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Cost effectiveness analysis of school based mantoux screening for TB infection

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COST EFFECTIVENESS ANALYSIS OF SCHOOL BASED MANTOUX SCREENING FOR TB INFECTION IN CENTRAL SYDNEY

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THE CENTRE FOR HEALTH ECONOMICS RESEARCH AND EVALUATION (CHERE) began in 1991. CHERE receives research infrastructure funding from NSW Health and is supported by Central Sydney Area Health Service. CHERE is the national centre for health economics in public health, funded by the Commonwealth Department of Health and Family Services under the Public Health Education and Research Program. CHERE is affiliated with the Department of Public Health and Community Medicine and it is an Affiliated Research Centre within the Faculty of Medicine at the University of Sydney. CHERE aims to promote the development and application of health economics. The Discussion Paper Series reports on the work of the Centre and is intended to stimulate discussion. However the views expressed are not necessarily the views of the Centre's funding bodies.

CONTENTS

ABSTRACT

A cost effectiveness analysis of differing school based TB infection screening regimes was conducted for 1996 populations of Year 1 and Year 8 students who attended schools in the areas of Central Sydney Area Health Service and South Western Sydney Area Health Service. The costs of screening would be partially offset by savings in future costs of treating adult cases of TB disease. Screening the high risk group of Year 8 students was found to be the most cost effective screening option. The cost per case prevented and the cost per death prevented were comparable with other health programs which are judged to be 'value for money'. Screening Year 1 students was found to be not as effective nor as cost effective. Universal screening would prevent more cases of adult TB disease than targeted screening but at a relatively high cost per case.

1. INTRODUCTION

Tuberculosis (TB) is a mycobacterial disease. TB usually affects the lungs (pulmonary TB), but can affect other parts of the body (extrapulmonary TB). TB infection in children is not contagious. However, a proportion of those infected in childhood will develop infectious TB disease in adulthood, a contagious and potentially fatal disease. Children can be tested for non-contagious TB infection by means of Mantoux (tuberculin) testing and offered preventive therapy which will reduce the probability of developing the disease in adulthood. Antibiotic treatment is delivered to diagnosed adult cases of TB.

Australia has one of the lowest rates of TB in the world. Population screening for contagious active disease in adults was widespread from 1948 through to 1976; the reported incidence declined from 50.0/100,000 persons in 1955 to 7.0/100,000 in 1985.[1&2] However, recently NSW has reported an increase from 5.7/100,000 in 1989 to 6.8/100,000 in 1991 and 7.7/100,000 in 1995. The highest reported incidence of 16.2.0/100,000 was in Central Sydney Area Health Service (CSAHS), the next highest is South Western Sydney Area Health Service (SWSAHS).

Other developed countries' experience has been similar; that is a gradual decline until 1990 followed by a slowing of the decline or even an increase. Japan, USA, Britain, Denmark, Netherlands, Sweden and Switzerland all follow this pattern. In the USA, the rise is associated with the increased incidence of human immunodeficiency virus (HIV), increased poverty and a breakdown in the public health system. Australia has not experienced these problems; the proportion of new TB cases who have HIV infection is very low.[2&3] However, the increased incidence is partly explained by infection acquired in high prevalence countries; the incidence for the NSW overseas born population is 26.3/100,000. The proportion of the population born in a non English speaking country in CSAHS is 35% and in SWSAHS, 28% .[2]

TB control in a low prevalence population such as Australia is best accomplished by case identification, appropriate supervised treatment and contact tracing. Population screening can then be considered as a further strategy. In South Australia and Queensland secondary

school children in Years 8 and 9 are screened periodically to monitor the prevalence of infection and those infected are offered preventative therapy[2]. Two prevalence surveys of tuberculosis infection have been carried out amongst school children in CSAHS. For Year 8 (14 year old) students in CSAHS and Canterbury in1992 the prevalence of non contagious TB infection (assessed by Mantoux test) was 10%, and 27% in overseas born pupils[1]. For Year 1 (6 year old) students in CSAHS, SSAHS (Southern Sydney Area Health Service) and SWAHS in 1994, prevalence was 6.5%, and 17.8% in overseas born pupils[2].

This study was commissioned to provide information on the cost effectiveness of a school based screening program for Central Sydney. Alternative screening strategies considered were universal versus targeted screening, and screening Year 1 and Year 8 age groups. The effectiveness of the program was assessed by the number of cases of adult TB prevented and the number of deaths prevented (due to prevention of TB infection during childhood). There is only one published study, based in the US, looking at the cost effectiveness of childhood screening for TB[4].

2. METHODS

The cost-effectiveness analysis was based on a modelling approach of the costs and consequences of the following alternative Options:

Option 1 - no screening for TB infection
Option 2 - school based screening for TB infection for all children in Year 1
Option 3 - school based screening for TB infection for all children in Year 8
Option 4 - school based screening for TB infection for children in Year 1 born overseas
Option 5 - school based screening for TB infection for children in Year 8 born overseas

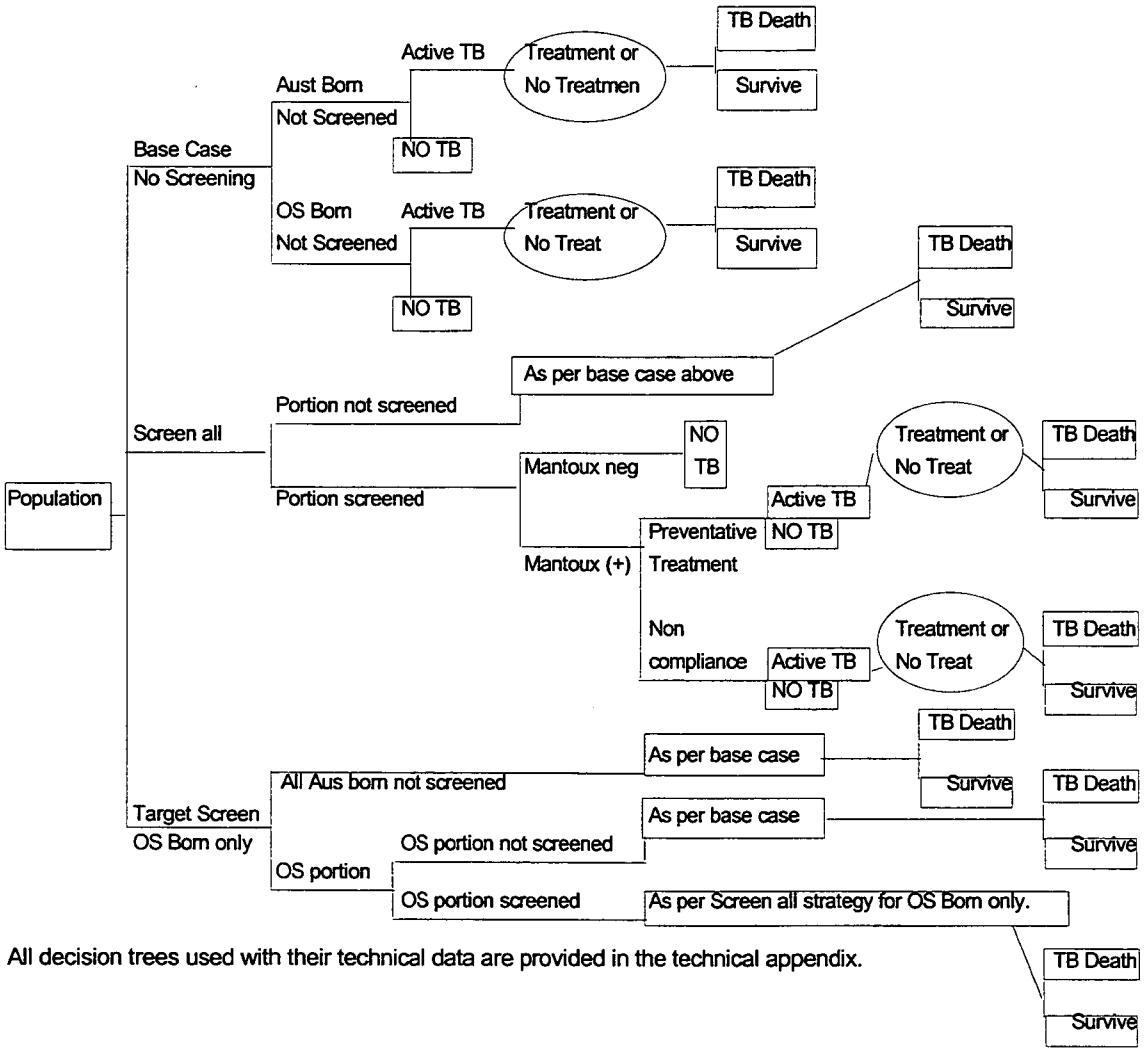
The screening program was assumed to operate in the areas covered by the CSAHS and SWSAHS, and would involve the following major steps:

1. Co-ordination with schools and provision of information to parents.
2. Administration of the Mantoux tests (requiring injection).
3. Assessment of Mantoux reaction, 72 hours after the injection, requiring a repeat visit to the school.
4. Diagnostic assessment of those children with significant reactions.
5. Preventative therapy for those cases identified.

The costs and consequences arising from implementing a single year of each option were estimated from a health care perspective. Consequences measured were the number of adult cases of TB prevented and the number of deaths prevented by identification of infected children. Costs consisted of direct costs of the screening programs (costs associated with each step above) and the costs of treating cases of TB that develop in adulthood. The decision analysis model shown in figure one illustrates the stages analysed in comparing screening strategies. The analysis required the estimation of the probabilities of the events at each node. Given the specified population, the final costs and consequences were calculated. The costs and consequences of each screening option were compared with the costs and consequences of option 1. The cost per case prevented and the cost per death prevented were then calculated. The option with the lowest cost per case and cost per death prevented was the most cost-effective screening option.

In adults, TB is contagious and may increase the spread of the disease. The number of adult cases and deaths prevented was estimated only for those identified in the screening program. To the extent that adult TB disease is contagious, the total number of cases and deaths prevented by screening will be under-estimated; however ongoing screening would reduce the prevalence of disease, and so the consequences prevented will be over-estimated to this extent (if results are extrapolated to annual ongoing screening program).

FIGURE 1 DECISION TREE ANALYSIS CONDUCTED FOR YEAR 1 AND YEAR 8 STUDENTS



All decision trees used with their technical data are provided in the technical appendix.

A feature of this modelling process is the inclusion of intertemporal costs and consequences. Future costs were discounted at 5%; benefits were not discounted. There is a lack of agreement as to whether benefits occurring in the future should be discounted; and if so whether they should be discounted at the same rate. The impact on the results of discounting costs at a different rate and discounting the benefits was tested by sensitivity analysis.

3. DATA

3.1 The screened population

The number of schools and estimates of school populations were drawn from the 1996 NSW Department of School Education Census which is collected by the Commonwealth Department of Education and Training[5] (Table 1). The target populations for screening were 17472 Year 1 students and 16138 Year 8 students, in all the LGAs covered by the earlier prevalence studies.

TABLE 1 1996 POPULATION OF YEAR 1 AND YEAR 8 STUDENTS AND SCHOOLS IN CSAHS AND SWSAHS.

	Year 1		Year 8	
Area	Students	Schools	Students	Schools
CSAHS	5402	127	5115	47
SWSAHS	12070	208	11023	77
Combined	17472	335	16138	124

Data from the results of the two school surveys provided estimates of:

- The proportion of children born overseas;
- The proportion of the population offered screening who would participate;
- The proportion of screened children with significant Mantoux reactions requiring further assessment;
- The proportion of children with significant reactions with past BCG vaccination (defined as non-cases);
- The proportion of children with significant reactions classified as having TB infection;
- The proportion of cases treated by INH alone or INH plus Rifampicin;
- The proportion of cases who would complete the course of preventive therapy.

3.2 Events and consequences

Estimates of the probability of developing TB in adulthood and the probability of death from TB in adulthood were drawn from the published literature and/or provided by clinicians expert in the area.

The lifetime risk of progressing from TB infection in childhood to adult TB has been estimated at between 5-10% [1,3,&6]. The lower risk boundary of 5% for the development of adult TB after childhood infection with incomplete or no preventive therapy was used throughout the main body of analysis. This conservative assumption will suggest lower benefits from screening than if the higher risk boundary had been used. The impact of a 10% risk rate was assessed in the sensitivity analysis. Completion of a six months course of preventative therapy for childhood infection was estimated to reduce these lifetime risks by 90%[3,7]. For children not infected, it was assumed that the probability of developing adult TB was zero.

All cases detected by screening would be offered preventative treatment though not all would complete the course of treatment. Based on the Year 1 prevalence study it was assumed that 60% of children would complete preventive therapy[9]. Preventative therapy involves a six month course of INH or of INH and Rifampicin combined. It was assumed, based on clinical advice, that 5% of cases born overseas would be offered the combined treatment, while all remaining cases would be offered INH. As the risk of Isoniazid (INH) hepatitis is exceptionally rare in children [10, 11], there was assumed to be no risk of developing this complication.

Estimates for the effectiveness of BCG vaccination have ranged from 0 to 80% and a recent meta analysis demonstrated a reduction in risk of 50%[8]. This 50% risk reduction estimate was used in the analysis, reducing the estimated probability of developing adult TB after childhood vaccination to 2.5%. This estimate was varied to 80% in the sensitivity analysis.

There are different forms of TB disease in adulthood. The most common is pulmonary accounting for approximately 60% of TB disease notifications in 1994 in Australia [12 &3]

and 90% of all TB deaths globally. Treatment data in this study were based on pulmonary TB. It was assumed that all adult cases would be treated.

The case fatality rate associated with adult TB cases was calculated from ABS Causes of Death data and disease notifications rates for the periods 1990 to 1994[12,13,14], giving a probability of death of .0766.

3.3 Costs

All costs in the analysis are reported at 1996 prices unless otherwise stated. A summary of baseline costs is reported in table A1 of the Appendix.

Duration of professional time used in screening and the cost of all consumables was drawn from information in the Year 1 survey[2]. Industrial awards were used to estimate professional time costs [15]. Costs for diagnostic chest X-rays were taken from the 1996 Medical Benefits Schedule[16].

The cost of preventive therapy for childhood cases was based on drug costs only; costs of supervising treatment were not included since this is rarely done for preventive therapy. A six month course of INH cost $16.43; a six month course of combined INH plus Rifampicin cost $109.51.

The total cost of treating a case of pulmonary TB was estimated to be $2,935. The components and associated costs of treating pulmonary TB (including investigations) are summarised in table A2 of the appendix. This treatment schedule was developed after consultation with a Tuberculosis specialist [17] at Royal Prince Alfred Hospital, a teaching hospital within CSAHS.

4. RESULTS

4.1 Effectiveness of screening programs

On baseline assumptions it was estimated that an individual screening program could prevent between 14.54 and 31.92 cases of adult TB disease and between 1.11 and 2.45 deaths (table 2) for one year of screening. Throughout the following analysis the number of cases and deaths are rounded to two decimal places. Although less than one whole case or death prevented makes little intuitive sense it is anticipated that any chosen program would run for a number of years, and these fractional cases allow accurate calculation of outcomes over an extended program life.

Screening all year 8 students was shown to prevent the most adult cases of TB disease. It would also prevent the most deaths from TB disease, although differences across the screening strategies in number of deaths prevented were small due to the low case fatality rate.

TABLE 2 OUTCOMES OF DECISION TREE ANALYSIS

	No. of adult cases		No. of deaths	
Year 1 population 17,472	occurring	prevented	occurring	prevented
No Screening	70.39	Nil	5.39	Nil
Universal Screening	48.70	21.68	3.73	1.66
Target Screening	55.85	14.54	4.28	1.11
Year 8 population 16,138				
No Screening	96.33	Nil	7.38	Nil
Universal Screening	64.40	31.92	4.93	2.45
Target Screening	66.07	30.25	5.06	2.32

4.2 Costs of Screening

The costs of the screening strategies were estimated at approximately $50,000 to $200,000 per screening round. There were fixed costs associated with the program, such as preparation of information for parents and translation. Some costs varied with the number of schools involved (such as an information evening for parents), others with the number of students to be screened. A detailed breakdown of these costs is shown in table A3 of the Appendix.

Screening Year 8 students cost less than screening Year 1 students as high schools are generally larger than primary schools and therefore more students could be screened per session. However, once costs of preventive therapy were included the total screening costs for Year 8 students were higher than for Year 1 students for targeted screening and approximately the same for universal screening (see table 3). This was due to the higher number of cases detected and requiring preventive therapy.

As screening and preventive therapy reduces the number of cases of adult TB infection, there would be future savings in TB treatment costs. These were included to estimate the net total costs of the screening program. The cost of treating a case of adult TB infection was estimated at $2935.27. Once discounted at a 5% discount rate, this gave a present value of the treatment cost of adult TB infection as $1344.68 for a child in Year 8 and $910.13 for a child in Year1 (difference due to the average time before the adult TB infection would develop).

The cost of screening and preventive therapy is higher than the treatment cost savings for all screening strategies, so the net cost of screening programs is positive (table 3).

TABLE 3 COSTS OF SCREENING FOR TB INFECTION AND TREATMENT SAVINGS OF TB (PULMONARY TYPE) IN ADULTHOOD

	Year 1		Year 8	
	Universal	**Target**	**Universal**	**Target**
Total screening cost	358,441	191,551	344,770	248,913
Treatment savings	19,735	13,233	42,924	40,681
Net costs of screening program	338,706	178,318	301,846	208,232

Costs are discounted at 5%, total screening cost includes preventive treatment for cases detected.

4.3 Cost effectiveness analysis

The most efficient screening strategy is not necessarily the least costly. The objective of screening is to prevent morbidity and mortality due to TB. Therefore it is important to

compare the strategies in terms of the cost per case prevented. Table 4 summarises the results of the cost effectiveness analysis.

TABLE 4 RESULTS SUMMARY

	Year 1		Year 8	
	universal	**target**	**universal**	**target**
Net Costs	$338,706	$178,318	$301,846	$208,232
No. of cases prevented	21.68	14.54	31.92	30.25
No.of deaths prevented	1.66	1.11	2.45	2.32
Cost per case prevented	$15,620	$12,264	$9,456	$6,883
Cost per death prevented	$204,040	$160,647	$123,202	$89,755

The most cost-effective strategy was shown to be targeted screening of students in Year 8, at a cost per case prevented of $6,880. Universal screening of Year 8 students would prevent a higher number of cases than targeted screening. The incremental, or additional, cost per case of moving from a targeted screening strategy to a universal was $56,056.

However, the introduction of a screening program which targets children born in non English speaking countries could have undesired and unintended consequences. Targeting a group based on their country of birth could introduce or exacerbate discriminatory attitudes and lead to stigmatisation of this particular group.

5. SENSITIVITY ANALYSIS

To check the robustness of the cost-effectiveness ratios a one-way sensitivity analysis was conducted. In the sensitivity analysis cost-effectiveness ratios were calculated using the base-line assumptions while varying key parameters of interest. The results of this analysis are presented in Table 5. Full details are shown in the appendix.

The approach adopted in the study was to discount costs at 5% but to leave benefits undiscounted. Sensitivity analysis was performed with both costs and benefits undiscounted, with costs and benefits both discounted at 5% and with costs discounted at 3% while benefits were undiscounted. As program costs of screening would be incurred in the present, varying the discount rate would have no impact here. However savings in treatment costs and the benefits of screening would be incurred in the future and these would be affected by changes in discount rates. Even with a zero discount rate, the net costs of screening were positive. The number of cases averted by targeted Year 8 screening were 30.25 at baseline (benefits undiscounted), discounting benefits at 5% reduced this to 13.2.

The cost-effectiveness ratios were sensitive to changes in discount rate, although the changes did not change the ranking of screening strategies. When both costs and benefits were undiscounted the cost per case averted for targeted Year 8 screening reduced to $5,292. At the other end of the scale when costs and benefits were both discounted at 5% the cost per case averted increased to $15,923.

The estimate of the effectiveness of BCG vaccination used in the baseline analysis was 50%. Other studies have estimated this rate to be as high as 80%, the cost effectiveness ratios were recalculated with this higher rate. This resulted in very small reductions in the number of cases and deaths prevented by screening, consequently the cost effectiveness results were insensitive to this change.

The lifetime risk of progressing from TB infection in childhood to adult TB has been estimated at between 5-10%, and no consensus exists on where the true risk lies within this

range. The baseline assumption of a 5% risk of developing TB from childhood infection was varied in the sensitivity analysis to a 10% risk. When the risk of developing TB was 10% rather than 5% the number of cases prevented increased by 100% for all screening strategies. The net costs (due to increased treatment savings) decreased by 6% for universal and 7% for targeted Year 1 screening, by 9% for universal Year 8 screening and by 20% for targeted Year 8 screening. This change did not change the ranking of the strategies but led to the cost effectiveness ratios for all screening options falling to below half their baseline level, with the cost per case averted for targeted Year 8 screening falling to $2,769. The incremental, or additional, cost per case of moving from a targeted to universal Year 8 screening strategy at a 10% risk level would be $27,439.

TABLE 5 SENSITIVITY ANALYSIS

	Year 1		Year 8	
Assumptions	Universal	Target	Universal	Target
Baseline	**15,620**	**12,264**	**9,456**	**6,883**
discount costs 0%, benefits 0%	13,595	10,239	7,865	5,292
discount costs 3%, benefits 0%	15,087	11,730	9,025	6,452
discount costs 5%, benefits 5%	50,403	39,538	21,820	15,923
80% BCG efficacy	15,616	12,261	9,379	6,883
10% risk of TB	7,355	5,677	4,056	2,769

Cost per case prevented with changes in key study parameters.

6. DISCUSSION

On baseline estimates, childhood screening for TB would yield a net cost, that is the cost of screening and prophylactic treatment would not be completely offset by the future savings from the treatment of adult TB.

Four alternative screening strategies were analysed. Screening Year 8 children was both less costly and prevented a larger number of cases than screening Year 1 children, it is a dominant strategy. Targeted screening was more cost effective than universal screening and this ranking remained throughout the changes tested in the sensitivity analysis. On baseline assumptions it was estimated that it would cost $6,883 to prevent a case of TB using a targeted Year 8 screening strategy. This strategy would lead to a net cost of $208,232 for an annual round of screening.

Moving from targeted screening to universal screening increased the net program costs by approximately 50%. This would be a significant expense, as the program would be expected to be run annually. However, the increase in cases detected was marginal, at most 3, and we would not expect to prevent an extra death from each annual run of the universal screening program. It was estimated that at baseline assumptions it would cost $56,056 per additional case of TB prevented by moving from a targeted to a universal Year 8 screening program.

The estimates of cases in this analysis, have been limited to the cases which develop in adulthood from childhood infection. Adult TB disease is infectious, each adult case prevented will therefore prevent subsequent cases arising. The number of estimated cases prevented is, consequently, an under-estimate. However it is unlikely that this under-estimation would have caused a change in the ranking of the strategies.

The costs of the screening program were estimated from a health care perspective. If a societal perspective were taken and saved costs from time off work due to TB were included the net program costs would be lower. However the costs of the screening

program have not included contact tracing. Contact tracing would increase the costs of the program. On previous experience, it is not clear whether this would be successful in identifying and treating many adult cases.

The results were insensitive to changes in BCG efficacy. However the results were sensitive to changes in the discount rate, with no discounting of cost and benefits reducing the cost per case prevented (targeted Year 8) to $5,292 and discounting of benefits as well as costs at 5% increasing the cost per case prevented to $15,923. The results were very dependent on the risk rate of developing adult TB from childhood infection, with the consensus being that the rate is between 5% and 10%. Throughout the analysis the 5% risk level was conservatively used. If the rate were in fact closer to the 10% risk level as is often suggested the cost per case prevented for all strategies considered here would decrease dramatically (at 10% they are less than half).

The results of the model provide useful information. In Australia, programs which fall in the range of $16,000 - $30,000 per life year saved are considered worth funding. As the average age at death from TB is 64 (saving an average of 11.6 years of life), targeted screening of Year 8 students, the most cost-effective screening strategy at around $90,000 to prevent a death (equivalent to $7,759 per life year saved) is clearly worth serious policy consideration. However targeted screening of overseas born students may exacerbate negative attitudes towards this group and lead to further discrimination. The possibility of these unintended consequences must be weighed against the incremental costs of universal screening.

REFERENCES

1. Alperstein, G., Fett, M.J. Reznik, R., Thomas, M., and Senthil, M. "The prevalence of tuberculosis infection among year 8 schoolchildren in inner Sydney in 1992." *Medical Journal of Australia* 1994; 160: 197-201.

2. Alperstein, G., Morgan, K. R., Fett, J., Nossar,V., and Stewart, G.J. "Prevalence of tuberculosis infection among primary school-entry children in Sydney." *Australian and New Zealand Journal of Public Health* 1996; 20: 123-128.

3. NHMRC Tuberculosis Working Party. Towards the Elimination of Tuberculosis II. Guidelines and protocols for controlling tuberculosis in Australia. Draft- June 1996.

4. Mohle-Boetani, J.C., Miller, B., Halpern, M., Trivedi, A., Lessler, J., Solomon, S.L., and Fenstersheib, M. "School Based Screening for Tuberculous Infection A Cost Benefit Analysis. *Journal of the American Medical Association* 1995; 274; 613-619.

5. Commonwealth Department of Education and Training. 1997. NSW Schools Census 1996. Canberra.

6. Rieder, H.L., Cauthen G.M., Comstock, G.W.,Snider, D.E.Jr., "Epidemiology of Tuberculosis in the US." *Epidemiology Review* 1989; 11: 79-98.

7. O'Brien, R.J. "The treatment of tuberculosis." In Tuberculosis A Comprehensive International Approach. *Lung Biology in Health and Disease* Edt Claude Lenfant 1993; 66: 207-240.

8. Colditz, G.A., Brewer, T.F., Berkely, C.S., Wilson, M.E., Burdick, E., Fineberg, H.V., Mosteller, F. "Efficacy of BCG Vaccine in the Prevention of Tuberculosis Meta -analysis of the Published Literature." *Journal of the American Medical Association* 1994; 271,9 :698-702.

9. Alperstein, G., Morgan, K.R., Mills, K., Daniels, L., "Compliance with anti-tuberculosis preventative therapy among 6 year old children" *Australian and New Zealand Journal of Public Health.*

10. Rose, D.N., Schechter, C.B., Fahs, M.C., and Silver, A.L. "Tuberculosis Prevention: Cost Effectiveness Analysis of Isoniazid Chemoprophylaxis." *American Journal of Preventative Medicine 1988*; 4, 2: 102-109.

11. Fitzgerald, J.M. and Gafni, A. "A Cost Effectiveness Analysis of the Routine Use of Isoniazid Prohylaxis in Patients with a Positive Mantoux Skin Test." *American Review of Respiratory Diseases* 1990; 142:848-853.

12. Oliver, G. "Tuberculosis Notifications In Australia, 1994." *Communicable Diseases Intelligence* 1996; 20, 5:108-115.

13. Australian Bureau of Statistics Year Books Cat 1301.0 Numbers 78, 77, 76. 1996, 1995, 1994, ABS.

14. Australian Bureau of Statistics Causes of Death Cat 3303. 1990,1991,1992,1993 & 1994.

15. 1996 Industrial Awards and Public Hospital Nurses State award information supplied by NSW Health Salaries Department.

16. 1996 Medicare Benefits Schedule. Commonwealth Department of Health and Community Services. Canberra.

17. Seale, P. RPA Chest Clinic 1997. Personal Communication.

18. Morgan, K.R. St.George Chest Clinic Sep 1996. Personal Communication.

APPENDIX

- Decision trees for Yr 1 and Yr 8 cases
- Costs

  A1- Base Line costs

  A2 - TB treatment costs

  A3 - Screening costs
- Sensitivity analysis results.

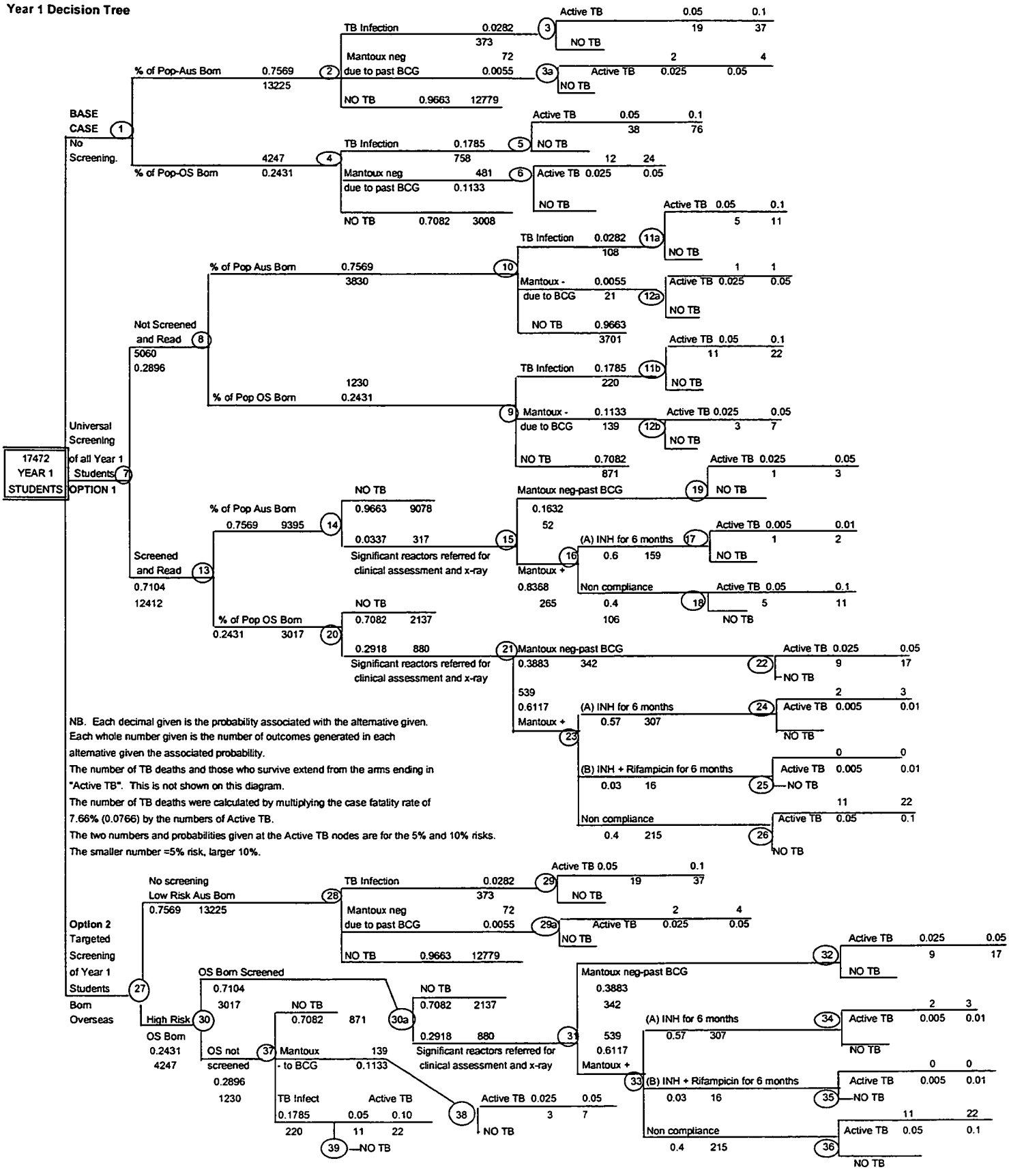
  A4 - Costs discounted at 3%,

  A5 - Costs and benefits undiscounted,

  A6- Costs and benefits discounted at 5%,

  A7- Risk of developing adult TB from childhood infection 10%.

Year 1 Decision Tree



Year 8 Decision Tree.

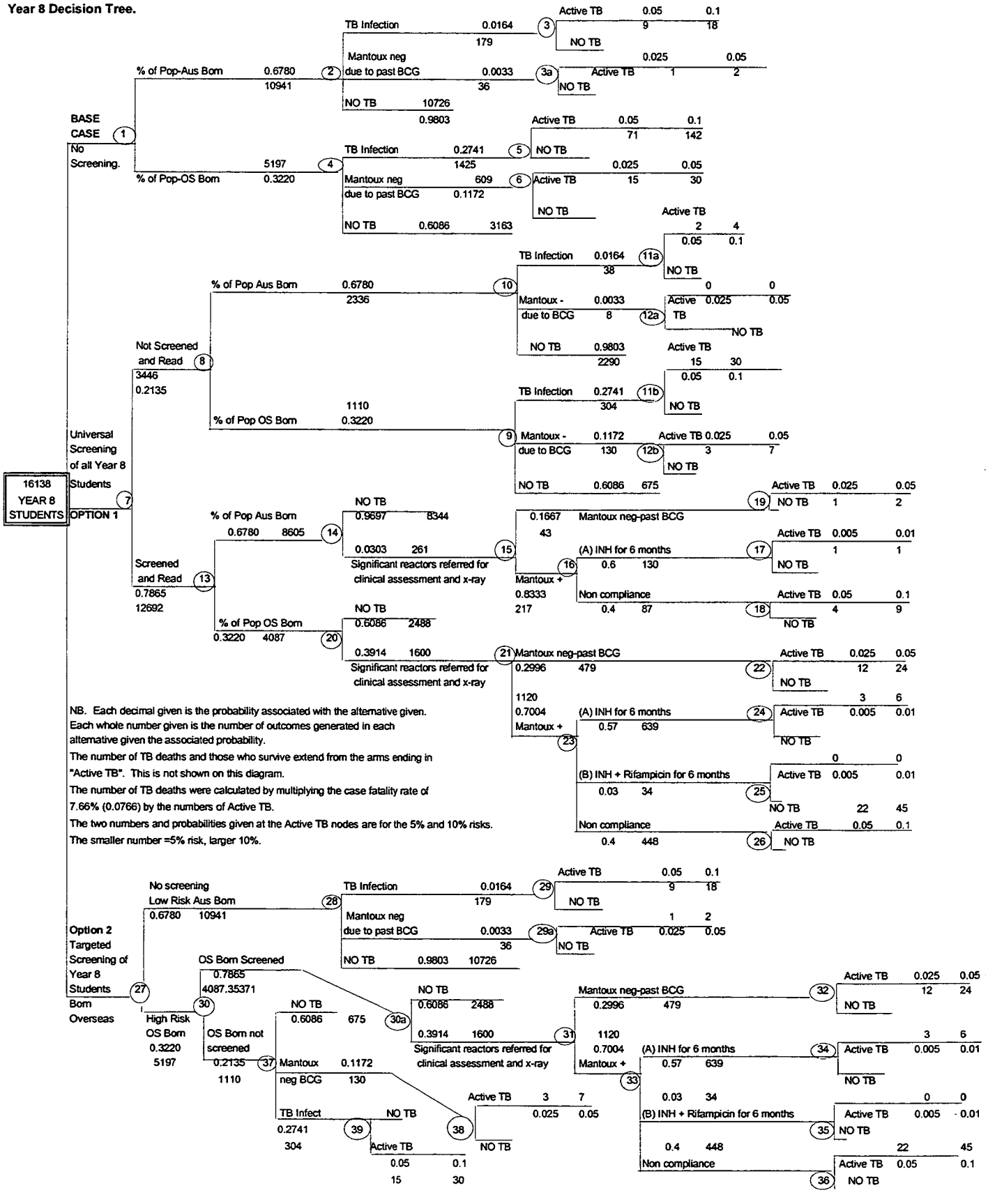


TABLE A1 BASELINE COSTS

Baseline 1996 Costs				
Human Resources	**1996 PW**	**1996 PHT**	**Source**	
Clinical Nurse Specialists	$750.60	$19.75	Public hospital nurses state award	
Reg Nurse Year 8 thereafter	$721.00	$18.97	Public hospital nurses state award	
School Nurses	$721.00	$18.97	Public hospital nurses state award	
Project Co-ordinator (Clinical Nurse Specialist)	$922.80	$24.28	Public hospital nurses state award	
Health Promotion Staff	$747.18	$19.66	1996 Industrial Award -NSW Health	
Interpreters Grade 3	$564.16	$14.85	Industrial Award	
TB Clinician	$2,086.98	$54.92	NSW Health Scheme A CSAHS Y3	
	1996			
Interventions used in clinical assessment	**Unit Cost**	**Frequency**		
Chest X-ray - Medicare item number 58503	$48.80	1 per patient	Medicare Benefits Schedule Book	
	Per patient	**Per patient**		
Consumerables-	**1994 Actual**	**1996**		
Syringes, needles, surgical wipes, sharps containers	$0.81	$0.88	Adjusted to 1996 prices	
PPD vials	$1.33	$1.44	Adjusted to 1996 prices	
Printing Costs for 2044 students $320 in 1994	$0.16	$0.17	Adjusted to 1996 prices	
	1994 Actual per session	**1996 per session**		
Refreshments at Info session	$17.40	$18.88	Adjusted to 1996 prices	
Fixed Costs	**1994 Actual**	**1996**		
Translation Costs info sheets etc-Fixed Cost	$9,000.00	$9,766.30	Adjusted to 1996 prices	
	1996			
Drugs used in chemoprophylaxis	**Unit Cost**	**Duration**	**$ per patient**	**Source**
-Isoniazid (INH) 300mg daily	$0.09	6 months	$16.43	Westmead Pharmacy
-Rifampicin 600mg daily	$0.51	6 months	$93.08	Westmead Pharmacy

CPI Indecations		Nat Ave	
Years	All groups	Multiplier	Source
1989/90	100.0	1.00	ABS 1996 Year Book p507
1990/91	105.3	1.05	ABS 1996 Year Book p507
1991/92	107.3	1.07	ABS 1996 Year Book p507
1992/93	108.4	1.08	ABS 1996 Year Book p507
Year 1's 1993/94	110.4	1.10	ABS 1996 Year Book p507
1994/95	113.9	1.14	ABS 1996 Year Book p507
1995/96	119.8	1.20	ABS Information Service

TABLE A2 COSTS OF TREATING PULMONARY TB DISEASE

TB Treatment Pulmonary Disease	**Source**	**Unit Cost**	**Frequency**	**Cost per Case**
Mantoux test	Medicare Item No.73811	$10.60	x1	$10.60
X-rays	Medicare Item No.58503	$48.80	x5	$244.00
Sputum / AFB's	Medicare Item No.69213	$99.35	x5	$496.75
Liver Function Test	Medicare Item No.66211	$19.80	x5	$99.00
Full Blood Count	Medicare Item No.65007	$17.20	x5	$86.00
Clinical Visits TB Clinician initial visit.	Medicare Item No. 104	$62.85	x1	$62.85
Clinical Visits TB Clinician subsequent visits.	Medicare Item No. 105	$31.45	x4	$125.80
Directly Observed Therapy Costs-Comm Nurse Time	Public hospital nurses state award.	$18.97	3 hrs p/week	$1,479.95 6 months
Drugs			**Duration**	**Cost per case**
-Isoniazid 300mg 3 times per week	Westmead Pharmacy	$0.09	6 months	$16.43
-Rifampicin 600mg 3 times per week	Westmead Pharmacy	$0.51	6 months	$93.08
-Pyrazinamide 1500mg 3 times per week	Westmead Pharmacy	$1.92	2 months	$116.80
-Ethambutol 1200mg 3 times per week	Westmead Pharmacy	$1.71	2 months	$104.03
TOTAL				$2,935.27

All costs are in 1996 prices.

TABLE A3 COSTS OF SCREENING IN 1996 PRICES

Costing of each of the Screening Alternatives

Year 1 population =	17472	**Year 8 population =**	16138
Year 1 schools=	335	**Year 8 schools=**	124
Year 1 students screened=	12412	**Year 8s screened=**	12692
Year 1 target screen pop=	4247	**Y8 target screen pop=**	5197
Y1 target screened students=	3017	**Y8 target screened students=**	4087

	Strategy		Strategy	
	Screen	Target	Screen	Target
Screening Proceedures deployed for Year 1 study in 1994	All	Screen OS	All	Screen OS
Prior to screening	Year 1s	Year 1s	Year 8s	Year 8s
Initial Contact-Telephone and Letter to each school by Project co-ordinator 1/2 hr per school	$4,067.61	$4,067.61	$1,505.62	$1,505.62
Visit by Project Co-ordinator-1 hour per school	$8,135.21	$8,135.21	$3,011.24	$3,011.24
Schools Information Session 1 for all schools. Time -2 Hours				
-TB Clinician	$109.84	$109.84	$109.84	$109.84
-Health Promo Staff (Grade Yr9 thereafter)	$39.33	$39.33	$39.33	$39.33
-School Nurses (Reg Nurse Yr8 thereafter)	$37.95	$37.95	$37.95	$37.95
-Refreshments	$18.88	$18.88	$18.88	$18.88
Parents Meetings 1 hour per school				
-Project Co-ordinator (Clinical Nurse Specialist)	$8,135.21	$8,135.21	$3,011.24	$3,011.24
-Interpreters x3 for 20 mins at each school	$4,973.52	$4,973.52	$1,840.94	$1,840.94
Translation Costs for Info & Consent Forms				
-Information statement, TB the facts, consent form.	$9,766.30	$9,766.30	$9,766.30	$9,766.30
Printing Costs	$2,968.24	$721.58	$2,741.62	$882.92
Total Lead up to Screening	**$38,252.08**	**$36,005.42**	**$22,082.96**	**$20,224.27**
Cost per school	$114.19	$107.48	$178.09	$163.10
Cost per student invited to be screened	$2.19	$8.48	$1.37	$3.89
Cost per student screened	$3.08	$11.93	$1.74	$4.95
Screening				
Testing				
-Clinical Nurse Specialists x2 x3.5 Hrs per school. Target Screening=25% of this.	$46,319.92	$11,579.98	$17,145.28	$4,286.32
-School Nurses x2 x 3.5Hrs per school Targeted screening =25% of this.	$44,493.29	$11,123.32	$16,469.16	$4,117.29
Equipment Used				
Syringes, needles, surgical wipes, sharps containers	$10,909.84	$2,652.18	$11,155.80	$3,592.65
PPD vials	$17,913.69	$4,354.82	$18,317.55	$5,899.04
Total Testing Costs	**$119,636.74**	**$29,710.30**	**$63,087.79**	**$17,895.30**
Cost per school	$357.12	$88.69	$508.77	$144.32
Cost per student invited to be screened	$6.85	$6.99	$3.91	$3.44
Cost per student screened	$9.64	$9.85	$4.97	$4.38
Reading				
-Clinical Nurse Specialists x2 x1.5 Hrs per school. Targeted screening 25% of this.	$19,851.39	$4,962.85	$7,347.98	$1,836.99
-School Nurses x2 x 1.5 Hrs per school. Targeted screening=25% of this.	$19,068.55	$4,767.14	$7,058.21	$1,764.55
-Co-ordinator preparing letters of results 0.5 hours per school	$4,067.61	$4,067.61	$1,505.62	$1,505.62
-Stationary used and postage charges @ 60c per child screened	$7,447.27	$1,810.43	$7,615.16	$2,452.41
Total Reading Costs	**$50,434.82**	**$15,608.02**	**$23,526.97**	**$7,559.58**
Cost per school	$150.55	$46.59	$189.73	$60.96
Cost per student invited to be screened	$2.89	$3.67	$1.46	$1.45
Cost per student screened	$4.06	$5.17	$1.85	$1.85
Follow up and Chemoprophylaxis				
Respiratory Paediatricians Medicare consult x no of patients	$75,233.25	$55,334.80	$116,929.32	$100,541.50
Chest X-ray x per student referred for clinical assessment	$58,415.00	$42,964.81	$90,789.99	$78,065.64
Co-ordinator preparing letters of results 2hrs total	$48.57	$48.57	$48.57	$48.57
Stationary used and postage charges @ 60c per child	$718.22	$528.26	$1,116.27	$959.82
Drugs				
-Isoniazid 300mg daily	$13,196.58	$8,845.08	$21,973.14	$18,404.19
-Rifampicin	$2,506.11	$2,506.11	$5,214.52	$5,214.52
Total Follow up and Chemoprophylaxis Costs	**$150,117.71**	**$110,227.62**	**$236,071.81**	**$203,234.24**
Cost per school	$448.11	$329.04	$1,903.80	$1,638.99
Cost per student invited to be screened	$8.59	$25.95	$14.63	$39.11
Cost per student screened	$12.09	$36.53	$18.60	$49.72
Total Cost of Screening	**$358,441.35**	**$191,551.36**	**$344,769.54**	**$248,913.39**
Cost per school	$1,069.97	$571.80	$2,780.40	$2,007.37
Cost per student invited to be screened	$20.52	$45.10	$21.36	$47.89
Cost per student screened	$28.88	$63.48	$27.16	$60.90

Screening costs are the sum of prior to screening, screening and reading costs. Adding follow up and chemoprophylaxis gives total program costs of screening.

TABLE A4 COSTS, BENEFITS AND COST-EFFECTIVENESS RATIOS OF SCREENING FOR TB INFECTION WHERE COSTS ARE DISCOUNTED AT 3%, NUMBER OF CASES AND DEATHS PREVENTED ARE UNDISCOUNTED

	Year 1		Year 8	
	universal	**target**	**universal**	**target**
program cost	$358,441	$191,551	$344,770	$248,913
treatment savings	$31,310	$20,995	$58,389	$55,339
net costs	$327,131	$170,556	$286,380	$193,575
No. of cases prevented	21.68	14.54	31.92	30.25
No.of deaths prevented	1.66	1.11	2.45	2.32
Cost per case prevented	$15,087	$11,730	$8,971	$6,398
Cost per death prevented	$196,953	$153,137	$117,121	$83,530

Discounted values for treating a case of TB (pulmonary type) at 3% is $1,444 for Year 1 and $1829 for Year 8. The incremental cost per case prevented in moving from targeted year 8 screening to universal year 8 screening programs is $53,746.

TABLE A5 COSTS, BENEFITS AND COST-EFFECTIVENESS RATIOS OF SCREENING FOR TB INFECTION WHERE COSTS, NUMBER OF CASES AND NUMBERS OF DEATHS ARE ALL UNDISCOUNTED

	Year 1		Year 8	
	universal	**target**	**universal**	**target**
program cost	$358,441	$191,551	$344,770	$248,913
treatment savings	$63,647	$42,678	$93,698	$88,802
net costs	$294,794	$148,873	$251,072	$160,111
No. of cases prevented	21.68	14.54	31.92	30.25
No.of deaths prevented	1.66	1.11	2.45	2.32
Cost per case prevented	$13,595	$10,239	$7,865	$5,292
Cost per death prevented	$177,485	$133,668	$102,681	$69,090

The undiscounted cost of treating a case of TB (pulmonary type) is $2935. The incremental cost per case prevented in moving from targeted year 8 screening to universal year 8 screening programs is $54,468.

TABLE A6 COSTS, BENEFITS AND COST-EFFECTIVENESS RATIOS OF SCREENING FOR TB INFECTION WHERE COSTS, NUMBER OF CASES AND NUMBERS OF DEATHS PREVENTED ARE ALL DISCOUNTED AT 5%

	Year 1		Year 8	
	universal	**target**	**universal**	**target**
program cost	$358,441	$191,551	$344,770	$248,913
treatment savings	$6,119	$4,103	$18,728	$17,749
net costs	$352,322	$187,448	$326,042	$231,164
No. of cases prevented	6.72	4.51	13.93	13.20
No.of deaths prevented	0.07	0.05	0.15	0.14
Cost per case prevented	$52,403	$41,578	$23,411	$17,513
Cost per death prevented	$4,816,119	$3,821,267	$2,151,564	$1,609,559

Discounting costs and benefits does not change the order of cost effectiveness of the programs. As expected it increases the net costs of screening. The incremental cost per case prevented in moving from targeted to universal Year 8 screening is $129,970.

TABLE A7 COSTS, BENEFITS AND COST-EFFECTIVENESS RATIOS OF SCREENING FOR TB INFECTION WHERE THE LIFETIME RISK OF PROGRESSING FROM TB INFECTION IN CHILDHOOD TO ADULT TB IS 10%.

	Year 1		Year 8	
Future risk of TB is 10%	universal	target	universal	target
program cost	$358,441	$191,551	$344,770	$248,913
treatment savings	$39,470	$26,466	$85,848	$81,363
net costs	$318,971	$165,085	$258,922	$167,551
Net Costs	$318,971	$165,085	$258,922	$167,551
No. of cases prevented	43.37	29.08	63.84	60.51
No.of deaths prevented	3.32	2.23	4.89	4.63
Cost per case prevented	$7,355	$5,677	$4,056	$2,769
Cost per death prevented	$96,020	$74,112	$52,945	$36,150

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