HPV testing in women over age 30 years reduced advanced cervical cancer incidence and mortality by 50%, whereas VIA and Pap testing did not yield significant reductions in disease burden (70). Other studies in India have found VIA to yield modest reductions; Sankaranarayanan and colleagues found that one round reduced incidence by 25% and mortality by 35% (71).

A study that was done by Nicole G. Campos et.al to compare the cost and cost effectiveness of screening test (HPV testing, VIA and Pap smear), screening algorisms and screening strategies; Screening once or three times in a woman's lifetime with HPV testing (provider-collection) at 70% coverage with linkage to treatment may reduce cervical cancer risk by 25–50%. VIA yielded lower reductions in cancer risk even the model assume that VIA screen-and-treat could usually be delivered in a single visit, whereas HPV testing required at least two visits. The low cancer reduction was due to reduced test sensitivity, which impacts screening effectiveness more than test specificity when screening opportunities are limited. Pap testing was the least effective strategy, due to both low sensitivity and the higher number of required visits. When all screening tests were compared in each country, only HPV testing was considered very cost-effective, with incremental cost-effectiveness ratios for screening three times in a lifetime below per capita GDP in each setting.

In line with study done by Nicole G. Campos et.al a study that use model-based approach to synthesize population, demographic, and epidemiological data from 50 low-and lower-middle-income countries estimated that both HPV vaccination and screening would be very cost-effective, and a comprehensive program could avert 5.2 million cases, 3.7 million deaths, and 22.0 million DALYs over the lifetimes of the intervention cohorts for a total 10-year program cost of US $3.2 billion, screening method they used was once-in-a lifetime screening (with treatment if needed) of women aged 35 years with either HPV testing or VIA.

A study that was done in Nicaragua at health facility level include Screening strategies (1) Pap testing every 3 years, with referral to colposcopy for women with an atypical squamous cells of undetermined significance or worse result ('Pap'); (2) HPV testing every 5 years, with referral to cryotherapy for HPV-positive eligible women (HPV cryotherapy or 'HPV-Cryo'); (3) HPV testing every 5 years, with referral to triage with visual inspection with acetic acid (VIA) for HPV-positive women ('HPV-VIA'); and (4) HPV testing every 5 years, with referral to Pap testing for HPV-positive women ('HPV-Pap'). HPV-based screening strategies were more effective than Pap testing. HPV-Cryo was the least costly and most effective strategy, reducing lifetime cancer risk by 29.5% and outperforming HPV-VIA, HPV-Pap and Pap only, which reduced cancer risk by 19.4%, 12.2% and 10.8%, respectively. With an ICER of US$320/YLS, HPV-Cryo every 5 years was very cost-effective using a threshold based on Nicaragua's per capita gross domestic product of US$2090 (72).

A study done by Perkins et al. in Honduras 1000 hypothetical women of age 35 were include in the strategies: never-screened women, women screened with VIA, and women screened with Pap smears using computer based modeling. The analysis revealed that screening with VIA would cost U.S. $3,198 per cancer case avoided and reduce cancer cases by 42%, versus U.S. $36,802 and 2% for Pap screening over ten year. Thus, VIA screening was more cost-effective than Pap smear screening by an order of magnitude (73).

Gaps identified

Most of the study's findings show that HPVDNA test (hybrid capture II or care HPV or PCR) and VIA screening methods were cost effective based on the country GDP and give greater health benefit. Most of the studies don't include costing analysis using primary cost data when they perform cost effectiveness analysis, only compare two strategies and don't include the care HPV test which is recommended now a day's for low income countries. according to the WHO, less costly cervical cancer screening methods are more applicable in low income areas, when assessing cost only; not the combination of screening costs and outcomes.

In this study, a cost effectiveness analysis was conducted to each cervical screening method (VIA, Pap smear and care HPV DNA test) in terms of combination of cost and outcome, to determine the most cost effective screening method in our setting where the incidence of cervical cancer is high. So this study will fill these gaps by incorporate primary cost data and compare three screening test using country specific data.

CHAPTR 3: OBJECTIVES

3.1 General objective

- To estimate and compare the cost and cost-effectiveness of cervical cancer screening methods in Addis Ababa, Ethiopia.

3.2 Specific objectives

- To estimate cost of Pap smear and VIA cervical cancer screening methods from societal perspective.
- To identify the cost effective cervical cancer screening methods.

CHAPTER 4: METHODS

4.1 Study area

The study was conducted at family guidance association Addis Ababa, Ethiopia. Addis Ababa is the capital city of Ethiopia. Administratively, the city is divided into ten sub-cities. According to CSA estimated for 2015 total population was 3,384,569, of which female account 52.4% and female in reproductive age 35.5% of the total population. Currently there are 48 hospitals and more than 90 health centers in Addis Ababa. Of 48 hospitals, 13 hospitals are public, in Addis Ababa. Out of 13 public hospitals, Tikure Anbassa specialized hospital is the only one which gives cervical cancer treatment and St.paul Hospital Millennium Medical College and Zewditu hospitals are the one which give cervical cancer screening using VIA and cervical precancerous treatment. From 90 health center fourteen of them give cervical cancer screening (VIA) and cervical precancerous treatment (cryotherapy).

Recently nine FGAES Clinics are providing VIA/cryotherapy service. In Addis Ababa there are three FGA clinics that give both VIA and Pap smear screening and cryotherapy treatment. FGA as the study area was chosen because both VIA and Pap smear screening service is given and most public health facilities refer women's to the clinics to get pap smear test. Screening strategies in this study included screening with VIA, Pap smears, and HPVDNA test(care HPV).

4.2 Study Design and period

An Institutional based cross sectional study design was used to collect cost data from provider and patient perspective. The study period was from August up to September 2017/2018

4.3 Population

4.3.1 Target population

All women who are eligible for cervical cancer screening and all clinics that provide cervical cancer screening service in Addis Ababa, Ethiopia.

4.3.2 Source population

All women who are eligible for cervical cancer screening at the three family guidance clinic and the three family guidance clinics found in Addis Ababa

4.3.3 Study population

All Women who screened in the family guidance clinic Addis Ababa, Ethiopia were the study population and those who fulfill the inclusion criteria and available in the three family guidance clinic during time of data collection period.

4.4 Eligibility criteria

4.4.1 Inclusion criteria

Women who underwent screening for cervical precancerous lesions using Pap smear or VIA within the age range between 30-49 years and screened for the first time at the family guidance clinics within the data collection period were included for the data collection

4.4.2Exclusion criteria

A woman who was pregnant and previously screened was excluded from the study.

4.5 Cost estimation

4.5.1 Identification

The cost where estimated from societal perspective including direct medical cost (i.e., medical resources required for the intervention including supply, equipment, personnel, building space, sample transportation and women out of pocket many for registration card, test and treatment cost), direct non- medical cost (i.e., other resources consumed as part of the intervention, such as patient two way transportation costs, food and water) and indirect cost (i.e., time spent travelling, waiting for receiving care, time spent to get counseling, time spent to get the test and to get the

test result). The cost includes screening and treatment of precancerous lesions for the screening methods. Screening counts the costs of screening visits. Treatment counts the cost of cryotherapy and loop electrosurgical excision procedures (LEEP) depending on the screening strategies given.

Cost that is included from provider perspective for Pap smear costs used in our model include the cost of supply, equipment, clinician's time, building space, specimen transport, and specimen processing and analysis. VIA costs include the costs of supply, equipment, clinician's time, building space. The cost of LEEP and cryotherapy include supply, equipment, clinician's time, and building space. The cost is categorized as fixed, those costs not related to consumption, and they do not vary over the short term and variable cost, vary according to the consumption of services. Average costs were calculated per screened women for all tests and treatment. HPV test kit cost was based on literature, as the test is not yet available at the health facilities as part of regular service.

4.5.2 Measurement

A micro-costing bottom-up approach to collect individual cost data was used .This method was used because it is more accurate and it takes into account cost variability among individuals. Costs associated with each types of testing and precancerous treatment was determined individually for each screening method. The identified resource needed for screening and treatment of precancerous lesions was quantified then change in monetary value. For each individual clinical visit and laboratory test, the following items were included in the costing exercise: consumables (quantity used and unit price), equipment (quantity used, price, years of useful life with discount rate (for annutization), number of cases processed annually and inflation rate (CPI) to get base year cost), and staff (staff category, working time breakdown, time spent in each activity and procedure per second and gross salary), building space (number of room ,space of the room per square meter, number of cases processed annually in the room, rental price of the space),transportation (price, years of useful life with discount rate (for annutization), number of km traveled annually, number of days traveled for sample transportation, number of km traveled

per hour and inflation rate(CPI) to get base year cost). The cost of these items is also shared with other health program. So to estimate the cost specifically to screening service allocation based method was used. Data sources for direct medical, direct non- medical and indirect cost estimates were patient interviews. Direct medical costs were measure based on the amount of out of pocket many spent for registration, test and treatment. Direct non- medical costs were measured based on the amount of many spent for two way transportation, food and water. Indirect costs were measured based on time spent in minutes. Costs of all individual items and salary data were then collected, along with the collected quantity data, to generate the final aggregated unit costs per women.

4.5.3 Valuation

When estimating equipment costs, it was assumed that the years of useful life was 5–10 years. It used enhanced annual volume and a discount (depreciation) rate of 3% to obtain the average equipment cost per woman. The maximum number of procedures estimated to be possible per practitioner during an eight hour work day given the time required per procedure, which includes time spent with each patient (counseling and procedure). Salary information for staff was provided by the staff. Using these data, the average monetary cost of staff time allocated to each procedure was calculated.

The productivity loss due to cervical cancer screening and treatment was based on human capital approach for those women who are unemployed and house wives. To convert women's time into equivalent earnings loss, assuming 8 working hours per day it was taken an average monthly gross minimum wage rate.

Data were initially calculated in Ethiopian birr and then converted to US dollars in 2017 (base year) for different timing of cost adjustments to inflation were done using the consumer price index (CPI= 249.1) and the official exchange rate of the Ethiopia birr to US dollar (1US$ = birr 22.40). To account for different timing cost were discounted using 3% which is recommended by WHO and used in different studies.

4.6 Time Horizon

The time horizon taken was life time horizon. Because the outcome will took longer time to happen. Since the time horizon is more than a year, costs and effects are discounted at 3%.

4.7 Outcome measurement

Disability adjusted life year (DALYs) were used as the primary outcome measurement and ICER for assessing cost-effectiveness between alternative screening strategies.

4.8 Model structure

Decision analytic modeling allows for variability and uncertainty associated with all decisions. Decision analysis is defined as a systematic approach to decision making under uncertainty. Decision analytic modeling is useful in economic evaluations as it provides framework for combining various types of evidence, such as effectiveness evidence and resource use data (74).

In cases where decisions are to be made in absence of formal evidence and on basis of assumptions and judgments, decision analysis provides an explicit analytical framework within which this can be done. Decision trees and Markov models are commonly used decision models (63).

For this study, full economic evaluation (cost effectiveness analysis) using Markov model was used because HPV infection is recurrent event and chronic disease. The model was used to simulate the natural history of HPV infection induced cervical dysplasia and incorporated procedures used in the screening and treatment of precancerous lesions of the cervix to compare cost and clinical effectiveness of Pap smear, VIA and HPV DNA test. The conceptual foundation and structure of these models are similar with the natural history of the disease and adjusted to reflect current screening scenario in Ethiopia context with expert's consultation. The current practice in Ethiopia, according to the expert opinion is that women with abnormal screening result get precancerous treatment depending on the length of the lesion. The women suspected

for invasive cancer are referred for further diagnosis and treatment. The model comprises mutually exclusive health states that represent established stages of cervical disease. Individual women enter the model at age 30 years with a healthy cervix and transition between health states within one year cycle until death. As individuals age, they can acquire HPV infections, which can clear or progress to high-grade precancerous, classified as cervical intraepithelial neoplasia (CIN), grades 1,2 or 3. Women with precancerous can regress or progress to invasive cancer, which can be detected at the local, regional or distant stage. Death from background mortality can occur from any health state, stage-dependent mortality can occur from the cancer states. At each transition, the model produced figures for the costs incurred and the DALYs according to the individual's health condition.

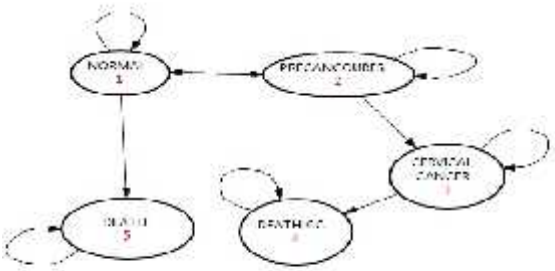
Table.1. Input parameter for the cost effectiveness model

		Range value		
Variables	**Base value**	**Low**	**High**	**Source**
Initial age of women	30			
Prevalence of HPV infection	0.048	0.023	0.159	(75, 76)
Case fatality rate cervical cancer	0.798	0.55	0..82	(36)
Effective coverage of the screening test	0.01	0	0.8	(75)
Cost of test and precancerous treatment				Primary Collected data
Cost of cryotherapy	59.4	44.55	74.25	>>
Cost of HPVDNA	19.06	14.295	23.83	>> and (69)
Cost of LEEP	429.71	322.28	537.14	>>
Cost of pap smear	21.48	15.38	25.64	>>
Cost of VIA	14.23	10.68	17.78	>>
Cost of cervical cancer treatment				(60)
Local	1135			
Regional	6447			
Distance	5107			
Test accuracy				
positive predictive value of DNA	0.844	0.812	0.866	Estimated
Positive predictive value PAP	0.899	0.854	0.932	>>
Positive predictive value VIA	0.573	0.498	0.629	>>
Sensitivity of DNA	0.859	0.77	0.923	(77)
Sensitivity of PAP	0.541	0.425	0.709	>>
Sensitivity of VIA	0.577	0.454	0.686	>>

Specificity of PAP	0.974	0.969	0.978	>>
Specificity of DNA	0.932	0.924	0.939	>>
Specificity of VIA	0.816	0.804	0.827	>>
Transition probability				
Back to normal	0.70	0.5	0.9	(78)
Regression of precancerous to normal				(79)
CINI	0.6			
CINII	0.4			
CINIII	0.3			
Remaining at CIN				(79)
CINI	0.3			
CINII	0.35			
CINIII	0.48			
All cause age specific mortality				(80)
30	0.016			
35	0.023			
40	0.027			
45	0.03			
50	0.038			
55	0.049			
60	0.074			
65	0.118			
70	0.19			
75	0.295			
80	0.441			
85	1			
Disability weight of cervical cancer				(81)
Terminal phase	0.54			
Diagnosis and primary phase	0.288			
Controlled phase	0.049			
Metastatic phase	0.451			

4.8.1 Cost and epidemiological Data

The search for data revealed that there was no primary study that has been carried out for Ethiopia, which gave sensitivity and specificity of tests to detect precancerous lesion. Hence, data from studies carried out in low income settings was sought. As it has been discussed in the literature there is a wide range of sensitivity and specificity rates for screening tests reported in literature. For these study data for sensitivity, specificity Cost of cervical cancer treatment has been taken from study done in Nicaragua, Hyderabad and Kenya.



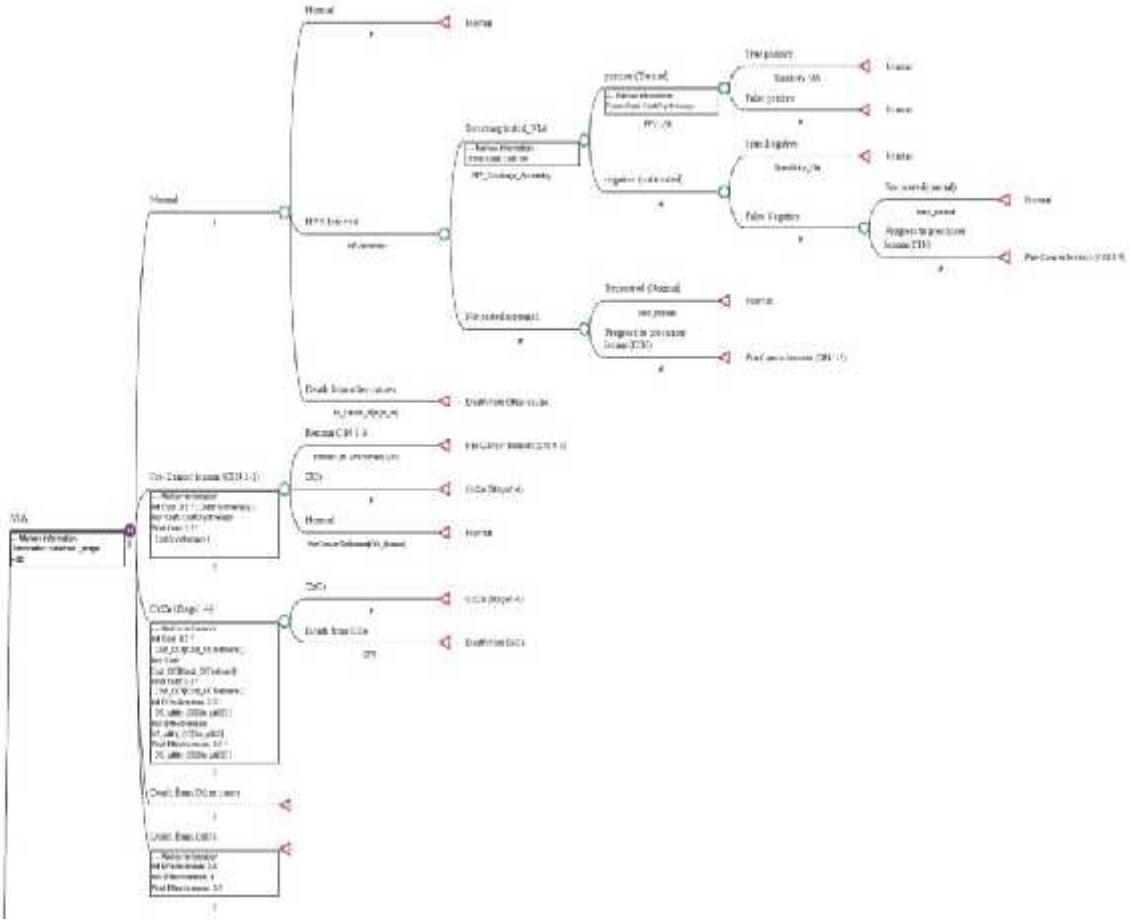


Figure 1 Markova State transition diagram and model tree for cervical cancer

The prevalence of HPV infection with normal cytology, effective coverage of screening and case fatality rate was obtained from HPV report in Ethiopia 2017. The transition probabilities were also obtained from study done by Holschneider CH. on Premalignant and malignant disorders of the uterine cervix. Mortality rates for the population were WHO age-specific all-cause mortality rates for Ethiopian females in 2016. Disability weight for cervical cancer stage was taken from WHO report.

Cost data for VIA and PAP screening and precancerous treatment was obtained from primary collected data, which include provider and patient perspective. HPV DNA test kit cost was obtained from literature and patient cost was taken similar with VIA assuming that it will be similar because both are single visit approach.

4.9 Sample size

The sample size was determined using a single population mean formula considering the following assumptions: mean 650.5 birr and standard deviation 263.06 birr as cost of cervical cancer screening (82).The final sample size is adjusted for a non-response rate of 10% and the total sample was.

$$n = \frac{(z)^2 \times \delta^2}{d^2} = \frac{1.96^2 * 263.06^2}{32.5^2}$$

$$= 277$$

where

n = sample size

z = reliability cofficent for 95% confidnce interval (1.96)

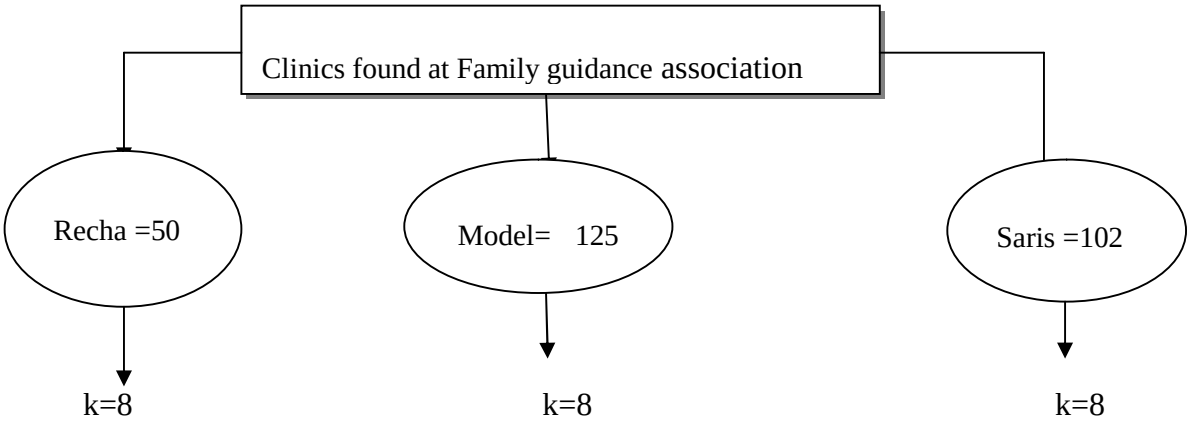
δ = population standard divation (263.06 birr)

d = marginal error (32.5 birr)

4.10 Sampling procedure

All the family guidance clinics were included in the study to collect cost data from provider and patient perspective. In collecting provider cost data only those directly involved in the cervical cancer screening service were included to identify lists of items and the quantities consumed for each procedure. From the three clinics for each two service provider were selected based on experience and training. Head of the clinic was also interviewed for clarity. Cost of equipment, supply, salary data were obtained from finance and accounting department.

In collecting patient cost 252 clients were interviewed from the three clinics. The sample size was distributed to each clinic, using probability proportional to size (PPS) based on 2009report. And the numbers of women required for the study in each clinic were determined. Systematic random sampling method was used to select study participant. Every K^{th} value of the participant was interviewed.



The first woman was selected randomly. Purposely the sample for both VIA and PAP screening methods were allocated equaly.

4.11 Data collection procedure

Data were collected by three BSC nurses and the principal investigator was also involved in the data collection and as supervisor. The data collectors were trained for one day about the study objective, what kind of data they should collect and clarify the questioner. The data collection

was done through face-to-face interviews using an adapted, pretested and modified structured questionnaire. The questionnaire was pre-tested in one of the clinic on 14 women, i.e., 5 % sample size prior to the data collection. The details and purpose of the study was explained to the participants attending the clinic and also to the staff who were involved in the interview. A printed consent form was read out to the study participants and their willingness to participate was obtained before collecting the data. The costs associated with clinic visits, including nurses or physicians' time spent on each procedure and salary information was obtained by interviewing the provider who give the service, the supplies and equipment needed and amount per women used to perform Pap smear, VIA, cryotherapy and LEEP was obtained from the service provider who perform the procedure and laboratory that processed the specimens, cost of supply and equipment data was obtained from medical store and finance office. Data that cannot be availed by the clinics were obtained from family guidance association head office finance. Data on Building space was estimated based on observation and measuring the area, and transportation cost data (i.e. per week how many days used to transport sample, km from clinic to sample site, per km how many hours they travel, per km how much gas used…etc) was obtained from the drivers.

4.12 Data analysis procedures

The Data were entered, cleared in Epi info version 7 and exported to SPSS version 20 for analysis. SPSS was mainly used in the descriptive analysis. Micro soft excel was used for costing analysis .TreeAge pro 2018 was also used in constructing the model, analyzing the tree model and uncertainty in the cost-effectiveness model. Sensitivity analysis was done on the variables that are uncertain and prone to change over time.

4.12.1 Cost analysis

A micro-costing approach were used to measure and aggregate the cost of all resources used to provide cervical cancer screening at the level of the individual patient with in the family guidance clinics.MS-Excel was used to analyze the cost.

4.12.2 Cost-effectiveness analysis

The alternative options in economic evaluation are compared in terms of incremental costs and effects, expressed as incremental cost effectiveness ratio (ICER), which are defined as additional cost per extra unit of effect from the more effective intervention (74). In these study Incremental cost-effectiveness ratios (ICERs) were calculated to compare the cost and effectiveness of each cervical cancer screening strategy which are VIA, Pap smear and HPV DNA test. The strategy with the highest cost and least effectiveness were considered the dominated strategy and the strategy with the greatest effectiveness and lowest cost the dominant strategy. Among the non-dominated options, ICER was calculated by ranking interventions from least costly to most costly comparing each option with next more costly and more effective option.

Since ICER does not necessarily reflect social opportunity cost of an intervention, to make decisions in economic evaluations, a societal Willingness-to-Pay (WTP) threshold is applied. A societal WTP threshold can be defined as maximum amount that society is willing to invest to achieve a unit of effectiveness (74). In Ethiopia because there is no established national societal WTP threshold, The gross domestic product (GDP) per capita were used as a threshold which is suggested by the WHO-CHOICE criteria categorized “cost effective” intervention as one that costs up to three times the per capital GDP of a country. If the cost drops below per capita GDP, the intervention is judged “highly cost effective”. The GDP for Ethiopia in 2017 was US$873. A half cycle correction was used in order to achieve a closer approximation to proper reward.

4.12.3 Uncertainty analysis

In every economic evaluation and in decision modeling there is uncertainty. There are two kinds of uncertainty: Structural or model uncertainty and parameter uncertainty. Structural uncertainty is related to structural assumption of the model, and is external to the model, whereas parameter uncertainty is related to estimation of input parameters in the model. Uncertainty is present in input parameters because data on key parameters are drawn from number of sources. So to handle this parameter uncertainty one way sensitivity analysis (tornado) and probabilistic sensitivity analysis (PSA) was used by varying several parameters in the model within a given

range and by doing Monte Carlo simulation. PSA allows for assessment of joint uncertainty across all parameters at the same time. Hence there are better chances of taking into account the interaction between the input parameters. In PSA, probability distributions were assigned to key parameters and uncertainty is propagated through the model using Monte Carlo simulation. Through Monte Carlo simulation, an empirical distribution of expected costs and effects and thereby cost effectiveness ratio was obtained by drawing 1000 random samples from these distributions

4.13 Assumption

There are number of assumptions made while building this model. The model assumes that every woman entered into the model is in the healthy state. Even after clearance from HPV infection and treatment, there is a chance of re infection with HPV. All women who get positive results from primary screening for VIA and HPV DNA test will get cryotherapy treatment and for Pap smear test when the result is CINII and CINIII the women will get LEEP treatment.

For the LEEP procedure women referred to one of the public hospital because the service is not available at the family guidance clinics. The cost from patient perspective was estimated assuming that the treatment is given the same day after they get pap result. Cost of HPV DNA test for the patient perspective was similar with that of VIA assuming that if the service is available the cost will not be different.

4.14 Data quality management

The questioner was pre tested, English version of the questionnaire used in this study was translated into Amharic than back to English ,experience data collector were hired and trained, regular supervision was conducted, each questioner have unique ID to identify if there is miss much of information and to simplify data entry. Half cycle correction was used to minimize over estimation. Sensitivity analysis was done to overcome parameter uncertainty

4.15 Operational definitions

- Cervical cancer screening**;** -Those women who got a Papanicolaou/VIA test for the first time at family guidance clinic
- Cost**;** -Resource/money spent to purchase service or other resource including direct and indirect costs
- Direct cost; - Direct medical and nonmedical cost (i.e. supply, equipment, consultation, laboratory transportation, salary of personnel, food etc.).
- Indirect cost; - Cost associated with productivity loss (i.e. time spent travelling, waiting time etc.).
- Cost effective;- Defines a threshold cost-effectiveness ratio, an intervention with an ICER less than Ethiopia's per capita gross domestic product (GDP) would be "very cost-effective" and less than three times per capita GDP would be "cost-effective".
- Incremental cost effectiveness ratio;-Defined as the additional cost of intervention divided by its additional clinical benefit, as compared with the next-less-expensive intervention.

4.16 Ethical consideration

Ethical clearance was obtained from Addis Ababa University, College of Health Sciences, Research and Ethics Committee of the School of Public Health and AAHB. A formal letter of cooperation was also obtained from each concerned bodies. Informed Consent was obtained from each respondent. Confidentiality of information was kept and no personal identification was used. In the study there was no any procedure and questions that may harm or give participant filling of discomfort. The participation was based on voluntary.

4.17 Dissemination of results

The finding of the research was submitted to the School of Public Health. Efforts will also be made to disseminate the findings through presentation to conferences, seminars and publication.

CHAPTER 5: RESULTS

From 277 sample size a total of 252 women were interviewed with response rate 90.9%. Equal respondent for each screening methods, from the total (126) VIA screened women four were screened positive and form the total (126) pap screened women two were CINII and two were CINIII. The descriptive data are presented as frequency; mean and standard deviation tables. The descriptive data are presented corresponding with the categories of questions, i.e., socio-demographics, reproductive health, direct medical cost, direct non-medical cost and indirect cost.

5.1 Socio- Demographic characteristics

The respondent women's age ranged between 30 and 49 years with a mean (SD) age of 39.37(5.5) years. Majority of the women were between the age 35-39 was 80(31.7%). Most of the respondents were married 162(64.3%), followed by single 32(12.7%) and widowed 29(11.5%). 26.6% of the women have been completed secondary education, followed by college diploma and primary education 22.2% and 21.4% respectively. majority of the women's (70%) are house wives (32.1%), government employee (23.8%) and merchant (15.1%). As a source of income for the women monthly income from employment 91(36.1%), trade 449(17.5%) and rent 34(13.5%) account most. Mean (SD) monthly income of the women was birr 3578.88(4069.55). Mean (SD) number of people living together were 4.42 (1.75). Majority of the house hold have 1-4 (52.4%) and 5-8 (46.4) people living together.

Table 2.Frequency table Socio- demographic characteristics of respondent women (252), Addis Ababa, Ethiopia 2017.

Characteristics	Number (%)	characteristics	Number (%)
Age		**Source of income**	
30-34	50(19.8)	House wives and don't have source of income	11(4.4)
35-39	80(31.7)	farming	4(1.6)
40-44	62(24.6)	trade	44(17.5)
45-49	60(23.8)	production of handy craft	3(1.2)
Marital status		daily labor	12(4.8)
Single	32(12.7)	monthly income from employment	91(36.1)
Married	162(64.3)	Rent	34(13.5)
Widowed	29(11.5)	Pension	10(4.0)
Married but not live together	9(3.6)	Other	43(17.1)
Divorced	20(7.9)	**Monthly income**	
Educational level		0-2500	156(61.9)
Illiterate	27(10.7)	2501-5000	58(23)
Read and write only	14(5.6)	5001-7500	26(10.3)
Primary education(1-8)	54(21.4)	7501-10000	5(2)
Secondary education(9-12)	67(26.6)	>10000	7(2.8)
College/ diploma	56(22.2)	**Number of People live together**	
University/ degree	34(13.5)	1-4	132(52.4)
Occupation		5-8	117(46.4)
Farmer	3(1.2)	9-12	3(1.2)
Retired	8(3.2)		
House wife	81(32.1)		
Gov't Employee	60(23.8)		
NGO Employee	15(6.0)		
Privet employee	31(12.3)		
Merchant	38(15.1)		
Student	1(0.4)		
Daily laborer	13(5.2)		
Unemployed	2(0.8)		

5.2 Reproductive characteristics

From the total respondent women's there were women who have been pregnant before and never been pregnant before which was 226(89.7%) and 26(10.3%) respectively. Out of pregnant women 160(70.8%) were pregnant 1-4 times, 56(24.8%) were 5-8 times pregnant and 10 (4.4%) were pregnant more than eight times. Women who have ever been given birth were 214(94.7%) and 12(5.3%) not given birth before. Out of women given birth 183(85.5%) were 1-4 times given birth, 29(13.5%) were 5-8 times given birth and 2(0.9%) were given birth more than eight times. 127(56.2%) Women have miscarriage history the rest 99(43.8%) doesn't have. out of women who have history of miscarriage 105(82.7%) have 1-2 times, 18(14.1%) have 3-4 times, 4(3.2%) have more than five times a history of miscarriage. Women were using and not using modern contraceptive were 194(77%) and 58(23%) respectively. Out of women who were used modern contraceptive majority of them used 71(36.6%) used combined oral contraceptives, 48(24.7%) injectable and 41(21.1%) Loop. Also from contraceptives used women 100(51.5%) of them used it for 1-4 years, 66(34%) for 5-8 years, 25(12.9%) for 9-12years, 3(1.5%) for more than twelve years.

Table 3.Reproductive health characteristics of respondent women, Addis Ababa, Ethiopia 2017.

Characteristics(N)	**Number (%)**	**Characteristics(N)**	**Number (%)**
Ever pregnant before(252)		**Used modern contraceptive (252)**	
Yes	226(89.7)	Yes	194(77)
no	26(10.3)	No	58(23)
Number of pregnancy(226)		**Type of contraceptive used (194)**	
1_4	160(70.8)	Combined oral contraceptives	71(36.6)
5_8	56(24.8)	Progestin only pills	7(3.6)
>8	10(4.4)	Injectable	48(24.7)
Ever given birth(226)		Implants	27(13.9)
yes	214(94.7)	Loop or IUCD	41(21.1)

no	12(5.3)	**How long the women used contraceptive (194)**	
No of given birth(214)		1-4	100(51.5)
1_4	183(85.5)	5-8	66(34)
5_8	29(13.5)	9-12	25(12.9)
>8	2(0.9)	>12	3(1.5)
Any miscarriage(226)			
yes	127(56.2)		
No	99(43.8)		
Number of miscarriage(127)			
1-2	105(82.7)		
3-4	18(14.1)		
>5	4(3.2)		

5.3 Cost of screening from societal perspective

From the total 252 screened women half were VIA and half Pap smear tested. Number of visit for VIA screened women who have one visit were 124(98.4%) and two visits were 2(1.6%). Number of visit for Pap smear screened women who have two visits were 111(88.1%), three visits 13(10.3%) and four visits 2(1.6%).

Average (SD) estimated screening costs per women for each screening method VIA and Pap smear from patient and provider perspective was birr 260.98(94.29), birr 57.68(5.23) and birr 326.03(90.05), birr 155.20(25.79) respectively. Average (SD) estimated treatment cost per women for each treatment from provider and patient perspective (croytherapy and LEEP) were birr 1102.05(445.22) and 228.37(31.15) and birr 9263.98(3937.21) and 361.67(7.05) respectively.

Table 4. Distribution of cervical cancer screening methods Cost from societal perspective, Addis Ababa, Ethiopia 2017.

Procedure and perspective	**Provider cost mean(SD)in birr**	**Patient cost mean(SD)in birr**	**Total cost (us $)**
VIA test	57.68(5.23)	260.98(94.29)	318.66(14.22)
Pap-smear test	155.20(25.79)	326.03(90.05)	481.23(21.48)
Cryotherapy treatment	1102.05(445.22)	228.37(31.15)	1330.42(59.39)
LEEP treatment	9263.98(3937.21)	361.67(7.05)	9625.65(429.71)

For each screening method (VIA and pap) from patient perspective average (SD) direct medical cost were birr 188.7(23.8) and birr 221.8(37.25), direct non-medical cost were birr 20.72(39.07) and birr 31.6(31.75), indirect cost were birr 51.56(74.08) and birr 72.63(77.90) respectively. Estimated average (SD) treatment (cryotherpy and LEEP) direct medical cost were birr 225(28.86) and birr 350(0), indirect cost were birr 3.37(3.44) and birr 11.67(7.05) respectively. Form the total screening cost for each methods (VIA and pap-smear) direct medical cost account 72.3% and 68.02%, direct non-medical cost account 7.93% and 9.69% and indirect cost account 19.75% and 22.27% respectively. For both treatment (cryotherapy and LEEP) direct medical cost account 98.5% and 96.8% from the total cost.

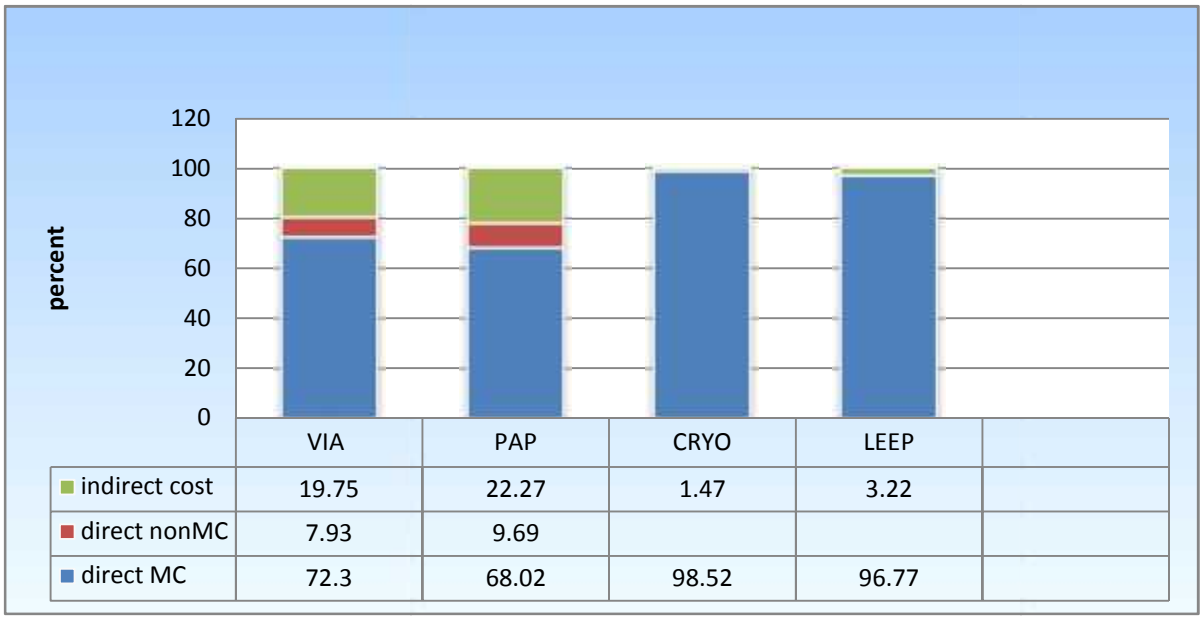
From the average direct medical cost of VIA and Pap smear screening test cost account 74.4% and 75.67% followed by registration cost 25.56 % and 24.32% respectively. From the average direct non-medical cost of VIA and Pap smear screening transportation cost account 78.8% and 77.36% followed by food and water cost 21.17% and 22.63% respectively.

Table 5 Distribution of cervical cancer screening methods Cost from patient perspective and time spent for each procedure, Addis Ababa, Ethiopia 2017.

Cost	VIA mean(SD)in birr/min	Pap-smear mean(SD)in birr/min	Cryotherapy mean(SD)in birr/min	LEEP mean (SD) in birr /min
Total cost	260.98(94.29)	326.03(90.04)	228.37(31.15)	361.67(7.05)
Direct medical cost	188.7(23.86)	221.82(37.25)	225(28.86)	350(0)
Direct non-medical cost	20.72(39.07)	31.62(31.75)		
Indirect cost	51.56(74.08)	72.63(77.9)	3.37(3.44)	11.67(7.05)
Total time spent	127.2(83.43)	258.3(169.14)	26.25(4.78)	41.25(6.3)
Time spent traveling	66.8(62.75)	148.76(122.86)		
Time spent waiting	36.14(40.16)	82.93(83.49)		
Time spent counseling	12.05(4.99)	15.5(6.19)	8.75(2.5)	12.5(2.88)
Time spent for producer	8.16(4.99)	5.99(4.21)	17.5(5)	28.75(8.54)
Time spent to get result	4.04(3.23)	5.1(5.2)		

Average (SD) total time spent for VIA and Pap smear screenings were 127.2 min (83.4) and 258.3min (169.13), time spent traveling 66.8min (62.75) and 148.7min (122.8), waiting 36.14min (40.16) and 82.9min (83.5), counseling 12.1min (4.9) and 15.5min (6.2) , testing 8.2min (4.9) and 5.9min (4.2) and getting result 4.0min (3.2) and 5.1min (5.2) respectively. Form the total time spent for VIA and pap-smear traveling 52.51% and 57.59%, and waiting time 28.4% and 32.1% take most of the time. Total average (SD) times spent for cryotherapy were 26.25min (4.78) and LEEP were 41.25min (6.29) from the total time spent time spent for treatment procedure take most of the time cryotherpy (66.6%) and LEEP (69.6%)

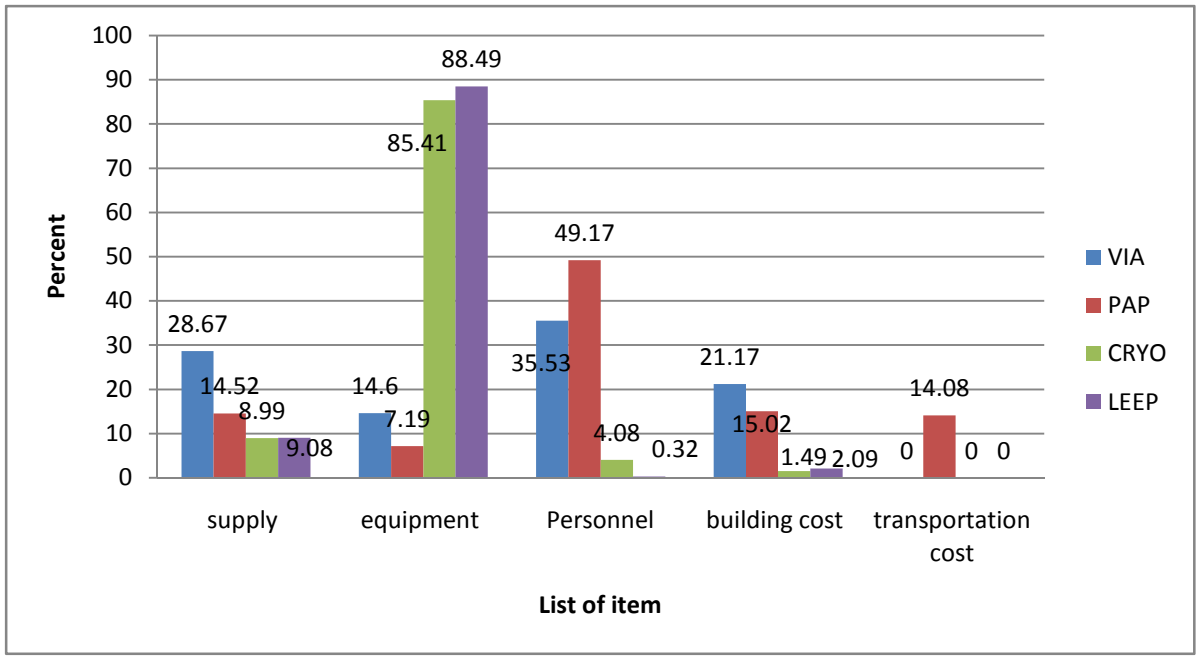
Figure 2.From average total cost share of direct medical, direct non-medical and indirect cost per women, patient perspective, Addis Ababa, Ethiopia 2017.



	VIA	PAP	CRYO	LEEP	
indirect cost	19.75	22.27	1.47	3.22	
direct nonMC	7.93	9.69			
direct MC	72.3	68.02	98.52	96.77	

As we can see from the figure cost from provider perspective for VIA test personnel and supply cost accounts most (35.53% and 28.67%), for Pap test personnel and building cost accounts most (49.17% and 15.02%), for cryotherapy treatment equipment and supply accounts most (85.41% and 8.99%) and for LEEP treatment equipment and supply accounts most (88.49% and 9.08%) respectively.

Figure 3. From average total cost share of supply, equipment, personnel, building and transportation cost per women, provider perspective, Addis Ababa, Ethiopia 2017.



5.4 Cost effectiveness analysis

The result of CEA showed that among the three screening strategies, VIA and HPVDNA test are most cost effective strategies, whereas Pap smear is not cost effective at the given WTP threshold which is 873 US$ GDP. Pap smear averted the highest number of DALY (0.8531) and VIA averted the least (0.857) because in case of DALY the effectiveness with lower value is preferable. The incremental cost for Pap smear was 147.39 US$ and incremental effect for Pap smear was 0.00006608. The ICER for Pap smear was 2230474 US$, as compared to HPVDNA test. Likewise, the incremental cost when switching from VIA to HPV DNA test was 0.15 US$ and incremental effect for HPV DNA test was 0.00056261. The ICER for HPV DNA testing was 268.09US$ per additional DALY averted.

Cost effectiveness analysis shows that VIA is the most cost effective strategy, followed by HPV DNA testing with ICER of 268.09 US$ per additional DALY averted and Pap smear is the least

cost effective strategy with high cost and more effective, when one time GDP per capita is used as the decision threshold, that is 873US$ in 2017GC.

Table 6.Costs, Effectiveness, Incremental Costs, Incremental Effects, Cost -Effectiveness Ratio and Incremental Cost effectiveness Ratio (ICER) for per woman screened, Addis Ababa, Ethiopia 2017.

Strategy	Costper screened women(US$)	Effectiveness per screened women (DALY averted)	Incremental cost	Incremental effectiveness	Cost effectiveness ratio	Incremental cost effectiveness ratio
VIA	76.79	0.8537	0	0	89.94	0
HPVDNA test	76.94	0.8532	0.15	0.00056261	90.18	268.0963
PAP-smear	224.34	0.8531	147.39	0.00006608	262.95	2230474

The cost effectiveness plane for the three tests compared is shown in Figure.3 the X axis represents the number of DALY averted according to screening method and Y axis represents cost per screening method. As shown by the figure, none of the screening test is dominated. However, as seen from Table.7, ICER of Pap smear test is very high, which indicates that VIA and HPV DNA is the most cost effective testes at given level of input parameters.

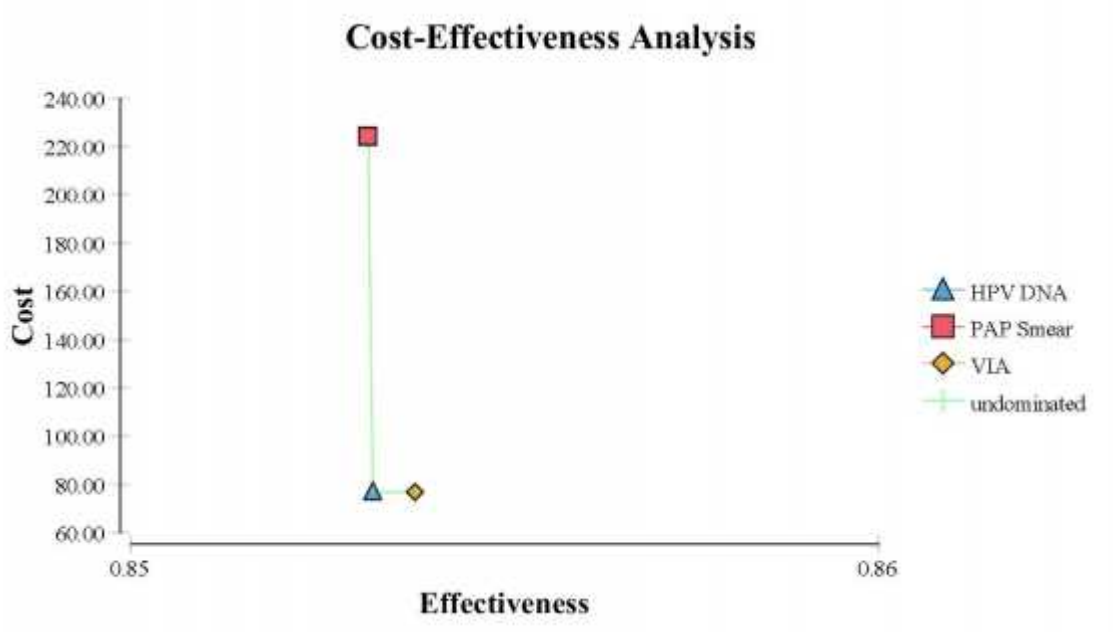


Figure 4. Cost Effectiveness Plane for the cost effectiveness analysis

5.5 Sensitivity analysis

I evaluated the robustness of the findings with sensitivity analyses using Tornado diagrams and probabilistic sensitivity analysis. Clinical input range was varied across the range reported and assumed beta distribution, while costs were varied by 25% and assumed a gamma distribution.

For the tornado diagram expected value is displayed on the horizontal axis, so each bar represents the selected node's range of expected values generated by varying the related variable and the vertical dotted line indicate the base line expected value. Results of the one -way sensitivity analysis are shown in Figures.4, with the widest bar representing the most influential parameter on the model results and vice versa.

As it shown in table.1 eighteen inputs parameters was displayed with lowest and higher range for sensitivity analysis. The net monetary benefit Tornado includes an EV dotted line which represents the base case NMB when each parameter uses its base case value. The analysis for net

monetary benefits which combine cost, effectiveness and willingness to pay revealed that prevalence of HPV infection ,back to normal, effective coverage of screening test, case fatality rate of cervical cancer and cost of cryotherapy was most sensitive parameters to the expected value within the given range.

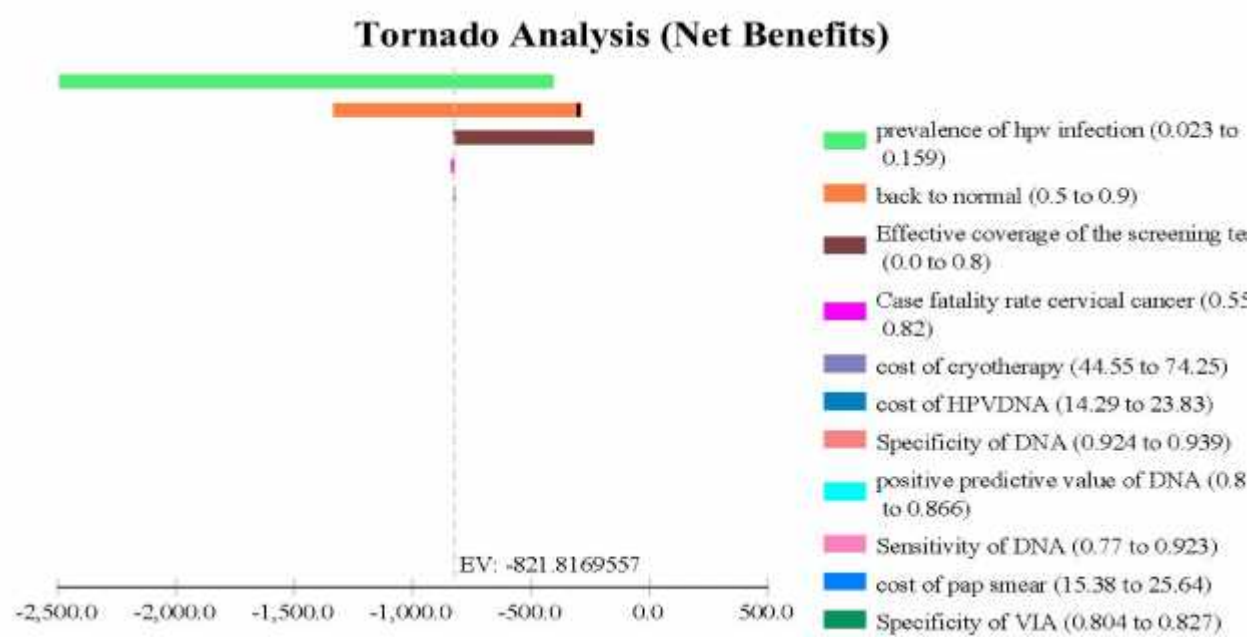


Figure 5 Tornado analysis

When comparing VIA verses HPVDNA test the tornado analysis show that the most impactful variable on the ICER result was back to normal, effective coverage of screening, cost of HPVDNA, cost of cryotherapy, cost of VIA, specificity of VIA, prevalence of HPV infection, positive predictive value of HPV DNA, case fatality rate of cervical cancer, specificity of HPVDNA and positive predictive value of VIA with decreasing impact.

In probabilistic sensitivity analysis it followed a standard Monte Carlo approach based on 1000 randomly generated simulations of parameter values. The PSA analysis result were presented using cost effectiveness analysis graph, cost effectiveness acceptability curve and cost effectiveness acceptability at willingness to pay.

In PSA cost effectiveness analysis each strategy is plotted using the mean cost and effectiveness statistics from the simulation summary. The result shows that there is a little bit difference in cost and effect. The ICER also shows almost the same ICER result with the original CEA.

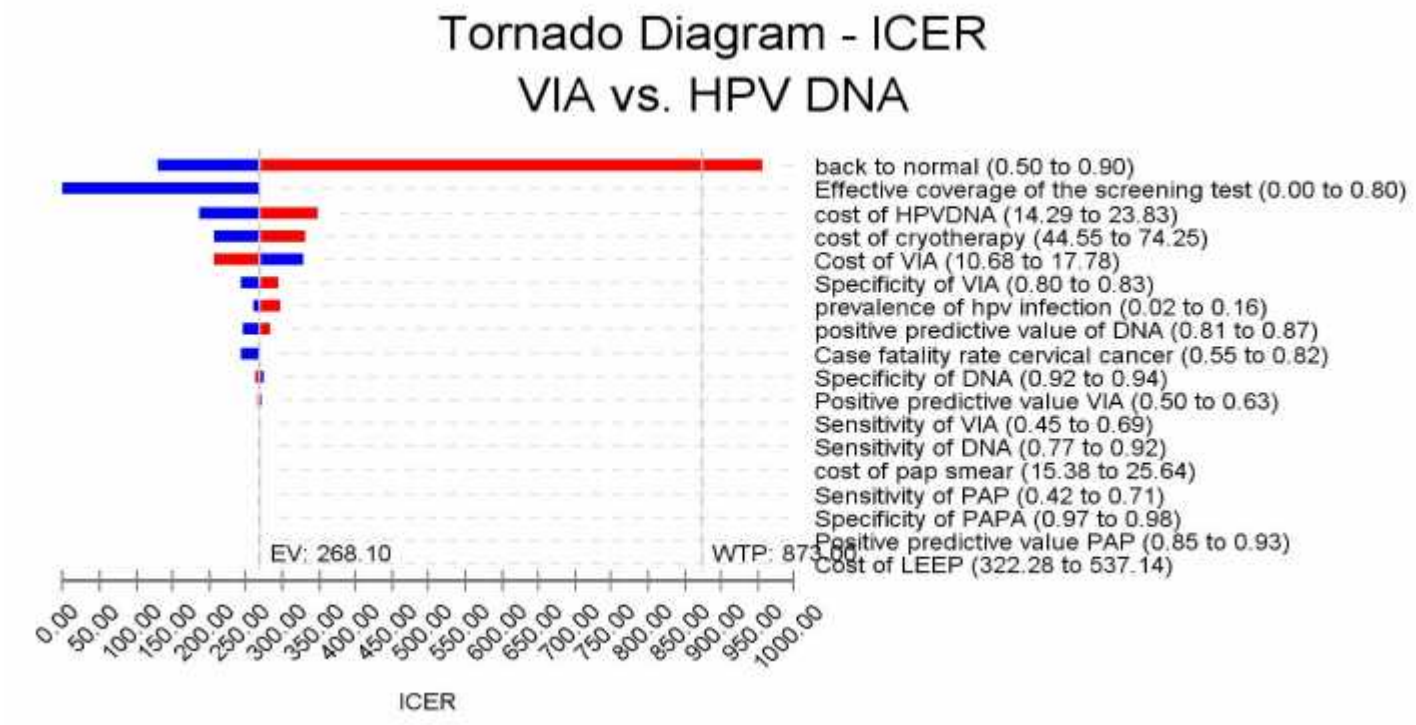


Figure 6; Tornado analysis VIA vs HPVDNA test

In the cost effectiveness acceptability curve for each WTP value, the graph uses net benefits to determine the percentage of simulation iterations that favor each strategy. The percentages will increase for more effective strategies as the WTP increases. The y-axis indicates the probability that screening methods being cost effective, given the values of the Willingness to Pay (WTP) threshold on the x-axis. At the WTP threshold of zero US$ per disability averted, the probability that VIA, HPVDNA and PAP smear being cost-effective was 0.857, 0.143 and 0 respectively.

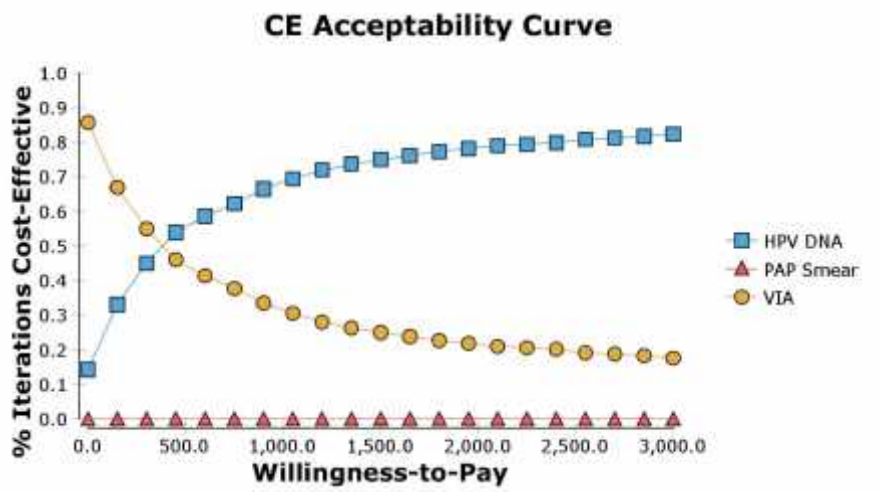


Figure 7 cost effectiveness curve

At 900 US$, the probability of the VIA, HPV DNA and PAP smear being cost-effective was 0.335, 0.665 and 0 respectively. The probability of HPVDNA test being cost-effective increases beyond 500 US$ thus HPV DNA test is cost-effective when the willingness to pay threshold increases. The acceptability willingness to pay graph shows at a specific willingness to pay value (873US$) the percentage of iterations that favor each screening strategy. So at 873US$ that is one GDP of Ethiopia HPVDNA test is 65.4 % times chosen as cost effective screening strategy.

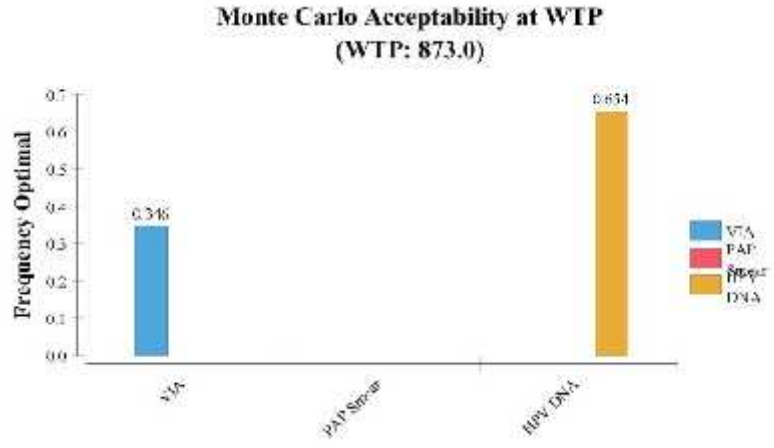


Figure 8 Acceptability at willingness to pay

CHAPTER 6: DISCUSSION

In this study it was performed a cost and cost-effectiveness study and evaluated three cervical cancer screening strategies using VIA, Pap smear and HPV DNA test.

6.1 Cost of cervical cancer screening

It often is difficult to compare cost studies, because they use different types of costing methods, depending on the objective and the viewpoint of the study. This study estimate cost of VIA, PAP and HPVDNA from societal perspective and shows that cost of VIA and pap smear to be 14.22 US $, 21.48 US $ and 19.US$. Form provider and patient perspective the cost of VIA and PAP were 2.57 US$ and 11.65 US$ and 6.92 US$ and 14.55 US$ respectively. The cost difference between VIA and Pap smear is may be because pap smear need at least two visit so the women have to come to the clinic at least twice, the need for laboratory and for interpretation of result it need higher level health professional.

The result for the cost of VIA from provider perspective was close with the study done by Nicole .G.Compos in 102 LMIC which Ethiopia was grouped under low income tier and cost of VIA for that group was 1.6 US$ and in Tanzania (VIA 1.45$). Also in south Africa cost of VIA and PAP from provider perspective was 3.67$ and 8.17$ the result was near to the study finding. And study in five developing countries the cost range for VIA was between 5$ and 30 $ (64, 68).So result of this study also is b/n the range.

In contrast to our study; in Kenya (VIA 18 US$,pap 39US$ and HPVDNA(care HPV) 32US$) ,rural Shanxi Province, China (VIA 4.40US$ and HPVDNA (care HPV) 10.14US$) and Thailand (VIA 2.05 US$,PAP 9.38 US$ and HPVDNA 31.88 US$) (60, 65, 67) even if the perspective was societal there was cost difference it is may be because of cost estimation and how they gave value (labor salary ,value of wage rate and volume of women screened)

6.2 Cost effectiveness analysis of cervical cancer screening

Comparing the three screening strategy, the most cost-effective strategies in this study is VIA and HPV DNA test (ICER $268.09 per DALY averted). The study showed that using HPV DNA test as screening strategy will avert more DALY compared with VIA. This study was consistent with study done in Kenya which shows VIA and care HPV to be cost effective, when care HPV test is considered as single visit approach method, In Nicaragua also found care HPV with cryotherapy every 5 years would be very cost-effective With an ICER of US$320/YLS, In South Africa in HIV infected women the result shows that VIA to be the most cost effective strategy compared with PAP and HPVDNA test (hybrid capture II), study done in five developing countries and 50 LMIC (60, 66, 72).

Sensitivity tornado analyses determined that prevalence of HPV infection, back to normal and effective coverage of test are parameters that shows difference on the net monetary benefit value. These results suggest that these parameters are vital to consider when attempting improving the net monetary benefit value. The robustness of the study is also supported by probabilistic sensitivity analysis shows that with the given distribution the result for the cost effectiveness analysis is almost similar (VIA and care HPV (ICER 257US$) test is very cost effective).

As pilot the FMOH is testing HPVDNA testing in some region of the countries. This result may encourage policy makers to plan for implementation of HPV DNA testing in Ethiopia because this cost effectiveness study result offers supporting evidence for decision making. The advantages to shifting to HPV DNA test include;-HPV DNA testing is more acceptable and more convenient for both participants and providers, its sensitivity is better than the two tests and the test can be done by provider or by the women herself (self-sampling method) and can thus improve the coverage of screening in target populations (49, 83) as the FMOH plan to achieve 80 % coverage . The health extension workers can also be a good opportunity in facilitating self-sampling along with the other health package.

In case of VIA its low cost, better sensitivity than Pap and theoretically facilitate single visit approach are the some of the strength. But it is less specific than the other two tests potentially resulting in more overtreatment and because the result of the test is subjectivity means it's based on practitioner performance the sensitivity may vary that cause missing case. So VIA requires intensive provider training and experience to achieve acceptable test sensitivity, raising obstacles to scalability

CHAPTER 7: LIMITATION AND STRENGTH

7.1 Limitation

As limitation the study doesn't consider lost to follow up for Pap smear screening, it was only calculate one time screening cost for the cost effectiveness analysis, the starting age and intervals of cervical screening are important factors for its effectiveness but the study doesn't consider different starting age and interval, the transition probability for cervical cancer stage (progression and regression from stage to stage) was not considered in the model. Cost of HPV DNA test kit and accuracy of tests was taken from literature.

7.2 Strength

As strength the costing was primary data using micro costing approach. The analyses include treatment cost for precancerous and cervical cancer and used final outcome (DALY) as effectiveness measure. To check for robustness of the result it underwent sensitivity analysis using range of value and distribution.

CHAPTER 8: CONCLUSION AND RECOMMENDATION

8.1 Conclusion

It is critical that when establishing guidelines for screening to incorporate practices that are not only effective, but also efficient. In Ethiopia where incidence rate of cervical cancer is high and coverage of screening is less than 1% we need more efficient screening method.

We performed a cost-effectiveness study and showed that organized cervical screening using VIA and HPV DNA test was the most cost-effective strategies. The results of the study can provide empirical evidence for cost-effectiveness of screening by VIA and HPV DNA testing, to help pave the way for a national program in the near future.

8.2 Recommendation

Based on the result I suggest conducting an evaluation in the project that is being piloted by FMOH on the cost and cost effectiveness of using HPV DNA testing as organized screening program. To avert more DALY concerned bodies like FMOH and those who have interest on cervical cancer prevention program should increase the uptake of cervical cancer screening using care HPVDNA test as the result shows DALY averted using HPV DNA test was higher than the two testes. The provision of VIA and HPVDNA test should be expanded by FMOH to increase coverage and avert more DALY. To know the accuracy of the cervical screening methods researchers should give focus on doing research on accuracy test because in different study the accuracy of test varies in different setting. Because this study was done based on many assumption and limitation; researchers should consider this and do further research.

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ANNEX

Questionnaire

Addis Ababa University College of Health Sciences
School of Public Health

Questionnaire prepared to estimate cost-effectiveness of cervical cancer screening methods at Family Guidance Association, Addis Ababa, Ethiopia.

Good morning /afternoon. My name is _____. I am a data collector on behalf of a master student in Addis Ababa university .who want to conduct this study. You are invited to participate in a study entitled "Cost effectiveness of cervical cancer screening at Family Guidance Association Addis Ababa, Ethiopia''.

The aim of the study is to evaluate the cost-effectiveness of cervical cancer screening methods. The study will be useful for academic paper and guide decision makers on cost and cost effective cervical cancer screening methods.

You are being asked to participate in this study simply because HPV infection and cervical cancer is a major health and economic burden to women and as such your insight as women will provide valuable information towards the understanding of cervical cancer screening related cost on women in Addis Ababa. Your participation in the study is voluntary. You will be asked depending on the questionnaire. The questionnaire will not identify your name or identity. Thus, your identity in this study would be anonymous.

This study will take approximately 20 minutes of your time. Approximately 252 women in family guidance clinic, Addis Ababawill participate in this study. There is no risk or harm for participating in the study. There is no direct benefit you drive from the study. However, the study would provide valuable information that will help guide decision makers. You can refuse to participate or to withdraw even after you decided to participate. There is no penalty or consequence of any kind for not participating or for withdrawing from the study. Please feel free to ask questions regarding this study

Are you willing to participate?

Yes _____

No _____

Questionnaires for women who underwent cervical cancer screening at family guidance clinics

Code No_____Date of interview_____

Interviewer name _____ signature _____

Checked by: Name of supervisor/investigator _____Signature_____

Section A: Demographic and Socio- economic status of the respondent

No.	Question	Answer	Skip
1.	Age of women in year	1. _____ years	
2.	What is your current marital status	1. Single 2. Married 3. Widowed 4. Not legally Divorced 5. Legally divorced	
3.	What is your educational level	1. Illiterate 2. Read and write only 3. Primary Edu (1-8 Grade) 4. Secondary Edu. (9-12 Grade) 5. College/diploma 6. University /degree 7. Other(specify) _____	
4.	What is your main current occupation?	1. Farmer 2. House wife 3. Gov't employee 4. NGO employee 5. Self employed 6. Merchant 7. Student 8. Daily laborer 9. Unemployed 10. Retired 11.Other _____	If answer 2&8. skip to Q.7
5.	What is your main source of income	1. farming 2. trade 3. production of handy craft 4. daily labor 5. monthly income from employment 6. rent received 7. pension 8. other (specify)_____	

6.	What is your monthly income?	1. _____ birr	
7.	Number of people living in your house hold	_____ number	
8.	Have you ever been pregnant before	1. Yes 2. No	If no skip to Q.14
9.	If yes, how many times have you been pregnant	1. _____times	
10.	Have you ever given birth before?	1. Yes 2. no	If no skip to Q .12
11.	If yes, how many times?	1._____times	
12.	Is there any miscarriages	1. Yes 2. no	If no skip to Q.14
13.	If yes, how many times	1. _____times	
14.	Have you ever used modern contraceptive?	1. Yes 2. No	If no skip to Q.17
15.	If yes, which type of modern contraceptive you was used? (more than one answer is possible)	1. Combined oral contraceptives(COC) 2. Progestin only pills (POP) 3. Injectable 4. Implants 5. Intra uterine contraceptive device (IUCD)or Loop 6. Others(specify	
16.	For how long did use it (specify for each method)	1. _____	

Section B: cost of cervical cancer screening incurred by women at family guidance clinics during her visits depending on the kind of screening methods

No.	Question	Answer	Skip
17.	Have you got any kind of cervical screening test in the clinic	1. yes 2. no	
18.	If yes what kind?	1. VIA 2. Pap-smear 3. Other (specify)_____	

19.	How many visit have you had for screening in these clinic(for the type of test they got)	1. For VIA_____ times 2. For pap- smear_____ times 3. Other (specify)_____	

Section B .1 Direct medical cost incurred by the women

	Cost incurred per visit	Visit 1	Visit 2	Visit 3	Visit 4	Remark
20.	How much birr have you spent for Registration fee/card					In birr
21.	For Test fee					>>
22.	For Investigation fee(laboratory or other) Specify _____					>>
23.	How long does it take you to travel from home to the clinic					In hour/minute
24.	How long did you spend at Waiting room to get the service					>>
25.	How long did you spend to get consultation service (contact with the clinician)					>>
26.	How long did you spend to get screening test (contact with clinician)					>>
27.	How long did you spend waiting laboratory result (for pap_smear)					
28.	What Transport modality have you used to travel from home to the clinic (put it in code)					Code;- 1=Walked 2=Cycled 3=Bus 4=Minibus 5=Taxi 6=Private car 7=Other
29.	How much do you spend for transportation when you go from home to clinic (single trip)					In birr
30.	How much do you spent for food, drink and other service while you go to health facility and waiting your turn for screening					In birr

- Depending on the number of visits to the health facility please fill each row appropriately.
- Please put the number that best describes how the women travelled from Home → clinic. If they used more than one form of transport, please indicate the main way of travel (longest in terms of distance).
- Please Put 0 for the service they didn't use

Result of the test

S.n	Type of test	Result of the test	Type of precancerous tretment	Remark

Section B.2 If the women get precancerous treatment service at the clinic ask the following questions(depending on the test result)

31	Have you got any kind of precancerous treatment	1. Yes 2. No	
32	If yes ,kind of treatment	1.Cryotherapy 2.LEEP 3.Other (specify)_____	
33	Did you take the treatment the same day with the screening	1.Yes 2.No	If yes skip to Q.39
34	If no, how many visit have you had to get the precancerous treatment	1._____times	
35	How much time did you spent traveling from home to the clinic	1._____min/hour	
36	What transport modality have you used to travel from home to health facility? (per one trip)	1.Walk 2.Bicycle/motor cycle 3.City Bus/Light train 4.Taxi 5.Own/relative's car 6.Other(specify)_____	
37	How much money have you spent for transportation when you go from home to health facility (for single trip)	1._____birr	
38	How much do you spent for food, drink and other service while you go to health facility and waiting your turn for treatment?	1. _____birr	
39	How much have you spend for precancerous treatment	1. _____birr	
40	How much time did you wait to get the consultation (contact with clinicians)	1. _____min/hour	
41	How much time did you spent for treatment(contact with clinicians)	1._____min/hour	
42	How long is the distance from your home to the clinic (or specify place)	1. _____km/m	

Addis Ababa University College of Health Science

School of Public Health

Questionnaire prepared to estimate the cost-effectiveness of cervical cancer screening methods at Family Guidance Association, Addis Ababa, Ethiopia.

Good morning/afternoon! My name is _____. I am a data collector in a study that will be conducted to evaluate the Cost effectiveness of cervical cancer screening at family guidance association Addis Ababa, Ethiopia. I would like to interview the responsible person and observe some of the procedures of cervical cancer screening and treatment. All information is confidential. You have also the right to refuse or order me to leave the room at any time of the observation.

Are you willing to participate? Yes_____ No_____

Date of interview/observation_____

Name of data collector _____Signature_____

Checked by: Name of supervisor/investigator_____ Signature_____

Section C: Questionnaires for service provider (provide this question to the team coordinator of the room or directly to the service provider)

Name of health facility _____ sub city _____

Respondent name_____ position_____

Profession _____

Unit/department_____ was respondent interviewed Y/N

No	Question	Answer	Skip
1	How many cervical cancer screening/treatment do you perform each day on average	1. _____women for VIA 2. _____women for PAP-smear 3. _____ women for cryotherapy treatment 4._____women for LEEP treatment 5. Other (specify)	
2	How much time would be needed per women to perform	1._____min/hour for VIA test 2._____min/hour for pap-smear test(to collect cervical sample) 3._____ laboratory test 4._____min/hour for cryotherapy treatment 5._____min/hour for LEEP treatment 5.Other (specify)_____	
3	How much is the distance from clinic site to laboratory	1._____km 2.Other (specify)_____	
4	How long does it take to get the result from the laboratory to the women on average	1._____days 2.Other(specify)_____	
5	How many pap-smear sample is	1._____ sample	

	transported per week	2.Other (specify)	
6	What kind of transportation modality is used to transport sample from clinic to the laboratory and vise versa	1.motor cycle 2.ambulance 3.Other(specify)_____	

7. Supply used for provision of VIA , pap-smear, cryotherapy and LEEP screening/treatment service per week(provide these questions to service provider and finance department)

S n	In put item used /supply for VIA and pap smear	Unit of measurement	Quantity	Year of purchase	Purchased Birr	Remark

8. Equipment used for provision of VIA and pap-screening service(provide these questions to service provider and finance department)

Sn	Types of equipment Used for VIA and pap smear	Year of purchase	Purchased birr	Month /year in operation	Days/month in operation	No of average client served per day	Remark

9. Building (get information from team coordinator and by observation)

Sr .n	Service given	No of room at the clinic	No of room used for screening	Was there joint service at the room, please specify	Average clients coming to the room per day (FP, CS, etc)	Room space (in square meter/ estimations)	Rental value of the space	remar k

10. Which professional do the procedure and average monthly salary (get information from team coordinator, finance and payroll)

Type of Profession and procedure	VIA test	Pap_smear (sample collection)	Laboratory test (cytology)	Lab result read	Cryotherapy treatment	LEEP treatment	Average net Monthly salary	Remark
Nurses								
Health officers								
General doctors								
Gynecologist								
Pathologist								
Cytologist								

11.	How much time did you spent per week on each activities	On counseling _____days_____ hour_____ minutes On VIA testing _____days_____ hour_____minutes On pap-smear(sample collection) _____days_____ hour_____ minutes On laboratory test _____days_____ hour_____ minutes On cryotherapy treatment _____days_____hour _____minutes On LEEP treatment _____days _____hours _____minutes On other(specify)_____days____hour_____minutes	Remark

በአዲስ አበባ ዩኒቨርስቲ፤የጤና ሳይንስ ኮሌጅ የህብረተሰብ ጤና አጠባበቅ

ትምህርት ቤት የመረጃ መሰብሰቢያ መጠይቅ

መግቢያ

ጤና ይስጥልኝ፤እንደምን አደሩ/አረፈዱ.እኔ _____ እባላለሁ፡፡በአዱስ አበባ ዩኒቨርሲቲ በሄልዝ ኢኮኖሚክስ የድህረ ምረቃ ተማሪ ለሆኑት በሳቸው በኩል ሆኜ መረጃ ለመሰብሰብ ነው፡፡ የጥናቱ ርዕስ እና አላማው የማህፀን በር ጫፍ ቅድመ ካንሰር ምርመራ ለማድረግ የምንጠቀምባቸው የምርመራ አይነቶች ከወጪ እና ከተሻለ ምርመራ ከመስጠት አንፃር ከተገልጋዩ እና ከአገልግሎት ሰጪው በኩል የትኛው ተመራጭ ነው የሚለውን ለማወቅ ነው፡፡

እርስዎ ለዚህ ጥናት የተመረጡት ያለምንም ቅድመ ሁኔታ ሲሆን፤በእርሶ ፍቃደኝት ላይ የተመሰረተ ነው፡፡በዚህ ጥናት ላይ ያለመሳተፍ መብትዎ ነው፡፡ ነገር ግን የእርሶ ተሳትፎ ለዚህ ጥናት ያለው አስተዋፅዖ የላቀ ነው፤ስለሆነም የቅድመ ካንሰር ጫፍ በር ቅድመ ካንሰር ምርመራውን በማድረግ በሽታው እንዳይከሰት የትኛው የምርመራ አይነት ከወጪና ከጥራት አንፃር የተሻለ መሆኑን ለማወቅ እና ህብተሰቡ አገልግሎቱን ወደ አቅራቢያው ወደሚያገኝበት ቦታለማድረስስለሚያግዝ እንዲሳተፉ እናበረታታለን፡፡

እዚህ ጥናት ላይ ሲሳተፉ በመጠይቁ መሰረት የተወሰኑ ጥያቄዎችን እናቀርብሎታለን፡፡ የሚቀርብሎት ጥያቄዎች አጠቃላይ መረጃዎች፤ለማህፀን በር ጫፍ ቅድመ ካንሰር ምርመራ ለማድረግ ሲመጡ ያወጡት ወጪ፤ያጠፉት ጊዜ እና ሌሎች ተያያዥነት ያላቸው ጥያቄዎች ያሆናሉ፡፡በዚህ ጥናት ምክንያት ሊደርስባቸው የሚችል ምንም አይነት ጉዳትም ሆነ ሊያሳስቦ የሚችል ነገር የለም ፡፡ በዚህ መጠይቅ ላይ የእርሶን ማንነት ሊገልፅ የሚችል መረጃ አይፃፍም፡፡መጠይቆቹ በሙሉ ማንም ሰው የማይደርስበት ቦታ ነው የሚቀመጡት፤ስለዚህም የሚሰጡት መረጃ ሚስጥራዊነት በጥብቅ የተጠበቀ ነው፡፡

በዚህ ጥናት ለመሳተፍ ፍቃደኛ ከሆኑ ጥያቄዎቹ በአጠቃላይ 15-20 ደቂቃ ሊወስድ ይችላል፡፡በዚህ መጠይቅ የሚረብሾ ወይም ያላመኑበት ነገር ቢኖር በማንኛውም ሰዓት የማቋረጥ መብት አለዎት ፡፡በዚህ ሳቢያ ሊደርስቦ የሚችል አንዳች የመብት ወይም የጥቅም መጓደል አይኖርም፡፡

ይህን ጥናት በተመለከተ ማንኛውንም ግልፅ ያልሆነልዎ ነገር ወይም ጥያቄ ካለዎት በስልክ ቁጥር 0922746731 ፌቨን ሰለሞን ብለው በስራ ሰዓት ማነጋገር ይችላሉ፡፡

በዚህ ጥናት ላይ ለመሳተፍ ፍቃድዎን ሊሰጡኝ ይችላሉ?

አዎ _____ቃለ መጠይቅ መጀመር ይችላሉ አይ _____አቁም

በቤተሰብ መምሪያ የማህፀን በር ቅድመ ካንሰር ምርመራ ለሚያረጉ ሴቶች የተዘጋጀ ቃለ መጠይቅ

መለያቁጥር_____መረጃ የተሰበሰበበት ቀን_____

የመረጃ ሰብሳቢው ስም _____ ፊርማ _____

ያረጋገጠው: የተቆጣጣሪው/ዋ ስም _____ ፊርማ_____

ክፍል 1 : ማህበራዊ ፤ ኢኮኖሚያዊ እና ሰነ ህዝባዊ መረጃ ጥያቄዎች

ተራ ቁ	ጥያቄዎች	አማራጭ ምላሾች	ወደ ተራ ቁጥር ዝለል
1.	እድሜዎ ስንት ነው?	1. _____ አመት	
2	በአሁኑ ወቅት የጋብቻ ሀኔታዎ እንዴት ነው?	1. ያላገባች 2. ያገባች 3. የትዳር አጋሯ በሞት የተለያት 4. ያገባች ከትዳር አጋሯጋር አብራ የማትኖር 5. በህግ አግብታ የፈታች	
3	ያጠናቀቁት የትምህርት ደረጃ ስንት ነው?	1. ያልተማረ 2. መፃፍና ማንበብ ብቻ የምትችል/የሚችል 3. የመጀመሪያ ደረጃ ትምህርት(ከ1-8ኛ ክፍል) 4. ሁለተኛ ደረጃ (ከ9-12ኛ ክፍል) 5. ኮሌጅ/ዲፕሎማ 6. ዩኒቨርስቲ /ዲግሪ 7. ሌላ ካለ ይጠቀስ _____	
4	በአሁኑ ወቅት ስራዎ ምንድን ነው?	1. አርሶ አደር 2. የቤት እመቤት 3. የመንግስት ሰራተኛ 4. መንግስታዊ ያልሆነ ድርጅት ተቀጣሪ 5. የግል ግርጅት ተቀጣሪ 6. ነጋዴ 7. ተማሪ 8. የቀን ሰራተኛ 9.ስራ አጥ 11. ጡረተኛ 12. ሌላ ካለ ይጠቀስ _____	
5	ሌላ የገቢ ምንጭ ካልዎትምንድን ናቸው?(ከአንድ በላይ መልስ ሊኖር ይችላል)	1. አርሶ አደርነት 2. ንግድ 3. የእጅ ስራ ውጤቶችን ማምረት 4. የቀን ስራ 5. ተቀጥሮ በሚገኝ ወርሀዊ ደሞዝ 6. የኪራይገቢ(የቤት፣የመሬት፣ቁሳቁስየመሳሰሉት 7. ጡረታ 8. ሌላ ካለ ይጥቀሱ_____	

6	አጠቃላይ ከገቢ ምንጭዎ ወርሀዊ ገቢዎ ምን ይህል ነው?	1. _____ ብር	
7.	እርሶ በሚገኙበት ቤተሰብ ውስጥ እርሶን ጨምሮ የቤተሰብ አባላት ብዛት ስንት ነው?	_____ ቁጥር	
8.	ከዚህ ቀደምአርግዘው ያውቃሉ?	1.አዎ 2.አይ	አይ ካሉ ወደ ቁ 14 ይዝለሉ
9.	አዎ ካሉ, ምን ያህል ጊዜ?	1._____ጊዜ	
10.	ከዚህ ቀደም ወልደው ያውቃሉ?	1.አዎ 2.አይ	አይ ካሉ ወደ ቁ 12 ይዝለሉ
11.	አዎ ካሉ, ስንት ጊዜ ወልደዋል?	1. _____ጊዜ	
12.	ውርጃ አጋጥሞት ያውቃል?	1.አዎ 2.አይ	አይ ካሉ ወደ ቁ 14 ይዝለሉ
13.	አዎ ካሉ, ምን ያህል ጊዜ?	1._____ጊዜ	
14.	ዘመናዊ የእርግዝና መከላከያ ተጠቅመው ያውቃሉ?	1.አዎ 2.አይ	
15.	አዎ ካሉ, የትኛዉን ዘመናዊ የእርግዝና መከላከያ ተጠቀሙ? (ከአንድ በላይ መልስ ያቻላል)	1. ጥምር በአፍ የሚሰጥ የወሊድ መከላከያ Combined oral contraceptives(COC) 2 .ለአጥቢዎች በአፍ የሚሰጥ የወሊድ መከላከያ Progestin only pills (POP) 3 .በመርፌ የሚሰጥ Injectable 4 .ክንደ ላይ የሚቀበር የወሊድ መከላከያ Implants 6. በማህፀን ውስጥ የሚገባ የወሊድ መከላከያ Loop 7. ሌላ ካለ ይጥቀሱ_____	
16.	የእርግዝና መከላከያውንለምን ያህል ጊዜ ተጠቀሙት? (ለእያንዳንዱ መከላከያ አይነት ጥቀሱ)	1. _____ዓመት/ወር/ቀን	

ክፍል 2: የማህፀን በር ቅድመ ካንሰር ምርመራ ለማድረግ ወደ ተቋሙሲመጡ ያወጡት ወጪ

ተራ. ቁ	ጥያቄዎች	አማራጭ ምላሾች	ወደ ተራ ቁጥር ዝለል
17.	እዚህ ክሊኒክ ውስጥ የማህፀን በር ጫፍ ቅድመ ካንሰር ምርመራ አድርገዋል?	1. አዎ 2. አይ	
18.	አዎ ካሉ ምን አይነት?	1.ቪአይኤ 2. ፓፕ እስሚር 3. ሌላ ካለ ይጥቀሱ_____	
19.	ለማህፀን በር ጫፍ ቅድመ ካንሰር	1. ለቪአይኤ _____ ጊዜ	

	ምርመራውን ለማድረግ ወደዚህ ክሊኒክ ምን ያህል ጊዜ ተመላለሱ?	2. ለ ፓፕ እስሚር _____ ጊዜ 3. ሌላ ካለ ይጥቀሱ_____	

ክፍል 2.1 በነበራቸው የጉብኝት ብዛት ያወጡት ወጪ

	በአንድ ጉብኝት ያወጡት ወጪ	በ1ኛ ጉብኝት	በ2ኛ ጉብኝት	በ3ኛ ጉብኝት	በ4ኛ ገብኝት	አስተያየት
20.	ለማህፀን በር ጫፍ ቅድመ ካንሰር ምርመራ ለማድረግ ሲመጡ ለካርድ ያወጡት ወጪ ምን ያህል ነው?					
21.	ለማህፀን በር ጫፍ ቅድመ ካንሰር ምርመራለማድረግ ያወጡት ወጪ?					>>
22.	ለተጨማሪ ምርመራ ያወጡት ወጪ?(ለላብራቶሪ ወይም ሌላ ካለ)ግለፁ _____					>>
23.	ከቤትዎ ወደ ክሊኒኩ ለመንገዝምን ይህል ጊዜ ወሰዶቧታል?					በ ደቂቃ/ሰዓት
24.	አገልግሎት እስከሚያገኙ ድረስ መቆያ ክፍል ውሰጥ ምን ያህል ጊዜ ጠበቁ/ቆዩ?					››
25.	የምክር አገልግሎት ለማግኘት ምን ያህል ጊዜ ወሰደቦት? (ከባለሞያዎች ጋር ያለው ግንኙነት)					››
26.	የማህፀን በር ጫፍ ቅድመ ካንሰር ምርመራ ለማድረግ ምን ያህል ጊዜ ወሰደቦት?					››
27.	የምርመራ ውጤትዎን ለመውሰድ ምን ያህል ጊዜ ወሰደቦት?					››
28.	ከቤትዎ ወደ ክሊኒኩ ለመንገዝ ምን አያነት የመንገዣ ዘዴ ተጠቀሙ?					መለያ 1=በእግር 2=በሳይክል 3=በከተማ ባስ 4=በታክሲ 5=በግል መኪና 6=ሌላ ካለ
29.	ከቤትዎ ወደ ክሊኒኩ ለመንገዝ ለተጠቀሙበት መንገዣ ምን ያህል አወጡ? (ለአንድ ደርሶ መልስ)					በ ብር
30.	ወደ ክሊኒኩ በሚንዙበት ጊዜ እና ለምርመራ ተራዎትን በሚጠብቁበት ሰዓት ለምግብ፣ለውሀ እና ለሌሎች አገልግሎቶች ምን ያህል ወጪ አወጡ?					››

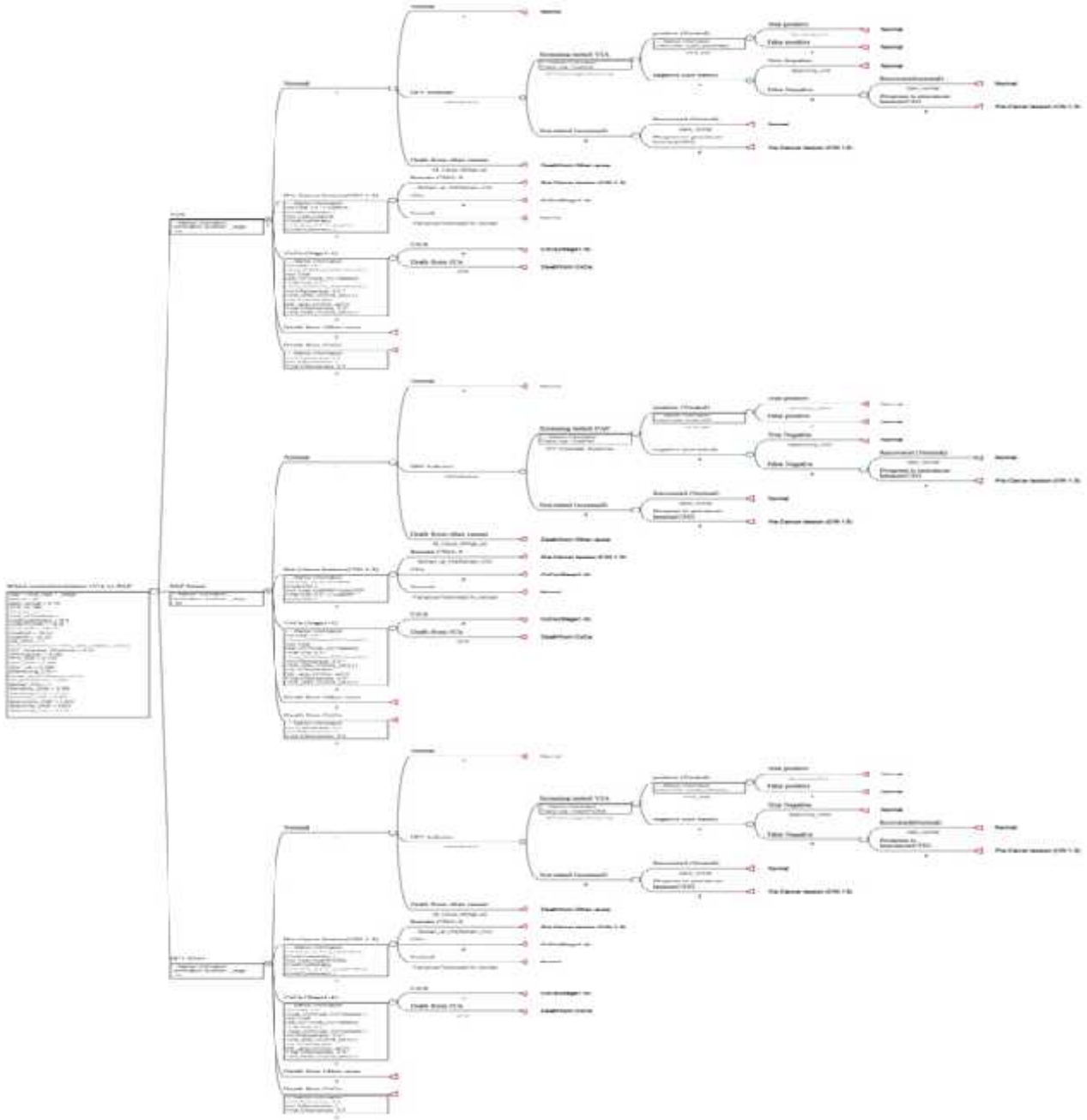
- እባክዎ በክሊኒኩ ባላቸው የገብኝት ብዛት መሰረት ለእያንዳንዱ ጥያቄዎች መልስ የሚሆኑትን ሙሉ
- እባክዎ ወደ ክሊኒኩ ሲንዙ የተጠቀሙበትን የመንገዣ ዘዴ በተቀመጠው መለያ መሰርት በትክክሉ ይሙሉ . የተለያየ አይነት መንገዣ ከተጠቀሙ ከፍተኛውን ርቀት የተንዙበትን ይምረጡ
- እባክዎ ላልተጠቀሙበት አገልግሎት 0 ያስቀምጡ

ክፍል 3. የማህፀን በር ጫፍ ቅድመ ካንሰር የምርመራ ውጤት

ተ.ቁ	የምርመራው አይነት	የምርመራው ውጤት	የታዘዘውየማህፀን በር ጫፍ ቅድመ ካንሰር ህክምና አይነት	አስተያየት
1				
2				

ክፍል 3.1 የማህፀን በር ጫፍ ቅድመ ካንሰር ህክምና አገልግሎት አግኝተው ከሆነ የሚከተሉትን ጥያቄዎች ይጠይቁ

31	የማህፀን በር ጫፍ ቅድመ ካንሰር ህክምና አገልግሎት አግኝተዋል?	1.አዎ 2.አይ	
32	አዎ ካሉ ምን አይነት ህክምና አግኝተዋል ?	1. ክራዮቴራፒ 2.ሊፕ ሌላ ካለ ይጥቀሱ	
33	የቅድመ ካንሰር ህክምናውን ከምርመራው ጋር በተመሳሳይ ቀን ነው የወሰዱት?	1. አዎ 2.አይ	አዎ ካሉ ወደ ተራ ቁ 39 ዝለሉ
34	አይ ካሉ, የቅድመ ካንሰር ህክምናው ለማግኘት ምን ያህል ጊዜ ተመላለሱ?	1._____ጊዜ	
35	ለህክምና ሲመጡ ከቤትዎ ወደ ክሊኒኩ ለመጓዝ ምን ይህል ጊዜ ወሰዶቢታል?	1._____ደቂቃ/ሰዓት	
36	ከቤትዎ ወደ ክሊኒኩ ለመጓዝ ምን አይነት የመጓጓዣ ዘዴ ተጠቀሙ?	1=በእግር 2=በሳይክል 3=በከተማባስ 4=በታክሲ 5=በግል 6.መኪና7=ሌላ ካለ	
37	ከቤትዎ ወደ ክሊኒኩ ለመጓዝ ለተጠቀሙበት መጓጓዣ ምን ያህል አወጡ? (ለአንድ ደርሶ መልስ)	1. _____ብር	
38	ወደ ክሊኒኩ በሚጓዙበት ጊዜ እና ለህክምና ተራዎትን በሚጠብቁበት ሰዓት ለምግብ፣ለውሀ እና ለሌሎች አገልግሎቶች ምን ያህል ወጪ አወጡ?	1._____ብር	
39	ለቅድመ ካንሰር ህክምናውን ለማግኘት ምን ያህል አወጡ?	1._____ብር	
40	ለህክምናው የምክር አገልግሎት ለማግኘት ምን ያህል ጊዜ ወሰደቦት? (ከባለሞያዎች ጋር ያለው ግንኙነት)	1._____ደቂቃ/ሰዓት	
41	የማህፀን በር ጫፍ ቅድመ ካንሰር ህክምና ለማድረግ ምን ያህል ጊዜ ወሰደቦት?	1._____ደቂቃ/ሰዓት	
42	ከቤትዎ ወደ ክሊኒኩ ለመድረስ ምን ያህል ርቀት ይጓዛሉ? (ወይም የመጡበትን ቦታ ይጠያቁ)	1._____ኪሎ. ሜ/ሜ	



Model structure

Figure 9. Markov model structure for cervical cancer screening