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HOW TO ESTIMATE INCREMENTAL
RESOURCE REQUIREMENTS AND COSTS
OF ALTERNATIVE TT IMMUNIZATION
STRATEGIES

A MANUAL FOR HEALTH AND PROGRAM MANAGERS

**Resources for
Child Health
Project**

REACH



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REVISED VERSION

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ALTERNATIVE TT IMMUNIZATION STRATEGIES**

A MANUAL FOR HEALTH AND PROGRAM MANAGERS

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This handbook contains quick methods for calculating incremental resource requirements and costs of TT immunization programs above and beyond those costs for routine immunization of infants and children. These methods complement more detailed manuals which have been developed for the costing of the EPI and other primary health care programs (see attached Bibliography). The resource requirements for any TT immunization strategy will be country-specific and will depend upon the level of coverage, as well as the organization and delivery of health services. This handbook has been developed to be sufficiently flexible to be applied in a variety of situations.

Only the most significant resource categories have been included in this handbook, and therefore, cost estimates cannot be precise. Costs have been sub-divided into variable and fixed costs. Variable costs are those which are directly linked to each vaccination, such as vaccine, syringes, and needles. Fixed costs refer to those which are required for the vaccination program, such as training, personnel, supervision, and transportation costs.

A. What are the variable costs of a TT immunization strategy?

A.1 Variable costs of supplies and vaccine

As stated earlier, variable costs for TT immunization strategies include vaccine, needles and syringes. These costs will be based on an analysis of demographic data and vaccine requirements for reaching a desired coverage level (TT2). It is assumed that some women have received one dose of TT during previous years and therefore, must receive only one additional dose to become fully immunized. In cases where TT coverage is very low, one should assume that no women have been immunized previously. Therefore, the value of #3 in the exercise (Table A) should be multiplied by 1.33 to estimate vaccine requirements assuming a wastage factor of 25%. The following series of calculations can be used to calculate variable costs.

If the immunization strategy requires 5 doses of tetanus toxoid for a woman to become fully immunized and most women have not received tetanus toxoid, the annual vaccine requirement will be 6.8 for each pregnant women and 5.5 for each woman of childbearing age. These figures include recurrent vaccine requirements. With the aid of these coefficients, it is possible to estimate vaccine requirements over a period of 5 years to achieve the desired coverage goal of TT5.

To calculate the vaccine requirements for full immunization of women e.g., TT5) who have already received one dose of TT, the coefficients 5.8 for pregnant women and 4.5 for women of childbearing age can be used. These figures are based upon coverage rate calculations by Foulon, 1989.

Target Population:	Pregnant Women	_____
	Childbearing Age	_____
Coverge Objective:	TT2	_____
	TT5	_____

TABLE A
VARIABLE COSTS FOR TT IMMUNIZATION PROGRAMS

1. What is the desired TT2 coverage rate (or TT5)? _____
2. What is the total population of women? _____
3. How many women must receive vaccinations to reach the coverage rate of TT2 or TT5? (Multiply #1 by #2) <and by 2 if TT2; by 5.8 or by 4.5 if for TT5 target coverage). _____
4. What is the expected wastage rate of TT vaccine? (1.33, as esimated by WHO in cases of fixed schedule of vaccination days, or 1.5 to 2 in cases where vaccination is given upon any contact with the health system). _____
5. How many doses of TT must be on hand to reach the target coverage rate? (Multiply #3 by #4) _____
6. What is the average price per dose of TT vaccine? _____ \$0.04 _____
7. What is the cost of TT vaccine required to reach the coverage target (Multiply #5 by #6)? _____
8. What is the average price per syringe? (disposable=\$0.04, reusable= \$0.01) _____
9. What is the cost of syringes needed to vaccinate the target population? (Multiply #3 by #8) _____
10. What is the average price per needle? _____ \$0.001 _____
11. What is the cost of needles needed to vaccinate the target population? (multiply #3 by #10) _____
12. What is the total variable cost? (Add lines 7, 9, and 11) _____
13. What is the total variable cost per dose of TT2 or TT5(divide #12 by #3)

NB: Unit prices and wastage factors based on recent costing studies for the EPI performed for the WHO, UNICEF, and AID. Purchase prices include shipping costs. Number 5 is the number of total doses necessary to obtain the desired coverage rate. It represent the probable consumption over a four to five year period of a TT5 strategy or over a period of one to two years of a TT2 strategy.

A.2 Variable costs of personnel

To calculate the cost of additional personnel, the type and number of health personnel involved in the TT immunization program need to be determined. In addition, volunteer labor should be estimated as well. These figures will be used to estimate the volume of vaccination activity for each health worker to assess the proportion of time spent on TT immunization separately from other immunizations. This proportion of time is based on an assumption that one vaccination requires approximately five (5) minutes of a health workers' time. This assumption can be changed depending upon the specific country experience. This proportion is multiplied by an estimate of annual earnings to determine incremental personnel costs for TT immunization. The formula used in Table B for calculating personnel costs is the following:

PERSONNEL =	NUMBER OF	X	PROPORTION OF TIME	X	ANNUAL GROSS
COSTS	WORKERS		FOR TT VACCINATION		EARNINGS OF
			FOR EACH WORKER		EACH WORKER

To calculate incremental personnel costs, if the proportion of time is greater than 50%, one could assume that it will be necessary to recruit additional health personnel to implement the TT immunization strategy. It would be necessary to include these additional personnel at Numbers 6 and 10 in Table B to reflect the total resource requirements.

TABLE B
INCREMENTAL PERSONNEL COSTS FOR TT IMMUNIZATION

INDICATOR	A CHILD	B TT STRATEGY (TT 2,3,4,5)	C BOTH (A + B)	REM
1. Target population (pop. X coverage)				
2. Number doses/yr/ individual (One dose/yr for the TT5 strategy, two doses in the first year for immunization of pregnant women).	8			
3. Total yearly doses given (#1 X #2)				
4. Total daily doses (#3/# working days/yr)				
5. Daily doses/health center (#4/no.health centers)				
6. Daily doses/vaccinator (#5/no.vaccinator/hc)				
7. Minutes/vaccination	5	5	5	
8. Hours/day/vaccination (#6 X #7)/60 mins.				
9. Proportion vaccination time to other activities (#8/no.working hrs/day) If 9C greater than 50%, then increase staffing go back to #6)				
10. Yearly earnings/vaccinator				
11. Number vaccinators				
12. Personnel cost (#9 X #10 X #11)				

B. What are the fixed costs of TT immunization strategies?

Fixed costs are those which occur as a result of operating the delivery strategy, such as cold chain equipment, training of personnel and transportation. It is more difficult to calculate fixed costs for TT immunization because many costs are shared with child immunization. Therefore, fixed costs will represent additional costs for TT vaccination above program costs for childhood immunization.

B.1 Cold chain equipment costs

Cold chain equipment costs are shared usually between child and adult immunization. For this analysis, we shall measure the incremental cold chain requirements for alternative TT immunization strategies to determine whether additional cold chain equipment must be purchased. To simplify the calculations, cold chain transport requirements have not been included in the handbook. However, these can be added easily to the model. In order to complete this analysis, information on the volume and prices of cold chain equipment must be known. This information is available in the "EPI Product Information Sheets" which are updated on a regular basis by the WHO. In addition, the following data may be useful:

TABLE C
NATIONAL COLD CHAIN SYSTEM REQUIREMENTS

LEVEL	POPULATION	TYPE OF	VOLUME (LTRS)	UNIT COST
National Store	10 million	Cold Room	30 m ³ or 30,000 ltrs	\$8,000
Regional Store E 3/22	1 million	Top Loading Refrigerator (electric)	200	\$1,000
E 3/08		Freezer (electric)	198	\$250
E 3/18		Top Loading Refrigerator (kerosene)	142	\$900
E 3/09		Freezer (kerosene)	142	\$900
District Store E 3/22	200,000	Top Loading Refrigerator (electric/gas)	24	\$800
Health Center E 3/22	40,000	Top Loading Refrigerator	24	\$800

Source: WHO/EPI/Product Information Sheets, 1988/89.

Table D can be used to calculate total additional cold chain requirements and potential costs for the TT immunization strategy. Some approximate prices have been included in the table. The requirements for child immunization are included because the refrigeration is shared.

TABLE D
ESTIMATION OF ADDITIONAL COLD CHAIN REQUIREMENTS
FOR ALTERNATIVE TT IMMUNIZATION STRATEGIES

INDICATOR	A CHILD	B TT STRATEGY	C BOTH (A+B)
1. Total volume yearly doses each individual(cc) at 4°C	8.5	2.5	
2. Number to vaccinate at coverage level (population X coverage level)			
3. Total yearly expected volume (#1 X #2)			
4. Wastage factor (WHO)	1.33	1.33	1.33
5. Grossing factor (WHO)	1.2	1.2	1.2
6. Volume to stock/year (cc) (#3 X #4 X #5)			
7. Volume to stock/year (ltrs) (#6 divided by 1,000)			
8. Capacity central store (ltrs) (# liters X #cold rooms)			
9. #8C - #7C if negative, then must purchase additional storage space; if positive, skip to #13			
10. Number additional cold rooms (#9C divided by volume and rounded to nearest whole number)			
11. Unit price/cold room	\$8,000	\$8,000	
12. Additional cost (#10 X # 11)			

TABLE D
(cont'd)
ESTIMATION OF ADDITIONAL COLD CHAIN COSTS
FOR ALTERNATIVE TT IMMUNIZATION STRATEGIES

INDICATOR	A CHILD	B TT STRATEGY	C COMBINED
13. Volume per region/3mos. (#7 / 4 / # regions)			
14. Capacity per region (#refrigerators X volume)			
15. #14C - #13C If negative, then must purchase more equipment, if positive, then skip to #19			
16. Total additional refrigerator (15C / volume per refig X no. regions)			
17. Unit price/refrigerator	\$1000	\$1000	\$1000
18. Additional cost (#17 X #16)			
19. Volume per district/mo. (#7/no. districts/12)			
20. Capacity per district (#refrigerators X volume)			
21. #20C - #19C If negative, then must purchase more equipment; if positive, then skip to #25			
22. Total additional refrigerator (21C / volume per refig. X # districts)			
23. Unit price/refrigerator	\$800	\$800	\$800
24. Additional cost (#23 X #22)			
25. Volume/health cen/mo (#7/no. hc/12)			
26. Capacity per hc/mo (# refrigerators X volume)			

TABLE D
(cont'd)
ESTIMATION OF ADDITIONAL COLD CHAIN COSTS
FOR ALTERNATIVE TT IMMUNIZATION STRATEGIES

INDICATOR	A CHILD	B TT STRATEGY	C COMBINED
27. #26C - #25C If negative, then must purchase more equipment; if positive, finished			
28. Total additional refrigerator (27C/volume per frig. X # hc)			
29. Unit price/refrigerator	\$800	\$800	\$800
30. Additional cost (#29 X #28)			
31. Total additional cost (#12 + #18 + #24 + #30)			
32. Average useful life of cold chain equipment	5 years	5 years	5 years
33. Present worth of annuity factor (at 10% inflation)	3.79	3.79	3.79
34. Proportion of cold chain equipment for TT	15-20%	15-20%	15-20%
35. Depreciated value of new cold chain equipment for TT (#31/#33) X #34			

NB: WHO EPI Costing Guidelines and the AID Guidance on Costing of Health Service Delivery Projects recommend to depreciate each piece of equipment separately; however, to simplify the calculations, the depreciation is performed at the end of the calculations. Values for present worth of annuity factors are located at the back of this handbook. The Grossing Factor allows for dead air space in cold chain equipment needed for proper cooling and has been estimated by the WHO. Total volume of yearly doses are estimated directly from WHO figures.

Cold chain operation and maintenance costs will be affected by additional purchases of cold chain equipment. Table E will help in calculating these additional costs.

**TABLE B
ADDITIONAL COLD CHAIN OPERATION REQUIREMENTS**

STEP	CENTRAL LEVEL	REGIONAL LEVEL	DISTRICT LEVEL	HEALTH CENTER	TOTAL
<hr style="border-top: 1px dashed black;"/>					
1. Original quantity					
2. New quantity					
3. Total (#1 + #2)					
4. Ratio (#2/#3)					
5. Operating cost/mo. per level	\$1000	\$500	\$250	\$50	
6. Additional cost/mo. (#5 X #4)					
7. Total cost/mo. (#5 + #6)					
8. Total cost (#7 X 12)					

NB: Figures for operating cost per month are based on rough estimates from previous costing studies and should be changed to reflect the actual operating costs in a specific country.

B.2 Transportation costs

Transportation costs are principally the costs of fuel to move vaccines, supplies, and personnel from one place to another. Additional costs for TT immunization may be estimated from assumptions about additional fuel per vehicle per health center. The following table can be used to estimate additional transportation costs:

TABLE F
TRANSPORTATION COSTS FOR TT IMMUNIZATION

1. Total number of additional kilometers driven per month per vehicle for TT immunization? (depends upon additional trips for supervision or replacement or stock)	
2. Total number of vehicles per facility?	
3. Total number of additional kilometers travelled per month per facility? (#1 multiplied by #2)	
4. Average price per liter?	
5. Number of kilometers per liter? (estimated)	
6. Average price per kilometer? (#4 multiplied by #5)	
7. Average fuel cost per month/facility? (#6 multiplied by #3)	
8. Average fuel cost per year per facility? (#7 multiplied by 12)	
9. Number of health facilities?	
10. Additional annual transportation cost for TT immunization (#8 multiplied by #9)	

B.3 Training costs

Training costs include the cost of producing training materials as well as travel, per diem, and proportion of annual salaries of trainers and trainees for training time. These methods focus on additional training for TT immunization. The following table can assist in making these calculations:

TABLE G
TRAINING COSTS FOR TT IMMUNIZATION

Salaries-Trainees

1. Numbers of persons to be trained per year? _____
2. Average annual earnings for trainees? _____
3. Total annual earnings for trainees?
(#1 multiplied by #2) _____
4. Number of work days/year/person? _____
5. Number of TT training days per person? _____
6. Total number of TT training days?
(#1 multiplied by #5) _____
7. Proportion of training to work days?
(#5 divided by #4) _____
8. Cost of annual earnings allocated
to TT immunization training?
(#3 multiplied by #7)

Salaries-Trainers

1. Number of trainers? _____
2. Average annual earnings per
trainer? _____
3. Total annual earnings for TT
trainers? (#1 multiplied by #2) _____
4. Proportion of TT training days
compared to work days? (#7 above) _____
5. Annual trainers earnings allocated
to TT immunization training?
(#3 multiplied by #4)

Per diem

1. Number of trainers? _____
2. Number of trainees? _____
3. Daily rate for lodging and food
at training site? _____
4. Number of TT training days? _____

5. Per diems- trainers
(#1 X #3 X #4)

6. Per diems-trainees
(#2 X #3 X #4)

7. Total per diem for TT training
(#5 plus #6)

--

Transportation

1. Number of trainers and trainees?

2. Number of roundtrip journeys?

3. Price of a roundtrip ticket by
airplane, bus, train, boat, etc.?

4. Cost of transportation for TT
immunization training? (#2 multiplied
by #3)

--

Production of training materials

1. Number of additional materials
to be produced for TT training?

2. Average cost to produce one
set of materials?

3. Total TT production cost? (#1
multiplied by #2)

--

Training Total

(sum of all sections)

--

B.4 Supervision costs

Supervision costs include additional travel, per diem and proportion of annual salaries of health workers devoted to supervising TT immunization program activities. Supervision of TT activities is usually part of overall immunization program supervision. However, a more intensive strategy may require additional hours of supervision for TT immunization alone. The following table can assist in making these calculations, though each step should be adjusted according to the type of strategy which is being costed.

TABLE H
SUPERVISION COSTS FOR TT IMMUNIZATION

Salaries-Supervisors

1. Numbers of supervisors? _____
2. Average annual earnings for supervisors? _____
3. Total annual earnings for supervisors?
(#1 multiplied by #2) _____
4. Number of work days/year/person? _____
5. Number of TT supervision days/year? _____
6. Total number of TT supervisory days?
(#1 multiplied by #5) _____
7. Proportion of TT supervisory days to
work days (#5 divided by #4) _____
8. Cost of annual earnings allocated
to TT immunization supervision?
(#3 multiplied by #7)

Per diem for Supervision

1. Number of supervisors? _____
2. Number of additional supervision
rounds per year for TT supervision? _____
3. Total number of TT supervisory visits
per year? (#1 X #2) _____
4. Number of days/ TT supervisory visit? _____
5. Total number TT supervisory days?
(#3 X #4) _____
6. Daily rate for lodging and food
at supervisory sites? _____
7. Per diem for supervisors?
(#5 multiplied by #6)

Transportation for Supervision

- 1. Number of additional supervisory trips
trips per year for TT immunization? _____
- 2. Number of roundtrip journeys? _____
- 3. Price of a roundtrip ticket by
airplane, bus, train, boat, etc.? _____
- 4. Cost of transportation for TT
immunization supervision (#2
multiplied by #3)?

Supervision Total
(sum of all sections)

B.5 Evaluation and monitoring costs

Monitoring of NNT can take two forms: 1) coverage surveys and 2) routine reporting systems. The following table and set of formulas can help estimate survey costs for TT coverage or NNT mortality. The total cost will depend upon the size and level of detail of the survey.

TABLE I
MONITORING COSTS FOR TT COVERAGE SURVEYS

- 1. Number of clusters to sample? _____ 30 _____
- 2. Number of interviewers? _____
- 3. Total field days (#1 / #2) _____
- 4. Total survey days (#workers X #3) _____
- 5. Average annual earnings/interviewer? _____
- 6. Average daily earnings (#5/#working
days) _____
- 7. Total personnel costs for survey?
(#4 X #6)
- 8. Daily rate for lodging and
food? _____
- 9. Total per diem for survey?
(#4 X #9)
- 11. Average kilometers driven per day? _____
- 12. Number of kilometers/liter? _____ 4 _____

- 13. Price per liter of fuel? _____
- 14. Total fuel cost for survey?
(#11 / #12 X #13) _____
- 15. Number of roundtrips by plane? _____
- 16. Price per roundtrip? _____
- 17. Plane travel cost
(#15 X #16) _____
- 18. Total transportation cost
(#14 plus #17)
- 19. Total survey cost
(Add #7, #9, #18)

B.6 Social mobilization costs

These additional costs refer to those incurred in promoting and encouraging the population to participate and become vaccinated, including cost of radio and television transmission time, production of leaflets and brochures, and painting of billboards. A formula and table to calculate these costs is recommended below:

$$\text{MEDIA COST} = \text{Additional units} \times \text{Price/Unit}$$

TABLE J
ADDITIONAL MEDIA COSTS FOR TT IMMUNIZATION

Type of Media	Additional Units	Price/Unit	Cost
Radio			
Television			
Posters			

C. Total Cost

Once these selected variable and fixed costs have been calculated, Table K can be used to summarize the total cost of a particular strategy. These calculations can be repeated for alternative TT immunization strategies, and cost results compared to see which strategy is the least costly.

D. Cost-effectiveness

Table K also provides a format for calculating and comparing the cost-effectiveness of alternative TT immunization strategies. Cost-effectiveness can be calculated by dividing the total TT strategy cost by the estimated numbers of women fully vaccinated (TT2 figures). The formula below can be used to calculate cost-effectiveness. The lowest cost per fully immunized women is considered to be the most economical strategy for achieving a desired level of coverage.

$$\text{COST-EFFECTIVENESS} = \frac{\text{INCREMENTAL COST OF TT IMMUNIZATION (dollars or local currency)}}{\text{EFFECTIVENESS OF TT IMMUNIZATION (number of TT2,3,4 or 5 doses; \# fully immunized women, etc.)}}$$

E. Incremental Cost-effectiveness

To determine whether changing from one TT immunization strategy to another would be more economical and cost-effective, the costs and effectiveness of these two strategies can be compared. To do this, the difference in cost is compared with the difference in effectiveness, using the following formula:

$$\text{INCREMENTAL COST EFFECTIVENESS} = \frac{\text{COST OF SECOND STRATEGY} - \text{COST OF FIRST STRATEGY}}{\text{EFFECTIVENESS OF SECOND STRATEGY} - \text{EFFECTIVENESS OF FIRST STRATEGY}}$$

If the incremental cost-effectiveness ratio is higher than the original ratio of the first strategy, then it would never be economical to change from the first strategy to the second. If the incremental cost-effectiveness ratio is lower than the original, then the second strategy is preferred.

TABLE K
SUMMARY TABLE FOR COST AND COST-EFFECTIVENESS
OF ALTERNATIVE TT IMMUNIZATION STRATEGIES

RESOURCE CATEGORY	STRATEGY 1	STRATEGY 2	DIFFERENCE
VARIABLE COST			
Vaccines			
Needles			
Syringes			
Personnel			
Subtotal			
FIXED COSTS*			
Transport			
Training			
Supervision			
Social Mobilization			
Monitoring			
Cold Chain Equip.			
Cold Chain Oper.			
Subtotal			
GRAND TOTAL			
<hr/>			
Number Immunized			
(with TT2, 3, 4, or 5)			
Cost/Immunized			
Woman			

*Vehicles and buildings costs not described in handbook.

APPENDIX 1: Capital Annualizing Factors (WHO/GEN/79/5)

RATE 5%

PRESENT WORTH OF AN ANNUITY FACTOR
How much I received or paid annually for X years is worth today

Year		Year	
1	.952 381	1	.934 579
2	1 859 410	2	1 808 018
3	2 723 248	3	2 624 316
4	3 545 951	4	3 387 211
5	4 329 477	5	4 100 197
6	5 075 692	6	4 766 540
7	5 786 373	7	5 389 289
8	6 463 213	8	5 971 299
9	7 107 822	9	6 515 232
10	7 721 735	10	7 023 582
11	8 306 414	11	7 498 674
12	8 863 252	12	7 942 686
13	9 393 573	13	8 357 651
14	9 898 641	14	8 745 468
15	10 379 658	15	9 107 914
16	10 837 770	16	9 446 649
17	11 274 066	17	9 763 223
18	11 689 587	18	10 059 087
19	12 085 321	19	10 335 595
20	12 462 210	20	10 594 014
21	12 821 153	21	10 835 527
22	13 163 003	22	11 061 240
23	13 488 574	23	11 272 187
24	13 798 642	24	11 469 334
25	14 093 945	25	11 653 583
26	14 375 185	26	11 825 779
27	14 643 034	27	11 986 709
28	14 898 127	28	12 137 111
29	15 141 074	29	12 277 674
30	15 372 451	30	12 409 041
31	15 592 811	31	12 531 814
32	15 802 877	32	12 646 555
33	16 002 549	33	12 753 790
34	16 192 804	34	12 854 009
35	16 374 194	35	12 947 672
36	16 546 852	36	13 035 208
37	16 711 287	37	13 117 017
38	16 867 893	38	13 193 473
39	17 017 041	39	13 264 928
40	17 159 086	40	13 331 709
41	17 294 368	41	13 394 120
42	17 423 208	42	13 452 449
43	17 545 912	43	13 506 962
44	17 662 773	44	13 557 908
45	17 774 070	45	13 605 522
46	17 880 066	46	13 650 020
47	17 981 016	47	13 691 608
48	18 077 158	48	13 730 474
49	18 168 722	49	13 766 799
50	18 255 925	50	13 800 746

RATE 7%

PRESENT WORTH OF AN ANNUITY FACTOR
How much I received or paid annually for X years is worth today

Year		Year	
1	.909 091	1	.909 091
2	1 735 537	2	1 735 537
3	2 486 852	3	2 486 852
4	3 169 865	4	3 169 865
5	3 790 787	5	3 790 787
6	4 355 261	6	4 355 261
7	4 868 419	7	4 868 419
8	5 334 926	8	5 334 926
9	5 759 024	9	5 759 024
10	6 144 567	10	6 144 567
11	6 495 061	11	6 495 061
12	6 813 692	12	6 813 692
13	7 103 356	13	7 103 356
14	7 366 687	14	7 366 687
15	7 606 080	15	7 606 080
16	7 823 709	16	7 823 709
17	8 021 553	17	8 021 553
18	8 201 412	18	8 201 412
19	8 364 920	19	8 364 920
20	8 513 564	20	8 513 564
21	8 648 694	21	8 648 694
22	8 771 540	22	8 771 540
23	8 883 218	23	8 883 218
24	8 984 744	24	8 984 744
25	9 077 040	25	9 077 040
26	9 160 945	26	9 160 945
27	9 237 223	27	9 237 223
28	9 306 567	28	9 306 567
29	9 369 606	29	9 369 606
30	9 426 914	30	9 426 914
31	9 479 013	31	9 479 013
32	9 526 376	32	9 526 376
33	9 569 432	33	9 569 432
34	9 608 575	34	9 608 575
35	9 644 159	35	9 644 159
36	9 676 508	36	9 676 508
37	9 705 917	37	9 705 917
38	9 732 651	38	9 732 651
39	9 756 956	39	9 756 956
40	9 779 051	40	9 779 051
41	9 799 137	41	9 799 137
42	9 817 397	42	9 817 397
43	9 833 998	43	9 833 998
44	9 849 089	44	9 849 089
45	9 862 808	45	9 862 808
46	9 875 280	46	9 875 280
47	9 886 618	47	9 886 618
48	9 896 926	48	9 896 926
49	9 906 296	49	9 906 296
50	9 914 814	50	9 914 814

RATE 10%

PRESENT WORTH OF AN ANNUITY FACTOR
How much I received or paid annually for X years is worth today

Year		Year	
1	.892 857	1	.892 857
2	1 690 051	2	1 690 051
3	2 401 831	3	2 401 831
4	3 037 349	4	3 037 349
5	3 604 776	5	3 604 776
6	4 111 407	6	4 111 407
7	4 563 757	7	4 563 757
8	4 967 640	8	4 967 640
9	5 328 250	9	5 328 250
10	5 650 223	10	5 650 223
11	5 937 699	11	5 937 699
12	6 194 374	12	6 194 374
13	6 423 548	13	6 423 548
14	6 628 168	14	6 628 168
15	6 810 864	15	6 810 864
16	6 973 986	16	6 973 986
17	7 119 630	17	7 119 630
18	7 249 670	18	7 249 670
19	7 365 777	19	7 365 777
20	7 469 444	20	7 469 444
21	7 562 003	21	7 562 003
22	7 644 646	22	7 644 646
23	7 718 434	23	7 718 434
24	7 784 316	24	7 784 316
25	7 843 139	25	7 843 139
26	7 896 660	26	7 896 660
27	7 942 554	27	7 942 554
28	7 984 423	28	7 984 423
29	8 021 806	29	8 021 806
30	8 055 184	30	8 055 184
31	8 084 986	31	8 084 986
32	8 111 594	32	8 111 594
33	8 135 352	33	8 135 352
34	8 156 564	34	8 156 564
35	8 175 504	35	8 175 504
36	8 192 414	36	8 192 414
37	8 207 513	37	8 207 513
38	8 220 993	38	8 220 993
39	8 233 030	39	8 233 030
40	8 243 777	40	8 243 777
41	8 253 372	41	8 253 372
42	8 261 939	42	8 261 939
43	8 269 589	43	8 269 589
44	8 276 418	44	8 276 418
45	8 282 516	45	8 282 516
46	8 287 961	46	8 287 961
47	8 292 822	47	8 292 822
48	8 297 163	48	8 297 163
49	8 301 038	49	8 301 038
50	8 304 498	50	8 304 498

RATE 12%

PRESENT WORTH OF AN ANNUITY FACTOR
How much I received or paid annually for X years is worth today

Year		Year	
1	.869 565	1	.869 565
2	1 625 709	2	1 625 709
3	2 283 225	3	2 283 225
4	2 854 978	4	2 854 978
5	3 352 155	5	3 352 155
6	3 784 483	6	3 784 483
7	4 160 420	7	4 160 420
8	4 487 322	8	4 487 322
9	4 771 584	9	4 771 584
10	5 018 769	10	5 018 769
11	5 233 712	11	5 233 712
12	5 420 619	12	5 420 619
13	5 583 147	13	5 583 147
14	5 724 476	14	5 724 476
15	5 847 370	15	5 847 370
16	5 954 235	16	5 954 235
17	6 047 161	17	6 047 161
18	6 127 966	18	6 127 966
19	6 198 231	19	6 198 231
20	6 259 331	20	6 259 331
21	6 312 462	21	6 312 462
22	6 358 663	22	6 358 663
23	6 398 837	23	6 398 837
24	6 433 771	24	6 433 771
25	6 464 149	25	6 464 149
26	6 490 564	26	6 490 564
27	6 513 534	27	6 513 534
28	6 533 508	28	6 533 508
29	6 550 877	29	6 550 877
30	6 565 980	30	6 565 980
31	6 579 113	31	6 579 113
32	6 590 533	32	6 590 533
33	6 600 463	33	6 600 463
34	6 609 099	34	6 609 099
35	6 616 607	35	6 616 607
36	6 623 137	36	6 623 137
37	6 628 815	37	6 628 815
38	6 633 752	38	6 633 752
39	6 638 045	39	6 638 045
40	6 641 778	40	6 641 778
41	6 645 025	41	6 645 025
42	6 647 848	42	6 647 848
43	6 650 302	43	6 650 302
44	6 652 437	44	6 652 437
45	6 654 293	45	6 654 293
46	6 655 907	46	6 655 907
47	6 657 310	47	6 657 310
48	6 658 531	48	6 658 531
49	6 659 592	49	6 659 592
50	6 660 515	50	6 660 515

RATE 15%

PRESENT WORTH OF AN ANNUITY FACTOR
How much I received or paid annually for X years is worth today

Year		Year	
1	.869 565	1	.869 565
2	1 625 709	2	1 625 709
3	2 283 225	3	2 283 225
4	2 854 978	4	2 854 978
5	3 352 155	5	3 352 155
6	3 784 483	6	3 784 483
7	4 160 420	7	4 160 420
8	4 487 322	8	4 487 322
9	4 771 584	9	4 771 584
10	5 018 769	10	5 018 769
11	5 233 712	11	5 233 712
12	5 420 619	12	5 420 619
13	5 583 147	13	5 583 147
14	5 724 476	14	5 724 476
15	5 847 370	15	5 847 370
16	5 954 235	16	5 954 235
17	6 047 161	17	6 047 161
18	6 127 966	18	6 127 966
19	6 198 231	19	6 198 231
20	6 259 331	20	6 259 331
21	6 312 462	21	6 312 462
22	6 358 663	22	6 358 663
23	6 398 837	23	6 398 837
24	6 433 771	24	6 433 771
25	6 464 149	25	6 464 149
26	6 490 564	26	6 490 564
27	6 513 534	27	6 513 534
28	6 533 508	28	6 533 508
29	6 550 877	29	6 550 877
30	6 565 980	30	6 565 980
31	6 579 113	31	6 579 113
32	6 590 533	32	6 590 533
33	6 600 463	33	6 600 463
34	6 609 099	34	6 609 099
35	6 616 607	35	6 616 607
36	6 623 137	36	6 623 137
37	6 628 815	37	6 628 815
38	6 633 752	38	6 633 752
39	6 638 045	39	6 638 045
40	6 641 778	40	6 641 778
41	6 645 025	41	6 645 025
42	6 647 848	42	6 647 848
43	6 650 302	43	6 650 302
44	6 652		

**APPENDIX 2:
BIBLIOGRAPHY OF SELECTED ARTICLES AND MANUALS ON COST-EFFECTIVENESS**

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**APPENDIX 3:
GLOSSARY OF TERMS**

Resource: The inputs which are used to provide or deliver immunization services. Resources consist of labor, materials, and money.

Cost: A cost refers to the value of resources used to deliver immunization services. In this report, the terms cost, full cost, resource cost, and full resource cost are synonymous.

Total Cost: The total cost of an EPI is equal to the sum of the value of all resources used. Total costs can be divided into fixed costs and variable costs. Fixed cost plus variable cost equal total cost.

Variable Cost: Variable costs equal the value of resources used each time an immunization is given. The cost of vaccines is a variable cost because each child receives a vaccine and incurs a cost for the EPI.

Fixed Cost: Fixed costs are those which do not increase or change with increasing numbers of children immunized. For example, one fixed cost for an immunization program is vehicle cost because each child immunized does not require a separate vehicle. However, all costs are variable in the long run.

Investment Cost: Investment costs (or capital costs) are the value of resources which accrue benefits in the future or which are used infrequently in a program. For example, building costs and vehicle costs represent investment costs for immunization programs.

Recurrent Cost: Recurrent costs (operating costs) are equal to the value of resources used on a frequent basis (e.g. each month, each day) to provide immunization services. For instance, vaccine costs occur every day of an immunization program and are therefore a recurrent cost of that program.

Opportunity Cost: An opportunity cost is a measure of the value lost by undertaking one activity or another. For instance, the value of a mother's time spent traveling to have her child immunized represents an opportunity cost to the mother, or the family, who could have been earning wages or performing other household activities.

Cost-effectiveness: A technique which determines whether the effectiveness of a program (health outcomes) are worth their costs. The ratio between the total cost and the effectiveness of a program is its cost-effectiveness ratio.

Cost Category: A name given to classify a wide variety of program inputs into similar groups such as personnel, transportation, media and equipment.

Cost Profile: A comparison of the value of cost categories (e.g., personnel) to the total cost of an EPI. This analysis gives proportions. It is calculated by taking ratios between total cost and the value of each cost category.

Expenditure: Money which is actually spent.

Budget: A yearly account which estimates how much money goes in and comes out of the national government or of a household. This budget may or may not be equivalent to the amount of money spent at the end of the year.

Financial Analysis: An evaluation of who is paying for immunizations and how much is being spent.

Financing: How something is paid for. When individual patients give donations to health centers, they are financing some part of the delivery of services.

Fully Immunized Woman: In these studies, a fully immunized woman refers to a woman who has received at the number of required doses of tetanus toxoid: either two doses for a TT2 strategy, three doses for a TT3 strategy, and five doses for a TT5 strategy.

Marginal or Incremental Cost: This is the additional cost to provide one more immunization with a country EPI. A marginal cost analysis would evaluate how much more it would cost at higher levels of coverage (greater numbers of children immunized).