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*RESEARCH ARTICLE*

# SEXUALLY TRANSMITTED DISEASES AND COUNSELING: AN ECONOMIC EVALUATION

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## Abstract

Sexually transmitted diseases (STDs) are among the most important diseases, with annual incidence of about 20 million cases, that impact the public health in the USA.[1,2] There are several health education preventive strategies. Kamb et al studied 3 different interventions: didactic messages, brief and enhanced counseling. We analyzed the cost-effectiveness of those 3 intervention strategies using the original Kamb's data and new data from the state of Georgia with different intervention effectiveness and completion rates.[3]We looked at the state prospective. We computed the results based on the incremental cost-effectiveness ratio (ICER), built our decision tree usingTreeAgesoftware assuming some variables that are not available in the literatures and conducted sensitivity analyses for some variables.Based on the ICER, when using the Kamb's data we found that the brief counseling dominates both enhanced counseling and didactic messages. However, when we increase either one of the effectiveness or the intervention completion rates alone for the enhanced counseling, or when we increase both of them simultaneously, there was no dominant strategy.Sensitivity analyses showed that the enhanced counseling strategy became optimal if the intervention completion rates exceeded 72% or the incidence rate was less than 11.5%.From an economic point of view, we concluded by recommending against routine use of the enhanced counseling program for STDs high-risk populationsthat are not expected to complete all the counseling sessions. On the other hand, we encourage utilizing the brief counseling strategy for moderate to high-risk populations with higher probability of drops out from the program. It should substitute the current practice of didactic messages.The policy makers may consider other non-economic factors to complete the view before putting these recommendations in play.



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## Introduction:-

Sexually transmitted diseases (STDs) are among the most significant health problems that impact the public health in the USA and account for high health care spending.[1]Although many cases of STDs continue to go undiagnosed and thus unreported, CDC, in 2013 report, estimated that the incidence of STDs is about 20 million cases per year and cost about 16 billion US dollar.[1] It's estimated that half of the new cases is diagnosed among the age group 15 to 24 year.[1]STDs include but not limited to HIV, Gonorrhea, Chlamydia and Syphilis.[1,2] Among the risk factors of acquiring STDs is the risky sexual behavior.[2,3] Counseling aims at changing the riskybehaviors, although found effective for other health problems like Alcohol, has not been definitely studied for the effective content and duration in STDs.[3]

A randomized controlled trial, project RESPECT, was conducted to compare the effect of two different counseling strategies with the standard of care to prevent HIV infection and other STDs.[3] The two strategies were the enhanced and brief counseling; while the standard of care was the didactic prevention messages given during the consulting visits in current practice.[3] The RCT was conducted between 1993 and 1996 in five different public clinics around the states.[3]It enrolled 5758 heterosexual patients who tested negative for HIV and aged 14 years or older.[3] The patient were given the interventions during the initial four weeks and followed for 12 months with questionnaires on $3^{rd}$,$6^{th}$,$9^{th}$ and $12^{th}$months.[3] STDs tests were carried out at enrollment,on $6^{th}$ and $12^{th}$ months.[3] It was concluded that counseling is more effective than didactic intervention, while there was no difference between the enhanced and brief counseling in reducing new STDs cases after 12 months.[3]

## Objectives:-

To determine the cost-effectiveness of counseling versus standard of care, and thenenhanced versus brief counseling, in preventing HIV and STDs using different combination of different 4-weeks-intrvention completion rates and effectiveness rates.

**Settings:**

The setting of the intervention is suggested to be the public STD clinics in Georgia.

## Methods:-

This study intends to be utilized by the health policy makers at the state of Georgia, but it would benefit health care providers, patients at risk of contracting STDs and insurers as well. In this study, wecompared the current practice of didactic intervention messages to two different counseling interventions. Wewant to determine which one of them is the more cost-effective in preventing STDs.

This study is a cost-effective analysis. We compared the different interventions in regard to their costs and new cases of STDs. We analyzed the intervention based on the incremental cost-effectiveness ratio (ICER).

As the audience of this economic analysis is mainly the state of Georgia, the analysis looks at the state level as it considers planning and providing healthcare servicesto the target population. Social costs, although important, is out of the scope in this analysis.

There are three interventions arms: the enhanced counseling, the brief counseling and didactic messages. The enhanced counseling arm consists of four sessions. The first one is 20 minutes and the subsequent three are 60 minutes long each, all are 200 minutes in total. The content of the sessions were designed to build up on the previous session with behavioral goal-setting exercise. The brief counseling arm consists of two sessions, 20 minutes long each, and to be completed within 10 days from enrollment. The content of the $1^{st}$ session is similar to the $1^{st}$ session of enhanced counseling, but the second session is about discussion of the HIV test result and some counseling. The didactic messages arm participants were provided 2 informational messages just like the current practice in STD clinics. For all the intervention arms, counseling sessions have been conducted within the initial 4 weeks. The patients were requested to return on 3, 6, 9, and 12 months to complete the questionnaires and to get tested for STDs twice: on the 6th and$12^{th}$months. Testing for STDs took place at enrollment, on the $6^{th}$and$12^{th}$months.3Table-1 provides the details of the variables used in building the decision tree.

We did not discount for the cost of interventions or the tests, as they would be addressed in one year only. The cost of healthcare of HIV/AIDS and other STD patients was out of our scope in this analysis. Our study time frame and analytic horizon are one year.

Decision tree was constructed using Tree Age software (Appendix II-1,2). The cost and effect were assigned to each decision terminal and cost-Effectiveness Analysis (CEA) is conducted. An incremental analysis (ICER) will be used since the strategies are different in content and duration.

The costs are measured by Macro-coasting approach (gross costing). The cost is expressed in the 2015-US-dollar value, and the average costs of the following variables will be counted for:1st clinic consultation visit, the subsequent counseling visit, and STD testing. The cost of the 1st clinic consult visit is estimated to be $ 82.[4]It's the 1st clinical visit and assumed to be conducted by a physician. Health educator would carry the subsequent visits and the cost depends on duration of each one. A 60-minute visit costs $28, a 20-minute visit costs approximately $10, and a 5-minute visit estimated to be $5.[5,6] STD testing costs approximately average of $100 for the most common STDs.[7,8]

Implicit costs such as travel cost, timecost, and intangible cost like suffering are not considered in this direct cost analysis. For the effect, we counted the new STD cases.

The analysis contains some uncertaintyfor it is based on many assumptions. Firstly, as we intendtominimizethe cases of STDs, we need to count for dropouts. We assume that the follow up survey completion rates are the same as continuation rates. We accounted for the dropouts at four week, not on weekly basis. Secondly, we assume that any participant who did not complete the intervention at 4 week would eventually contract an STD over the 12-month period at rate of 100%. The dropouts at month 3 may have 80% chance of developing an STD over the 12-month period, while dropouts at months 6,9, and 12 may have 60%, 40%, and 20% chance of contracting an STD over 12-month period respectively. We assume that the chances of contracting STDs for the dropouts are similar for the different intervention strategies. Thirdly, we assume that physicians carried out the 1st counseling session, as the participant would come to see a physician and get tested. A health educator would conduct the subsequent sessions. Fourthly, we assumed that dropped out at 4-week costs only the 1st consultation session and the 1st test.

Sensitivity analysis will be carried out to check for the effect of some of those assumptions on the result of analysis.

## Results:-

For the original Kamb'sdata**,**we entered the total cost as mentioned above, and the effect, expressed in term of new cases (incidence) of STDs, as payoffs at each terminal node.Werolled back the tree to calculate the best intervention in term of cost and effect. Among the three intervention arms (didactic, brief and enhanced counseling), the didactic intervention (standard of care) was the preferred intervention in term of cost, with the expected total cost of $236.5 per STD case prevented. The brief and enhanced counselingwere more costly with expected total cost of $240.1 and 293.38 per every STD case prevented, respectively. On the other hand, Counseling, either brief or enhanced, was the preferable intervention in term of effect, compared to Standard of care (didactic intervention). There was no difference in effect between brief and enhanced counseling. Cost-Effectiveness Analysis (CEA) was performed on the tree and showed that the brief counseling dominated the enhanced, but there was no intervention eliminated by extended dominance. Figure 1 shows that the standard of care was the least costly, but the least effective, while both enhanced and brief counseling interventions had the same effectiveness, but the brief one was less costly. Figure 2 shows the text report of CEA, with ICER of the brief counseling = $680.5/STD case prevented.

Using the new effectiveness rate from the recent data from Georgia, which showed that the enhanced counseling is 25% more effective than brief counseling in reducing STD cases at 12-month, weconducted the CEA on the tree as shown in figure 3. The new rate was calculated from the initial rate of 11.5%. It was 0.086 =(75/100*11.5/100) or (0.115- 25*0.115/100). The new rate was entered as the payoff of the effect at the terminal node of the enhanced counseling arm.The CEA shows that the enhanced counseling is now more effective than brief counseling, but still more costly, while the standard of care is still the least costly and least effective. The ICER for the brief counseling is still the same as in Kamb's data ($680.5/STD case prevented) compared to the standard of care while the enhanced counseling is $12155/STD case prevented. No intervention strategy was clearly dominated by any other or eliminated by extended dominance as in the text reportfigure 4.

To examine the impact of different values of the effectiveness rate on the study result, we first transformed it into the variable: pSTD_Infected. We then used one-way sensitivity analysis to determine at what rate enhanced counseling becomes the preferred strategy in term of STDs cases.Figure9 presentsthe graph of one-way sensitivity analysis that shows how the mean expected value of STD cases changes based on different values of the effectiveness rate expressed in term of incidence of STDs. The threshold values, at which there would be no difference between brief and enhanced counseling strategies, are 0.115 for the incidence rate and 0.624 cases of STDs. If the incidence rate exceeds 11.5%, the enhanced counseling would become less preferred in minimizing the new cases of STDs. If the new cases of STDs are more than 624 per 1000 population, the enhanced counseling becomes less preferable than the brief counseling. At incidence rate of 15% and new cases of STDs of 628 in 1000, there would be no difference between the enhanced counseling and the standard of care, however, any value below those figures are in favor of the enhanced counseling strategy for minimizing the new cases of STDs.

We then used the new intervention completion rate from the recent data from Georgia, which showed that the enhanced counseling completion rates at 4 weeks were 95% compared to 72% originally reported, while the effectiveness rate was the initial one: 0.115. The new completion rate was entered as the probability under the arm of those who completed 4 weeks, in the enhanced counseling arm. We carried out the CEA on the tree as shown in figure 5. The CEA shows that the enhanced counseling is stillmore effective than brief counseling, but still more costly, while the standard of care is still the least costly but theleast effective. From the graph, no intervention strategy was clearly dominated by any other or eliminated by extended dominance,as illustrated by the text report as in figure 6. The ICER for the brief counseling is still the same as in original Kamb's data ($680.5/STD case prevented) compared to the standard of care while the enhanced counseling is $739/STD case prevented.

To determine the values of the intervention completion ratesat which the enhanced counseling becomes the preferred strategy, we first need to transformthe rate into the variable: pSTD_Completed1. We then used one-way sensitivity analysis to determine at what rate enhanced counseling becomes the preferred strategy in term of STDs cases. Figure 10 presents the graph of one-way sensitivity analysis that shows how the expected value of STD cases changes based on the expected completion rate over the range of values from 0-1. The threshold values, at which there would be no difference between brief andenhanced counseling strategies, are 72% completion rate and 624/1000 new cases of STDs. If the intervention completionrates were more than 70%, the enhanced counseling would become more preferred than thestandard of care. If the rateswere more than 72%,the enhanced counseling would become the most preferable strategy compared to both the brief counseling and the standard of care. In regard to cases of STDs, if the new cases are less than 624 per 1000 population, the enhanced counseling will be superior to the brief counseling. Moreover, the cases of STDs have to be less than 628 per 1000 people in order to judge the enhanced counseling strategy superior to standard of care.

Lastly, we used both new values for intervention completion rate (95%) and effectiveness rate (0.086) for the enhanced counseling. Figure 7pictures the CEA that showed the enhanced counseling is stillmore effective and costly than brief counseling, and the standard of care is still the least costly and the least effective. Again, no intervention strategy was clearly dominated by any other or eliminated by extended dominance according to the text report as in figure 8. The ICER for the brief counseling is still the same ($680.5/STD case prevented) compared to the standard of care while the enhanced counseling is $705/STD case prevented.

To examine the impact of simultaneous changes in both new values for intervention completion rate (95%) and effectiveness rate (0.086) for the enhanced counseling as variables, we conducted a two-way sensitivity analysis as shown in figure 11. There are 2 regions, blue and green with a green line between them. On the X-axis, there are the different values of the effectiveness rate expressed in term of incidence of STDs. On the Y-axis we see the different values of intervention completion rates varied from 0-1. The blue region contains the (X,Y) combination values that favor the enhanced counseling. On the other hand, the green region contains the coordinates values where the brief counseling is the optimal strategy. Any value that takes place right on the green borderline has no preference between the two strategies. As the incidence of STDs increases, and hence the effectiveness decreases, the more the brief counseling becomes the optimal strategy, while as the completion rate increases more than 72%, the optimal strategy becomes the enhanced counseling. Brief counseling is depicted to be more optimal for more combinations of intervention and effectiveness rates.

## Discussion:-

Kamb's data analysis showed that the brief counseling strategy dominates both the didactic intervention and the enhanced counseling intervention. That sounds reasonablebecausethe brief counseling is as effective as enhanced counseling, but less costly. It's slightly more costly than didactic intervention ($3.6 more/case), but way more effective. When we analyzed the new data from Georgia with the new effectiveness rate (0.086) for the enhanced counseling, the brief counseling became less effective than the enhanced, but still the same cost. That, in turn, changed the whole dominance picture and made no dominant strategy. When we analyzed the date using new intervention completion rate (95%) for the enhanced counseling, but with the original effectiveness rate (0.115), again, no dominant, but the brief counseling became less effective than before. When we combined the new rates, we got almost the same picture with no dominance, but with minor decrease in effectiveness of the enhanced counseling. We could depict a trend of decrease effectiveness of brief counseling from CEA diagrams (figure 1,3,5,7) from almost right angle to$180^{o}$, (imaging that the angle head is the brief counseling and the arms are enhanced and standard of care).

Although the increase in effectiveness rate of enhanced counseling changed the CEA picture and made the enhanced counseling more cost-effective than originally was, however, the improvement in intervention completion rate had more impact on the picture. Logically thinking, with increased compliance to visits, and more return of patients, the effect, expressed in less STDs, would be better. On the other hand, improved completion rates would be expected to increase the cost as the tests and counseling sessions would be utilized more. Does that make the enhanced counseling more or less cost-effective? We conducted the sensitivity analysis to determine the value of completion rate at which the enhanced counseling becomes the preferred strategy, and it interestingly found to be at the rate more than 72%! Moreover, the sensitivity analysis showed that the incidence rate should to be less than 11.5% in order for the enhanced counseling to become the preferred strategy.

When we combine the two new rates and performed the sensitivity analysis on thetwo, the brief counseling captured most of the graph area. On the other hand, the intervention completion rate was the determinant factor or more influence than the effectiveness rate in favoring the enhanced counseling strategy.Finally, as mentioned earlier, the more the increase in the incidence of STDs, and hence the effectiveness decreases, the more the brief counseling becomes the optimal strategy.

## Recommendations:-

We recommend against adopting the enhanced counseling as the new standard of care. Instead, utilizing the brief counseling for most population at moderate to high risk of contracting STDs is highly recommended. However, the enhanced counseling might be reserved for situations where the compliance on appointments and advice is expected to be high.

We encourage the state of Georgia to adopt the brief counseling for high-risk populations and keep enhanced counseling for low to moderate risk populations with high compliance rates.

Factors such as subgroups prevalence of STDs, the state fiscal capacity and any distributional effect of the strategies should be considered.

We recommend as well to revise this analysis if new data surfaces or after 3-5 years.

**Table 1:-** Probability Input Table.

| Variable Name | Description | Value | Reference | Notes |
|---|---|---|---|---|
| **Cost Input** | | | | |
| **cConsult** | Cost of STD Initial consultation visit | 82 | 4 | |
| **cCounsel_20** | Cost of STD counseling visit for 20 min. | 10 | 5,6 | |
| **cCounsel_5** | Cost of STD counseling visit for 5 min. | 5 | 5,6 | |
| **cCounsel_60** | Cost of STD counseling visit for 60 min. | 28 | 5,6 | |
| **cSTD_Test** | Cost of STDs testing | 100 | 7,8 | |
| **Epidemiology & Completion Rates Input** | | | | |
| **pSTD_Infected** | Incidence of STDs | 0.086 | - | New rate |

| | | | |
|---|---|---|---|
| **pCompleted_1** | Intervention completion rate at 4 weeks | 0.72 | 3 |
| **pReturn3** | Patients returned for the 3 months visit | 0.71 | 3 |
| **pReturn6** | Patients returned for the 6 months visit | 0.70 | 3 |
| **pReturn9** | Patients returned for the 9 months visit | 0.64 | 3 |
| **pReturn12** | Patients returned for the 3 months visit | 0.66 | 3 |

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**Technical Appendix I:**

**Figure 1:-** Cost-Effectiveness Analysis using the Original Kamb's Data.

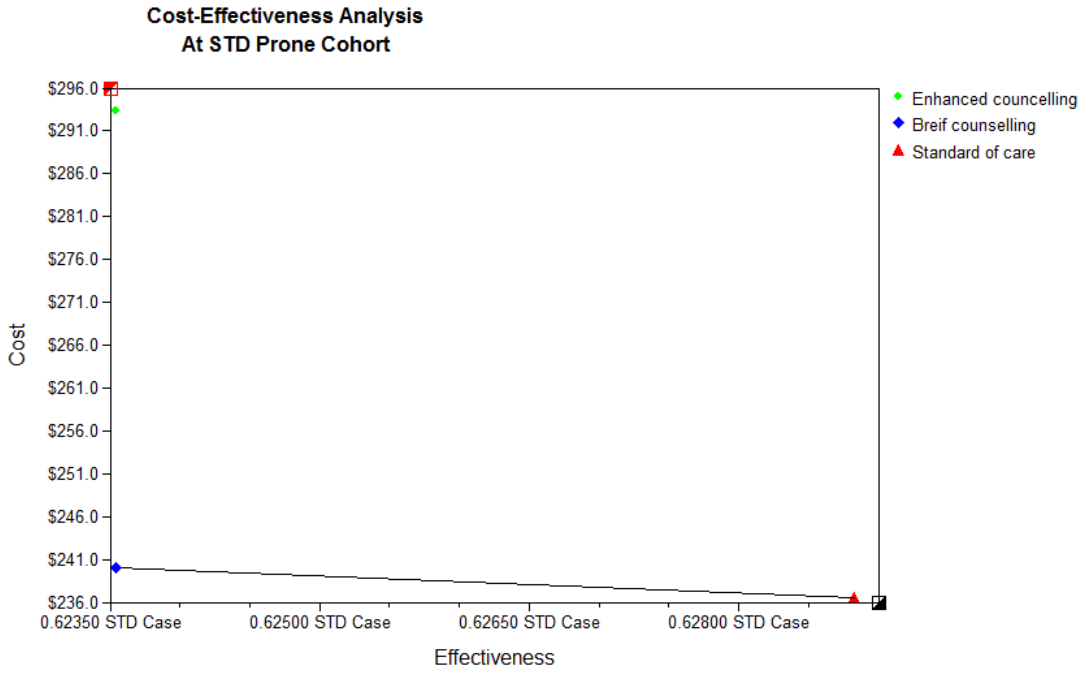


**Figure 2:-** Text Report of CEA using theOriginalKamb'sData.

| Strategy | Cost | Incr Cost | Eff | Incr Eff | C/E | Incr C/E (ICER) |
|---|---|---|---|---|---|---|
| Standard of c... | $236.5 | | 0.62883 STD Case | | 376.09 $/STD case prevented | |
| Breif counselli... | $240.1 | $3.6 | 0.62354 STD Case | 0.00529 STD Case | 385.06 $/STD case prevented | 680.49 $/STD case prevented |
| Enhanced co... | $293.4 | $53.3 | 0.62354 STD Case | -0.00000 STD Case | 470.51 $/STD case prevented | (Dominated) |
| TABLE 2 - all ... | | | | | | |
| Standard of c... | $236.5 | | 0.62883 STD Case | | 376.09 $/STD case prevented | |
| Breif counselli... | $240.1 | $3.6 | 0.62354 STD Case | 0.00529 STD Case | 385.06 $/STD case prevented | |
| Enhanced co... | $293.4 | $56.9 | 0.62354 STD Case | 0.00529 STD Case | 470.51 $/STD case prevented | |
| TABLE 3 - wit... | | | | | | |
| Standard of c... | $236.5 | | 0.62883 STD Case | | 376.09 $/STD case prevented | |

Notes:

Dominance Report:
The strategy "Enhanced councelling" is dominated by "Breif counselling".

Extended Dominance Report:
No strategies were eliminated by extended dominance.

**Figure 3:-** CEA using the New Effectiveness Rate for Enhanced Counseling.

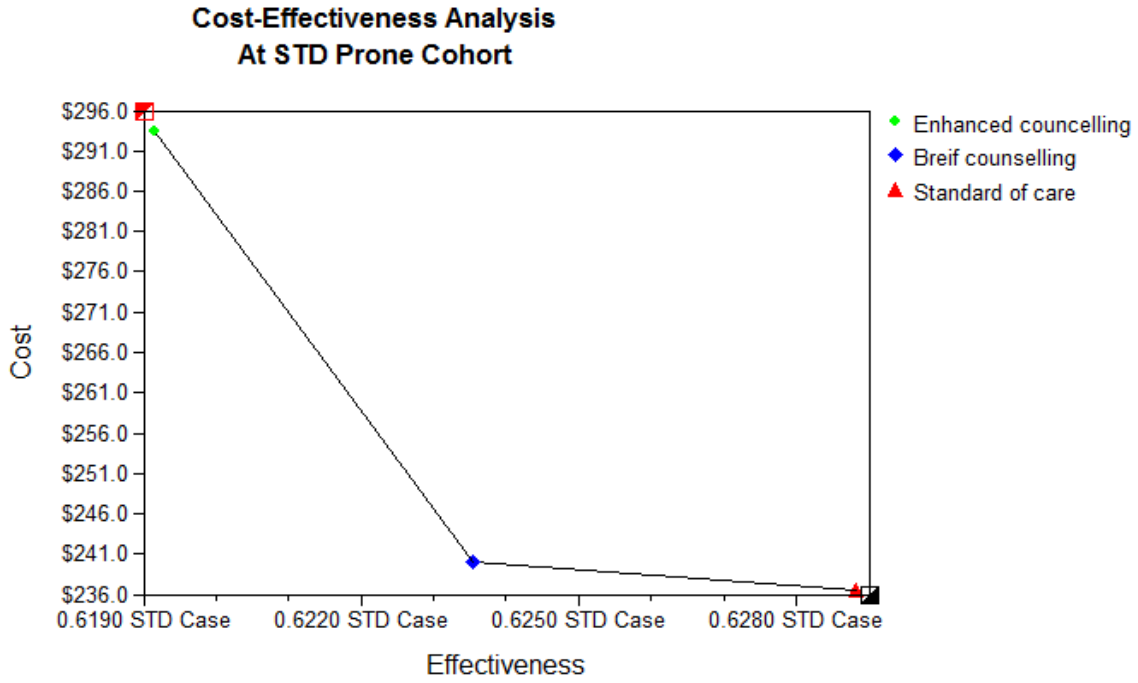


**Figure 4:-** Text Report of CEA using the New Effectiveness Rate.

| Strategy | Cost | Incr Cost | Eff | Incr Eff | C/E | Incr C/E (ICER) |
|---|---|---|---|---|---|---|
| Standard of c... | $236.5 | | 0.6288 ST... | | 376.09 $/STD case averted | |
| Breif counselli... | $240.1 | $3.6 | 0.6235 ST... | 0.0053 STD... | 385.06 $/STD case averted | 680.49 $/STD case averted |
| Enhanced co... | $293.4 | $53.3 | 0.6192 ST... | 0.0044 STD... | 473.84 $/STD case averted | 12154.96 $/STD case averted |
| | | | | | | |
| TABLE 2 - all ... | | | | | | |
| Standard of c... | $236.5 | | 0.6288 ST... | | 376.09 $/STD case averted | |
| Breif counselli... | $240.1 | $3.6 | 0.6235 ST... | 0.0053 STD... | 385.06 $/STD case averted | |
| Enhanced co... | $293.4 | $56.9 | 0.6192 ST... | 0.0097 STD... | 473.84 $/STD case averted | |

Notes:

Dominance Report:
No strategies were clearly dominated by any other.

Extended Dominance Report:
No strategies were eliminated by extended dominance.

**Figure 5:-** CEA using the New Intervention Completion Rate (95%).

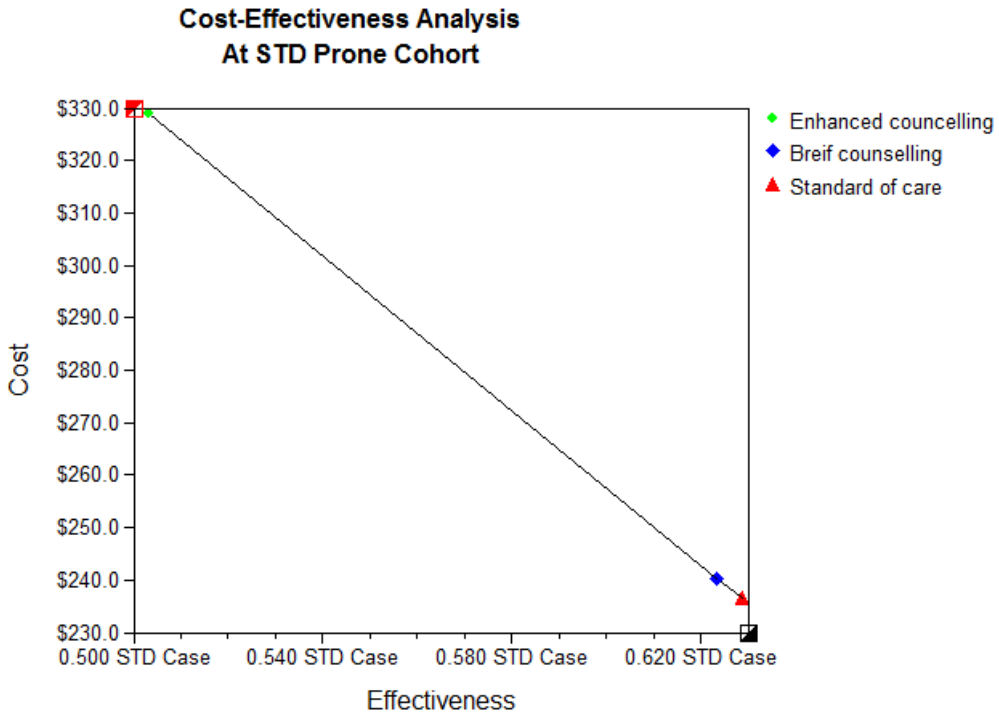


**Figure 6:-** Text Report of CEA using the New Intervention Completion Rate.

| Strategy | Cost | Incr Cost | Eff | Incr Eff | C/E | Incr C/E (ICER) |
|---|---|---|---|---|---|---|
| Standard of c... | $236.5 | | 0.629 ST... | | 376.09 $/STD case averted | |
| Breif counselli... | $240.1 | $3.6 | 0.624 ST... | 0.005 STD ... | 385.06 $/STD case averted | 680.49 $/STD case averted |
| Enhanced co... | $329.0 | $88.9 | 0.503 ST... | 0.120 STD ... | 653.63 $/STD case averted | 738.91 $/STD case averted |
| | | | | | | |
| TABLE 2 - all ... | | | | | | |
| Standard of c... | $236.5 | | 0.629 ST... | | 376.09 $/STD case averted | |
| Breif counselli... | $240.1 | $3.6 | 0.624 ST... | 0.005 STD ... | 385.06 $/STD case averted | |
| Enhanced co... | $329.0 | $92.5 | 0.503 ST... | 0.126 STD ... | 653.63 $/STD case averted | |

Notes:

Dominance Report:
No strategies were clearly dominated by any other.

Extended Dominance Report:
No strategies were eliminated by extended dominance.

**Figure 7:-** CEA using both New Effectiveness and Intervention Completion Rates.

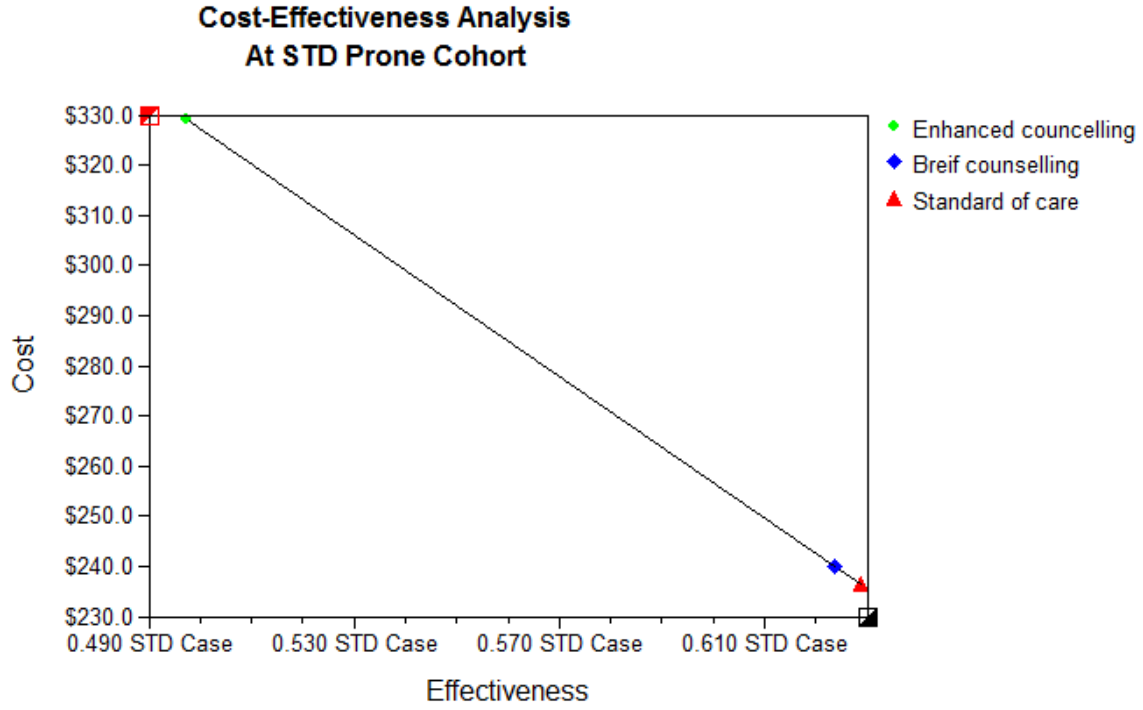


**Figure 8:-** Text Report of CEA using both New Effectiveness and Intervention Completion Rates.

| Strategy | Cost | Incr Cost | Eff | Incr Eff | C/E | Incr C/E (ICER) |
|---|---|---|---|---|---|---|
| Standard of care | $236.5 | | 0.629 STD Case | | 376.09 $/STD c... | |
| Breif counselling | $240.1 | $3.6 | 0.624 STD Case | 0.005 STD Case | 385.06 $/STD c... | 680.49 $/STD case averted |
| Enhanced councelling | $329.0 | $88.9 | 0.497 STD Case | 0.126 STD Case | 661.22 $/STD c... | 705.00 $/STD case averted |
| | | | | | | |
| TABLE 2 - all options r... | | | | | | |
| Standard of care | $236.5 | | 0.629 STD Case | | 376.09 $/STD c... | |
| Breif counselling | $240.1 | $3.6 | 0.624 STD Case | 0.005 STD Case | 385.06 $/STD c... | |
| Enhanced councelling | $329.0 | $92.5 | 0.497 STD Case | 0.131 STD Case | 661.22 $/STD c... | |

Notes:

Dominance Report:
No strategies were clearly dominated by any other.

Extended Dominance Report:
No strategies were eliminated by extended dominance.

**Figure 9:-** One-Way Sensitivity Analysis using the New Effectiveness Rate.

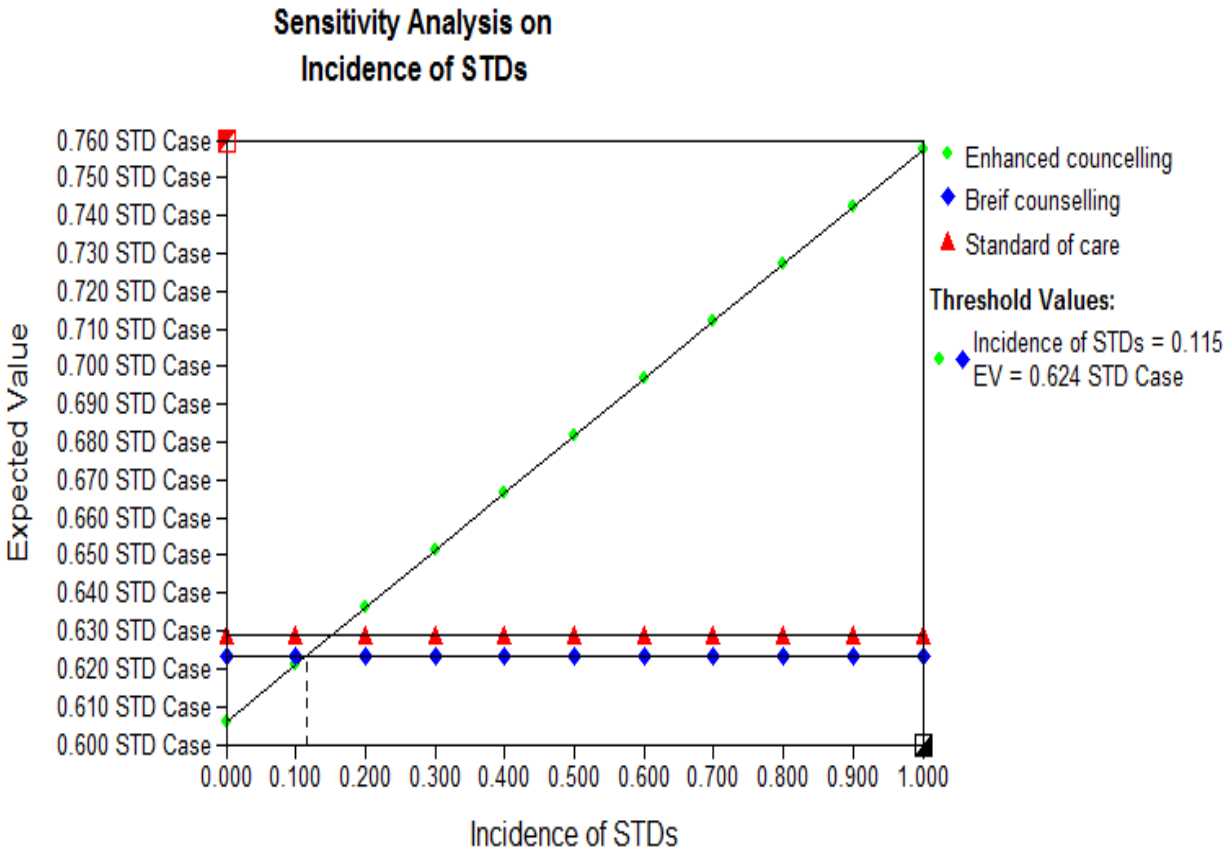


**Figure 10:-** One-Way Sensitivity Analysis using the New Intervention Completion Rate.

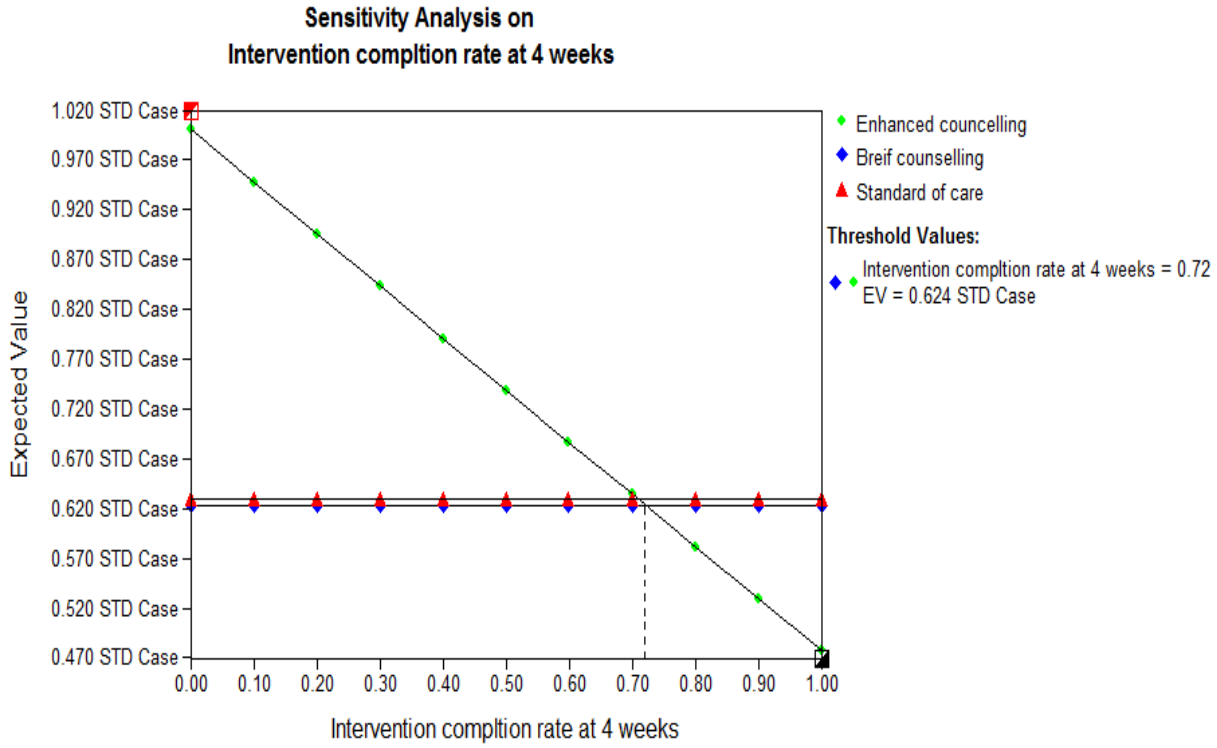
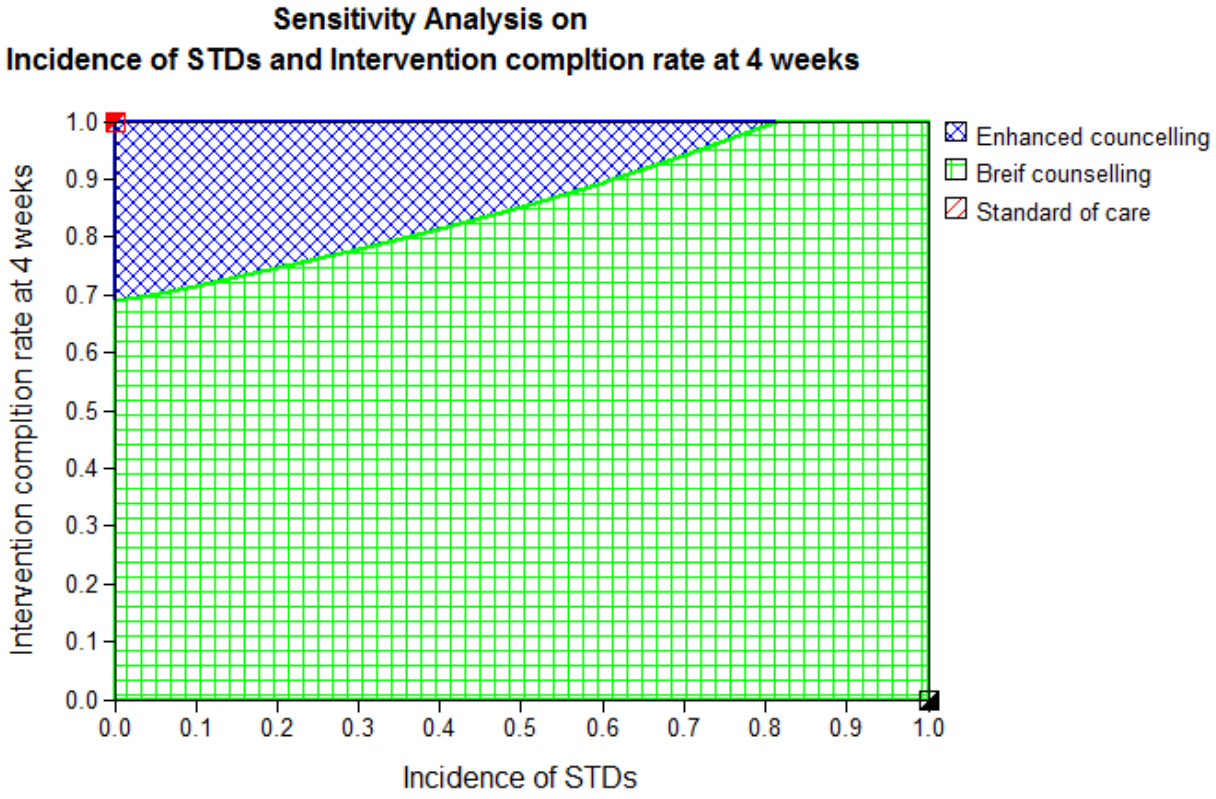



**Figure 11:-** Two-Way Sensitivity Analysis using BOTH New Effectiveness and Intervention Completion Rate.



**Technical Appendix II:**

**Figure 1:-** STDs Tree with Costs and Effects:

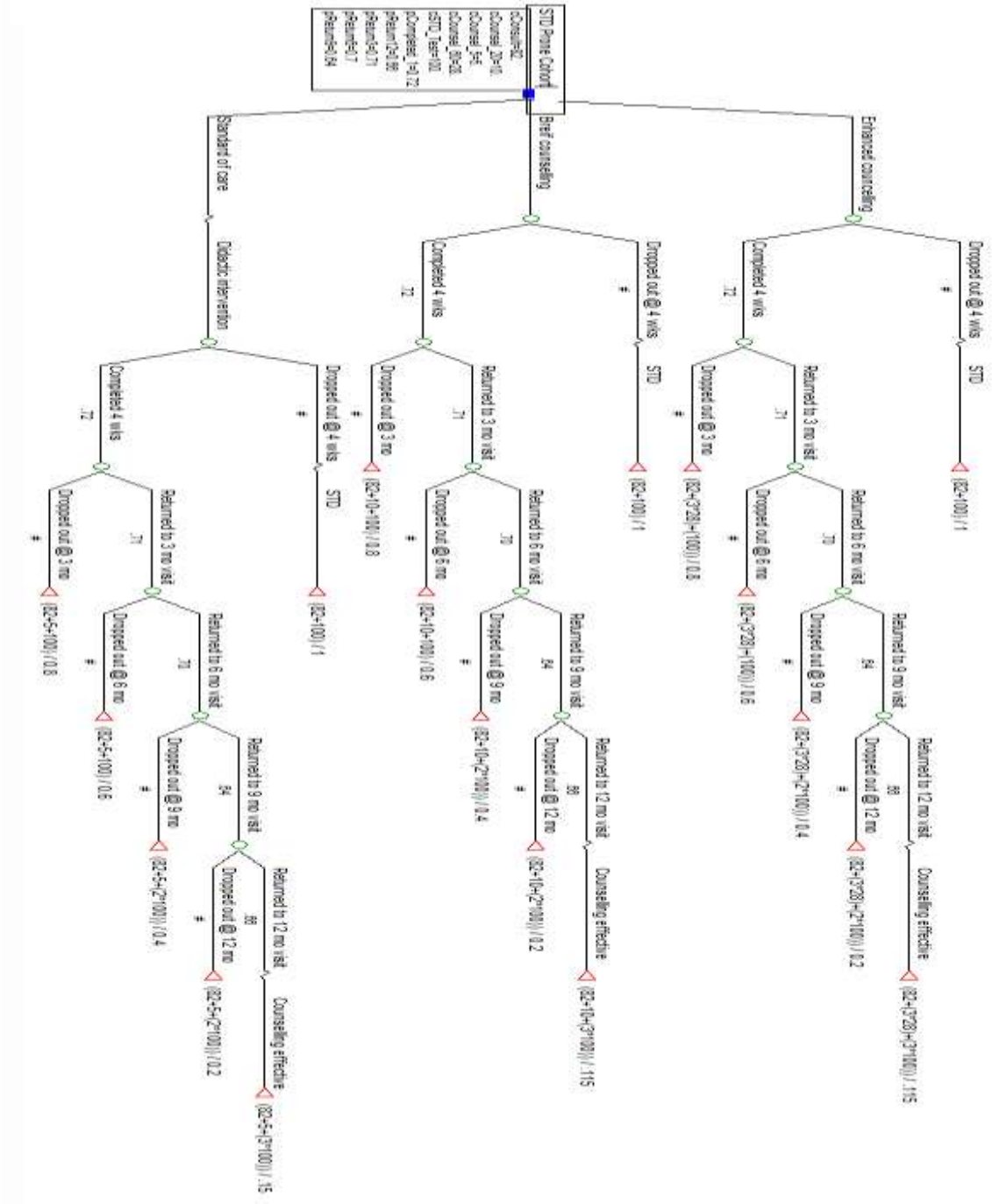


**Figure 2:-** STDs Tree with Variables: