Chapter V

Discussion

The study described in this paper set out to assess the feasibility and effectiveness of providing combination of oral education, pit and fissure sealant, fluoride, and preventive resin restoration (PRR) for school children in public primary schools in Bangkok as an alternative to doing nothing and to determine the costs and outcomes associated with these types of care.

This study provides an empirical analysis of the cost-effectiveness of the school-based oral health preventive program at public primary schools in Bangkok. The comparison group in this study is by no means a control group. Ethical considerations require that these school children be allowed to continue to receive regular dental care from private dentists or from other sources. Therefore, it may be hypothesized that if a pure control group could be used as a basis for comparison, it would be possible to demonstrate even greater reductions in dental caries increment than those observed.

5.1 The impacts of school-based oral health preventive program at public primary school in Bangkok

It has long been a cornerstone of oral health education, pit and fissure sealant, PRR and fluoride provided to children suffering from dental caries less than doing nothing program. There have been reported on the effective of these programs on reducing dental caries.

One of the purposes of the present study was to test the effective of theses types of preventive dentistry; oral health education, pit and fissure sealant, PRR and fluoride, would be sufficient to prevent or reduce the occurrence of dental caries in children in whom the age was 6 – 7 year olds.

These analyses are based on secondary data from five years of school-based oral preventive program at public primary schools in Bangkok. This program provided by the fifth year dental students supervised by staffs of the Community Dentistry Department at the Faculty of Dentistry, Mahidol University.

This study design was intended to test the hypothesis in the school-based oral health preventive program at public primary school in Bangkok using an adequate number of participants and a concurrent comparison group.

A significant positive relationship between the baseline DMFT index of students and subsequent dental caries increment was found. In addition, program effectiveness as measured by differences in DMFT increment between the two study groups was significantly different.

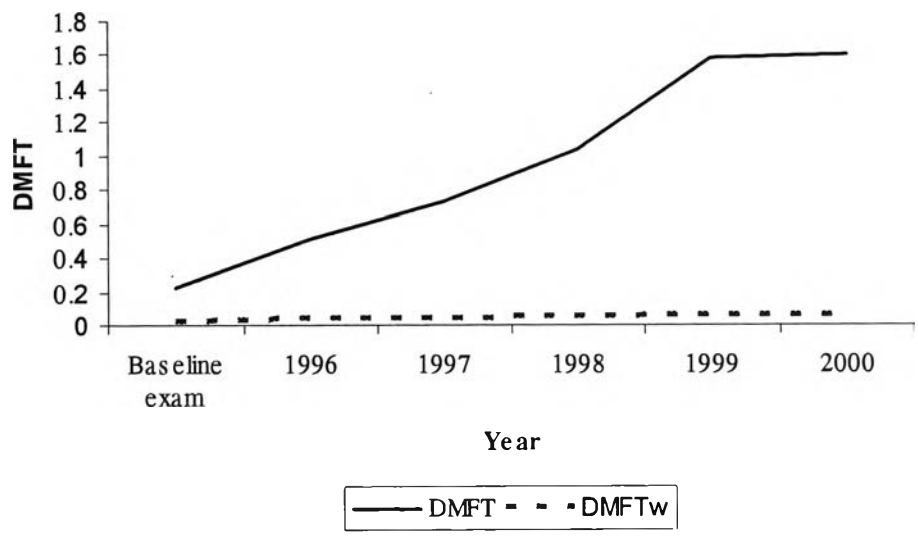
5.1.1 Statistical significant difference of DMFT after implementing program

The results suggested the oral health preventive care provided by the program does offer an effective way of reducing the incidence of caries in children. The reductions in caries in the experimental group took place and would be presumably related to the effects of oral education, pit and fissure sealant, PRR and fluoride. The results provide an estimate of the effect which could be achieved over a fairly short time period if programs of this kind were to be made more generally available provided by primary dental care services in the community as an alternative to the doing nothing care.

The finding in this study of a statistically significant association between permanent caries experience and the occurrence of oral health preventive program has been reported that the caries experience of permanent teeth in experimental group, after 5 years implementing the program, is less than that of control group, not implementing the program. The mean DMFT index in the experimental group after 5 years was 1.60, while the mean DMFT index in control group was 1.993. The difference between the two groups was statistically significant. The results of this study showed that 11 -12 year olds children in experimental group had 19.72% (i.e., [(1.993 - 1.60)/ 1.993)]*100% =19.72%) fewer caries than their counterparts in control group. This figure compares contrary with 75.2% reduction in caries compared to DMFT scores over seven years following a single application of fissure sealants program as part of community-based teaching and training in study of Van Wyk, Kroon and White (2003).

As indicated in table 4.5, the results showed that there were statistically significant differences of annual increment DMFT in experimental group for every year which was attributed by difference of increment in D component. However, this study found small caries experience increment observed of DMFT weighted by number of tooth (DMFTw). It was significant different in the first and the fourth year of study. D weighted component (Dw) was significant different in the last two years of the study. The figure 5.1 presented DMFT and DMFTw in experimental group as follow:

Figure 5.1: DMFT and DMFTw in experimental group



5.1.2 Caries reduction

The effectiveness of experimental group was 1.37 as an effectiveness of control group was 1.793. A reduction of 23.59% in dental caries was achieved after 5 years when compared to a control group of children with no organized preventive program. Although the increment of caries for permanent teeth in the experimental group after five years is less than that of control group, the absolute percent reductions in caries increment are relatively small. More importantly, the final DMFT in the experimental group (1.6 in the year 2000) was still over the national oral health goal for 12-year-olds. The prevalence of school children suffering from dental caries after 5 years implementing program in experimental group is nearly that of control group; 59.38% in experimental group and 66% in control group (as shown in tables 4.2 and 4.3). These prevalences of dental caries in both groups in 2000 were insignificantly different as calculated by using Z test for proportion as shown in section 4.1.2.

Results of the study by Donaldson, et al (1986) showed that supervised use of personal health education, oral fluoride supplements and pit and fissure sealant in children 7-10 year olds could lead to a 85% reduction in the rate of dental caries over 4 years, the incremental improvement in DMFT scores of preventive care was 0.36 - 0.53, which was not quite similar to the present study.

Several factors may be related to the low caries reduction of this oral health preventive program. The population selected for study was at an age in which the permanent teeth most susceptible to caries were newly erupted, and many not yet erupted, or erupting, and thus, their length of exposure to the oral environment was short. The low levels of caries reduction could also be attributed to the low rate of repeated application of fluoride because the school children received fluoride mouthwash and/ or fluoride-containing paste only one visit at all over 12 mouth interval on the basis of individualized treatment plans established at the time of the annual dental examinations. In addition the benefits of this oral preventive care were limited by the low level efficiency of some equipment for providing in this program such as saliva ejector. The saliva ejector used in this program was low power saliva suction. Moreover, a few numbers of dental assistants was the problem also. Because of the technical problem and lack of dental assistants, the dental students could not control children's saliva appropriately. The moisture control is necessary for pit and fissure sealant and PRR. Then the retention rate of pit and fissure and PRR might be low from these problems. Furthermore, the low benefits were also attributed to low experiences and skill of dental students to do this program.

Furthermore, the time limitation for providing this program to school children is the other reason for low level of caries reduction. This oral health preventive program is based upon the "incremental technique", the dental students emphasized to provide dental care for the school children more in the first grade than the other grades. The school children then received most of dental cares at the first year and for the following years they received less and less dental care. Consequently, this program provided the oral preventive care for about two hours per visit. At the same time the dental students had to provide this program to the other classes' students in the same schools of experimental group and also provided this program to school children in the other schools in school-term period. Then, the experimental group did not receive oral preventive care as much as possible.

The period required for this program was quite for long time, therefore, the schools participated in this program should give the extremely good cooperation. Moreover, the school children in these schools should participated in the program throughout 5 years to assess the effectiveness of this program.

5.2 Costs to provider for establishing and operating this program

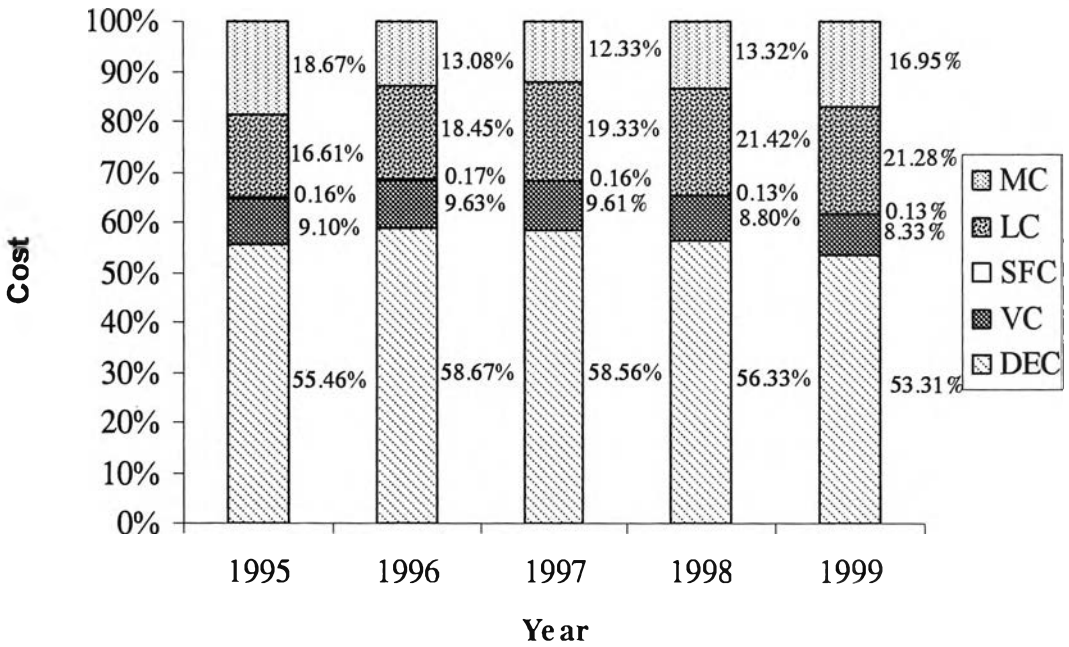
There were costs incurred in school-based oral health preventive program implemented by dental students of the Faculty of Dentistry, Mahidol University including both explicit costs and implicit costs. Because this program was a community-based learning and teaching, the dental students did not receive the salaries for operation. Moreover, this program provided oral preventive care at schools in which costs of school facilities and utilities were gratis. Although they were gratis, this study calculated in economic costs. Thus these costs should be included in the total costs of this program. So, annual total costs of this program were presented in 4 patterns;

- annual total cost at current price
- annual total cost at constant price (based on year 2000 value)
- annual actual total cost at current price
- annual actual total cost at constant price (based on year 2000 value)

Costs of the school-based oral health preventive program for establishment and operation consist of capital costs and recurrent costs in which capital costs shared a majority part of this program. The year-to-year range of percentage of capital costs was 61.76% - 68.47% of total cost and 65.71% of total cost for over all 5 years. Cost of dental equipment was responsible for more than half of total costs. In contrast, costs of school facilities shared the few parts but these costs did not include in actual cost calculation. The percentage of capital cost considerably increased at the second year then slightly decreased as shown in tables 4.19-4.20 for economic cost calculation. But for actual cost calculation the capital cost increased at the first three years and then decreased in the last two years.

For recurrent costs as, they were divided into 2 categories, labor cost and material cost. The greatest part of labor costs attributed by annual salaries of supervisor compared with annual salaries of school teacher were the lowest part as presented in tables 4.14 and 4.15. A great majority of material costs was costs of material for pit and fissure sealant as shown in tables 4.17 and 4.18. It means that this program emphasized to provide pit and fissure sealant to school children. The recurrent costs decreased in the second year, and then slightly increased year by year in the following years for current economic cost calculation. But for constant economic and actual cost calculation, these costs were decreased year by year and they slightly increased again in the last year. For current actual cost calculation, the least recurrent costs were in the third year of study. The percentage of recurrent cost considerably decreased at the second year then decreased for economic cost calculation. But for actual cost calculation it decreased at the first three years and then increased. The labor costs and material costs shared the percentage of total costs over all 5 years 19.37% and 14.93% respectively. The material costs decreased in the first three years and then be increased in the last two years because of providing more. The annual percentage of input's costs of this program was shown in figure 5.2.

Figure 5.2: Annual percentage of each input's cost of this program



As indicated in Figure 4.16, total cost tends to decrease year by year during the first 4 years and they slightly increased at the last year of study for current actual and constant both actual and economic cost calculation but it changed to decrease and increase every year for current economic cost calculation. Total cost all over 5 years of program was 227.963.09 baths. It means that the average annual total cost was 45,592.62 baths. However, this study is short period and it needs few additional years for the long run costs study. However, naturally, primary school system always limits the study period to 5-6 years at most; therefore, the decision makers might have to implement the pilot program in schools which were included both primary system and high-school system for expanding the follow-up period of school children in such program.

Because most of the dental equipments and materials for providing oral preventive care in this program were imported, the total costs between the two schemes (current and constant price) would be different when the period of this study involved in Thai economic crisis in 1997. Especially, the changes of the policies of Thai baht and the interest rate. Consequently, both capital costs and recurrent costs incurred in this program were considerably affected from these changes when using constant price schemes for calculation as shown in tables 4.26 and 4.27, the gap of total costs of about 5% and 10% interest rate between pre- and post crisis periods were 23,792.91 baths (233,860.41-210,067.50 =23,792.91).

For the average cost, it tended to decrease year by year for the first four years of study and it slightly increased in the last year by using constant price schemes for calculation but it change to decrease and increase every year of study by using constant price schemes for calculation. Average cost all over 5 years of program was 459.53 baths

Since dental equipments were employed by school children both who participated and not participated in this study for only half day per visit and only 6.5 mouths per year. The remaining time of each visit and each year of these equipments would be loss of

opportunity costs. A great number of allocated costs of these inputs costs were then assigned to this program. Therefore, if these equipments were used by the other programs during the remaining time, these allocated equipment costs to this program will be decreased. The total cost, average cost and incremental cost will be decreased as well.

5.3 Cost-effectiveness of the school-based oral health preventive program

Given the improvements in the technology of preventive dentistry for children in the recent years and the gains in clinical measures of the outcome as summarized in tables 4.2, 4.3 and 4.4, it will be quite obvious that these school-based oral health preventive care present an attractive alternative to doing nothing care for comparing the outcome.

This study estimated that the incremental cost-effectiveness ratio (ICER) for the overall five-years intervention compared to a control group varied between 5,432.66 - 6,208.91 baths depending upon the assumptions used in the analysis; current and constant price scheme for calculation. It means that the estimated costs are 5,432.66 baths per increment DMFT prevented over the five-year period. When comparing children in control group, not implemented this program, the incremental cost-effectiveness ratio was unfavorable (children with oral health program incurring relative higher costs).

As demonstrated by Morgan, Crowley & Wright in 1998, the potential cost-effectiveness for sealing teeth, weekly fluoride mouthrinsing and an annual oral hygiene education session compared to control group, receiving oral hygiene education only improve as the costs for sealants decrease relative to the costs for non sealing and non fluoride mouthrinsing uses. Their incremental cost-effectiveness ratio was 472 baths ($11.80) per DMFS prevented over three-year period. Based on the observed patterns of sealant and fluoride use, therefore, the finding of incremental cost-effectiveness ratio in current study was not quite similar Morgan *et al.*'s study. However, the present study is not directly comparable with the study by Morgan *et al.*

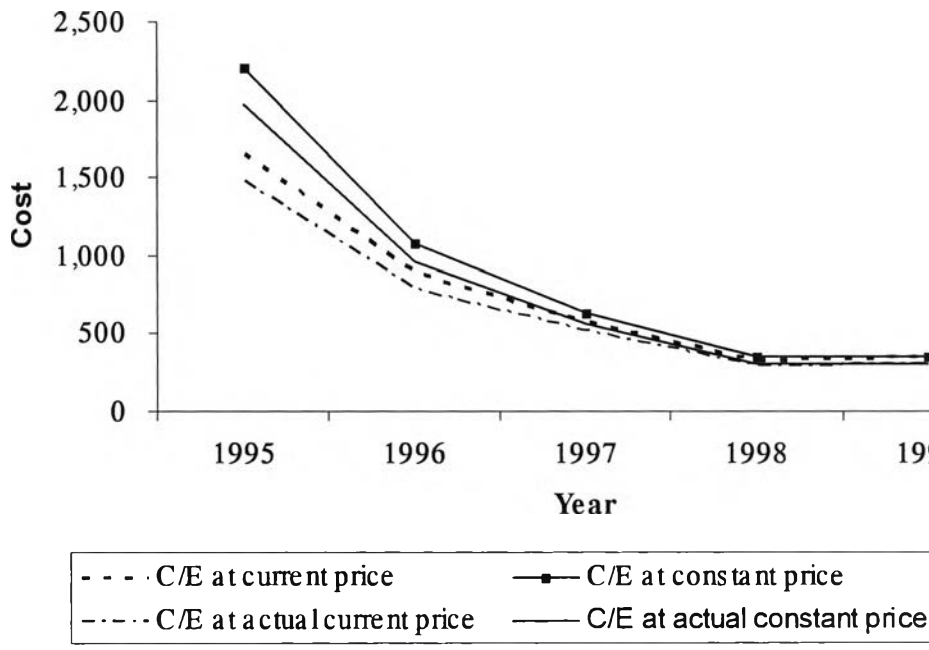
In addition, the results of Weintraub, *et al* (1993) suggested that the incremental cost-effective of sealant on all first permanent molar teeth after 11 years for 7 years children were 162.40 baths ($4.06). These results are extremely differ from the present study because the environmental and assumption are different.

As shown in table 4.23, summarizing the cost-effectiveness ratio for the experimental group, both for the overall program and for each year of the program, the primary analysis estimated an overall cost-effectiveness ratio of 1,677.38 baths per DMFT prevented over the five-year period (i.e., [(227,963.09 / 99.2)/1.37] = 1,677.38). The overall cost-effectiveness ratio was 1,917.06 baths per DMFT prevented using 10% and 5% discount rate for 2 phase's cost calculation. For actual cost scheme calculation, cost-effectiveness of this program was 1,490.33 and 1,703.85 baths for current and constant price respectively. It is difficult to make a judgment as to whether the preventive program constitutes a rational use of scarce community resources on the basis of the results of this program. Because it was lack of Thai studies on the relative cost effectiveness of alternative dental prevention and treatment programs, the results of this study should be interpreted with cautions. For example, studies have focused on either pit and fissure sealant or fluoride mouthrinsing or oral education with less emphasis on combined approaches, have targeted children of different ages, have been

performed within communities with varying levels of water fluoridation, and have been undertaken in different time periods. In addition, the assumptions used in the analyses are based on imperfect data.

The annual cost-effectiveness ratio considerably decreased year by year and it was the least at the forth year. It slightly then increased in the last year. These results might be effect from incremental technique as mentioned earlier. The dental students aimed to provide dental care for the younger students and provide less for older students. But this program also emphasized to provide dental care for the sixth grade, the oldest grade student of this program. If they graduated from these schools, there is no free of charge of dental care for them any longer. So, plentiful costs incurred for the last year. On the other hand, the interval of the last oral examination was done earlier than the first six times because the exam had to do before the school children graduated from schools. The last exam may be then close by the sixth exam. Accordingly, the last year effectiveness slightly increased from that of the fourth year then it affects to raise the cost-effectiveness ratio significantly high. The annual cost-effectiveness was presented in figure 5.3.

Figure 5.3: Annual cost-effectiveness of this program



Additionally, as mentioned above, these dental equipments had not been used extremely with their useful time. A lot of these input costs were allocated to this program. This program is based on the community-based learning and teaching for education of the fifth year dental students, for instance; salaries of supervisor. Thus a great deal of costs for implementing this program would be incurred. The cost-effectiveness ratio was then relatively high.

The cost-effectiveness of the program was based on the results of a single prospective community intervention. Fous aspects of this point need discussion. First, the cost of parents' own time has not been included in the analysis. Therefore, the results on the cost-effectiveness from this program may be underestimated. But, if it had been, the cost of preventive care relative to doing nothing cares would have been much greater.

In terms of resource savings, the cost burden would have shifted from the health center or provider to the parents with overall costs including those of parents having to attend the health center more often, taking time to administer sealant, fluoride program and more generally supervising their children's dental health.

Evans and Robinson (1983) cited by Donaldson, *et al* (1986) explained that such an interpretation of costs is erroneous because it neglects the fact that parents want to look after their children and will pay a premium to do so. If the parents in the study had not wanted to administer preventive care to their children, or travel more often to the health center, then they could have dropped out of the study at no additional financial cost. A "revealed preference" argument shows that the value of time to the parents is at most no greater than the valued of the opportunity to care for their child or, alternatively, that the extra benefit is at least as large as the extra cost of caring for the child. It would be wrong to include parental cost without also including parental benefit.

Secondly, the care given in a trial may not reflect the pattern of care found in the usual practice setting. For example, extra care may be taken with the placement and repair of the dental sealants because of the high standards of research evaluation or extra care may be taken consistent with fluoride mouthwash for every week, thus resulting in higher effectiveness rates.

Thirdly, given the current knowledge of sealant and fluoride effectiveness, it might be considered unethical to conduct an experimental study that would intentionally withhold sealants from some children. The children in experimental group would receive the preventive care from private clinic or the other sources and these costs did not include in this study. It has been unable to exclude the concurrent effect of general improvements in dental health over the period of this retrospective study. Therefore, the results on the cost-effectiveness from this program may be underestimated.

Fourthly, the possible benefit from training and teaching in the principle of community-based program of the dental students did not include in the benefits of this program for calculating cost-effectiveness of this program. Because in the future after these dental students graduate and work as the good dentists for providing the oral health care to the next generation child, DMFT of children may be decreased which were the possible benefit in the long-run resulted from education of dental students.

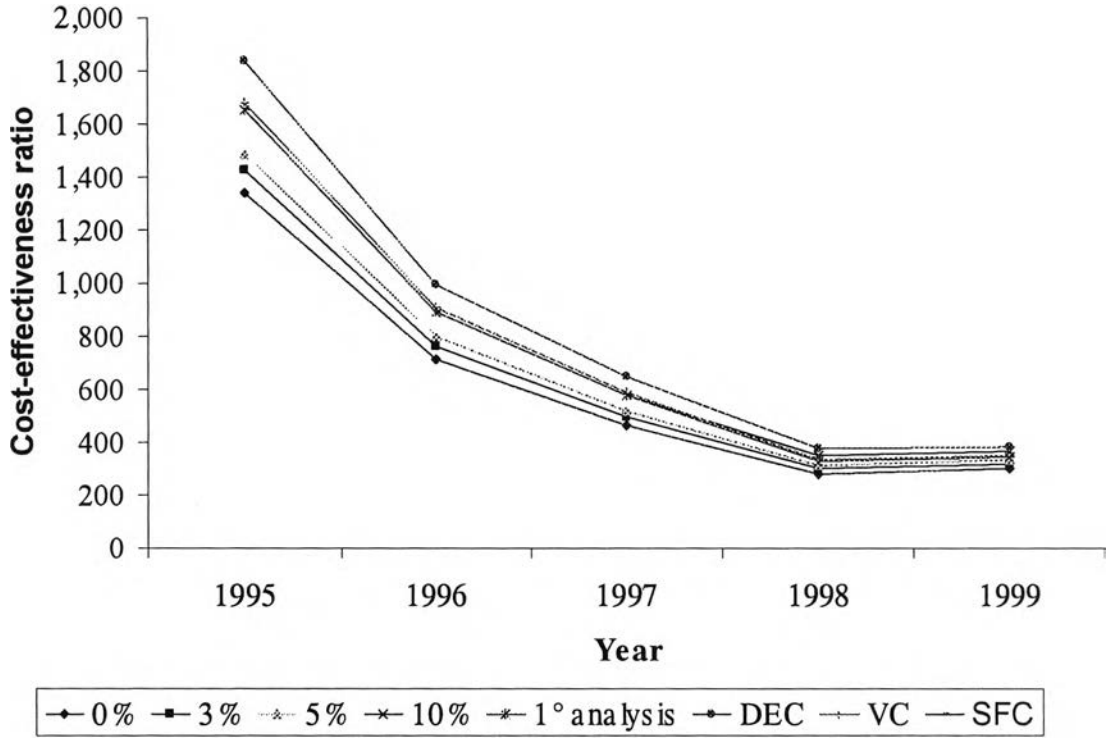
5.4 Sensitivity analysis to analyze the impact of input costs on this program

In sensitivity analysis of the impacts of the program on the cost-effectiveness ratio, there were five major aspects for sensitive the impacts of the program. The first was the change of the interest rate used to annualize the capital cost. The second was the 20% increasing any items of capital input costs. The third was disregard the last year's cost of program. The fourth was excluding some costs, and the last sensitivity analysis was changing costs of dental equipments.

As indicated in tables 4.24 - 4.30, the results found that the total costs, average cost, the incremental cost effectiveness ratio and cost-effectiveness of this program were highly sensitive to the changes of interest rate used to annualized capital costs. Moreover, the capital costs were the main part of total costs. It means that the capital costs of this program depended heavily on the interest rate. These results might be effect from the

import of these equipments. The trend of cost-effectiveness of this program on sensitivity analysis on changing the interest rate and increasing of each capital cost was presented in figure 5.4. This figure also demonstrates the effect of the study duration. The longer the 'follow-up' period, the better cost-effectiveness is achieved.

Figure 5.4: Cost-effectiveness of this program on sensitivity analysis on changing the interest rate and increasing each of capital cost



As the results presented in the fourth chapter the capital costs were a majority part of total costs of the program. Therefore, if this study violate from the primary assumption or analysis, change of any item of capital costs will lead to the change of total cost, average cost, the incremental cost effectiveness ratio and cost-effectiveness ratio. Among these items, annual costs of dental equipments is the most significant item because when annual costs of these equipments increased 20% of original costs, the change of total cost, average cost, the incremental cost effectiveness ratio and cost-effectiveness ratio were the greatest and vice versa. It is necessary to find the way to reduce these capital costs of the program in order to achieve the greatest cost-effectiveness of the program.

As shown in table 4.31, the total cost, average cost, ICER, and cost-effectiveness of this program over 5 years period were sensitive to disregarding the last year's cost of program. The provider had to pay only 4,345.13 baths for additional DMFT prevented.

The salaries of supervisor, costs for education of the dental students in the principle of community-based oral health preventive program, were the greatest part of the labor costs. So, this study tested by excluded these costs from the primary assumption; total cost, average cost, ICER, and cost-effectiveness of this program were decreased. As indicated in table 4.32, ICER over 5 years was 5,102.93 baths, that is, costs of this

program for reducing one more additional DMFT per person were 5,102.93 baths if this program was implemented in the other public primary schools by dental nurses.

Furthermore, the total cost for excluding transportation costs of this program was 213,978.86 baths which the provider can save the transportation cost to 13,984.23 baths (227,963.09[a]-213,978.86[b] = 13,984.23) over 5 years program as shown in table 4.33. The provider can save 333.27 baths (5,432.66[c]-5,099.39[b] = 333.27) per additional DMFT prevented if this program set up and provide at the public dental health center, stationary clinic, which the school children and their parents had to visit this center by themselves. The transportation costs were shift to be the responsibilities of patient. For example, this program were established and operated by dental nurses at public health center or Sathani Anamai in rural area. The patient (children and their own parents) have to undertake the transportation costs for receiving this program. The policy makers have to pay only 333.27 baths for one additional DMFT prevented per person over 5 years. Although the ICER in provider perspective of this program was decreased but the effectiveness obtained in societal perspective for providing at public health center may be less than that of using mobile dental units at schools. Because if this program was implemented at schools, all school children would receive this preventive care. But if it was implemented at public health center including the parents did not give good cooperation for introducing their children to receive this program, then some children would be not participated in this program. Then, the effectiveness may be decreased. However, the decision makers have to compare the cost and effectiveness of this program in all perspectives.

Moreover, when this study was sensitive by concurrent excluding both salaries of supervisor and transportation cost; total cost, average cost, ICER were extremely decreased. Especially, cost-effectiveness of this program was decreased 31.08% over 5 years as shown in table 4.34.

Finally, as mentioned earlier, the dental equipment costs was the majority part of total cost, it was responsible for more than half of total cost. Therefore, the other sensitivity test of this program was changing to use the new price of dental mobile unit for calculation. These costs at the current price in 2005 were converted into present value in 1995. According to the results in table 4.35, cost-effectiveness of this program was decreased 6.48% over 5 year's program. Few decreasing cost-effectiveness may be due to the lack of dental assistants, less experience and skill of dental students, low efficiency of some equipments. Because the new equipments used to annualize in sensitivity analysis were still comprised of the low power saliva ejector which can not control the humidity in oral cavity appropriately. The other reasons may be the effect of low qualified of dental materials used in this program. The dental material should therefore be improved for easy manipulate at the lower price. The cost-effectiveness on sensitivity analysis on excluding some costs and changing new equipment cost were presented in figure 5.5.

(**Note**: [a] =from table 4.19, [b] =from table 4.33, and [c] =from section 4.3)

Figure 5.5: Cost-effectiveness of this program on sensitivity analysis on excluding some costs and changing new equipment cost