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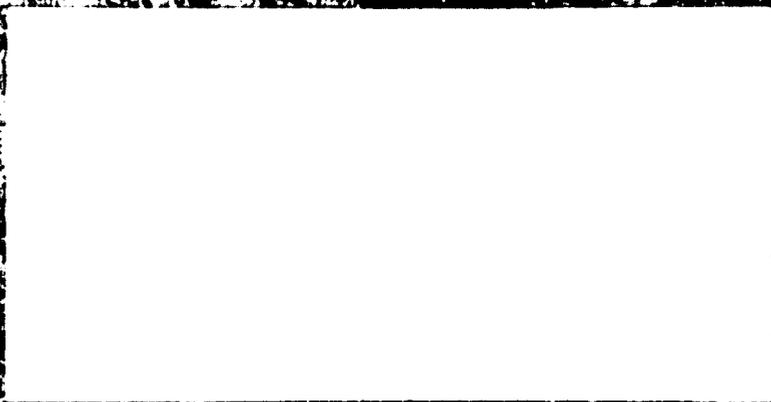
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A REPORT ON
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THE LAMPANG HEALTH DEVELOPMENT PROJECT

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Special thanks go to Pien Chiowanich, John Rogosch, and Donald Wilson, whose roles in the project made their association during the consultation especially critical. These persons offered constant encouragement, focused attention on key issues, directed efficient attention to important information, and offered valuable insights during numerous discussions.

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I. INTRODUCTION

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Scope of Work

The Lampang Health Development Project (LHDP) is at a critical stage in consolidating the vast amount of data gathered before and during the operational phase, analyzing and interrelating the information from the several data sets, and preparing final documentation on the project. In particular, the cost and task analyses provide an exceptionally rich, though only partially tapped, basis for an evaluation of the project's performance and for future planning.

The main purpose of the consultation was "to refine and expand the cost and task analysis." Progress in analyzing other data and their linkage to cost and task analysis was a second concern of the consultant. Additional data from the Community Health Survey were tabulated in recent months, but several errors were found in the calculations. The consultant therefore devoted considerable effort to the appraisal of community health services and to a possible means of ensuring the accuracy of results in the limited time remaining for evaluation. A third objective of the consultation was to review with project staff the draft documentation on evaluation. The consultant especially directed attention to draft Monograph No. 2, A System of Evaluation and Management Information for Integrated Rural Health Care.

Broadly speaking, the present consultation and report are considered to be an update of a consultation by the author in June 1980. That consultation resulted in the report entitled "An Evaluation of the Lampang Health Development Project."

Work Plan

The consultancy began at the National Institute of Development Administration (NIDA), where discussions were held with NIDA and LHDP staff on the current status of cost and task analysis and the findings of the Community Health Survey. These meetings (December 29-31, 1980) constituted an essential orientation to the consultancy on the central role of the NIDA in collecting data and preparing these topics.

Work with these and other project data proceeded in Lampang, Thailand, in collaboration with project staff, until January 13, 1981. On January 14-15, the activity shifted back to Bangkok, where discussions and debriefings were held at NIDA offices and the AID mission.

II. FINDINGS AND CONCLUSIONS

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Cost and Task Analysis

The cost and task analysis should serve two purposes. One, it should provide an opportunity for comparing costs and personnel activities before and after project intervention. Two, the post-intervention findings should provide a wealth of data of potential value for future policy analysis and planning following assessments of the implications of possible program modifications.

With these purposes in mind, the consultant reviewed available information and found that a composite of follow-up data from areas E1 and E2 could provide an excellent profile of post-intervention operating conditions. Since the 1975 task analysis did not provide truly comparable pre-intervention data, the corresponding profile of pre-intervention operating conditions must rely heavily on the extensive task data obtained from the 1977 baseline task analysis in E2 and the C1 follow-up study. Unfortunately, a few questions about the accuracy of E2 baseline data remained at the time of the consultancy.

An analytical model was developed to serve the two purposes cited above, and follow-up data from E1 and E2 were consolidated for application to the model. A detailed description of the analytical process and results is attached to this report. This document, entitled "Proposed Methodology for Integrated Cost/Task Analysis," should be useful in planning and policy analysis. The detailed description of necessary calculations and tabulations should serve as a set of instructions for establishing a comparative profile of pre-intervention conditions once the E2 baseline data are in usable form.

In using the analytical approach and tabulations as they are now constituted, it must be emphasized that analysis is limited to the health facilities and excludes, for example, the services of health post volunteers. Total activities and services are therefore underrepresented, whereas unit costs are inflated. Final analysis requires the incorporation of other sources of use data.

Community Health Survey

The report on the June 1980 consultancy outlines a recommended format for Community Health Survey analysis, using E1 and C1 results for illustration. Two of the major analytical problems identified in the report received special attention for follow-up investigation during the present consultation.

The first problem was an apparent underreporting of illness in large households. This problem was compounded by the conscious overrepresentation of large households in the baseline surveys, which made comparison with follow-up data difficult.

The second problem was a consequence of reporting baseline findings in terms of total population estimates obtained by extrapolation from sample data. Having lost sight of actual sample findings, staff found that statistical analysis was virtually impossible. The problem was exacerbated when it was suspected that the multipliers used in the extrapolation process were based on erroneous assumptions.

Because of these problems, it was recommended that baseline tabulations be rerun on the sample information itself and that certain additional tables be produced, including further breakdowns by household size. In general, these recommendations were followed, although breakdowns by household size were limited to illness data. Moreover, the tabulations are now available for all surveys, except the C2 baseline study.

The analytical format outlined earlier involved 20 key tabulations. These tabulations were examined for 7 surveys (E1, E2, and C1 baseline; E1, E2, C1, and C2 follow-up), for a total of 140 tables. Of the 140 tables of interest, 19 are still unavailable. Of the 121 that are available, about one-fourth (28 tables) are obviously in error and therefore unusable because of incorrect or conflicting control totals.

The 93 tables available and not obviously in error were reviewed to determine distribution of samples by household size, patterns of illness, service use, and household environmental conditions. The four sets of findings are discussed below.

A. Representativeness of Samples

The four follow-up studies produced wide variations in sample distribution by household size. For example, the proportion of households with one to three members varied from 14.2 percent (C1) to 22.7 percent (E2). Such differences are highly significant statistically and suggest one of two possibilities. First, the four areas studied may indeed differ in household structure. There is no known reason why this should be so. Second, the sample may not have been representative of the areas studied. On the face of it, this appears to be the more plausible explanation. In fact, non-randomness was built into the sampling procedure. Half of the follow-up sample was selected for reinterview of families selected in the baseline survey, which was purposely weighted to favor inclusion of larger households.

In any case, the sampling resulted in differential weighting by size of household in different areas and between survey rounds. Small households tended to report more illness and to have lower incomes, which may have affected service use patterns. Comparisons must be treated with caution, therefore, and, where feasible, adjustments should be made for differential representation.

B. Illness Rates

The most striking finding on morbidity is the consistently higher rate reported in small families. Among households with one to three persons, nearly 14 episodes of illness in the preceding two weeks were reported per 100 persons. This was more than twice the level reported in households with at least seven members. Underreporting in large households was discerned earlier in E1 and C1. This phenomenon is maintained consistently in the larger data set. In addition, the lower economic status of smaller households may have contributed to more real illness.

No apparent change in overall morbidity levels occurred in the interval between the baseline and follow-up studies. The decline in E1 (discerned earlier) was not sustained in E2. In fact, the illness rate increased in E2 from 6.9 percent to 10.0 percent during the project period. The results must be treated with skepticism in view of the erratic shift in representation by household size; however, correction of this problem is not expected to produce dramatic evidence of a decline in morbidity.

C. Utilization of Services

The Community Health Survey, like other data sources, produces some evidence of increased use of government services. About 30 percent of illness episodes were first treated by government providers in E1 and E2, according to the follow-up surveys. This compares with 24 percent in C1 and C2. Unfortunately, comparison with baseline conditions is impossible, because all of the relevant baseline tables are either unavailable or obviously inaccurate.

The proportion of deliveries at home declined in E1 and E2 during the project period from 61 percent to 47 percent. Correspondingly, the proportion of deliveries assisted by qualified personnel (doctor, nurse, midwife) increased from 43 percent to 51 percent. The follow-up findings are somewhat better than those obtained in C1 and C2. Unfortunately, baseline data for the latter areas are not available at this time.

None of the use data are broken down by household size. This may cause some distortion in the comparison of baseline and follow-up results. Tables that present use patterns by economic status will be useful, however, in assessing the magnitude of possible distortion and in adjusting the findings (as appropriate).

D. Household Environmental Conditions

No apparent errors were found in the tables illustrating household environmental conditions. These tables showed clear signs of improvement in project intervention. This finding suggests that the addition and correction of tables on other aspects of the surveys may produce clearer evidence of change than is discernible at this time.

The June 1980 report summarized environmental information for E1 and C1 (see Table 9 of that report). The further elaboration now available is summarized in this report in Table 1, page 6, which has been updated. The table applies to E1, E2, and C1. C2 findings, available only for the follow-up round, generally show conditions superior to those in C1.

Nutrition Survey

The most extensive nutrition survey data are available from E2, which covers both baseline and follow-up conditions. The follow-up results show some improvement in the weight status of preschool children, especially the poor and the young. Only among infants, however, are the improvements significant statistically. Comparative results by age are shown in Table 2.

Health Post Volunteer Services

Project staff have extensively analyzed service statistics for health post volunteers. The analyses are hampered by incomplete reporting. Service reports may not be submitted for some volunteers for some months.

The incomplete information can be handled in one of two ways, depending on the assumptions that are made. On the one hand, it can be assumed that non-reporting reflects lack of activity. On the other hand, it can be assumed that non-reporting is a random phenomenon not associated with volunteer effort. In the latter case, effort not reported can be expected to be at approximately the same level as effort reported. This assumption dictates the number of volunteers to be used in the denominator of calculations of average services per volunteer per month or per year. Under the first

Table 1
HOUSEHOLD ENVIRONMENTAL CONDITIONS

<u>Number of Households in Sample</u>		<u>Baseline</u>	<u>Follow-up</u>	
	E1	1,539	759	
	E2	2,600	1,291	
	C1	1,060	530	
<u>Condition</u>		<u>Percent Baseline</u>	<u>Percent Follow-up</u>	<u>Percent Change</u>
Drink Water from Well	E1	87.7	97.8	+ 12
	E2	73.4	77.5	+ 6
	C1	79.2	70.9	- 10
Well Covered	E1	10.3	16.9	+ 64
	E2	11.8	15.8	+ 34
	C1	17.6	16.8	- 5
Water Improved	E1	NA	13.6	-
	E2	15.8	18.7	+ 18
	C1	8.3	5.7	- 31
Waste Water Disposal	E1	NA	49.3	-
	E2	27.2	54.5	+100
	C1	33.2	34.9	+ 5
Excreta Disposal	E1	43.9	55.9	+ 27
	E2	61.3	71.1	+ 16
	C1	51.3	62.1	+ 21

Source: Tables 2.4, 2.6, 2.8, and 2.9.

Table 2
NUTRITION STATUS OF UNDER-FIVES IN E2
(Gomez Classification - NAS Standards)

Age in Months	Baseline Percentage				Follow-up Percentage			
	<u>n</u>	<u>Normal</u>	<u>1⁰</u>	<u>2⁰+3⁰</u>	<u>n</u>	<u>Normal</u>	<u>1⁰</u>	<u>2⁰+3⁰</u>
0-6	107	61.7	25.2	13.1	38	81.6	10.5	7.9
6-12	121	37.2	47.9	14.8	37	56.8	32.4	10.8
12-24	243	20.6	56.0	23.4	68	20.6	57.4	22.0
24-60	<u>1,127</u>	<u>12.9</u>	<u>58.5</u>	<u>28.7</u>	<u>410</u>	<u>14.6</u>	<u>56.8</u>	<u>28.5</u>
TOTAL	<u>1,598</u>	<u>19.1</u>	<u>55.1</u>	<u>25.8</u>	<u>553</u>	<u>22.8</u>	<u>52.1</u>	<u>25.1</u>

assumption, the total number of volunteers is used in the calculation; in the second case, the number of reporting volunteers is used. Project staff have followed the first, more conservative, approach.

A review of data by district by year showed little or no correlation between level of reporting and average number of service contacts reported. The second assumption of randomness therefore appears to be plausible. Accordingly, calculations were made on the basis of reporting volunteers alone. The results, presented for E1 and E2 in Table 3, provide an upper limit on the estimates of service activity to go with the lower limit derived by project staff. The truth is evidently somewhere between these limits, but probably closer to the upper limit recorded in Table 3.

Table 3 shows a steady increase in average service levels for medical care throughout the project period. Family planning activity per volunteer was fairly level until 1979, when it increased dramatically.

It has been determined that the average volunteer serves a population of approximately 677. Therefore, the 332 service contacts per year represent about 475 contacts per 1,000 population. This compares with an estimate of 396 derived by project staff under the aforementioned, more conservative,

assumption. The difference is quite small, indicating that service reporting was quite complete.

The Community Health Survey showed that about 12.8 percent of the population consisted of currently-married women between the ages of 15 and 44. This works out to 86 per volunteer service area. The 142 pill cycles dispensed per volunteer in 1979 (Table 3) provided protection for the equivalent of 12 women for the full year. This amounts to nearly 14 percent of the target population.

Table 3
AVERAGE SERVICES PER YEAR PER HEALTH POST VOLUNTEER
IN E1 AND E2

Year	Service Type			
	All Contacts	Medical Care	Pill Cycles	FP Acceptors
1975	288	119	28	27
1976	209	70	30	24
1977	253	176	46	28
1978	238	168	51	41
1979	322	194	142	125

Integration of Results

The cost and task analysis provides detailed information on personnel activity, costs, and associated services by function. The data are based on limited periods of observation. These may not be fully representative, however, and extrapolation of annual statistics must be treated with caution. Annual service statistics do not present information in detail by facility and function. Volunteer statistics represent another source of service data compiled systematically and not reflected in the cost and task analysis. The Community Health Survey would also provide useful insights into patterns of service use if results were compiled completely and accurately.

A preliminary review of the four data sets suggests that the figures are reasonably compatible. Annual service statistics are now being compiled in greater detail. This is a priority effort, as is the cleaning of

Community Health Survey tabulations. When these tasks are completed, it will be possible to examine data more closely and to integrate the various sources of information on service use.

Progress on Monographs

Monograph No. 2, on evaluation methodology, has been revised. It now reflects consideration of reviewers' comments, including those in the report on the June 1980 consultancy. It is clear that the monograph will in its present state serve a most useful purpose in promoting an understanding of the Lampang evaluation process and in guiding subsequent efforts.

During the consultation, further discussions were held on the need for additional elaboration in a few places in the monograph on evaluation. In addition, the entire set of evaluation indicators was reviewed in the light of current knowledge of actual evaluative findings. The review confirmed the validity, feasibility, and usefulness of nearly all indicators. Suggestions for clarification were made in only a few cases, and a few indicators were added.

Although not a principal concern, the consultant had occasion to review drafts of several additional monographs. In every case, he was impressed with the quality of the documents. Given the time required for editing and printing, further progress on documentation must be accelerated.

III. RECOMMENDATIONS

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1. The one remaining gap in cost and task analysis requires final compilation of E2 baseline task data. Application of these data to the model developed and described in this report is a straightforward procedure that will provide useful comparisons of pre- and post-intervention activity profiles. It should be noted, however, that the comparisons are not expected to produce striking differences inasmuch as the task analyses did not include health post volunteers or child nutrition centers, innovative features of the interventions.
2. Community Health Survey findings have become the principal bottlenecks to completion of the project evaluation. There is a real concern about how much can be accomplished in the limited time available. The present tabulations of data on service use are especially weak. Of the 28 tables clearly found to be in error, 21 relate to use of health services, contraceptive practice, and fertility. An especially important consideration, which was identified in the June 1980 report, was the need to separate in documentation those persons who received services from the number and types of services rendered to recipients. This task required additional tabulations, many of which were not carried out satisfactorily, if at all. The variety and magnitude of problems to be tackled in a short time require the establishment of clear priorities and close supervision of the programming effort needed to meet them.

- a. Attention should be focused on the 20 sets of tables identified as being of principal importance. These are:

1.1	2.9	3.1.13	3.3.2
1.4	3.1.1	3.2.4	3.3.3
2.4	3.1.7	3.2.7	4.4
2.6	3.1.8	3.2.10	4.6
2.8	3.1.9	3.2.15	4.7

- b. Within these data sets, priority should be given to those that are at this time missing entirely and to those that were established in June 1980 to reflect use of services (notably, Table 4.4).
 - c. Existing tables with erroneous control totals should not be difficult to correct. They represent the next level of priority.
3. Detailed breakdowns of annual service statistics by facility type and category of service are being prepared. This information deserves priority attention to permit integration with other sources of services data in the analysis and interpretation of data compatibility and trends.

4. The time required to produce documents is invariably underestimated. The Lampang Project is no exception. Greater appreciation of the urgency of submitting documentation for final production is needed. Temptations to postpone the submission of such information to make minor refinements must be avoided.
5. As in other evaluations of large studies, the evaluation of the Lampang Project will undoubtedly produce a mixture of results that indicate varying degrees of success or lack of success. For example, there is likely to be evidence of increased use of services with uncertain impact at the periphery but little or no change in health center activity. Peripheral services require a level of support and supervision that may not have been achieved during the life of the project. Malnutrition is a major problem with no easy solution. Impact on the problem was apparently slight, especially in the most vulnerable age groups. In view of the importance attached to the project in Thailand and around the world, an enhanced understanding of difficulties and failures is as significant as evidence of success. Furthermore, it ensures that mistakes will not be repeated elsewhere. These considerations lead to two related recommendations.
 - a. Evaluative reporting must be critically objective. This recommendation is self-evident, but it is stressed because evaluators who are closely associated with the project and strongly committed to its success find it difficult to be objective. Moreover, project results are likely to defy some of the emerging conventional wisdom about primary health care and are therefore prone to be dismissed lightly, unless conscientious efforts to the contrary are made.
 - b. Even where quantitative data and qualitative experience do not produce evidence of unqualified success, they can provide valuable insights into the causes of failure. For example, limited success in the battle against malnutrition is undoubtedly due in part to the difficulty of mounting an effective program of nutrition surveillance. By recognizing failure and carefully assessing its causes, one can make significant contributions to the evaluation that should not be overlooked.

Appendix

**PROPOSED METHODOLOGY FOR
INTEGRATED COST/TASK ANALYSIS**

Appendix

PROPOSED METHODOLOGY FOR INTEGRATED COST/TASK ANALYSIS

Lampang Project Task Analyses yielded a truly impressive body of information in exceptional detail regarding personnel utilization in a range of service functions at District Hospitals, Health Centers, and Midwifery Centers. Follow-up data alone (on which the present discussion is based) covered a total of 8,190 personnel-hours of recorded observation.

Observed allocations of time also form the basis for distributing salary costs among service functions. According to Cost Analysis findings, personnel costs represent about half of the total cost of facility operation. These and other costs were determined for 44 facilities in Areas E1 and E2 in 1979 (the reference year in the present discussion) and were distributed among service functions according to well-designed methods outlined by NIDA staff in a separate document.

In principle the Task and Cost Analysis information together can serve two important purposes. First, it can provide a comparison of service operations before and after Project interventions. Second, the detailed description of operational patterns emerging from the interventions can provide the framework for investigating policy questions. For example: Are current staffing patterns appropriate? If a specified proportion of Health Center medical care and family planning service activities were transferred to community volunteers, what would be the ramifications on Health Center operations

and costs? What would be the likely manpower and cost implications of a doubling of nutrition program efforts?

Unfortunately, there are data limitations in pursuing the first objective of comparative analysis. In the first place, pre-intervention data are relatively weak. The 1975 Baseline Task Analyses were less detailed than subsequent data-gathering efforts, used somewhat different definitions of terms, and produced data of questionable validity. It is recommended, therefore, that the 1975 data be disregarded in order to avoid misleading comparisons. The C1 follow-up data are potentially more useful for comparative analysis, but since the Task Analysis covered only 560 personnel-hours of observation, it is subject to considerable sampling error, a severe constraint to definitive comparison. The E2 baseline data are more extensive and therefore afford the best prospect for comparative analysis. However, these data were not available in usable form at the time of consultation. The analytical format developed during consultation and described below could be readily utilized, however, for rapid processing of the E2 data.

Most important for comparative purposes, an important operational aspect of Project intervention concerned activities and services of Health Post Volunteers and Child Nutrition Centers, which were not incorporated into the Task and Cost Analyses and must therefore be assessed separately. In summary, comparative analysis through task and cost data alone are of limited potential value, and this value is further reduced in practice because of constraints on the availability of pre-intervention task information.

As a result, the main purpose of the following discussion is to present methods for organizing task and cost data for evaluative policy analysis. The methods serve to document the operating conditions found at the conclusion of Project intervention and provide a springboard for consideration of future modifications.

The Data Base

Three sets of post-intervention task data are available: E1 second round, i.e., first follow-up (E1/2); E1 second follow-up (E1/3); and E2 follow-up (E2/F). Examination of the data sets separately revealed considerable variability but no systematic differences in spite of the fact that data collection extended over a two-year period from January, 1978 to January, 1980. It is to be expected that activity patterns observed during a particular week of observation would differ considerably by chance from those encountered during a week of observation several months later. It was deemed appropriate, therefore, to combine the three data sets to produce a more stable distribution of "typical" activity over a period of time. This is important in view of the need to convert activity and costs to an annual basis.

The composite data represent the aforementioned 8,190 personnel-hours of activity. Forty-two percent of the observation time took place in District Hospitals, 48 percent in Health Centers, and 10 percent in Midwifery Centers. Subsequent analysis of the Midwifery Center is, therefore, least reliable. One-fourth of the observation time was devoted to midwives, who are crucial

to the health care system. In contrast, only 105 hours of observation (1.3 percent of the total) related to the Dental Health Officer in the District hospital. While his resulting activity pattern is at best a rough approximation of reality, his efforts are less central to Project purposes. Complete elaboration of observation time is presented in Table 1.

Direct service time was recorded by function. In order to convert the results into time per service contact it was necessary to record the number of contacts by function during the period of task observations. Six functions were identified: medical care (MC); communicable disease control (CDC); sanitation (S); maternal and child health (MCH); family planning (FP); and nutrition (N). Because sanitation activity was uncommon, separate analysis of this function would produce very unreliable results. It was therefore combined with CDC to produce a community-oriented CDC/S function to be distinguished from the personal service functions.

Nutrition services were also uncommon but were kept separate because of their importance in Project objectives. Findings from the nutrition component of the analysis must be treated with special caution, however.

Even the more common service functions produced relatively few service contacts, as shown in Table 1. Moreover, there were a few occasions in which direct service time was associated with few or no service contacts, suggesting that the time may have been devoted to general surveillance activities. In any event, it is important to recognize that services are quite heterogeneous, even within functional categories, so that analysis of time and cost per unit of service has limited meaning and validity.

Detailed cost data were gathered by facility for 1975, 1977, and 1979. They show, for example, that the average cost of District Hospital rose from about 500,000 baht in 1977 to over 800,000 baht in 1979. The increase perhaps reflects some difference in real resource inputs but is undoubtedly due mostly to inflation, even though capital costs were calculated in constant 1977 terms. Salary costs increased by 40 percent between 1977 and 1979, although the Task Analysis revealed no marked difference in activity patterns during this period. Thus comparison of unit costs over time, utilizing the two sets of cost data, would suggest reduced efficiency in resource utilization, whereas in fact inflation in the cost of essentially the same resources would be the principal cause of unit cost increases.

For purposes of present analysis, therefore, 1979 cost data from E1 and E2 are utilized. Any cost implications of contemplated policy changes would be expressed in real terms for 1979, even though the actual cost at time of implementation might be higher due to subsequent inflation. For example, a change calculated to produce a 10 percent cost reduction in 1979 prices should in fact produce a 10 percent saving on the higher budget applicable at time of actual implementation.

Table 1 shows the number of facilities on which cost data for 1979 are based. Details of the resulting average costs are presented in Table 3. The average cost of salaries, including allowances, for each category of worker were available for E1 and are listed in Table 2.

Table 4 presents the proportional time allocations determined from the composite Task Analysis. Distributions are shown separately for each worker category in the three types of facilities.

The first four tables together represent a compilation of all the basic data required for construction of the analytical model described in the following sections. Other bodies of data could be subjected to the same analytical procedures. In particular, if E2 baseline data (E2/B) were to be compared with the post-intervention results reported herein, the E2/B data would be compiled as in Tables 1-4, and analysis would then proceed as described below.

The analytical procedures are described in detail, along with associated assumptions. Methods of initial data gathering are accepted as outlined in a separate document by NIDA staff. It should be noted, however, that a similarly detailed description of data-gathering methods for Task and Cost Analysis is needed as a companion document to the present discussion.

Time Distribution of Effort Per Worker

Table 4 reveals that workers typically spend relatively little time in direct service activity (roughly one hour per day) and that the bulk of time they do spend is for medical care. The midwife, who is common to all three types of facilities, is primarily a medical care provider at the Health Center and the Midwifery Center. In the District Hospital, however, her service responsibilities are more often devoted to MCH and family planning activities.

Supervision and support, along with other indirect service activities (administration and housekeeping), generally consume 2-3 times as much effort as direct service. Except for the District Hospital sanitarian, no staff member was found to devote as much as 10 percent of time to field work. On the other hand, non-productive time as high as 50 percent of the total is not uncommon.

In general, the time distributions displayed in Table 4 do not differ radically from those found in other studies, and they tend to conform to perceptions of the Thai health care system. In short, the data base seems reasonable for further analysis with a couple of exceptions.

First, the occasional presence of trainees resulted in large proportions of seemingly non-productive time. The analysis should not confuse training with normal operations, and it seems unreasonable to include trainees in the routine staffing pattern. For purposes of subsequent analysis, therefore, it was assumed that whatever productive effort was recorded for the Medex (wechakorn) trainee during observation would be performed normally by the Medex. A similar assumption was made concerning the sanitation and sanitarian trainee.

Second, although the midwife was found to be the principal provider at Midwifery Centers, she was occasionally assisted by other staff members during the observation period. Assuming that the Midwifery Center is to be staffed only by a midwife under usual conditions, all observed productive time was transferred to the midwife.

Table 5 shows the results of the two adjustments above. Naturally, a corresponding reduction in non-productive time is obtained.

As noted in Table 4, indirect service time is typically a substantial proportion of the total and is not readily attributable to specific functions. Yet for costing purposes, some basis for allocation must be chosen. The assumption made here is that each worker's indirect service time is utilized in proportion to his expenditure of effort on direct service. Consider, for example, a hypothetical worker who performs two hours of medical care direct service for every hour of MCH direct service and serves no other functions. Then two-thirds of his indirect service time would be allocated to medical care and one-third to MCH activities. Although this basis for allocation is probably not entirely realistic, it seems to be the most reasonable approach under conditions that inevitably require arbitrariness. It is noteworthy, however, that the allocation method used necessarily exerts a significant impact on time and cost analyses because of the relatively large amount of indirect time to be allocated. The results of the allocation procedure chosen are displayed in Table 6.

Time Distribution of Effort per Function

The column percentages of Tables 5 and 6 do not fully depict the effort going into each service function. Such a portrayal requires assumptions regarding proportionate staffing levels. To illustrate, one nurse devoting 20 percent of effort to medical care will contribute as much to the medical care function as two midwives, each devoting 10 percent of effort to medical care. In order to obtain time distributions by functions

(effectively row percentages), it is necessary to weight each of the preceding column percentages by the relative number of workers in each category.

In principle, the results of these calculations are shown in Table 7. Instead of recording percentages, however, the data are shown as "minutes per week" contributed by a staff of average composition. Apart from trainees, for example, a District Hospital was found during the period of observation to average fifteen staff consisting of one doctor, three nurses, and other members as indicated in Table 7. In effect, the table synthesizes the entire period of observation into an average week of activity by facility type.

Time and Cost per 1,000 Service Contacts

From Table 1 we note, for example, that District Hospitals experienced on the average 21 CDC/S contacts and 46 FP contacts per week. From Table 7 we see that the latter utilized 20 minutes of doctor direct service time, four minutes of Medex time, etc. For purposes of subsequent analysis and manipulation, it is useful to convert these findings into "times per 1,000 service contacts". If a doctor contributes 20 minutes of direct service time to 46 FP service contacts, he can be expected to contribute

$$\frac{1,000}{46} \times 20 = 435$$

minutes of time in providing 1,000 service contacts. The results of similar conversions for all staff, functions, and facilities are reproduced in Table 8.

Table 8 assumes that each unit of service by function requires the composition of worker input observed during Task Analysis. Any other

assumption must be incorporated into Table 7 before the conversion is made to produce Table 8. For example, a contemplated expansion of family planning effort at the District Hospital may shift some of the responsibility from the nurse to the nurse-aide. This shift should be reflected as seems appropriate in Table 7. More generally, suppose that two nurses per District Hospital are considered adequate in place of three. Then, it may be reasonable to reassign one-third of the nurse time in each category of Table 7 to the nurse-aide column. This is similar to what was done with trainee time in Table 4. As an initial estimate of time required per 1,000 service contacts under observed conditions, however, Table 8 serves a useful purpose as presently constituted.

A portrayal of cost per 1,000 service contacts, as shown in Table 9, serves as a useful corollary to the time distribution of Table 8. The relation between the two tables is based upon the assumption that salary costs are as shown in Table 2. Although only the "total" column of Table 9 is needed in subsequent analysis, the table provides the detail necessary to apply alternative assumptions. Suppose, for example, that consideration is given to an increase in allowances for doctors that would increase their salary cost by 20 percent. To assess the effects of this, each of the values in the "doctor" column of Table 9 would be increased by 20 percent and the "total" column would be adjusted accordingly.

Field Time and Cost

Table 10 turns attention from individual service contacts to field work. Estimated annual time in the field per worker is based upon three factors.

First, the percentage of time in the field is used from Table 5. This is applied to the number of workers, as shown in Table 7. Finally, the results are extrapolated to an annual basis. To illustrate, the three District Hospital nurses were found to spend an average of 3.67 percent of their time in the field, a total of 3.85 hours per week. Projecting this activity over 52 weeks results in a total of approximately 200 field hours per year.

Any of the three components of the calculation might be modified as seems appropriate. For example, if only 48 weeks per year were available, the numbers in Table 10 would each be reduced by a factor 48/52. Since the values in Tables 5 and 7 are averages of experience over the entire period of observation, however, multiplication by 52 seems to be quite reasonable.

Conversion from hours to baht in Table 10 requires assumptions about salary cost per worker. Values from Table 2 have been used and have the same implications discussed earlier in connection with service costs.

Annual Service Activity

Projection of other activities and costs on an annual basis requires assumptions about service loads. In Table 11 these are assumed to be 52 times the weekly averages recorded in Table 1. If reliable and available at the necessary level of detail, service records would provide a more useful basis for annual projections. Preliminary review of service statistics suggests that they do not differ markedly from the projections of Table 11. Those projections are taken, therefore, as a satisfactory first approximation for analytical purposes.

Resulting service time requirements are then derived from Table 8. To illustrate, Table 11 supposes that a typical District Hospital has 8,242 medical care contacts per year. Each of the medical care times per 1,000 contacts in Table 8 is therefore multiplied by 8,242 to produce the results in Table 12. Similar calculations have been performed for other functional categories.

Annual Salary Costs

The remaining tables associate these service levels with costs incurred. Table 13 establishes personnel costs on the basis of assumed staff mixes. If the observed District Hospital mix of Table 7 prevailed over the entire year, salary costs of 414,000 baht would be incurred. Since this is very close to the actual average of Table 2, the observed mix has been retained in further analyses.

If Health Center staffing levels observed during Task Analysis were applied on an annual basis, however, salary costs would substantially exceed the 55,000 baht level found in practice in Table 2. It was assumed, therefore, that the average Health Center had two full-time-equivalent staff divided by category as shown in Table 13. The staffing ratios are quite similar to those found in Table 7, and the total numbers bring salary costs in line with those of Table 2.

By further assuming that the typical Midwifery Center is staffed only by a full-time midwife, salary costs essentially the same as those found in Table 2 were incurred.

Other staffing patterns could be used, but it is assumed throughout that the proportionate contribution of various staff categories to each functional area would not be affected. This is a tenuous assumption, but resulting costs are not very dependent on the assumption. For instance, the balance of Health Center effort between midwives and sanitarians could shift substantially with little effect on cost, since their average salary levels are nearly identical. It is important that assumed staffing patterns not require more service time than is actually available. Because of the slack available in the form of non-productive time, however, considerable flexibility exists in staffing ratios.

Allocation of Annual Personnel Time

Applying the staffing levels of Table 13 to Table 14, one obtains staff hours available annually, assuming 1,820 working hours per person per year. This is based upon 35 hours per week times 52 weeks per year. Because of leave time, of course, workers are not in fact available to provide services for a full 52 weeks. This can be handled in one of two ways. First, salary cost per worker can be increased to cover replacements during leave time. If, for example, leave time amounts to 4 weeks per year, it may be necessary to pay 56 weeks of salary to get 52 weeks of service coverage. This approach, however, would inflate salary costs above the levels found in Table 2.

The second approach is to consider leave time to be a part of the "non-productive" hours during which salary costs are incurred but no services are rendered. This approach has been used for it seems to be more realistic.

During the absence of one worker the service load tends to shift to others and vice versa, so that in the end each worker contributes the approximate number of service hours calculated.

Against the total number of hours available (Table 14), one applies the direct and indirect service hours derived in Table 12, along with the field hours from Table 11. This leaves a residual of non-productive time.

The distribution of non-productive time may cause a reassessment of staffing and activity patterns. For example, Table 14 suggests that the number of nurses and nurse-aides in District Hospitals may be excessive. Tentative reductions in staffing and shifts in activity levels could be inserted into Table 7 and ramifications developed through subsequent tables to establish the end results in Table 14.

Likewise, the expected effects of possible changes in service load can be assessed through Table 14. For example, suppose that Health Center MCH activity is projected to increase by 25 percent. Will existing staff be able to handle this increase? The MCH service hours would be increased accordingly in Table 12 and reflected in Table 14, thereby reducing the non-productive hours to the extent that they are available to absorb the additional work load. Since Table 14 is used for later cost calculations, as described below, the consequent cost implications of an increased service load could be ascertained as well.

Allocation of Annual Salary Costs

It will be recalled that the time per 1,000 service contacts (Table 8) applied against annual service loads produced the annual time estimates of Table 12. Similarly, the cost per 1,000 service contacts (Table 9) applied against annual service loads produces the service cost distributions of Table 15. The table also shows the percentage of service costs attributable to each service function.

Table 16 presents a compilation of the various annual costs derived to this point. Consider salary costs first, using the District Hospital for illustration. Total direct costs of 67,917 baht and indirect costs of 117,885 baht are brought forward from Table 15. Field costs of 18,515 baht are added from Table 10. Since total salary costs (Table 13) are 413,592 baht, this means that a cost of 209,275 baht is attributable to non-productive time. In summary, productive effort costs

$$\begin{array}{r}
 67,917 \\
 + 117,885 \\
 + 18,515 \\
 \hline
 204,317 \text{ baht}
 \end{array}$$

and non-productive time costs

$$\begin{array}{r}
 413,592 \\
 - 204,317 \\
 \hline
 209,275 \text{ baht}
 \end{array}$$

The next question is how to allocate non-productive costs among functions. The most reasonable approach seems to be in accordance with the percentage distribution of productive costs derived in Table 15. Thus, 70

percent of the non-productive District Hospital costs of 209,275 baht have been assigned in Table 16 to the medical care function.

While this method of allocation is as sensible as any, it is arbitrary and the non-productive component of cost should be separately identified in unit cost analysis. Consider, for example, the aforementioned prospect of increased MCH service load in the Health Center. This would result in a withdrawal of non-productive costs from all functional categories and a corresponding reassignment as productive costs to the MCH category. Non-MCH unit costs would consequently decline. Because of the increased MCH service contacts denominator, the unit cost of MCH services would decline as well.

Annual Allocation of Other Costs

The allocation of capital, maintenance, and expendables costs in Table 16 is taken directly from Table 2. Added to the salary cost allocations, they produce an overall cost picture for each facility type.

It should be noted that field work is not attributed to functional categories. Moreover, none of the non-salary costs are assigned in support of field work. This is the result of unfortunate shortcomings in the data collection methods employed in the Task and Cost Analyses. Because of the limited attention given to field work, the shortcomings are not considered serious. However, the cost implications of substantial increases in field effort are virtually impossible to ascertain.

Unit Cost Analysis

Table 17 translates the costs per facility of Table 16 into costs per service contact. Table 18 shows the proportion of unit costs attributable to each of the identified cost components. Other unit costs of interest can likewise be determined. For example, it is seen that the 95,000 baht annual cost of Health Center operation amounts to approximately 16 baht per capita, assuming that the typical Health Center serves a population of approximately 6,000.

Estimated costs per service contact must be treated with caution for a number of reasons. As already mentioned, the number of service contacts used as denominators is somewhat problematical. Estimated numbers of nutrition services are especially subject to error. Even if the number of services is realistic, their inherent heterogeneity gives limited meaning to a "unit of service".

These two concerns are reinforced by the unexpectedly high cost of expendables, especially in relation to family planning and nutrition services. It is possible that some of the expendables charged to a facility were actually used for Health Post Volunteer services which were not included in the present analysis. On the other hand, some of the drug costs for medical care may have been excluded from facility budgets. These possibilities highlight the difficulty of evaluating components of the overall health care delivery system separately.

To gain insight into the extent of possible distortions introduced by volunteer activity, the allocation of expendables among functions in 1977,

before volunteers were widely utilized, was compared with 1979 data. Little difference in proportional distribution was noted, so that attribution of expendables remains an open issue.

Cost per service contact for family planning can be expected to vary according to whether one or three cycles of oral contraceptives are dispensed per contact. This again calls attention to the possible heterogeneity of services. To the extent that Health Centers and Midwifery Centers give three cycles at a time, the calculated expendables cost of approximately 30 baht per service contact is quite reasonable.

In spite of the cautions expressed, the unit cost figures of Table 17 merit attention in relative terms. It is seen, for example, that medical care costs are similar at the Health Center and the Midwifery Center, where they are about one-third the level found at the District Hospital. In contrast family planning services uniformly cost about the same, regardless of source of service.

Table 1
SOURCES OF DATA FOR ANALYSIS

TASK ANALYSIS

	DISTRICT HOSPITAL				HEALTH CENTER				MIDWIFERY CENTER			
	E1/2	E1/3	E2/F		E1/2	E1/3	E2/F		E1/2	E1/3	E2/F	
DAYS	10	5	5		10	5	5		10	5	5	
FACILITIES	1	1	3		6	6	22		3	3	10	
PERSONNEL				OBS. MIN.				OBS. MIN.				OBS. MIN.
Dr.	1	1	3	12,600								
Medex	1	2	3	14,700	6	6	22	84,000		1	1	4,000
Medex Trainee	3			12,600								
Nurse	3	4	8	37,800								
Nurse Aide	4	6	8	46,200	6	6	2	42,000				
Midwife	2	3	4	23,100	4	1	20	60,900	3	3	10	39,900
Sanitarian	1		3	10,500	2	2	12	37,800			1	2,100
San. Trainee			2	4,200		3	3	12,600				
Dent. Hlth. Off.	1	1		6,300								
Other	1	1	15	37,800							1	2,100
SERV. CONTACTS				Avg. Per Fac/Wk				Avg. Per Fac/Wk				Avg. Per Fac/Wk
MC	313	192	446	158.5	373	191	863	35.7	64	72	242	19.9
CDC/s	45	11	70	21.0	249	6	104	9.0	2	0	61	3.3
MCH	39	19	84	23.7	79	52	209	8.5	86	6	54	7.7
FP	145	23	108	46.0	174	55	277	12.6	67	18	126	11.1
NUT	0	1	4	0.8	18	8	12	1.0	12	5	7	1.3

COST ANALYSIS-1979

FACILITIES	3	28	13
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Table 2
AVERAGE ANNUAL SALARY COSTS
E1-1979

Personnel	Cost (Baht)
Dr.	73,500
Medex	28,498
Nurse	33,224
Nurse Aide	20,545
Midwife	27,209
Sanitarian	26,198
Dent. Hlth. Off.	27,495
Other	15,450

Table 3
 AVERAGE COST ALLOCATION
 PER FACILITY
 E1.E2 - 1979

	DISTRICT HOSP.		HLTH.CTR.		MM.CTR.	
	Baht	Pct.	Baht	Pct.	Baht	Pct.
CAPITAL	55,431	6.6	6,858	7.0	3,987	6.3
Pct - Mc	65.7		58.2		57.7	
- CDC/S	8.5		6.7		6.2	
- MCH	9.4		16.4		9.9	
- FP	16.3		17.9		25.0	
- NUT	0.1		0.8		1.2	
MAINTENANCE	14,564	1.7	1,293	1.3	898	1.4
Pct - Mc	61.4		57.5		59.6	
- CDC/S	11.8		6.9		6.7	
- MCH	9.7		15.2		6.6	
- FP	17.0		19.5		26.1	
- NUT	0.1		0.9		1.0	
EXPENDABLES	337,711	40.0	34,555	35.4	29,329	46.1
Pct - Mc	75.2		25.4		17.6	
- CDC/S	10.1		2.0		9.7	
- MCH	2.5		5.1		3.9	
- FP	9.9		61.4		56.0	
- NUT	2.3		6.1		12.8	
SALARIES	435,553	51.7	54,900	56.3	29,390	46.2
TOTAL	843,259		97,606		63,604	

Table 4
 PERCENTAGE DISTRIBUTION OF TIME
 BY FACILITY TYPE AND WORKER CATEGORY

Personnel	Dr.	Medex	Med.Tr	Nurse	N.Aide	MW	San	San.Tr.	Dent.HI	Other
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DISTRICT HOSPITAL

Dir - Mc	27.42	8.20	15.79	6.89	14.79	1.08	2.39	5.95	11.47	6.36
- CDC/S	0.67	1.14	0.12	0.55	0.75	0.81	0.16	4.48	0.02	0.12
- MCH	0.96	0.27	3.57	2.67	1.29	3.05	0.32	0.12	0.24	0.76
- FP	0.96	0.04	0.13	1.61	0.90	4.25	0.64	0.19	0	1.02
- NUT	0	0	0	0.25	0	0	0	0	0	0.15
Sup. Sup.	8.73	16.80	3.39	26.14	12.80	15.56	11.79	4.57	12.10	17.63
Other Ind.	15.41	14.98	3.15	8.43	3.52	11.19	17.85	11.26	10.70	16.53
Field	1.48	5.85	0	3.67	0.71	7.23	18.84	29.98	2.38	1.35
Non - Prod	43.37	52.71	73.85	49.79	65.24	56.83	48.01	43.45	63.09	56.03

HEALTH CENTER

Dir - Mc	10.13	5.76	7.49	3.85	5.84
- CDC/S	1.55	0.36	1.45	7.77	5.56
- MCH	1.52	1.61	2.14	0.32	0.25
- FP	1.02	1.03	1.66	0.28	0.45
- NUT	0.32	0.04	0.19	0.99	0.01
Sup. Sup.	14.48	15.46	17.80	8.81	5.48
Other Ind.	17.47	14.47	16.23	34.75	7.94
Field	6.31	0.95	6.25	8.46	4.18
Non - prod.	47.20	60.12	46.79	34.77	70.29

MIDWIFERY CENTER

Dir - Mc	0.76	7.15	0.85	1.38
- CDC/S	0	0.86	0	0.24
- MCH	0	2.90	0	0
- FP	0	1.68	0	0.43
- NUT	0	0.27	0	0
Sup. Sup.	0.98	18.81	1.19	4.52
Other Ind.	0	25.77	26.33	82.43
Field	0	8.87	0	0
Non - Prod.	98.25	33.49	71.62	11.00

Table 5
ADJUSTED PERCENTAGE DISTRIBUTION OF TIME
BY FACILITY TYPE AND WORKER CATEGORY

Personnel	Dr.	Medex	Nurse	N.Aide	MW	San.	Dent.H	Other
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DISTRICT HOSPITAL

Dir. - MD	27.42	21.73	6.89	14.79	1.08	4.77	11.47	6.36
- CDC/S	0.67	1.24	0.55	0.75	0.81	1.95	0.02	0.12
- MCH	0.96	3.33	2.67	1.29	3.05	0.37	0.24	0.76
- FP	0.96	0.15	1.61	0.90	4.25	0.71	0	1.02
- NUT	0	0	0.25	0	0	0	0	0.15
Indirect	25.14	37.38	31.57	16.32	26.75	35.97	22.30	34.21
Field	1.48	5.86	3.67	0.71	7.23	30.83	2.38	1.35
Non - Prod.	43.37	30.31	49.79	65.21	56.83	25.40	63.09	56.03

HEALTH CENTER

Dir - MD	10.13	5.76	7.49	5.79
- CDC/S	1.55	0.36	1.45	9.52
- MCH	1.52	1.81	2.14	0.40
- FP	1.02	1.03	1.65	0.43
- NUT	0.32	0.04	0.19	1.00
Indirect	31.95	29.93	34.03	48.03
Field	6.31	0.95	6.25	9.86
Non - Prod.	47.20	60.12	46.79	24.87

MIDWIFERY CENTER

Dir. - MD	7.35
- CDC/S	0.88
- MCH	2.90
- FP	1.90
- NUT	0.27
Indirect	50.71
Field	8.87
Non - Prod	27.12

Table 6
 ADJUSTED PERCENTAGE ALLOCATION
 OF INSPECT TIME
 BY FACILITY TYPE AND WORKER CATEGORY

Personnel	Dr.	Medex	Nurse	N. Aide	MA	San.	Dent.	HT	Other
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DISTRICT HOSPITAL

MC	22.99	30.71	19.90	13.61	3.14	22.00	22.29	25.87
CDC/S	0.56	1.75	1.59	0.69	2.36	8.99	0.04	0.49
MCH	0.80	4.71	7.71	1.19	8.88	1.71	0.47	3.09
FP	0.80	0.21	4.65	0.83	12.37	3.27	0	4.15
NUT	0	0	0.72	0	0	0	0	0.61

HEALTH CENTER

MC	22.26	19.15	19.71	16.13
CDC/S	3.41	1.20	3.82	26.80
MCH	3.34	6.02	5.53	1.11
FP	2.24	3.43	4.37	1.20
NUT	0.70	0.13	0.50	2.79

MIDWIFERY CENTER

MC	28.02
CDC/S	3.36
MCH	11.06
FP	7.25
NUT	1.03

Table 7
ADJUSTED AVERAGE MINUTES PER WEEK
BY FACILITY AND WORKER CATEGORY
 (according to task analysis staffing)

* - Less than 0.5 minutes

Personnel	Dr.	Medex	Nurse	N. Aide	Ma.	San.	Dent.H.	Other
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DISTRICT HOSPITAL

No. Personnel	1.0	1.167	3.0	3.667	1.833	0.833	0.5	3.0
Direct- MC	576	532	434	1,139	42	83	120	401
- CDC/S	14	30	35	58	31	34	*	0
- MCH	20	82	168	99	117	6	3	48
- FP	20	4	101	69	164	12	0	64
- NUT	0	0	16	0	0	0	0	9
Indirect- MC	483	752	1,254	1,048	121	385	234	1,630
- CDC/S	12	43	100	53	91	157	*	31
- MCH	17	115	466	92	342	30	5	195
- FP	17	5	293	64	476	57	0	261
- NUT	0	0	45	0	0	0	0	38

HEALTH CENTER

No. Personnel	1.0	0.5	0.725	0.45
Direct- MC	213	60	114	55
- CDC/S	33	4	22	91
- MCH	32	19	33	4
- FP	21	11	25	4
- NUT	7	*	3	9
Indirect- MC	467	201	300	152
- CDC/S	72	13	58	253
- MCH	70	63	86	10
- FP	47	36	67	11
- NUT	15	1	8	26

MIDWIFERY CENTER

No. Personnel	1.0
Direct- MC	154
- CDC/S	18
- MCH	61
- FP	40
- NUT	6
Indirect - MC	583
- CDC/S	71
- MCH	232
- FP	152
- NUT	22

Table 8
ESTIMATED MINUTES PER 1,000 SERVICES
BY FACILITY AND WORKER CATEGORY

Personnel	Dr.	Medex	Nurse	N.Aide	P.	San.	Dent.H.	Other	Total
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DISTRICT HOSPITAL

Direct - MC	3,554	3,356	2,39	7,186	265	524	757	2,530	20,990
- CDC/S	667	1,429	1,667	2,762	1,476	1,518	10	381	10,011
- MCH	845	3,465	7,098	4,183	4,944	254	127	2,028	22,944
- FP	435	87	2,196	1,500	3,565	261	0	1,391	9,435
- NUT	0	0	18,903	0	0	0	0	11,345	30,253
Indirect - MC	3,047	4,744	7,912	6,512	763	2,429	1,476	10,294	37,267
- CDC/S	571	2,048	4,762	2,524	4,333	7,476	20	1,476	23,210
- MCH	716	4,859	20,535	3,387	24,450	1,268	211	8,239	64,167
- FP	370	109	6,370	1,391	20,348	1,239	0	5,674	28,501
- NUT	0	0	54,454	0	0	0	0	46,134	100,588

HEALTH CENTER

Direct - MC	5,971	1,682	3,196	1,542	12,391
- CDC/S	3,677	446	2,451	10,139	16,713
- MCH	3,765	2,235	3,982	471	10,353
- FP	1,560	870	1,975	316	4,822
- NUT	7,074	442	3,045	9,347	20,508
Indirect - MC	13,090	5,634	8,409	4,261	31,394
- CDC/S	8,022	1,448	6,462	28,189	44,121
- MCH	8,235	7,412	10,118	1,176	26,941
- FP	3,715	2,846	5,296	870	12,727
- NUT	15,474	1,437	8,013	27,753	56,577

MIDWIFERY CENTER

Direct - MC	7,741	7,741
- CDC/S	5,428	5,428
- MCH	7,939	7,939
- FP	3,602	3,602
- NUT	4,489	4,489
Indirect - MC	29,555	29,555
- CDC/S	21,411	21,411
- MCH	30,193	30,193
- FP	13,538	13,538
- NUT	17,126	17,126

Table 9
ESTIMATED SALARY COST PER 1,000 SERVICES
BY FACILITY AND WORKER CATEGORY
(Bant)

Personnel	Dr.	Medex	Nurse	N. Aide	Ph.	San.	Dent. h	Other	Total
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DISTRICT HOSPITAL

Cost per Minute	.6731	.2610	.3042	.1081	.2492	.2399	.2513	.1416	
Direct - MC	2,446	676	833	1,352	66	125	191	358	6,248
- CDC/S	449	373	507	520	368	388	3	54	2,662
- MCH	569	904	2,159	787	1,232	61	32	287	6,031
- FP	293	23	668	282	888	63	0	197	2,414
- NJT	0	0	5,752	0	0	0	0	1,606	7,358
Indirect - MC	2,051	1,238	2,407	1,244	190	583	372	1,456	9,541
- CDC/S	384	535	1,449	475	1,080	1,793	5	209	5,930
- MCH	483	1,263	6,247	731	3,601	304	53	1,167	13,354
- FP	249	28	1,938	262	2,579	297	0	803	6,155
- NJT	0	0	16,565	0	0	0	0	6,533	23,098

HEALTH CENTER

Cost per Minute	.2610	.1881	.2492	.2399	
Direct - MC	1,558	316	796	370	3,040
- CDC/S	960	84	611	2,432	4,087
- MCH	983	420	967	113	2,453
- FP	432	164	492	76	1,165
- NJT	1,846	83	759	2,386	5,074
Indirect - MC	3,416	1,060	2,036	1,022	7,594
- CDC/S	2,094	272	1,610	6,763	10,739
- MCH	2,149	1,394	2,521	282	6,346
- FP	970	538	1,320	209	3,034
- NJT	4,039	270	1,997	6,658	12,964

MIDWIFERY CENTER

Cost per Minute	.2492	
Direct - MC	1,929	1,929
- CDC/S	1,353	1,353
- MCH	1,978	1,978
- FP	898	898
- NJT	1,119	1,119
Indirect - MC	7,365	7,365
- CDC/S	5,335	5,335
- MCH	7,524	7,524
- FP	3,411	3,411
- NJT	4,268	4,268

Table 10
ESTIMATED ANNUAL FIELD TIME AND COST
BY FACILITY TYPE AND WORKER CATEGORY

Personnel	Hours per Year			Sal. Cost. Per Hr.	Sal. Cost (Baht)		
	DH	HC	MC		DH	HC	MC
Dr.	26.9			40.38	1,086		
Medex	124.4	114.8		15.66	1,948	1,798	
Nurse	200.4			18.25	3,657		
Nurse Aide	47.4	8.6		11.29	535	97	
Midwife	241.2	82.5	161.4	14.95	3,606	1,233	2,413
Sanitarian	467.6	80.8		14.39	6,729	1,160	
Dent. Mltn. Off.	21.7			15.11	328		
Other	73.7			8.49	626		
Total	1,203.3	286.7	161.4		18,515	4,291	2,413

Table 11
ESTIMATED ANNUAL SERVICE CONTACTS
BY FACILITY TYPE

Service	DH	HC	MC
MC	8,242	1,855	1,035
CDC/S	1,092	467	172
MCH	1,231	442	400
FP	2,392	653	577
NUT	43	49	66

Table 12

ESTIMATED ANNUAL SERVICE HOURS BY FACILITY
TYPE AND WORKER CATEGORY

Personnel	Dr.	Medex	Nurse	Nurse Aide	MA	San.	Cent. Hlth.	Other
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DISTRICT HOSPITAL

Direct - MC	499.2	461.0	376.1	357.1	36.4	72.0	101.0	347.5
- CDC/S	12.1	25.0	30.3	50.3	26.9	29.5	0.2	6.9
- MCH	17.3	71.1	145.6	85.8	101.4	5.2	2.6	41.6
- FP	17.3	3.5	87.5	59.8	142.1	10.4	0	55.5
- NUT	0	0	13.5	0	0	0	0	8.1
Indirect - MC	418.6	651.7	1036.8	908.3	104.8	333.7	202.8	1112.7
- CDC/S	10.4	37.3	86.7	45.9	78.9	136.1	0.4	26.9
- MCH	14.7	99.7	421.3	79.7	236.5	26.0	4.3	169.0
- FP	14.8	4.3	254.0	55.5	412.5	49.4	0	226.2
- NUT	0	0	39.0	0	0	0	0	33.1

HEALTH CENTER

Direct - MC	184.6	52.0	98.3	47.7
- CDC/S	28.6	3.5	19.1	13.9
- MCH	27.7	16.5	28.6	3.5
- FP	18.2	9.5	21.7	3.5
- NUT	5.8	0.4	2.5	8.1
Indirect - MC	404.7	174.2	260.0	131.7
- CDC/S	62.4	11.3	50.3	219.4
- MCH	60.7	54.6	74.5	8.7
- FP	40.7	31.2	53.1	9.5
- NUT	12.6	1.2	6.5	22.7

MIDWIFERY CENTER

Direct - MC	133.5
- CDC/S	15.6
- MCH	52.9
- FP	34.6
- NUT	4.9
Indirect - MC	509.8
- CDC/S	61.4
- MCH	201.3
- FP	131.6
- NUT	19.8

Table 13
ESTIMATED ANNUAL SALARY COSTS
BY FACILITY

Personnel	No. Personnel			Salary Cost Per Person	Annual Sal. Cost (Baht)		
	DH	HC	HC		DH	HC	HC
Dr.	1.0			73,500	73,500		
Medex	1.167	0.75		28,498	33,248	21,374	
Nurse	3.0			33,224	99,672		
Nurse Aide	3.667	0.35		20,545	75,332	7,191	
Midwife	1.833	0.5	1.0	27,209	49,283	13,604	27,209
Sanitarian	0.833	0.4		26,198	21,932	10,479	
Dent. Hltn. Off.	0.5			27,495	13,748		
Other	3.0			15,459	46,377		
Total	15.0	2.0	1.0		413,592	52,648	27,209

Table 14
ESTIMATED ANNUAL TIME DISTRIBUTION
BY FACILITY TYPE AND WORKER CATEGORY

Personnel	Dr.	Medex	Nurse	A.Aide	TA	San.	Dent.HH	Other	Total
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DISTRICT HOSPITAL

No. Personnel	1.0	1.167	3.0	3.667	1.833	0.833	0.5	3.0	15.0
Annual Hrs.	1,820.0	2,123.35	5,460.0	5,673.33	3,336.7	1,516.7	910.0	5,460.0	27,300.0
Direct Hrs.	545.9	561.6	653.0	2,183.0	306.8	117.1	106.0	459.6	3,933.8
Indirect Hrs.	459.5	793.0	1,337.3	1,089.4	892.7	545.2	207.5	1,857.9	7,742.0
Field Hrs.	25.9	124.4	200.0	47.4	241.2	467.6	21.7	73.7	1,203.3
Total Prod. Hrs.	1,031.3	1,479.0	2,741.2	2,319.8	1,440.7	1,129.9	336.0	2,401.2	12,679.1
Non-Prod. Hrs.	789.7	644.3	2,719.8	4,353.5	1,836.0	386.8	574.0	3,058.8	14,420.9
Pct. Non-Prod.	43.3	30.3	49.8	65.2	56.9	25.7	63.1	56.0	52.8

HEALTH CENTER

No. Personnel	0.75	0.35	0.5	0.4	2.0
Annual Hrs.	1,365.0	637.0	910.0	728.0	3,640.0
Direct Hrs.	264.9	81.9	170.7	141.7	659.2
Indirect Hrs.	581.1	272.5	449.4	392.0	1,695.0
Field Hrs.	114.5	8.6	82.5	80.8	286.7
Total Prod. Hrs.	960.8	363.0	702.6	514.5	2,647.9
Non-Prod. Hrs.	404.2	274.0	207.4	113.5	999.1
Pct. Non-Prod.	29.6	43.0	22.8	15.6	27.4

MIDWIFERY CENTER

No. Personnel	1.0	1.0
Annual Hrs.	1,820.0	1,820.0
Direct Hrs.	241.5	241.5
Indirect Hrs.	922.9	922.9
Field Hrs.	161.4	161.4
Total Prod. Hrs.	1,325.8	1,325.8
Non-Prod. Hrs.	494.2	494.2
Pct. Non-Prod.	27.2	27.2

Table 15
ESTIMATED ANNUAL SERVICE COSTS
BY FACILITY TYPE AND FUNCTION
(Baht)

DISTRICT HOSPITAL

	MC	CDC/S	MCH	FP	NUT	TOTAL
Direct Costs	51,496	2,907	7,424	5,774	316	67,917
Indirect Costs	78,637	6,476	17,054	14,725	993	117,885
Sum	130,133	9,383	24,478	20,499	1,309	185,802
Pct. of Total	70.1	5.0	13.2	11.0	0.7	100.0

HEALTH CENTER

	MC	CDC/S	MCH	FP	NUT	TOTAL
Direct Costs	5,639	1,909	1,097	767	249	9,661
Indirect Costs	14,087	5,015	2,805	1,995	635	24,538
Sum	19,726	6,924	3,902	2,763	884	34,199
Pct. of Total	57.7	20.2	11.4	8.1	2.6	100.0

MIDWIFERY CENTER

	MC	CDC/S	MCH	FP	NUT	TOTAL
Direct Costs	1,997	233	791	518	74	3,613
Indirect Costs	7,623	918	3,010	1,968	282	13,801
Sum	9,620	1,151	3,301	2,486	356	17,414
Pct. of Total	55.3	6.6	21.8	14.3	2.0	100.0

Table 16
ESTIMATED ANNUAL TOTAL COSTS
BY FACILITY TYPE AND FUNCTION
(Bant)

DISTRICT HOSPITAL

	MC	CDC/S	MCH	FP	HUT	TOTAL
Capital	35,453	4,701	5,192	9,034	41	55,431
Maintenance	8,955	1,713	1,408	2,477	11	14,564
Expendables	254,035	34,085	8,533	33,360	7,698	337,711
Sal. - Direct	51,495	2,907	7,424	5,774	316	67,917
- Indirect	78,637	6,476	17,054	14,725	993	117,885
- Field						18,515
- Non-Prod.	146,574	10,568	27,570	23,009	1,474	209,275
Total	576,160	60,450	67,181	98,459	10,533	821,298

HEALTH CENTER

	MC	CDC/S	MCH	FP	HUT	TOTAL
Capital	3,990	459	1,125	1,227	57	6,858
Maintenance	744	89	197	252	11	1,293
Expendables	8,783	686	1,769	21,216	2,101	34,555
Sal. - Direct	5,639	1,909	1,097	767	249	9,661
- Indirect	14,087	5,015	2,805	1,996	635	24,533
- Field						4,291
- Non-Prod.	8,167	2,966	1,615	1,144	366	14,158
Total	41,410	11,024	8,609	26,602	3,419	95,354

MIDWIFERY CENTER

	MC	CDC/S	MCH	FP	HUT	TOTAL
Capital	2,300	248	395	997	47	3,987
Maintenance	536	60	59	234	9	898
Expendables	5,161	2,848	1,152	16,411	3,757	29,329
Sal. - Direct	1,997	233	791	518	74	3,613
- Indirect	7,623	918	3,010	1,968	282	13,601
- Field						2,413
- Non-Prod.	4,078	483	1,611	1,054	151	7,382
Total	21,695	4,795	7,018	21,182	4,320	61,423

Table 17
ESTIMATED COST PER SERVICE CONTACT
BY FACILITY TYPE AND FUNCTION
(Baht)

DISTRICT HOSPITAL

	MC	CDC/S	MCH	FP	NUT	TOTAL
No. Serv. Contacts	8,242	1,092	1,231	2,392	43	13,000
Capital Cost	4.42	4.30	4.22	3.78	0.95	4.26
Maintenance	1.09	1.57	1.14	1.04	0.26	1.12
Expendables	30.82	31.21	6.93	13.95	179.02	25.98
Sal. - Direct	6.25	2.66	6.03	2.41	7.35	5.22
- Indirect	9.54	5.93	13.85	6.16	23.09	9.07
- Non - Prod.	17.79	9.69	22.40	9.64	34.28	16.10
Total	69.91	55.36	54.57	36.98	244.95	61.75

HEALTH CENTER

	MC	CDC/S	MCH	FP	NUT	TOTAL
No. Serv. Contacts	1,355	467	442	658	49	3,471
Capital Cost	2.15	0.98	2.55	1.86	1.16	1.98
Maintenance	0.40	0.19	0.45	0.38	0.22	0.37
Expendables	4.73	1.47	4.00	32.24	42.86	9.96
Sal. - Direct	3.04	4.09	2.48	1.17	5.08	2.78
- Indirect	7.59	10.74	6.35	3.03	12.96	7.07
- Non-Prod.	4.41	6.14	3.65	1.75	7.48	4.08
Total	22.32	23.61	19.48	40.43	69.78	26.24

MIDWIFERY CENTER

	MC	CDC/S	MCH	FP	NUT	TOTAL
No. Serv. Contacts	1,035	172	400	577	66	2,250
Capital Cost	2.22	1.44	0.99	1.73	0.71	1.77
Maintenance	0.52	0.35	0.15	0.41	0.14	0.40
Expendables	4.99	16.56	2.88	28.44	56.92	13.04
Sal. - Direct	1.93	1.35	1.98	0.90	1.12	1.61
- Indirect	7.37	5.34	7.52	3.41	4.27	6.13
- Non-Prod.	3.93	2.64	4.02	1.92	2.29	3.23
Total	20.96	27.68	17.54	36.71	65.45	26.23

