

**Multi-Country Evaluation of the Integrated Management of
Childhood Illness (IMCI)**

**Analysis Report on the Costs of IMCI
in Tanzania**



**Department of Child and Adolescent Health and Development
World Health Organization**

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Analysis Report on the Costs of IMCI in Tanzania

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List of acronyms

AMMP:	Adult Morbidity and Mortality Project
CHMT:	Council Health Management Team
EPI:	Expanded Programme on Immunization
FTE:	full-time equivalent
HFS:	Health Facility Survey
HHS:	Household Survey
IDRC:	International Development Research Centre, Canada
IMCI:	Integrated Management of Childhood Illness
MCE:	Multi-Country Evaluation of IMCI effectiveness, costs and impact
MCHA:	Maternal and Child Health Aide
MoH:	Ministry of Health
OLS:	Ordinary Least Squares
TEHIP:	Tanzania Essential Health Interventions Project
WHO:	World Health Organization

Executive summary

Introduction

Tanzania is one of over 80 developing countries in which the Integrated Management of Childhood Illness (IMCI) strategy has been implemented. IMCI was designed by WHO and UNICEF with the aim of improving child health and development, particularly for children under five years of age. The Multi-Country Evaluation of IMCI Effectiveness, Costs and Impact (MCE) is a WHO project undertaken to evaluate the impact of IMCI. The study reported here as part of the MCE was undertaken in Tanzania with the aim of estimating:

1. The total economic costs of starting-up and implementing IMCI in a district –i.e., the full cost to society of IMCI-based services to children under five. Together with information on the effectiveness of IMCI, this allows an assessment of whether IMCI represents a good use of scarce health resources compared to other possible uses;
2. The additional economic costs (additional to those previously expended on under-fives) of introducing and running IMCI: this permits a conventional incremental cost-effectiveness analysis to determine whether the additional health effects of switching from routine practice to IMCI justify any additional resources that are required.

The current report focuses exclusively on the economic costs of IMCI. The results of this costing study will eventually be combined with the results from the mortality impact study for an analysis of the cost-effectiveness of IMCI in Tanzania.

Results on the corresponding financial costs from the perspective of the government of introducing and maintaining IMCI will be presented elsewhere.

Methodology

The MCE in Tanzania uses an observational design to compare two districts where IMCI has been implemented since late 1997 (“intervention” districts) with two districts where implementation began in 2002 (“comparison” districts).

Cost data were collected during the start-up period for implementing IMCI (from 1996 to 1997)⁸ and for maintaining child health care services including IMCI during 1999. They were collected for the following levels:

1. *National*: National costs of start-up and annual post-implementation costs of IMCI⁹, and of other activities related to under-fives such as the Expanded Programme on Immunization, nutrition and malaria programmes, were collected using interviews and record reviews based on a national-level cost questionnaire.
2. *District*: District-level start-up and post-implementation costs of under-five care were estimated through interviews and record review using a district-level cost questionnaire.
3. *Hospital*: The proportion of under-five children admitted to hospital during the previous year was estimated through interviews with a representative sample of households using a household survey questionnaire. This information was combined with local estimates of costs per bed-day and average length of stay in hospital (1) to estimate total costs of providing inpatient care for under-fives in each district.
4. *Primary facility*: Primary health facility costs at government health facilities were estimated through interviews and record reviews using the facility cost questionnaire during a cross-sectional survey of a representative sample of health facilities. During the same survey the proportion of time health workers spent with under-fives and with over fives was collected through observation of health workers using time-and-motion study observation record forms. Primary health care costs at non-government facilities are partly represented as out-of pocket payments made at these facilities, collected at the household-level. It is not in the scope of this analysis however to determine the extent to which these out-of-pocket payments relate to actual cost per visit made at non-government facilities.
5. *Household*: Out-of-pocket payments for services provided at facilities that were not included in the above categories, and time spent in seeking all types of care, were estimated through interviews with a representative sample of households using a household survey questionnaire.

⁸ The start-up period is defined as the time from the national decision to implement IMCI to the time when IMCI was provided to the first under-five through trained health workers in primary facilities.

⁹ The start-up costs of routine under-five care in the comparison districts was not assessed, therefore the total costs of under-five care in these districts could be under-estimated. These costs are expected to be minimal however. In IMCI district, they represented less than 1% of total costs of under-five care.

Cost at all these levels was summed to obtain the *total cost* to the district of providing care for under-fives. To allow comparison across districts, cost estimates were standardized to a hypothetical district with a population of 50,000 under-fives. This corresponds to a total population of around 300,000, which is roughly the average district population for Tanzania.

Estimates of the *additional cost* to the district of implementing IMCI were based on the difference in cost of under-five care between IMCI and comparison districts. The total cost of care for under-fives in a standard comparison district was subtracted from the total cost in a standard IMCI district. The difference is the estimated change in under-five costs attributable to IMCI.

In addition, regression analysis was performed to explore if IMCI had an independent effect on the costs of providing services at health facilities, independent from the effect of other factors not related to IMCI such as facility size and availability of vehicles. Finally, sensitivity analysis was used to test the sensitivity of the results by using a range of values for the uncertain variables.

Results

For 1999, the cost per child of caring for under-fives in IMCI districts was US \$ 11.19, 44% lower than in the comparison districts (\$16.09).

Cost differences from the comparison of costs in IMCI and comparison districts in relation to each level can be explained as follows:

- National costs were higher in IMCI districts owing to the additional costs of establishing and implementing IMCI. These costs were minimal, however (less than 1% of the total costs of under-five care).
- District-level costs were 50% higher in comparison districts during the survey period. This is linked to the higher costs of supervision and administration observed in those districts during the study period, which are likely to be independent of IMCI.
- Hospital-level costs were 250% higher in comparison districts, owing to a higher number of admissions per child in these districts relative to IMCI districts.
- There was no difference in the cost per child at government primary-facility or at household levels between IMCI and comparison districts.

One of the key differences was that IMCI districts incurred lower hospitalization costs because a lower proportion of under-fives was admitted to hospital in the year ending July-August 1999 than in comparison districts (6% in IMCI districts against 15% in comparison districts, $p < 0.001$). There are

two possible explanations: (1) improved quality of care and drug availability for under-fives at IMCI primary facilities reduced the need for referral and subsequent admission to hospital; or (2) factors other than IMCI, such as differences in the quality of the hospitals in the different settings or access to them meant that children in non-IMCI districts were more likely to seek care at hospitals. It is not very likely, however, that IMCI would have been in operation long enough to increase the quality of care in IMCI facilities at the time of the study, so the observed differences are more likely to be due to other factors. However, even after excluding the hospital component of costs, the total cost per under-five child in IMCI districts was still lower than in comparison districts (6%).

At the facility level, the average number of under-five visits per facility was similar between IMCI and comparison facilities (1% higher in comparison districts, $p=0.6$). The univariate comparison also showed similar average cost per under-five visit (visit (\$1.4 compared to \$1.6, 16% higher in comparison districts, $p=0.5$). This explains the similar cost per child at government health facilities in the two types of district.

Results of the two major components of cost per visit at government facilities, i.e., personnel and drug costs, are discussed in turn.

With respect to personnel cost per visit, the main findings on the average time spent per consultation at government facilities, derived from the time-and-motion study, are:

- Both in IMCI and comparison districts, health workers spent more time per consultation with under-fives than with over-fives.
- Taking health centres and dispensaries together, IMCI health workers spent, on average, almost two more minutes per consultation with each under-five than did those in comparison facilities (8.2 vs 6.3 minutes, $p=0.0003$). This difference was largest in health centres, which received only 18% of the total visits by under-fives.
- It is worth noting, however, that health centre workers did not compensate by spending less time with over-fives ($p=0.4$). It appears, therefore, that the increase in time spent with children in health centres was due to a shift in the time spent in administrative activities or non-productive time, part of which was allocated to under-fives, to provide clinical services for under-fives.
- Because the longer time spent with under-fives was only observed in health centres, which receive a smaller proportion of under-five visits than dispensaries, overall, personnel cost per under-five visit was similar between IMCI and comparison districts.

IMCI facilities spent 30% less on drugs and vaccines per average visit than comparison facilities, although because of the considerable variation in drug costs per visit, the difference was not statistically significant. A detailed analysis of possible disaggregate differences in drug spending and types of drugs consumed will be undertaken in future work.

It is interesting to note that although the simple comparison of cost per visit showed no significant differences between IMCI and comparison districts, the multivariate regression analysis suggested otherwise. The regression explored the relationship between total costs of under-five care at health facilities and factors such as whether the facility had implemented IMCI, facility type (health centre or dispensary), availability of vehicles, and total under-five visits. By taking into account differences in the other determinants across facilities, in particular the number of visits per facility, the multivariate regression analysis increased precision in comparing between the two types of district, showing that total costs of under-five care and the cost per visit were lower in IMCI facilities ($p < 0.001$).

Sensitivity analysis showed the importance of hospitalization costs in the interpretation of total costs - the difference between IMCI and comparison districts was not sensitive to variation in the other parameters, only to the assumption about rates of hospitalization. If it is believed that the observed difference in hospital visits per child was not related to IMCI, it can be concluded that there is no difference in the cost of under-five care in the two types of districts. Otherwise, the costs in IMCI districts are lower than in the comparison districts.

In the intervention districts, IMCI was implemented concurrently with measures designed to strengthen district management such as evidence-based planning and expenditure mapping at district level. In fact, the decision to implement IMCI in the study districts has been attributed to the introduction of the evidence-based planning. Our study, therefore, assesses the effect of a dual intervention - IMCI together with an improved health system at district level and we are not able to separate the effects of IMCI from district strengthening measures. Our findings, therefore, can be interpreted as the costs of IMCI in the presence of a strong health system with adequate managerial capacity.

Implications

On balance, there is no evidence that treating children using IMCI in the context of measures to strengthen district health management was associated with higher costs than routine care at the time of the study. The costs are either not different or lower in IMCI districts depending on the interpretation of the rates of hospitalization in those areas. This finding was unexpected, as

IMCI has often been assumed to be more expensive than routine care for under-fives.

There are, however, some qualifications that should be made when interpreting the results. Districts differed in ways that could affect the cost of child care (e.g., the number and proportion of facilities managed by non-government organizations and under-five hospital admissions).

These findings will now be analysed in conjunction with the MCE results on quality of care and impact as the basis for cost-effectiveness analysis. In addition, both these results and the financial information obtained through the study have been reviewed and discussed with relevant MOH staff in Tanzania

Introduction

This document reports on the first detailed cost estimates of a major strategy for reducing child mortality and improving child health and development. It summarizes four years of work by public health staff in Tanzania, supported by technical assistance from the World Health Organization and a Technical Advisory Group representing global expertise in cost-effectiveness analysis, measurement, research design and child health.

The report is intended to be a resource document, in that it provides detailed and transparent descriptions of the assumptions and methods used. This is important for four reasons:

1. To increase the probability that the findings on the economic costs of implementing IMCI in Tanzania are correctly interpreted and used as the basis for policy and programme decisions.
2. To contribute to the methodological literature. All research has limitations, but the challenges of large-scale field studies of programme costs are unusual and have not yet been adequately described.
3. To serve as a baseline for future economic evaluation of child health interventions in Tanzania. The methods and procedures are described at a level of detail designed to be sufficient to guide future follow-up studies.
4. To serve as a reference document for MCE investigators and staff, and as the basis for developing more focused reports for publication

The findings reported must be understood in context. Readers are encouraged to review the background and methods section of the report in detail, and to refer back to it often, in order to understand exactly what is being costed and how it was measured. The reference year for the cost data presented is 1999; where possible, demographic and programme information has been provided for the same period.

This report presents the economic costs of the Integrated Management of Childhood Illness strategy in two rural districts of Tanzania. Future reports will provide information on the financial costs and cost-effectiveness results.

Study context and objectives

This section of the report describes the geographic and health-system setting for the evaluation, the overall design and the interventions implemented in the study districts, and the objectives of the costing study.

Study context: Tanzania

Tanzania is located in East Africa, bordering the Indian Ocean, between Kenya and Mozambique. It covers an area of 945,090 square kilometres, with a population of 31,270,820 ¹⁰ and a population growth rate of 2.14% per annum. The economy is heavily dependent on agriculture, which accounts for about 49% of Gross Domestic Product (GDP), provides 85% of exports, and employs 80% of the population of Tanzania. The GDP in 1999–2000 was US\$ 21.9 billion with an estimated per capita expenditure on health of \$ 11.37, including out-of-pocket expenses (2;3).

The public health system in Tanzania has a network of hospitals, health centres and dispensaries. Over 80% of health facilities are government-owned. The remainder are non-governmental, including facilities supported by religious missions and private, for-profit facilities. Over-the-counter drugs, including chloroquine, are widely available from private shops and kiosks. A 1999 survey of households in four rural districts found that 41% of children ill in the previous two weeks had been taken to an appropriate provider; this is a higher percentage than that seen in neighbouring countries with similar epidemiological profiles (4).

As part of the reform of the health sector and local government, the 114 local councils¹¹ in Tanzania in 1999 were preparing for increasing autonomy and control of their own health budgets and activity plans, which started to be phased in from 2000. A limited amount of donor-supported “basket” funding from the health Sector-Wide Approach (SWAp) (5) was available from 2000.

Standard indicators of child health and development in Tanzania show that high proportions of children are dying from diseases for which effective and affordable interventions are available. The estimated under-five mortality rate in 1999 was 131 to 147 per 1000 (probability of dying before reaching the age of five years) ¹². Ongoing sentinel demographic surveillance results from the study area show that these problems in order of importance are malaria,

¹⁰ http://www.photius.com/wfb/wfb1999/tanzania/tanzania_people.html

¹¹ The term “council” refers to the local government of both rural districts and urban municipalities

¹² Demographic Surveillance in study area.

pneumonia, malnutrition and diarrhoea which together account for around 85% of post-perinatal under-five mortality burden.¹³

Integrated Management of Childhood Illness

Integrated Management of Childhood Illness (IMCI) is a strategy developed by WHO, UNICEF and other technical partners to address major child health problems in the developing world (6). IMCI seeks to address these problems through three components – improved case-management, improved health systems support and improved family and community practices. By December 2002, IMCI was in the early implementation or expansion phase in over 80 developing countries, including most African countries south of the Sahara (7). More information is available at <http://www.who.int/child-adolescent-health>. IMCI guidelines and tools which must be adapted to the local epidemiological and cultural setting, are designed to build on and complement existing child health activities and mechanisms. For this reason, IMCI may look very different from one country to another or even in some cases from one district to another.

In Tanzania, the Ministry of Health in 1996 adopted IMCI as part of its child health policy. Shortly afterwards it began to adapt the generic IMCI case-management guidelines to reflect national child health policies (e.g., first-line and second-line treatments for malaria and pneumonia) and local terms for illness symptoms and care providers. Operational research was conducted as the basis for developing an IMCI nutrition and counselling card for use by health workers in educating mothers. All materials were translated into Swahili and used as the basis for preparing national and district level trainers. The 11-day training course was targeted at all health workers in first-level health facilities who manage children's illnesses

In 1997 the Ministry of Health introduced IMCI in a few districts in order to gain experience as a basis for informed planning for rapid expansion to broader coverage. By 1999 a total of 30 districts had introduced IMCI (Mbuya et al in preparation "MCE IMCI Tanzania sub-study 4, IMCI documentation"). During 2000, the Ministry of Health added IMCI into its Minimum Package of Essential Health Interventions.

¹³ Tanzania Essential Health Interventions Project: Rufiji Demographic Surveillance System data for 2000

MCE-Tanzania evaluation design

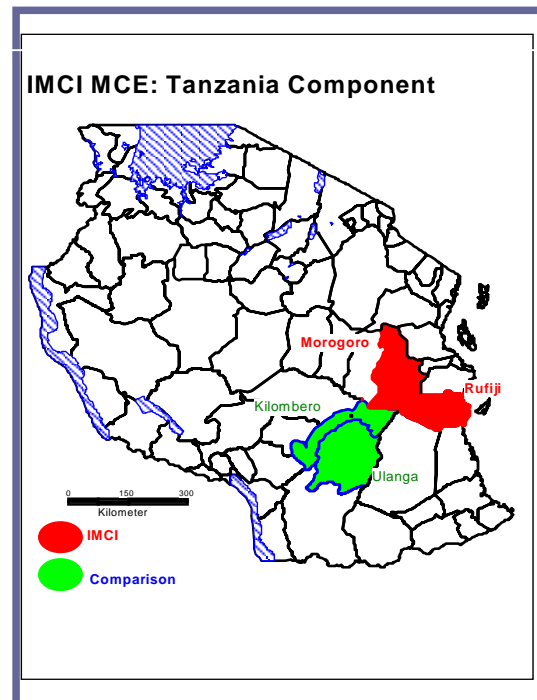
The Multi-Country Evaluation of IMCI (IMCI-MCE) seeks to generate information on the effectiveness, cost and impact of IMCI, with the object of using the information to strengthen the delivery of child health interventions and the implementation of the IMCI strategy. The evaluation is ongoing in Bangladesh, Brazil, Peru, Tanzania and Uganda.

The Tanzania MCE is using an observational design to compare two districts where IMCI has been implemented since late 1997 (“intervention” districts) and two districts where implementation began only in 2002 (“comparison” districts). The intervention districts are separated from the comparison districts by a large, uninhabited game reserve. Annex 3 provides a summary of the main geographic, demographic and health system characteristics of the study area.

MCE Tanzania includes six overall objectives, each of which has a specific sub-study, as follows:

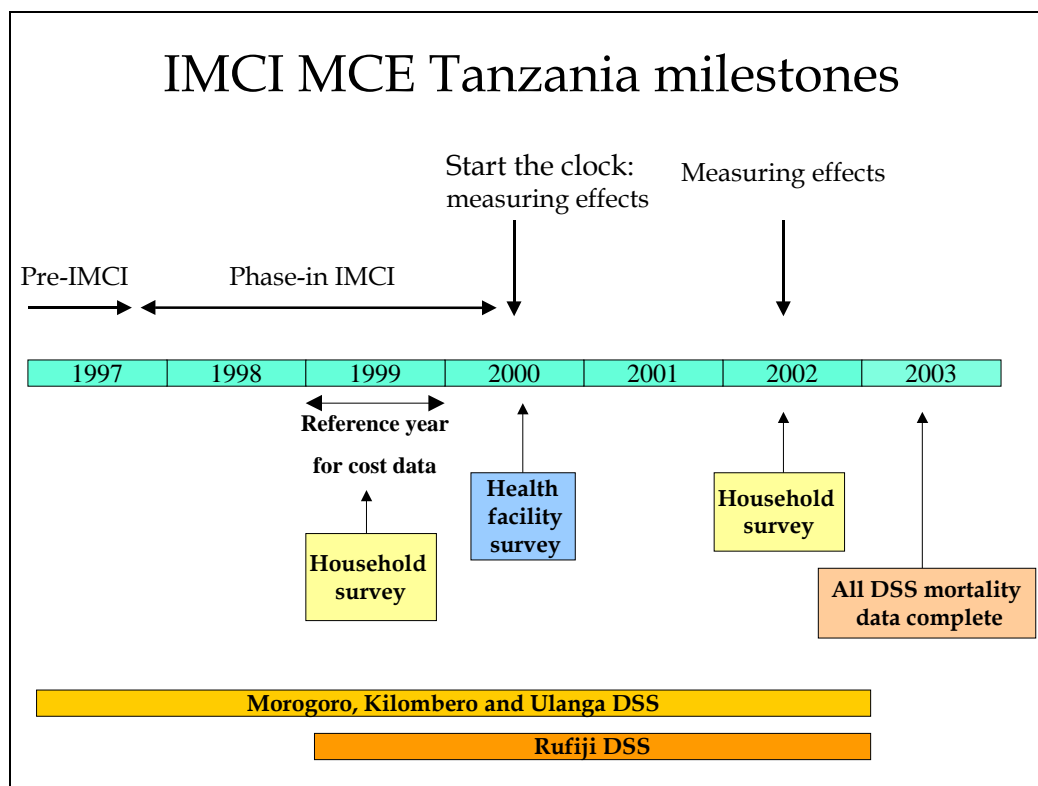
1. To measure the impact of the IMCI strategy on under-five mortality through demographic surveillance
2. To assess the effect of the IMCI strategy on child health indicators at household level through cross-sectional surveys in the phase-in period and after three years
3. To assess the effect of the IMCI strategy on child health care at health facility level at the end of the phase-in period
4. To document the implementation of IMCI in the two intervention districts
5. To describe other relevant activities in all four districts under study, particularly programmes and activities not involving IMCI
6. To estimate the economic cost of implementing and maintaining IMCI from a societal perspective (i.e., government provider as well as client cost will be estimated)

Map of IMCI and comparison districts



These six sub-studies are linked in time by a series of milestones (see Figure 1

Figure 1. IMCI MCE Tanzania milestones



Unfortunately, cost data could not be collected before IMCI was introduced in the intervention districts, as it was already well under way in those districts when the MCE studies began. The choice of districts for the MCE was based in part on the availability of longitudinal prospective demographic surveillance systems in four contiguous districts. Although these systems cover only a part of each of the four districts, they provide high-quality data on under-five mortality at a cost far below that of a large-scale cross-sectional retrospective demographic survey.

IMCI as implemented in the MCE intervention districts

This study compares the cost of delivering child health services in the “intervention” districts with that in the “comparison” districts. One important respect in which the two sets of districts differed is that the intervention districts had adopted IMCI. Other differences, however, could not be controlled for in the study design, and differences in costs and health outcome measures between the intervention and comparison districts cannot, therefore, be attributed solely to IMCI.

As described in the introduction, data on the cost component of MCE Tanzania were collected for 1999. Although cost data can be adjusted for other periods in future results, this first report describes IMCI implementation

(and child health activities in the two comparison districts) as it developed and proceeded until the end of 1999.

The Morogoro rural (Morogoro) and Rufiji District Health Management Teams decided to adopt IMCI, and to give highest priority to its introduction and implementation, based on evidence available to them from a sentinel burden-of-disease information tool and a district health budget mapping tool developed by the Tanzania Essential Health Interventions Project (TEHIP).⁽⁸⁾ In addition, TEHIP provided financial resources to districts of approximately \$0.92 per capita per year to simulate the sector-wide “basket” funding three years in advance of the actual start of “basket” funding. IMCI implementation began in Morogoro and Rufiji in 1997. A full account of the implementation of IMCI in these two districts is given elsewhere (Mbuya et al in preparation “ MCE IMCI Tanzania sub-study 4, IMCI documentation”). Briefly, activities implemented as of 1999 that are related to IMCI include the following:

- For **improving health workers’ performance**, Council Health Management Teams (CHMT) reported that over 80% of health workers managing under-five care at first facilities had been trained in IMCI by mid-2000. The training consisted of an 11-day course, of which approximately 30% of the time was given to clinical practice, and one follow-up visit by IMCI supervisors one month afterwards.
- Activities to **strengthen health system support** available in the IMCI but not in the comparison districts included (1) the flexibility that basic additional drugs needed for IMCI case-management were available at health facility level from special kits purchased by the district from the medical stores department¹⁴ of the Ministry of Health using their district level basket funds, and (2) the establishment of an Integrated Supervision Cascade. The Integrated Supervision Cascade is a reactivation of a former Ministry of Health approach to supervision, where health centres and some designated dispensaries are given the responsibility to supervise dispensaries located in their catchment areas. Further details of this and other health facility circumstances over time are given elsewhere (Mbuya et al in preparation).

Within the Integrated Supervision Cascade, the CHMT used basket funds to purchase solar operated radios from 1999. One expectation was that these radios could be used by health workers to obtain advice and assistance with health problems that were too severe to be handled at peripheral level.

¹⁴ Distribution of IMCI special kits was only implemented in the intervention districts and was not a global policy decision.

The leader of each local area for the Integrated Supervision Cascade was provided with a motorcycle, purchased by basket funds to facilitate all-purpose supervision of dispensaries.

- Finally, some activities to **improve key family practices at the household level** were in place in all four districts participating in MCE (i.e., both intervention and comparison districts). They included the introduction and social marketing of insecticide-treated nets for the prevention of malaria, which had only recently started at the time of the household survey in 1999. Three to seven percent of children under five years had used a recently-treated net the night before the survey, which was done in the dry season.

Further details of these and other activities designed to improve key family practices are given elsewhere (Schellenberg et al., in preparation “MCE IMCI Tanzania sub-study 5, Contextual Factors”)

Objectives of the costing study

The specific objectives of this report are:

1. To estimate the total cost of providing IMCI in a district, i.e., the full economic cost to society as a whole of services to children under five years of age (under-fives), based on the IMCI strategy. This allows a cost-effectiveness analysis, in order to assess whether treating under-fives on the basis of IMCI is a good use of scarce health resources.
2. To estimate the additional (incremental) economic cost of introducing and running IMCI from the societal perspective - e.g., what resources were required in addition to those already used in that setting. This allows a traditional incremental cost-effectiveness analysis, to assess whether the additional benefits over routine practice justify the additional resources.

These two objectives are used for different purposes and are achieved through different methods (9). These estimates are intended to serve as a foundation for future analyses of the cost-effectiveness of IMCI. Whether IMCI is a worthwhile public health investment, given its costs and effects, is a crucial question, but one that will have to wait until effectiveness data are gathered over the coming two years.

Overview of the study methods

The study objectives required information to be collected for the following levels: national, district, primary health facility, hospital, and household.

Cost data for starting IMCI from 1996 to 1997¹⁵ and for maintaining child health care services including IMCI during 1999 were collected for the following levels:

1. **National:** National costs of start-up and annual post-implementation costs of IMCI, and of other activities related to under-fives such as EPI, nutrition and malaria programmes were collected in October 2000 using interviews and record reviews based on a national-level cost questionnaire.
2. **District:** District-level start-up and post-implementation costs of under-five care were estimated through interviews and record review using a district-level cost questionnaire in June-July 2000.
3. **Hospital:** The proportion of under-five children admitted to hospital during the previous year was estimated through interviews with a representative sample of mothers/carers using a household survey questionnaire in July-August 1999. This information was combined with local estimates of costs per bed-day and average length of stay in hospital (1;10) to estimate total costs of providing inpatient care for under-fives in each district.
4. **Primary facility:** Primary health facility costs at government health facilities were estimated through interviews and record reviews using the facility costs questionnaire during a cross-sectional survey of a representative sample of health facilities in August 2000. During the same survey the proportion of time health workers spent with under-fives and with adults was collected through observation of health workers using the time-and-motion study observation record forms. Primary health care costs at non-government facilities are included in terms of out-of pocket payments made at these facilities, collected at the household-level.
5. **Household:** Out-of-pocket payments and time spent in seeking care were estimated through interviews with a representative sample of mothers/carers using the household survey questionnaire in July-August 1999.

¹⁵ The start-up period is defined as the time from the national decision of implementing IMCI to the time when IMCI was provided to the first under-five through trained health workers in primary facilities.

Data collection

Box 1 provides an overview of the types of cost data collected at national, district, facility and household levels. Figure 2 illustrates the time-line for data collection at different levels. Copies of data collection instruments can be found at www.who.int/imci-mce. See Annex 4 for more detail on data collection methods.

Box 1. Type of cost data collected at each level

National

The following IMCI-related activities were included:

- Planning and orientation meetings;
- Health-worker and pre-service training (including translation, adaptation and printing of questionnaires and training materials);
- Administration

In addition, cost information was collected on the subset of the EPI, nutrition and malaria programme related to under-fives.

District

- Training related to IMCI, included follow-up supervision after training, and to other under-five activities;
- Supervision for IMCI and for general-purpose activities related to under-fives;
- Costs of distributing drugs and vaccines for under-fives to health facilities (costs of drugs and vaccines are included in primary health facility costs);
- Administrative costs of under-five care at the district office.

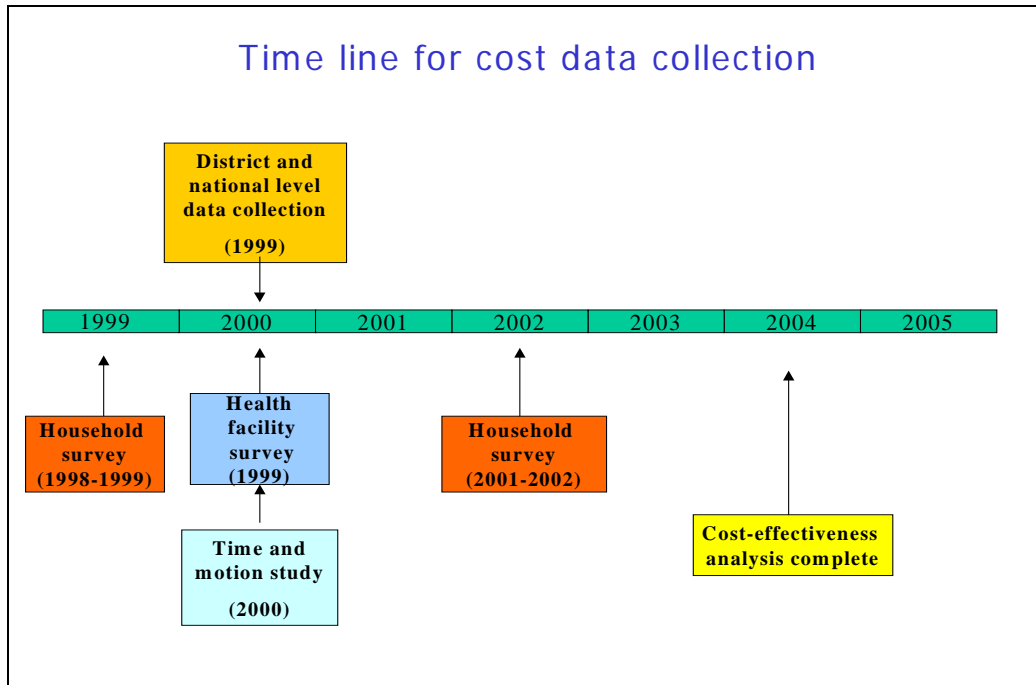
Primary health facility (only government)

- Staff time spent on under-five care;
- Drugs and medical supplies allocated to under-fives;
- Annual utilization rates (number of visits), from **HMIS** forms kept at health facilities;
- Overhead and capital costs allocated to under-fives.

Household

- Out-of-pocket payments (at government and non government providers) for:
 - Consultations;
 - Drugs and other medical supplies (for both those who sought care and self medication with no careseeking);
 - Travel cost
- Time spent in seeking care
- Admissions to hospital in the previous year

Figure 2. Time line for cost data collection (period covered by the data in parenthesis)



Quality control

For national, district and primary health facility data, all forms were checked for completeness and consistency, and follow-up visits were made to re-collect inconsistent or incomplete data. Each day during the household survey, a field supervisor checked all forms, sat in on one or two interviews, and made random re-visits to a sample of households.

Data processing

National, district and primary health facility data

Excel was used to process data on national, district and primary health facility costs. Quality was checked visually and through range and consistency checks.

Household survey

For data processing, two data-entry clerks made double entries into a FoxPro database system. The two files were compared and any inconsistency verified with reference to the original forms. Range and consistency were checked regularly.

Methods of analysis

WHO CostIt (11) and STATA software (12) were used for the analysis of cost data.

This section is in four parts: (A) Methods of estimating the total economic cost of providing IMCI-based child health services in a district (objective one); (B) Methods of estimating the additional economic cost to society of introducing and running IMCI in a district (objective two); (C) Sensitivity analysis; and (D) Regression analysis.

For objectives one and two, cost estimates were standardized to a hypothetical district with a population of 50,000 under-fives. This corresponds to a total population of around 300,000, which is roughly the average district population for Tanzania.

Annex 5 gives details of the methods of cost valuation and allocation of joint costs to under-five care.

A. Objective 1: To estimate the total economic cost of providing IMCI-based child health services in a district

This represents the full economic cost to society as a whole of services to children under five years of age (under-fives), based on the IMCI strategy. This allows a cost-effectiveness analysis, in order to assess whether treating under-fives on the basis of IMCI is a good use of scarce health resources (13;14).

The total cost of providing care for under-fives in a district consists of:

- at the **national** level, the share of the cost of management of child-health related programmes allocated to each district;
- at the **district** level, the cost of implementing, managing and supervising under-five child health care;
- at **district hospital** level, the cost of under-five hospital care (inpatient) for the district;
- at **primary facility** level, the cost of under-five health services;
- at **household** level, the cost incurred in seeking and obtaining treatment for under-fives.

Methods used to estimate district costs at each of these five levels are given below.

1. *Apportioning national-level costs to the district:*

The proportion of national-level costs of under-five care allocated to each type of district was calculated in two steps:

i. Classification of the total national-level costs of under-five care into two categories – one for intervention districts and one for comparison districts:

National-level costs for intervention districts include start-up and post-implementation costs of IMCI (coordinated by the child health component of the maternal and child health department), annual cost of EPI, and a proportion of the annual cost of activities related to malaria control and nutrition. National-level costs for comparison districts include the comparison share of the cost of the child health component of the maternal and child health department, the annual cost of EPI, and a proportion of the annual cost of activities related to malaria control and nutrition. The proportion of the annual cost of malaria control and nutrition activities is estimated for each district by the ratio of visits of under-fives to total visits.

ii. Estimation of the proportion of national-level costs allocated to a standard IMCI district and a standard comparison district:

National-level costs were divided by the number of districts, on the assumption that the national costs of implementing child health programmes, such as IMCI adaptation or support for a malaria or EPI programme manager, would not be influenced by whether a district was large or small. For IMCI-related activities, national costs were divided by 30 – the number of districts implementing IMCI in 1999. For other child health activities, national costs were divided by 114 – the number of rural district and municipal councils in Tanzania in 1999.

2. *District-level costs*

District-level costs of under-five care consisted of the following:

- The total cost of IMCI training and follow-up after training
- The total cost of EPI training, and part of the cost of malaria training, according to the proportion of under-five to total visits in the district
- For IMCI supervision visits in 1999 (excluding follow-up after training visits, which are covered in cost of training), a proportion of the salary of supervisors was allocated to the cost of under-five care on the basis of the number of days supervisors reported spending on IMCI supervision. In

addition, the daily allowance paid for these visits was included in the cost of under-five care in IMCI districts.

- For other general-purpose supervisory visits in 1999, for all ages (such as supervision for drug availability or completion of HMIS forms), the opportunity cost of supervisors' time and the proportion of daily allowance paid were estimated on the basis of the ratio of under-five to total visits in the district.
- The proportions of the salaries of the district officers and their assistants were determined from information obtained from interviews with the district medical officer or the staff concerned, indicating the proportion of their time given to under-five care. The corresponding proportions for supervisors other than the cold-chain and MCH staff, and for drivers assigned to supervision or drug-distribution duties, were based on the number of days spent in these activities.

3. Calculating total hospitalization costs for the whole district

The total cost of under-five hospitalization in a district was estimated from the product of the number of under-five hospital bed-days and the average cost per under-five bed-day. It was calculated as follows:

3.1. Number of under-five hospital bed-days

To obtain the total number of under-five hospital bed-days in 1999 the following estimates were used:

1. *Percentage of under-fives admitted to district hospitals in 1999.* This is obtained from the 1999 household survey (4).
2. *Number of admissions per admitted child per year:* In 1999, a study in the Saint Francis hospital, a designated district hospital in Tanzania (Kilombero district), found that the average incidence of under-five admissions to hospital was 1.2 admissions per admitted child per year (15) .
3. *Average length of stay (in days) per under-five admission:* estimated as 4.45 days (15).

The total number of hospital bed-days in a district was the product of the above three estimates multiplied by the under-five population of the district.

3.2. Average cost per under-five bed-day

The average cost per bed-day was obtained from a 1996 study by Alonso et al. (1), who estimated the average cost per under-five bed-day for cases of anaemia and malaria admitted to the district hospital in Kilombero district. These are the most common causes of under-five admissions to hospital and these costs were therefore used to estimate all under-five bed-days. The average cost per under-five hospital bed-day for a case of anaemia or malaria was US \$9.01 in 1999. The average cost reported in the study was converted to 1999 constant Tanzania shillings at the average official exchange rate prevailing in Tanzania in 1999 (1US\$=777 T sh)¹⁶ and with GDP¹⁷ deflator factors from the World Development Indicators report for 2001 (16).

Because of differences in estimated hospital admissions between the four districts, together with the lack of a direct estimate of hospitalization costs in each district, the analysis was repeated with and without the inclusion of estimated total hospitalization costs.

4. *Estimating the total cost of under-five care by projection from the sampled primary facilities to the whole district:*

The total cost of under-five care in the sampled facilities was used to estimate total district costs of primary care for under-fives. This was done in four steps:

Step one: Cost per under-five visit ("cost per visit") was estimated in two stages: (i) estimation of the total cost of under-five care of a single health facility; (ii) with the value obtained, estimation of the cost per visit at this health facility.

i. Total cost of under-five care for a single health facility is estimated as follows:

Equation 1. Total cost of under-five care for a single facility

$$TFC = \sum_{i=1} (W_i * P_i) + \sum_{j=1} (D_j * P_j) + \sum_{k=1} (S_k * P_k) + \sum_{l=1} (V_l * P_l) + \sum_{m=1} (E_m * P_m) + B$$

where TFC is total facility cost, i indexes categories of workers W ; j the different drugs D ; k the different supplies S ; l the different vehicles V ; m the different items of equipment E ; B annualized replacement cost of premises, and P prices/wages.

¹⁶ mid-year average exchange rate (source: Bank of Tanzania)

¹⁷ GDP: Gross domestic product

ii. Cost per visit was estimated as follows:

Equation 2. Unit cost per under-five visit

$$UC = TFC / N$$

where UC is the cost per visit, TFC is total (annual) cost of under-five care, and N represents the total number of under-five visits (curative and preventive).

Step two: The sampled facilities were divided into two types (dispensaries and health centres).

Step three: For each type, the average cost per visit was estimated as shown in Equation 3.

Equation 3. Average cost per visit by type of facility

$$\overline{AC} = 1/N \sum_{i=1}^N UC_i$$

where \overline{AC} is average cost per visit in one type of facility;
 UC_i is average cost per visit in the i th facility in this type of facility (estimated as in Equation 2; and N is the total number of facilities in this type.

Step four: To obtain total district costs of government primary care facilities, including those not sampled, total utilization at dispensaries (collected from the district office) are multiplied by average cost per visit to dispensaries, estimated from the OLS regression analysis as explained in step 2 above. The same procedure is used for health centres to give:

Equation 4. Total cost of under-five care for all facilities in the district

$$TC = \overline{AC}_d \sum_{i=1}^d V_i + \overline{AC}_{hc} \sum_{j=1}^{hc} V_j ,$$

where:

TC=Total cost of under-five care for all facilities in the district;

\overline{AC}_d = average cost per visit to dispensaries as estimated in Equation 3;

N_d = total number of dispensaries in the district;

V_i = visits (curative and preventive) by under-fives in the i th dispensary in the district;

\overline{AC}_{hc} = average cost per visit to health centres as estimated in Equation 3;

N_{hc} = total number of health centres in the district; and

V_j = visits (curative and preventive) by under-fives in the j th health centres.

5. Household health-care costs for the whole district:

Based on the two-week morbidity module in the 1999 household survey, information on costs incurred during under-five illness episodes in the two weeks prior to the survey were collected for each child in the household. The following average cost estimates were calculated:

- Consultation fee, calculated separately for government and non-government providers.
- Out-of-pocket payment for drugs and medical supplies, at government, non-government and other types of drug sellers (e.g., pharmacy, drug shops).
- Out-of-pocket payment for travel;
- Other non-medical expenses, e.g., food.

Household health care costs for the whole district was calculated in the following way¹⁸:

- *Total cost of consultations (at all providers, including non-government)*: The number of visits made to different types of provider, as well as the number of illness episodes for which care was not sought, along with their associated costs, were obtained through the standardized household questionnaire. To obtain total district costs, the total number of visits to government facilities was obtained from the district medical office. This figure was used as the starting point. Data from the HHS were then used to construct the ratio "visits made to non-government providers and episodes of illness for which care is not sought" / "visits made to government facilities". The ratio is used to obtain the total number of visits to different types of provider. These numbers are multiplied by the average cost per consultation visit to obtain total district cost.
- *Total cost of drugs and medical supplies (all sources)*: Drug and medical supply costs incurred at government, non-government or private pharmacies are collected by means of the household questionnaire. Methods of estimating total district costs are the same as described above for consultation costs. Average drug-cost incurred in illness episodes for which care is not sought (i.e., cost of self-medication) is multiplied by the proportion of illness episodes for which care is not sought; this proportion is estimated from the HHS, as described above.
- *Total cost of travel (to all providers)*: Average cost of travel to any type of provider is calculated. This is multiplied by the total number of visits made to any type of provider in 1999, to obtain total travel costs to seek care for under-fives for the district as a whole.

¹⁸ Household cost estimates will be revised to incorporate results from the 2002 household survey

- *Other household costs (e.g., food, overnight accommodation) incurred at any type of provider or in illness episodes for which care is not sought are estimated as described above.*

B. Objective 2: To estimate the additional economic cost of implementing IMCI, compared with providing routine care for under-fives.

This allows a traditional incremental cost-effectiveness analysis, to assess whether the additional benefits over routine practice justify the additional resources (14;17;18).

District-level estimates of the additional costs of implementing IMCI were based on the difference in cost of under-five care between IMCI and comparison districts. The total cost of care for under-fives in a standard comparison district was subtracted from the total cost in a standard IMCI district. The difference is the estimated change in under-five costs attributable to IMCI.

C. Sensitivity analysis

There is potential uncertainty about the values of several estimated parameters. Probabilistic sensitivity analysis permits the analyst to test the robustness of the conclusions to changes in key parameters by assigning ranges and distributions to uncertain parameters and re-estimating the results for various combinations using decision analytical techniques (19-21). This can be done with one-way sensitivity analysis, where one variable is varied at a time; with multi-way sensitivity analysis, where several variables are varied together; or using analysis of extremes, where a base-case estimate is determined and the uncertain parameters are then varied using their extreme “optimistic” and “pessimistic” values to elicit a best and a worst-case scenario (19).

One-way analysis may be sufficient if each of the uncertain variables is independent of the others. This is unlikely to be the case with cost estimates, but can provide a useful description of the magnitude of variation in total costs related to any single input or price used in the calculations. In addition, one-way analysis is easier to interpret than multi-way analysis. Analysis of extremes provides a more conservative estimate of the range around which the outcome of interest falls but has limited usefulness. It is unlikely, for example, that all pessimistic factors affecting costs will occur simultaneously. There are some combinations of factors that are much more likely than others to take place together.

One-way and multi-way probabilistic sensitivity analyses were performed using multiple simulation methods in which input variables were varied 1000 times within a specified range, using @RISK software (22). At each

iteration, values for each parameter were chosen at random from the defined probability distributions.

Four variables were identified for this analysis. The useful life of start-up costs, district-level cost per child, percent of under-fives admitted to hospital and average number of visits per child per day. The ranges used and their justification are presented in the results section.

The uncertainty about the selected variables are of three sorts. The first is a value judgement. The second and third are variables where the observed average differences in costs between the intervention and control groups is believed to be due to factors unrelated to IMCI, e.g., district-specific differences, while the fourth variable could be related to IMCI, e.g., number of visits per child per year. For all input parameters, the only information available was the range of possible values, a uniform distribution was assigned across the range (19;23).

D. Regression analysis

Objectives

Even in randomized controlled trials, where a large number of patients are randomized to intervention and comparison groups, the characteristics of patients in the two groups may differ simply by chance. In such cases, simple unadjusted univariate comparison of results may be misleading and other methods of analysis that control for differences in initial characteristics of patients need to be used. This type of question also arises in studies such as the MCE, where the unit of comparison is the district and data can be collected from only a small number of districts. In such cases it is important to explore whether the results of unadjusted univariate comparisons between intervention and comparison districts might be related to differences in the characteristics of the facilities rather than to the intervention itself.

Regression analysis is one way of trying to separate the influence of multiple factors on the quantity of interest. It is particularly useful for the analysis of primary-health-facility unit costs, which could be influenced by both IMCI and many factors other than IMCI.

Regression analysis requires a large number of observations for the quantity of interest – in this case, cost per visit. It cannot be performed on district level costs, for example, where there are only four observations.

Methods

Building on the cost function literature, Ordinary Least Squares regression analysis (OLS) was used to explain the variation in costs of under-five care at health facilities. A long-run cost function was used, the dependent variable

was total costs of under-five care at the i th health facility¹⁹. A variety of interrelated explanatory variables were included, such as IMCI (yes or no), whether the observation was a dispensary or health centre (coded as dispensary: yes or no), the annual number of under-five visits as a measure of output and dummy variables for the availability of four-wheel vehicles or motorcycles, as proxies for capital input.

A number of other explanatory variables were explored in this analysis including: the number of dental chairs and number of microscopes as proxies for the complexity of services delivered; and surface area of the facility in m² as a measure of size. These variables proved to be very highly correlated with the other variables of capital input described above, posing multicollinearity problems with the regression, and have therefore been excluded from the results reported here.

Because the distribution of the dependent and independent variables were not normally distributed in their natural units, all were transformed into logs. Log transformation has two added advantages. First, it eliminates heteroscedasticity in the model that may result from using total costs as the dependent variable. Second, coefficients can be readily interpreted as elasticities (e.g., the percentage change in the dependent variable resulting from a one percent change in the independent variable). Log transformation also specifies the relationship between dependent and independent variables to be non-linear, which is more consistent with theory.

The cost function specification of the OLS regression model can be written as:

Equation 5. Cost function specification of the Ordinary Least Squares regression model

$$TC_i = \alpha + \beta_1 X_1 + \beta_2 X_2 \dots \beta_N X_N + e_i$$

where TC_i is natural logarithm (ln) of total cost of under-five care in the i th facility; X_1 is a dummy for IMCI ; X_2 is a dummy for dispensary; X_3 is a dummy for the availability of vehicles or motorcycles; X_4 is the natural logarithm of the annual number of under-five visits; and e denotes the error term.

¹⁹ There is a wealth of literature on the appropriateness of using total rather than unit cost as the dependent variable when cost functions are estimated. On the one hand, using unit cost as the dependent variable runs the risk of introducing bias in the estimated coefficients when one of the explanatory variables is total visits – this variable is already the denominator of the dependent variable (e.g. cost per visit). On the other hand, the use of unit costs reduces the risk of error terms with non-uniform variance (heteroscedasticity) in the estimated regression. This could arise if total cost were used as the dependent variable, as the error term could be correlated with the size of the health facility (29;30). Total costs were used for this analysis as there was no evidence of heteroscedasticity after using the natural log transformation of the dependent variable.

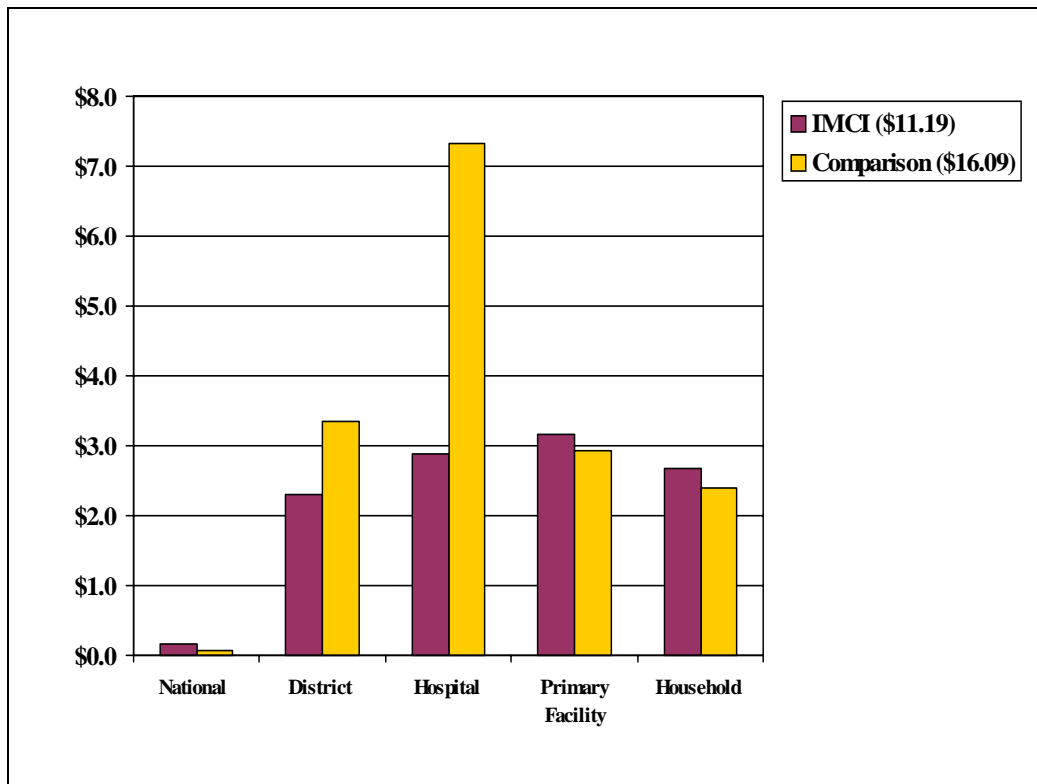
Results

In 1999, the district cost per child of under-five care in IMCI districts was US\$11.19, compared with \$16.09 in comparison districts. Costs have been estimated for a standard district with 50,000 under-fives. This section considers the components of total cost in turn to establish whether the observed differences are likely to be due to IMCI or to other factors in which IMCI and comparison districts differ.

A. Total cost of under-five care in a district (Objective 1)

Figure 3 and Table 1 show the breakdown of total cost of under-five care per child. The difference between IMCI and comparison districts is attributable mainly to differences in hospital costs. IMCI districts spent less than half as much on hospital care for under-fives as comparison district, not because of differences in the cost per under-five admission, but because fewer under-fives were hospitalized.

Figure 3. Components of cost of under-five care per child in a standard¹ district (1999 US\$)



¹ standard district with 50,000 under-fives

Table 1. Cost of under-five care per child in a standard¹ district in 1999 Tanzania shillings (US \$ in parentheses)

Level	Standard IMCI district		%	Standard Comparison district		%
	Tsh	(US\$)		Tsh	(US\$)	
National	129	(0.17)	1	55	(0.07)	0
District	1,784	(2.30)	21	2,605	(3.35)	21
Hospital	2,243	(2.89)	26	5,692	(7.33)	46
Primary-facility	2,455	(3.16)	28	2,283	(2.94)	18
Household	2,083	(2.68)	24	1,867	(2.40)	15
Total	8,695	(11.19)	100	12,503	(16.09)	100
Total excluding hospital costs	6,452	(8.30)		6,810	(8.76)	

¹ standard district with 50,000 under-fives

Each level described in Table 1 is discussed in turn below beginning with costs incurred at the national level, and full details are provided in Annex 9.

1. Costs of under-five care incurred at the national level

Table 2 shows the annual per-district national-level cost of under-five care for IMCI and comparison districts. Administrative costs include staff time and annualized cost of capital items used in activities related to IMCI, malaria control, EPI, and nutrition. Only the last three are included in the national-level cost of under-five care in comparison districts. The high administrative costs in IMCI districts reflect the start-up cost of establishing IMCI and the subsequent cost of its administration, at both the MoH and the WHO Tanzania office. It should be noted, however, that these costs account for less than 1% of the total cost of under-five care (Table 1).

Table 2. Annual per-district national-level cost¹ of under-five health care in 1999 Tanzanian shillings (US \$ in parentheses)

Type of district	Administration	IMCI planning	Adaptation of the IMCI guidelines	IMCI health worker training	IMCI pre-service training
	Tsh (US\$)	Tsh (US\$)	Tsh (US\$)	Tsh (US\$)	Tsh (US\$)
Standard IMCI district	5,264,048 (6,775)	7,864 (10)	6,284 (8)	101,822 (131)	5,111 (7)
Standard comparison district	387,974 (499)	-	-	-	-

Source: Data collection at national level

¹These estimates constitute the annualized start-up and post-implementation costs in a standard district with 50,000 under-fives. Start-up costs are annualized over a period of 10 years at a discount rate of 3%.

2. Costs of under-five care incurred by the district administration

District-level costs accounted for a more substantial proportion of the total district cost of under-five care: 21% in both IMCI and comparison districts (Table 1). Table 3 shows the breakdown of these costs for administration, training and supervision. Administration costs include staff time and costs of distribution of drugs and vaccines to health facilities. Included also is the annualized value of the district-health-system administration and training in the start-up period. The table indicates that costs were higher in the comparison districts with respect to administration and supervision and slightly lower for training. The higher training costs in IMCI districts are due to the introduction of IMCI, and the lower administration and supervision costs probably to district-specific factors such as frequency of visits to primary facilities for purposes of supervision and distribution of drugs and vaccines, proximity of health facilities and quality of roads. These factors are independent of IMCI. For the unstandardized district-level costs see Table 23.

Table 3. Annual district-level cost¹ of under-five care in a standard district in 1999 Tanzanian shillings (US \$ in parentheses)

District	Administration (e.g., salaries and drug distribution) Tsh (US\$)	Training on under-five related activities Tsh (US\$)	Supervision of primary care facilities on under- five related activities Tsh (US\$)
Standard IMCI district	20,435,266 (26,300)	5,984,959 (7,703)	23,168,889 (29,818)
Standard comparison district	28,523,491 (36,710)	5,609,272 (7,219)	33,224,499 (42,760)

Source: Data collection at district level

¹These estimates constitute the annualized start-up and post- implementation costs in a standard district with 50, 000 under-fives. Start-up costs are annualized over a period of 10 years using a discount rate of 3%.

3. Costs of under-five care incurred at hospitals

Hospital costs were 2.5 times as high in comparison as in IMCI districts. This is not due to differences in cost per bed day. As a full costing study was not feasible at hospitals, the cost of an under-five inpatient day was taken from a study by Alonso et al. (1). The same cost was used for all districts. The explanation is that children in comparison districts were more likely than those in IMCI districts to be admitted to hospital. The proportions of under-fives hospitalized were 19% and 12% in Kilombero and Ulanga (comparison districts) respectively, compared with 7% and 5% in Morogoro and Rufiji (IMCI districts). This difference was significant ($p < 0.001$), as shown by regression analysis allowing for clustering (4).

The total cost of under-five hospitalization is found in Annex 9, Table 24. Whether this difference was attributable to IMCI is considered in the discussion section.

4. Costs of under-five care incurred at the primary health facility

Table 4 summarizes the average cost per visit in the four categories of government facility (namely IMCI dispensaries, IMCI health centres, comparison dispensaries, and comparison health centres). The univariate comparisons indicate that there is no difference in costs by type of district (t-test: IMCI against comparison, $p=0.4$ for dispensaries and $p=0.7$ for health centres). It should be remembered, however, that the sample size for comparisons across health centres is small.

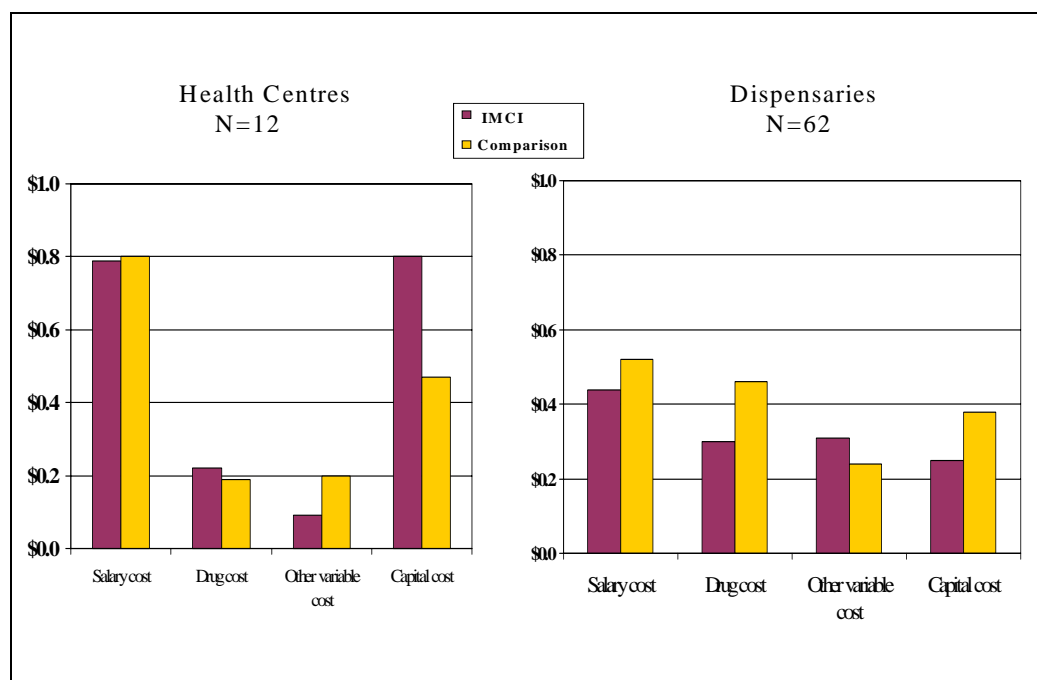
Table 4. Average cost per under-five child visit in government facilities in 1999 Tanzanian shillings (US \$ in parentheses)

Category	IMCI districts			Comparison districts	
	Mean	SD	sample no.	Mean	census no.
	Tsh (US\$)	Tsh		Tsh (US\$)	
Dispensary	1012 (1.30)	715	33	1,251 (1.61)	29
Health centre	1,479 (1.90)	1132	6	1,293 (1.66)	6

Source: HFS 2000 and district-level data collection

Figure 4 shows the breakdown of the different components of average cost per visit, presented separately for health centres and dispensaries. Only health centres show an apparent difference in average cost per visit; IMCI health centres have a higher average capital cost than comparison health centres because they are more likely to have vehicles. The difference is not statistically significant, however.

Figure 4. Comparison of the components of average cost per under-five visit at government facilities in 1999 US\$



Source: HFS 2000

In the remainder of this section, the main components of total facility costs (salaries and drugs) are reported in turn.

a) Salaries: Salaries²⁰ are attributed to under-five visits according to the proportion of staff time spent with under-fives compared with over-fives. This, in turn, is a function of the proportion of under-five visits to total visits, as well as the time spent per under-five consultation compared with that per over-fives.

Figure 5 shows the average time spent per consultation, by type of district and facility, derived from the time-and-motion study. The main findings are:

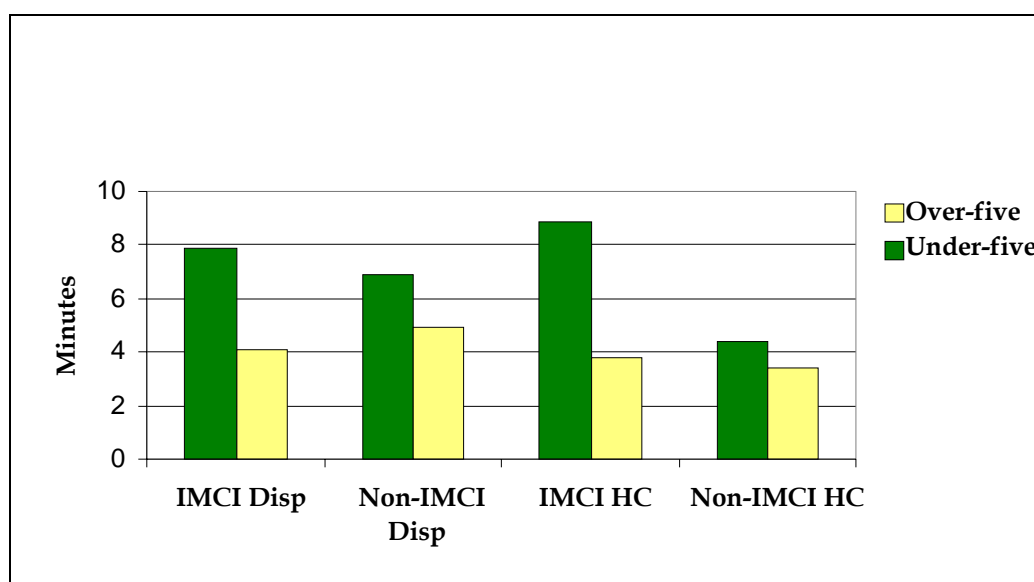
- In both types of facility and in both types of district, health workers spent more time with under-fives than with over-fives.
- Health workers at IMCI health centres spent more time, on average, with under-fives than did health workers in comparison health centres (9 vs 4 minutes, $p=0.0001$).
- These health workers did not compensate by spending less time with over-fives (3.8 minutes in IMCI health centres per over-five visit compared with 3.4 minutes in comparison health centres: $p=0.4$).

²⁰ Salaries are allocated differently to under-five visits for clinical and general staff. See methods of allocation in Annex 5.

- In dispensaries, the average time that health workers spent with under-fives was similar, but they spent more time in each over-five consultation in comparison facilities than at IMCI dispensaries (5 vs 4 minutes, $p=0.0004$).
- Taking health centres and dispensaries together, IMCI health workers spent, on average, almost two more minutes in consultation with each under-five than did those in comparison facilities (8.2 vs 6.3, $p=0.0003$).

Table 26 in Annex 9 provides more detail of the results of the time-and-motion study.

Figure 5. Comparison of average time spent per consultation visit, by facility type and age group



Source: time-and-motion study

Table 5 shows the average utilization in the sampled facilities in 1999. These data were collected from the Health Management Information System forms available at health facilities. They cover all types of visits to health facilities, curative and preventive, namely total outpatient (curative) visits, and visits for vaccination, antenatal care, family planning and dental care. Average utilization by type of service and age group is compared. The results show that there was no difference in the average number of under-five visits per facility. Similarly, there was no difference in capacity utilization of health workers, measured by the average number of consultations per health worker per day (Figure 6). More detail is provided in Table 25.

Table 5. Average utilization in the sampled facilities by type of visit in 1999

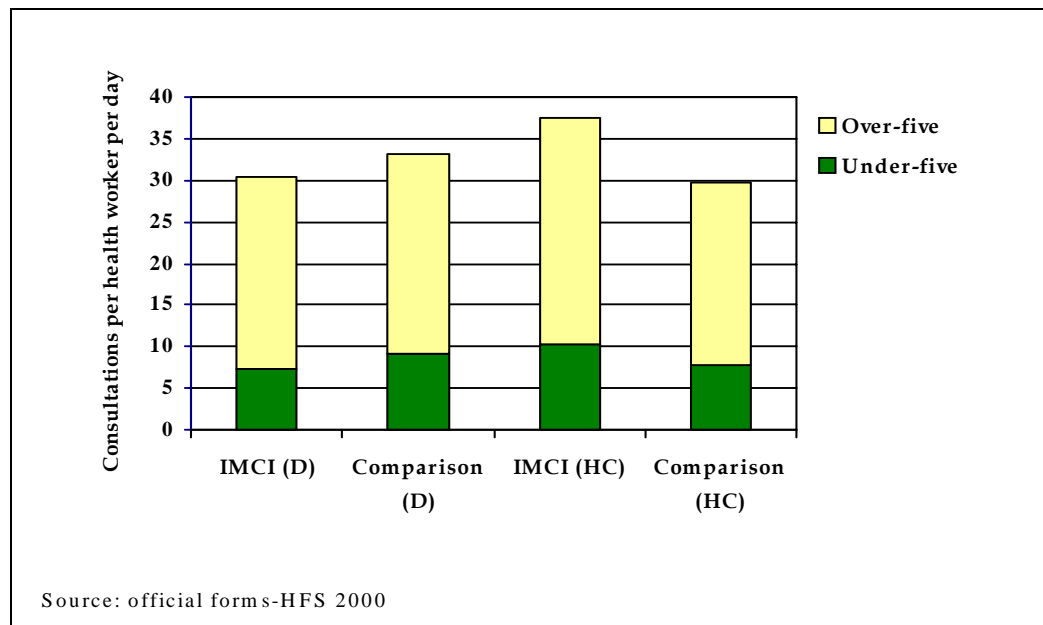
	Dispensary		p	Health centre		p
	IMCI N=33	Comparison N=29		IMCI N=6	Comparison N=6	
	Mean	Mean		Mean	Mean	
1) Total under-five visits	3184	3789	0.29	8324	6991	0.55
<i>OPD*</i>	2276	2822	0.23	6340	4829	0.45
<i>Vaccination</i>	895	967	0.72	1984	2162	0.77
2) Total over-five visits	5993	6254	0.76	13027	12188	0.80
<i>OPD*</i>	4914	4634	0.68	10178	8784	0.63
<i>Adult Preventive**</i>	1073	1620	0.08	2849	3404	0.60
Total visits	9178	10043	0.51	21352	19180	0.69

Source: HMIS forms available at health facilities

* OPD: Outpatient department

**preventive visits: antenatal, postnatal and family planning.

Figure 6. Average number of consultations¹ per health worker² per day in 1999



² Outpatient visits only

¹ Only health workers who reportedly examine patients

* t test (IMCI vs comparison dispensaries): P=0.8

** t test (IMCI vs comparison health centres): P=0.5

Table 6 shows the combined effect on the average personnel-cost per visit of the number of under-five visits and the increased time spent in consultation with under-fives in IMCI districts. Because the longer time spent with under-fives was only observed in health centres, which receive a smaller proportion of under-five visits than dispensaries (18%), overall, personnel cost per under-five visit was similar between IMCI and comparison districts.

Table 6. Comparison of average personnel costs per under-five visit in 1999 Tanzanian shillings (US \$ in parentheses)

Category	IMCI district			Comparison district		
	Mean	SD	N	Mean	SD	N
	Tsh (US\$)	Tsh		Tsh (US\$)	Tsh	
Government dispensaries*	344 (0.44)	317	33	406 (0.52)	268	29
Government health centres**	616 (0.79)	324	6	625 (0.80)	125	6
Weighted average	386 (0.49)	330	39	443 (0.57)	262	35

Source: HFS 2000 and district-level data collection

* t-test (IMCI vs comparison dispensaries): p=0.42

** t-test (IMCI vs comparison health centres): p=0.95

b) Drugs: Table 7 shows the costs of drugs for the four categories of facility. IMCI dispensaries spent less on drugs per visit than comparison dispensaries, as distinct from health centres, which spent more. In neither case is the difference statistically significant.

Table 7. Comparison of average drug costs per under-five visit in 1999 Tanzanian shillings (US \$ in parentheses)

Category	IMCI district			Comparison district		
	Mean	SD	N	Mean	SD	N
	Tsh (US\$)	Tsh		Tsh (US\$)	Tsh	
Government dispensaries*	235 (0.30)	152	33	356 (0.46)	318	29
Government health centres**	171 (0.22)	145	6	149 (0.19)	85	6
Average	223 (0.29)	150	39	295 (0.41)	299	35

Source: HFS 2000 and district-level data collection

* t test (IMCI vs comparison dispensaries) P=0.09

** t test (IMCI vs comparison health centres) P=0.74

5. Household care-seeking costs

Table 8 shows the out-of-pocket costs of such items as travel, consultation fees and drugs incurred in consultation with different types of provider, obtained from the HHS 1999 (Results by district are shown in Table 27). Information

on consultation fees and drugs purchased directly from the provider is reported for government and non-government facilities separately. Additional drugs, other medical supplies non-medical supplies and the costs of travel to seek care are reported for government and non-government facilities combined. These costs are cost per visit.

In addition, the costs of supplies purchased for episodes for which care was not sought at a formal-care provider are reported. These costs are the cost per episode of illness. Information on the number of visits per child per year, and on the number of episodes for which care was not sought, allows the household costs of under-five care to be calculated for the district as a whole, in Table 9. The estimates in Table 8 are combined with information on the total number of episodes per year to obtain the total household cost per child per year in Table 9. The methods used to aggregate total cost per child are described in the Methods section.

Table 8. Household average out-of-pocket cost per cost category in 1999 Tanzanian shillings (US \$ in parentheses)

	IMCI district				Comparison district		
	Mean cost per visit	SD	N		Mean cost per visit	SD	N
	Tsh (US\$)	Tsh			Tsh (US\$)	Tsh	
(i) Episodes for which care was sought from a formal-care provider							
1. Travel cost	51 (0.07)	291	206		69 (0.09)	341	239
2. Consultation cost							
<i>a) At government facility</i>	19 (0.02)	162	163		53 (0.07)	282	111
<i>b) At non-government facility</i>	34 (0.04)	141	34		401 (0.52)	939	80
3. Drug costs							
<i>a) At government facility</i>	129 (0.17)	477	159		189 (0.24)	390	108
<i>b) At non-government facility</i>	1016 (1.31)	1066	32		1005 (1.29)	1575	68
4. Additional drugs*	83 (0.11)	239	342		129 (0.17)	281	417
5. Medical supplies	14 (0.02)	74	507		27 (0.03)	117	538
6. Non-medical supplies**	151 (0.19)	728	228		170 (0.22)	753	266
(ii) Episodes for which care is not sought from a formal-care provider							
Drugs and Medical supplies	82 (0.11)	205	258		144 (0.18)	271	279

Source: HHS 1999

*Through self-medication or drugs supplied by pharmacists.

**Include purchases of food and drinks or for spending the night away from home while seeking care.

Household out-of-pocket payments per visit were slightly higher in comparison districts, owing mainly to differences observed in the Kilombero district. This may be due partly to a user-fee system in government facilities in this district. It may also have occurred because this district has the only large urban area of the four districts and because user fees at non-government facilities may be higher than in rural areas.

The average time spent in seeking care per visit to a primary facility was 3 h 24 min (n=195) and 4 h 22 min (n=201) in IMCI and comparison districts, respectively. The results are adjusted by the average number of care-takers travelling with the under-fives (1 h 25 min and 1 h 17 min in IMCI and comparison districts, respectively). Of time spent in seeking care, opportunity cost of time is not included in the analysis (24).

The out-of pocket cost per child for a district as a whole depends not merely on cost per visit, but on the number of visits per child, as well as on the costs of items purchased for episodes in which care was not sought. These components are in Table 9, which shows the average out-of-pocket cost per child²¹ for the district as a whole. The results take account of differences in the number of visits to the different types of provider with the exception of household costs incurred at hospitals where the number of observations from the 1999 household survey was too small to construct average costs - very few children were admitted to hospital in the two weeks prior to the survey. The results, disaggregated by district, are reported in Annex 9.

Although the unit costs were higher in comparison than in IMCI districts, the total cost per child over a year is very similar. This might be explained by the fewer visits per child per year to primary-level facilities in the comparison districts (Table 22).

²¹ These estimates are for an average child in the district

Table 9. Household out-of-pocket health care cost per child per year in 1999 Tanzanian shillings (US \$ in parentheses)

	IMCI district	Comparison district
	Mean cost per child per year	Mean cost per child per year
	Tsh (US\$)	Tsh (US\$)
(i) Episodes for which care was sought from a formal-care provider		
1. Travel cost	191 (0.25)	78 (0.10)
2. Consultation cost		
<i>a) At government facility</i>	78 (0.10)	111 (0.14)
<i>b) At non-government facility</i>	7 (0.01)	165 (0.21)
3. Drug costs		
<i>a) At government facility</i>	471 (0.61)	295 (0.38)
<i>b) At non-government facility</i>	255 (0.33)	377 (0.49)
4. Additional drugs*	293 (0.38)	243 (0.31)
5. Medical supplies	52 (0.07)	50 (0.06)
6. Non-medical supplies**	571 (0.74)	388 (0.50)
(ii) Episodes for which care is not sought from a formal-care provider		
1. Drugs and medical supplies	164 (0.21)	160 (0.21)
(iii) Total	2,083 (2.68)	1,867 (2.40)

Source: HHS 1999

* Through self-medication or drugs supplied by pharmacists.

** Include purchase of food and drinks or cost of spending the night away from home while seeking care.

B. Additional costs of implementing IMCI—compared with providing routine care for under-fives (Objective 2)

Table 10 summarizes the results of Table 1 in a slightly different form, by presenting the difference in average costs between IMCI and comparison districts for each of the five levels at which cost is incurred. The results have been adjusted to reflect a standard district with 50,000 under-fives. They are presented in 1999 Tanzanian shillings and US\$. In 1999, the total cost of providing under-five care was 44% lower in IMCI than in comparison districts. If the higher hospital costs in comparison districts are excluded, district costs were still lower in IMCI districts (6%).

Table 10. Differences between IMCI and comparison districts in cost per child, in 1999 Tanzanian shillings (US \$ in parentheses)

Level	Average cost IMCI districts		Average cost Comparison districts		Difference in cost per child in IMCI districts		Comparison : IMCI
	Tsh	(US\$)	Tsh	(US\$)	Tsh	(US\$)	
National	129	(0.17)	55	(0.07)	74	(0.10)	0.43
District	1,784	(2.30)	2,605	(3.35)	- 820	(- 1.06)	1.46
Hospital	2,243	(2.89)	5,692	(7.33)	- 3,449	(- 4.44)	2.54
Primary Facility	2,455	(3.16)	1,693	(2.94)	171	(0.22)	0.93
Household	2,083	(2.68)	1,867	(2.40)	216	(0.28)	0.90
Total	8,695	(11.19)	12,503	(16.09)	- 3,808	(- 4.90)	1.44
Total excluding hospital	6,452	(8.30)	6,810	(8.76)	-359	(- 0.46)	1.06

Source: MCE of IMCI in Tanzania

Estimates have been adjusted for a standard district with 50,000 under-fives.

C. Sensitivity analysis

Table 11 presents the input variables selected for sensitivity analysis, with the range of values and distribution used in the simulation. Three reasons for uncertainty around the selected variables were identified: uncertainty around the value of a parameter; i.e., useful life of start-up costs; factors that may not be related to IMCI such as district costs per child and percent of hospital admissions; and factors that may be related to IMCI, such as average visits per child per year.

For the first parameter, the useful life over which start-up costs are depreciated, values were allowed to vary between 5 and 15 years (10 years had been used in the base-case analysis). This applies only to the IMCI districts because there were no start-up costs in comparison districts. For the second and third parameters, the sensitivity analysis explored the impact of assuming that the observed differences between the districts were due to chance rather than to IMCI. Accordingly, the parameters were allowed to vary between the minimum and maximum values observed in the four districts, with no difference between IMCI and comparison districts.

For the fourth parameter, it is possible that IMCI was associated with more visits per child, as one of the IMCI districts had roughly twice as many visits per child in the study period as the other three districts (Table 22). For this reason, visits in IMCI districts were allowed to vary between the minimum

and maximum observed in those two districts only, while visits for comparison districts varied between the minimum and maximum only for the two comparison districts.

For each of the last three parameters, no information was available on the nature of the possible distribution – only four observations were available, one for each district. A uniform distribution was therefore assumed because it did not require any additional knowledge about variances.

Table 11. Input variables varied in the probabilistic sensitivity analysis.

Level	Variable / Assumption	Probability distribution
National	Useful life of start up costs ¹	Uniform between 5 and 15 years in IMCI districts.
District	District cost per child ²	Uniform between 1-4 \$/child in both types of districts.
Hospital	% of under-five admissions per year ²	Uniform between 5% and 19% in the four districts.
Health facility and household costs	Outpatient visits per child per year ³	Uniform between 2.7 and 4.9 in IMCI districts and 2.4 and 2.5 in non-IMCI districts.

1. Value judgement

2. Based on ranges observed in the four districts

3. Based on the observed values in IMCI and comparison districts, respectively. There was a greater variability in number of visits per child in IMCI district.

The results of the probabilistic sensitivity analysis are presented in Table 12. The table shows the results of the one-way analysis varying each of the input variables separately and, in the last row, the multi-way analysis where all variables were varied at the same time.

Table 12. Results of probabilistic one-way and two-way sensitivity analysis.

Parameters varied	Total cost per child (IMCI)			Total cost per child (Comparison)		
	Low	Mean	High	Low	Mean	High
Annualization of start up costs	11.18	11.19	11.20	16.09	16.09	16.09
District cost per child	9.89	11.39	12.89	13.73	15.23	16.74
% of under-five admissions per year	10.71	14.08	17.44	11.11	14.45	17.78
Outpatient visits per child per year	12.76	14.04	15.19	15.60	15.62	15.63
All parameters together	12.03	17.13	22.55	8.45	13.13	17.85

Changing the period over which start-up costs were annualized (only in IMCI districts) made almost no difference to the cost-estimates, which in any case are a very small part of total costs. IMCI still incurs higher start up costs but the overall costs per child in IMCI districts are still lower than in comparison districts.

Varying district-level costs per child makes little difference to the overall conclusion that the costs in IMCI districts are lower than in comparison districts. The difference is driven largely by the higher rates of hospitalization observed in the comparison districts.

When the rate of under-five admissions was allowed to vary over the same range in IMCI and comparison districts, on the assumption that the observed difference between the districts could not be due to IMCI, the overall district cost per child no longer differed significantly between the two types of districts.

The district level estimates suggest that IMCI districts incur lower costs than comparison districts even if the number of outpatient visits per year in both IMCI districts is allowed to increase to the level observed in the one district with the highest utilization pattern. This affected district cost per child in several ways (data not shown):

- At the facility level, increasing the number of visits lead to a proportional decrease in the fixed cost per child – as fixed costs were divided by a higher number of visits – and a constant increase in the variable costs (drugs) cost per additional visit.
- At the household level, as all components of costs constitute a variable factor, all of them increased as a function of the increase in the number of visits.
- Despite the overall increase in primary facility and household costs per child, IMCI districts still incurred significantly lower district costs per child because this analysis includes the higher rate of hospitalization observed in comparison districts.

The one-way analysis, therefore, shows that the results are critically sensitive to the assumption about the rate of hospitalization. The conclusion that costs are lower in IMCI districts is not sensitive to changes in other key variables.

The same conclusion can be drawn from the multi-way analysis which varied all parameters together, with no difference in hospitalization costs between IMCI and comparison districts. There was no significant difference in the costs of caring for each child under-five as shown by the overlapping uncertainty interval around the mean cost per child.

D. Regression analysis

In the previous sections, it was shown that personnel and drug costs, for example, differed in IMCI and comparison districts. This might be due to IMCI, but could also be due to differences in health facility infrastructure or other factors unrelated to IMCI. To explore whether these variables remain correlated with the presence of IMCI even after controlling for other possible explanatory variables, the determinants of total costs of under-five care at health facilities were explored using regression analysis. Table 13 presents the descriptive statistics for the various explanatory and control variables included in the model. Ordinary Least Squares (OLS) estimates of the coefficients are presented in Table 14 to Table 16 and the correlation matrix in Table 17.

Table 13. Ordinary Least Squares regression model variables, means and SD. (N=74)

Variable	Description	Mean in natural units	SD in natural units	%
IMCI	Dummy variable for district type. IMCI=1			53
Dispensary	Dummy variable for facility type. Dispensary=1 and Health Centres =0			84
Log visits	Natural log of total under-five visits (vaccine and curative)	4147	2933	
Vehicle dummy	Dummy variable for availability of vehicles used also as a proxy for capital availability. Available=1			12

Source: HFS 2000

Table 14 to Table 16 present the results from the OLS regression of the total costs of under-five care at health facilities on the explanatory variables described in Table 13 above. The analysis was done in a stepwise manner. First, the effect of IMCI on total costs was explored. Second, we controlled for facility size and capital costs. Third, we explored the effect of number of visits.

The overall findings from all three models reveal that, adjusting for facility type, availability of vehicles and number of visits:

- In all regressions, total costs were around 30% lower in IMCI districts than in comparison districts (estimated coefficient in model three = -0.34 and $p < 0.0001$);
- Dispensaries had 51% lower costs (total) than health centres (estimated coefficient in full model = -0.65 and $p < 0.0001$);

- The availability of vehicles (a proxy for capital availability) leads to a significant increase (99%) in total costs (estimated coefficient in full model= 0.69 and $p < 0.0001$).
- Each 1 % increase in the total number of under-five visits leads to an increase of 0.19% in the total costs of under-five care ($p < 0.0001$). This indicates that the cost per visit falls as the number of visits rise, or the presence of economies of scale;

Examination of the adjusted R^2 shows that the explanatory variables included in the model explain a large part (80%) of the variation in total costs across facilities. The p -value for the F-statistic is < 0.0001 , indicating a highly significant fit of the equation to the data. Because a major part of the variation in the dependent variable has been explained, this suggests that no important explanatory variable has been omitted. The correlation matrix in Table 17 shows that the explanatory variables are not highly correlated with each other; this is confirmed by the variance inflation factor tolerance test (VIF) that showed no evidence of multicollinearity (mean VIF = 1.63)²².

The key finding in these results is that after controlling for other factors that influence the estimated total costs of under-five care at health facilities, there is no confounding of the results showing that IMCI in significantly lower costs than routine care.

Table 14. Model 1: (dependent variable: natural log of total costs of under-five care)

Adjusted $R^2 = 0.06$ F-statistic = 5.34 $p = 0.02$ N=73

Variable	β	S.E.	P	95% CI	
IMCI	- 0.30	0.13	0.024	- 0.57	-0.04
Constant	15.07	0.09	< 0.0001	14.84	15.28

Source: HFS 2000

Table 15. Model 2: (dependent variable: natural log of total costs of under-five care)

Adjusted $R^2 = 0.76$ F-statistic = 77.4 $p < 0.0001$ N=73

Variable	β	S.E.	P	95% CI	
IMCI	- 0.37	0.07	< 0.0001	- 0.51	- 0.24
Dispensary	-0.77	0.12	< 0.0001	- 1.02	- 0.53
Vehicle dummy	0.78	0.15	< 0.0001	0.48	1.08
Constant	15.69	0.12	< 0.0001	15.46	15.93

²² Variance inflation factor (VIF) is used to test multicollinearity. A value more than 0.05 excludes the possibility of multicollinearity (12) .

Table 16. Model 3: (dependent variable: natural log of total costs of under-five care)

Adjusted R² = 0.79 F-statistic = 74.41 p < 0.0001 N=73

Variable	β	S.E.	P	95% CI	
IMCI	- 0.34	0.06	<0.0001	- 0.44	- 0.21
Dispensary	-0.65	0.12	<0.0001	- 0.87	- 0.50
Vehicle dummy	0.69	0.14	<0.0001	0.41	0.97
Log visits	0.19	0.05	<0.0001	0.08	0.29
Constant	14.07	0.48	<0.0001	13.12	15.02

Table 17. Correlation matrix of variables included in the OLS regression model.

Variables	Log total costs of under-five care	IMCI	Dispensary	Vehicle dummy	Log visits
Log total costs of under-five care	1.00				
IMCI	- 0.26	1.00			
Dispensary	- 0.79	0.02	1.00		
Vehicle dummy	- 0.70	- 0.16	- 0.67	1.00	
Log visits	0.62	- 0.12	- 0.50	0.43	1.00

Source: HFS 2000

To illustrate the overall fit of the model, regression residuals are plotted versus predicted values (Figure 7). The plot shows residuals symmetrically distributed around zero (symmetry is consistent with the normal-errors assumption), and with no evidence of outliers or curvilinearity.

Figure 7. Plot of residuals versus predicted values

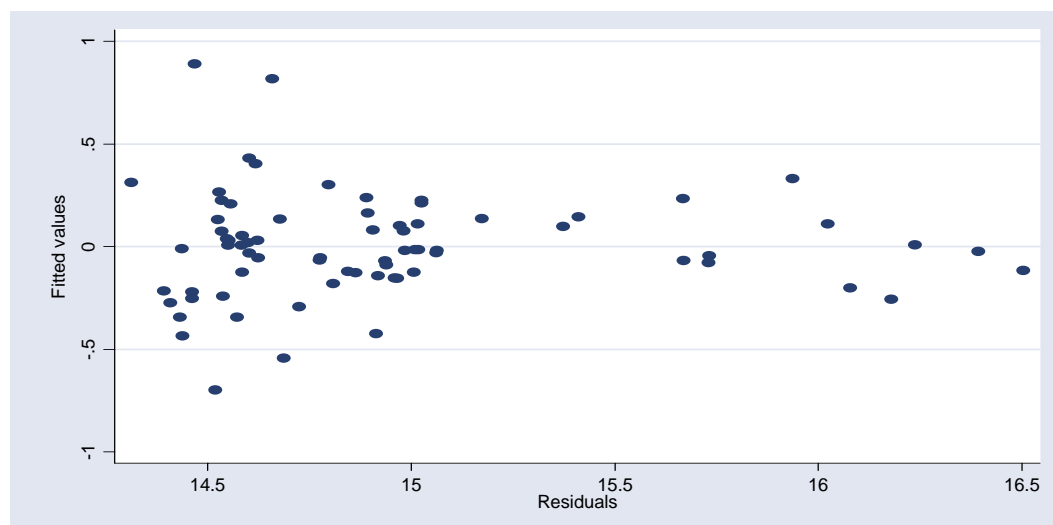
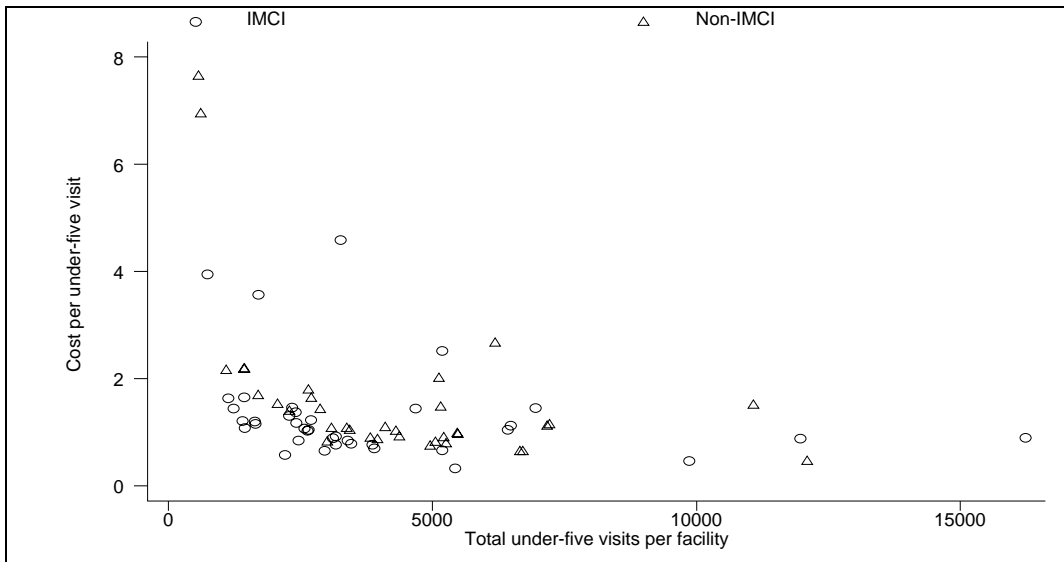


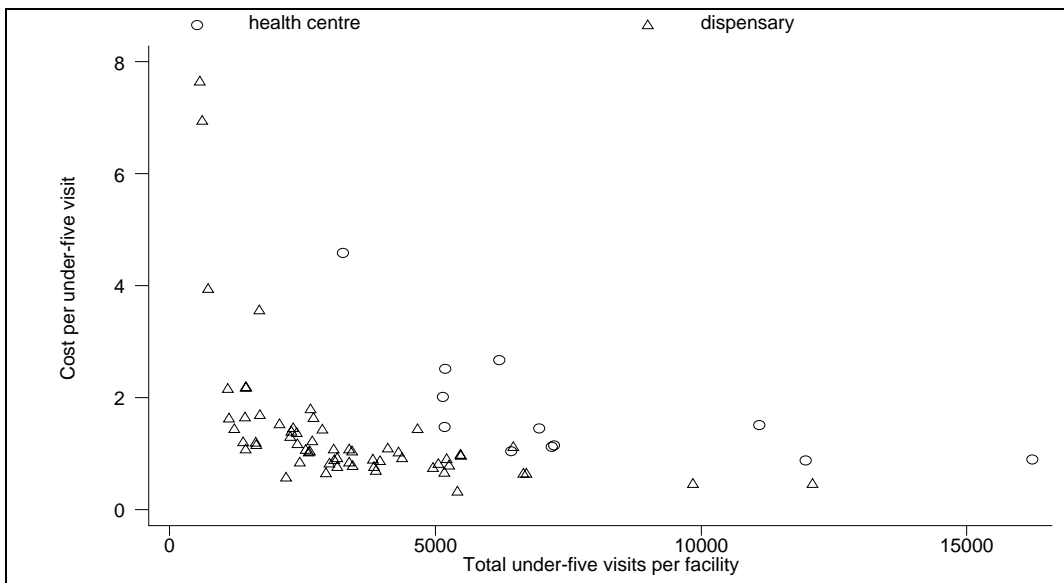
Figure 8 compares the cost per visit in IMCI and comparison facilities by plotting the average cost per visit against the total number of under-five visits. It illustrates the conclusions described above: IMCI facilities had a lower cost per visit than comparison facilities, and economies of scale exist—cost per visit decreases as the number of visits increases. Figure 9 shows cost per visit by facility type. Unit costs are higher in health centres than in dispensaries, and economies of scale were found in both types of facility.

Figure 8. Cost per under-five visit and total number of under-five visits (comparison between IMCI and comparison)



Source: HFS 2000

Figure 9. Cost per under-five visit and total number of under-five visits (dispensaries and health centres compared)



Source: HFS 2000

Discussion

The purpose of this study was to estimate the total economic cost of implementing IMCI and to identify any additional cost compared to routine care. It compared, therefore, the total cost of under-five care in four districts, two had introduced IMCI in late 1997 (IMCI districts) and two in 2002 (comparison districts). The study showed that, for 1999, there is no evidence that IMCI was associated with higher costs. These findings were unexpected, as IMCI has often been assumed to be more expensive than routine care for under-fives. To our knowledge, this study is the first attempt to estimate the actual cost of IMCI implementation.

For 1999, the measured cost per child of caring for under-fives in IMCI districts was estimated at \$11.19, 44% lower than in the comparison districts (\$16.09). The main determinant of these cost differences was at the hospital level where IMCI had lower hospital costs than comparison districts.

The difference in hospital costs between IMCI and comparison districts was due to fewer under-fives having being admitted to hospital in the year ending July-August 1999 in IMCI than in comparison districts (6% versus 15%, $p < 0.001$). Two competing explanations exist: (1) improved quality of care and drug availability for under-fives at IMCI primary facilities meant that fewer children were subsequently admitted to hospital; or (2) factors other than IMCI, such as differences in access to and quality of the hospitals meant that children in comparison districts were more willing or able to use hospitals. However, even if we assume that this difference was entirely due to other factors, and exclude the hospital component from the analysis, total costs per under-five child in IMCI districts were still lower than in comparison districts (6%).

At the facility level, univariate comparison of the total number of under-five visits and the cost per visit at government facilities were similar between the two types of district. Multivariate analysis, however, exploring the relationship between total costs of under-five care at health facilities and taking into account differences in the other determinants of costs such as IMCI, facility type, availability of vehicles, and total under-five visits, showed that IMCI facilities incurred significantly lower costs (30%) than comparison facilities ($p < 0.001$).

Results on the two major components of cost per visit at government facilities, i.e., personnel and drug costs, are discussed in turn.

With respect to personnel cost per visit, the main findings about the average time spent per consultation at government facilities, derived from the time-and-motion study, are:

- Both in IMCI and comparison districts, health workers spent more time per consultation with under-fives than with over-fives.
- Taking health centres and dispensaries together, IMCI health workers spent, on average, almost two more minutes per consultation with each under-five than did those in comparison facilities (8.2 vs 6.3 minutes, $p=0.0003$). This difference was only observed in health centres, which received only 18% of the total visits by under-fives.

This explains the similar personnel cost per visit, on average, between IMCI and comparison districts.

As an indication of the efficiency of health workers at government primary health facilities, health workers at IMCI health centers in 1999 examined, on average, more patients per day than those in comparison districts. In addition, more people in total, both under- and over-fives, visited IMCI health centers (See Table 5). This higher number of consultations did not, however, result in IMCI health workers spending less time per consultation with over-fives, as might be expected. On the contrary, they spent more time per under-five consultation on average, and no less time for each over-five consultation, than providers in the comparison districts (see Figure 5). It appears, therefore, that IMCI health-center staff used part of their non-clinical and slack time to provide better care for under-fives.

IMCI facilities spent 30% less on drugs and vaccines per average visit than comparison facilities. This difference was not statistically significant, however, due to very high variation across the visits. A detailed analysis of possible differences in drug spending and types of drugs consumed will be undertaken in future work.

Cost differences in relation to the other levels can be explained as follows:

- National costs were higher in IMCI districts owing to the additional costs of establishing and implementing IMCI. These costs were minimal, however (less than 1%).
- District-level costs were higher 0.5 times in comparison districts during the survey period. This is linked to the higher costs of supervision and administration in those districts, which is likely to be independent of IMCI.
- There was no difference in cost per child at the household level.

Probabilistic sensitivity analysis was performed to test the sensitivity of the results to variations in uncertain input variables, including the number of visits. It showed that the conclusion that costs were lower in IMCI districts

was sensitive only to assumptions about the number of hospital visits per child. It was not sensitive to the number of outpatient visits. Our judgement is that the observed differences in hospital costs are unlikely to have been due to the presence of IMCI at the time of the study. In this case, the sensitivity analysis showed that there was no significant difference in the costs of under-five care in the two types of district.²³ However, to the extent that the differences were due to IMCI, the cost of caring for children under-five was lower in IMCI districts.

Ideally, the study would have been preceded by the determination of under-five costs over a number of years before IMCI implementation in all four districts. This would have allowed before-and-after analysis to control for any cost changes resulting from district-specific factors or from trends in costs or utilization over time. IMCI was already in place, however, in 1999 when this study commenced, and this type of analysis was not possible.

One of the components of the MCE Tanzania study is a detailed documentation of 'contextual factors' – that is, district characteristics and activities other than IMCI, to be taken into account in the interpretation of its results. This part of the MCE Tanzania study is still in progress, but some of the ways in which the four districts differed are summarized here. These include the number and proportion of facilities managed by non-government organizations, under-five hospital admissions, care-seeking for children with danger signs, and home management of disease, all of which were better in comparison than in IMCI districts.

In the intervention districts, IMCI was associated with measures designed to strengthen district management such as evidence-based planning and expenditure mapping at district level (8). In fact, the decision to implement IMCI in the study districts has been attributed to evidence-based planning. Our study, therefore, assesses the effect of a dual intervention – IMCI together with an improved health system at district level, and we are not able to separate the effects of IMCI from district strengthening measures. Our findings reflect the costs of IMCI in the presence of strong health system and managerial capacity.

This analysis included the resources used at national, district, hospital and government primary facilities, and by households. Clearly, other health resources and activities also are devoted to under-five care in a district. We included the costs of all activities coordinated or planned by the district health office in the analysis, including such things as training of staff for IMCI, supervision visits and distribution of vaccines to NGO facilities. As the district office has very limited authority to oversee the implementation of IMCI in non-government facilities, these facilities were not included in the

²³ The 95% confidence interval around the estimate of cost per child overlapped, ranging between \$12 and \$23 in IMCI districts and \$8 and \$18 in comparison districts.

health-facility survey. At the household level, however, all costs incurred in obtaining care for under-fives were included. These include costs incurred in seeking care from non-government providers and traditional healers (e.g., consultation fees and payments for medications).

Considerably more work remains to be done to understand how the costs of implementing IMCI evolve over time, and how they are influenced by factors other than the existence of IMCI. For 1999, however, we conclude that there is no evidence that the cost of caring for children under the age of five was higher in the IMCI districts included in the study than in the comparison districts.

Next steps

This is ongoing work and the next steps include:

- Revising cost estimates to incorporate results from the 2002 follow-up household survey;
- Analyzing the cost results together with quality-of-care results from the health facility survey; and
- Using the cost estimates and the estimates of effectiveness for under-five mortality and morbidity to determine the cost-effectiveness of IMCI.

In addition, comparable economic analyses will be carried out in collaboration with the MCE investigators in other MCE sites.

Annexes

Annex 1. MCE Tanzania team members and affiliations

(Names are in alphabetical order)

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Annex 2. Funding sources

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Annex 3. Comparative features of study districts – 1999 estimates

Table 18. Geographical and environmental features of the study districts

FEATURES	DISTRICTS			
	IMCI		Comparison	
	Morogoro	Rufiji	Kilombero	Ulanga
Main Geographic Characteristic	Lowlands Highlands Savannah	Coastal Delta Mangroves Flood Plain Uplands	Flood Plain, Escarpment	Flood Plain, Highlands
Altitude (m)	600 - 2 000	0 - 500	200 - 2 000	200 - 1 000
Annual Rainfall (mm)	600 - 1 600	600 - 1 000	1 200 - 1 800	1 900
Land Area Devoted to national parks and game reserves (uninhabitable)	23%	30%	33%	46%
Habitable area km ²	14,867	9,458	9,045	13,060

Table 19. Demographic features of the study districts, 1999 (1999 unless otherwise stated)

FEATURES	DISTRICTS			
	IMCI		Comparison	
	Morogoro	Rufiji	Kilombero	Ulanga
Population (to nearest 1 000)	554 000	199 000	260 000	180 000
Population density /km ² (habitable area)	36	22	32	14
% Population Under five	16	16	16 (2001)	15 (2001)
Number of Villages	283	93	47	65
Average Household Size	4	5	5	5
Population under Demographic Surveillance (to nearest 1 000)	85 000	91 000	28 000	28 000
Percent of district population under demographic surveillance	16%	44%	10%	16%
Under-five Mortality 5q0 (areas under demographic surveillance)	142	136	147	131

Table 20. Health facilities by type and ownership, 1999

FEATURES	DISTRICTS			
	IMCI		Comparison	
	Morogoro	Rufiji	Kilombero	Ulanga
Total health facilities	97	55	45	35
Health facilities per village	0.34	0.59	0.96	0.54
Population per facility	5 577	3 727	6 489	5 143
Government health facilities	73*	50	23*	20
Government health facilities per village	0.26	0.54	0.49	0.31
Government and NGO health facilities	93*	55	35	34
Government and NGO health facilities per village	0.33	0.59	0.74	0.52
Private health facilities	4	0	10	1
All hospitals	4**	2	2	2
Government hospitals	2*	1	1*	1
All health centres	6	5	4	3
Government health centres	6*	5	3	3
All dispensaries	87*	48	39	30
Government Dispensaries	65*	44	20*	16

* Includes parastatals

** Not including Morogoro Regional hospital

Annex 4. Data collection methods

At the national level

1. Data collection process

The data were collected by the MCE economist in Tanzania. The WHO/MCE cost questionnaire at the national level was used for this purpose. Data collection at the national level took one week.

2. Costs included

IMCI implementation in Tanzania began in 1995. The main start-up activities at the national level were:

- adaptation of the international IMCI guidelines;
- development of IMCI training materials;
- training of front-line national trainers; and
- inclusion of the IMCI guidelines in the medical curriculum of the Muhimbili Medical College.

In October 1997, all start-up activities were in place and the first health facilities began to provide under-five care based on the IMCI strategy.

The main IMCI post-implementation activities at the national level were the coordination of IMCI training activities and the scaling up of IMCI to the remaining districts. These activities are coordinated by a full-time IMCI officer together with coordinators from other organizations such as WHO UNICEF and TEHIP.

Other, comparison, activities related to under-fives, relevant to both IMCI and comparison districts, are the Expanded Programme on Immunization (EPI) and activities related to malaria control and nutrition.

The types of cost included at the national level are:

- the opportunity cost of time of personnel employed on a daily basis in under-five related activities;
- daily allowance, travel allowance and opportunity cost of time spent at IMCI planning meetings and training activities;
- the cost of printing the IMCI guidelines and training materials; and
- the opportunity cost of capital items such as office space and equipment of personnel employed on a daily basis in activities related to under-fives.

At the district level

1.Data collection process

The data were collected by the MCE economist in Tanzania. The WHO/MCE cost questionnaire at the district level was used for this purpose. Data collection took four weeks – one week for each district.

2.Costs included

At the district level, the main IMCI start-up activities have been training of district trainers and supervisors in IMCI, and purchasing of IMCI-recommended drugs not included in the national essential drugs list. These activities began in the Morogoro rural and Rufiji districts in April 1997. In August 1997, the first health workers to be trained were able to use the IMCI strategy in examining under-fives at health facilities.

The main post-implementation activities at the district level are supervision visits to health facilities; IMCI training; and ensuring the availability of IMCI drugs at health facilities. Other (comparison) activities related to both IMCI and comparison districts include the opportunity cost of time of the EPI and the Maternal and Child Health coordinators and assistants.

Detail of the main start-up and post-implementation activities at the district level are given under the following 3 activities, training, supervision and administrative costs.

A. Training

i. In IMCI districts

The objectives of start-up training activities were to train district personnel from the Morogoro and Rufiji districts:

- to function as trainers of IMCI health workers;
- to perform follow-up visits after IMCI training;
- to supervise health workers implementing IMCI.

The training took place in the Morogoro district.

In the post-implementation period, courses for training health workers in IMCI were held approximately three times a year until all health workers in the district have been trained in IMCI. This analysis was based on training costs for 1999. On average, 16 trainees attended each course. The course staff consisted of one course director, one clinical instructor, four facilitators, an

accountant, a secretary and a driver. Training costs covered daily allowance, opportunity cost of the time of trainers and support staff ²⁴, stationery, rent of training venue, transport, and tea and snacks. Each course lasted 11 days, plus two travel days.

Follow-up visits after IMCI training required six supervisors per follow-up visit. About six workers were supervised per day.

Other under-five related training courses were also included, e.g., EPI and malaria case management:

ii. In comparison districts

In 1999, several training courses relating to under-five care were conducted in Kilombero and Ulanga districts. They included workshops in the use of insecticide treated nets for malaria prevention; in the application of the national guidelines on malaria diagnosis and treatment; in the case management of diarrhoea disease; and in the community-based health care programme (CBHC).

B. Supervision

Supervision relevant to this costing exercise is of two types: IMCI supervision visits, and other general-purpose supervisory visits for all ages (such as supervision for drug availability or completion of HMIS forms).

C. Administration

At the district level, administration costs include a proportion of the opportunity cost of time of personnel engaged daily in under-five related activities at the district office. These were the district cold-chain officer and assistants; the district maternal and child health officer and assistants; and district supervisors and drivers carrying out both supervision visits and distribution of drugs from the district office to health facilities.

At primary-health-facility level

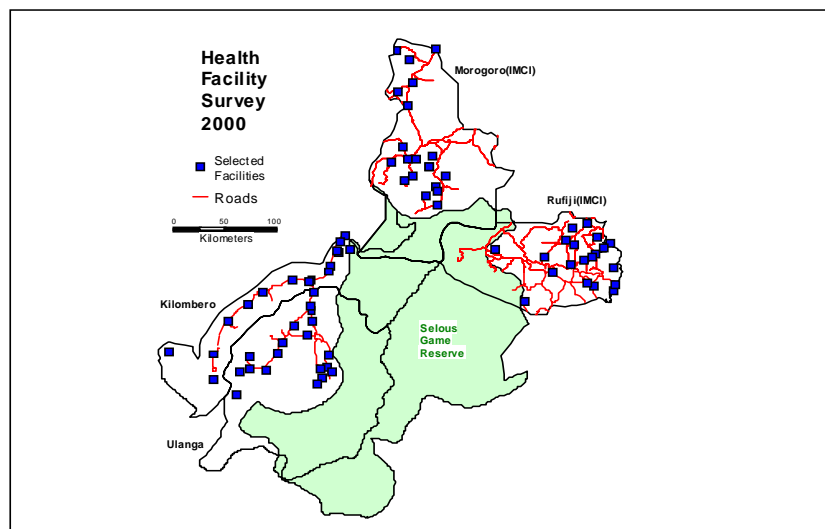
Two instruments were used: the primary-health-facility survey cost questionnaire (form 5A), and the time-and-motion tool; the data were collected for both activities during the primary-health-facility survey.

²⁴ The opportunity costs of trainees time is included in costs of under-five care at the facility-level.

1. Sampling method for the primary- health-facility survey (August 2000)

A stratified random sample of 20 facilities was selected in Morogoro Rural and Rufiji districts from government health facilities at dispensary and health centre level providing outpatient care for under-fives. In Kilombero and Ulanga districts, which have only 16 and 19 of such facilities respectively, all government dispensaries and health centres were included. The sample was stratified on facility type; three health centres were chosen from each district. Prior to selection, dispensaries were stratified by latitude (i.e., geographic) order, so that the different areas of the district were represented: thus there was implicit stratification on geographic area within each district. This approach to the sampling was taken after careful consideration of the costing objective of the survey: instead of sampling with probability proportional to utilization, it was decided to select a simple random sample and carry out a weighted analysis to allow for the sampling probabilities at a later stage. The map in Figure 10 shows the geographical distribution of the sampled facilities.

Figure 10. Map of sampled facilities



2. Data collection process

The primary health facility survey questionnaires from the WHO/MCE were translated, back-translated, pre-tested, adapted for use in Tanzania and finally given a full pilot-test during field-staff training. In addition to obtaining information on cost assessment and time-and-motion study, six forms

designed to obtain information on the following activities were administered; related to under-fives visiting the facility on the day of the survey:

1. enrolment,
2. observation of case-management,
3. an exit interview with the parent or care-giver,
4. medical re-examination,
5. an interview with the person in charge of the facility (which included items on an inventory of drugs and equipment),
6. an interview with a health worker responsible for medical care of under-fives to test his capacity in case management of under-fives needing referral, and for very young infants.

The survey teams consisted of four health workers, of whom two were trained in IMCI. In each team, one person was responsible for collecting cost data and another was responsible for the time-and-motion study together with Form 0 (enrolment) and Form 4 (facility inventory).

Data collection for the time and motion study was as follows:

- One health worker was observed at each facility included in the HFS.
- In facilities with more than one health worker, one was chosen at random.
- The selected health worker was continuously observed for half a day, and the time spent on the different activities was recorded.
- The observation and recording was performed in alternating morning and afternoon shifts, the first shift selected at random.
- If on any of the days of data collection the health worker was still seeing patients after working hours or still doing administrative work, observation was continued until the health worker was ready to leave the facility.

The teams spent one day in each facility. Data were collected from 7 August to 1 September 2000. All four teams collected data in all four districts, each team visiting five facilities in each district.

3. Costs included

The costing questionnaire at the first-level facility included the following items on the resources used for all aspects of health service delivery at the primary health facility:

1. Number and job title of personnel per facility (including volunteer labour)
2. Personnel time
3. Room dimensions
4. Medical equipment
5. Furniture

6. Drugs
7. Medical supplies
8. Non-medical supplies
9. Laboratory equipment and supplies
10. Number of patient visits by type
11. Utility (e.g., electricity, water, fuel, kerosene etc.) costs in 1999.
12. Staff time allocation based on the time-and-motion study.

A selected number of items are discussed in detail below.

3.1. Personnel

The list of personnel working at each of the sampled health facilities was obtained from the personnel and payroll department of the district medical office. The list was confirmed in the primary health facility survey (HFS) to verify the number of months and hours of work of facility staff members in 1999. It was supplemented by the number of volunteers and their activities with respect to facilities with volunteers. Personnel time was collected from the time-and-motion study, as described above.

3.2. Drugs

The amounts of drugs supplied to facilities were obtained at the district level, where the quantity of drugs received by each facility is available from drug ledgers and issue vouchers. These are used to determine the total amounts that each facility received in 1999, the reference year for data collection.

3.3. Capital items

The district office made available the list of equipment, furniture, and vehicles, provided at health facilities. The list was subsequently revised during the HFS to include only those items that were functional, and the duration of their functional use, in 1999. In addition, surface area of the health facility in m² was determined during the HFS.

3.4. Utilization data

Utilization data were obtained from the monthly forms issued by the Health Management Information System (HMIS) available at health facilities. They included the following variables:

- Total number of outpatient visits by age group;
- Vaccination visits;
- Other adult visits such as family planning and antenatal care visits;
- Inpatient days at health centres by age group;
- Laboratory tests by age group.

N.B.: These variables are used in two ways: to estimate the proportion of costs allocated to under-fives; and to estimate cost per visit, as explained below.

At hospital level

Data were collected on two variables: annual number of under-five admissions in each district (from the 1999 household survey); and average cost per under-five bed-day (from a web-based literature search). The section *Methods of analysis* describes the methods of estimation of those variables.

At household level

1. Sampling method for the household survey, July August 1999.

A representative cluster sample of 2500 households was taken from the four districts, Morogoro Rural, Rufiji, Kilombero and Ulanga. Thirty clusters were chosen from Ulanga, Rufiji and Morogoro rural districts, and 35 clusters from Kilombero. The increased sample size from Kilombero district was taken because of the urban centre of Ifakara. The investigators aimed at having 30 rural clusters from Kilombero as from the other three districts. Villages were chosen with probability proportional to estimated population size, and in each village 20 households were chosen using a modified EPI-type approach. This procedure gave every household in the district the same selection probability. All under-fives living in these households were included in the study.

2. Data collection process

The draft questionnaire from the WHO/MCE team was translated, back translated, pre-tested, adapted for use in Tanzania and finally given a full pilot-test during the field staff training. Two weeks of training were provided to familiarize field staff with the questionnaire and interview techniques. A full pilot test of the questionnaire was carried out during the second week, following which final changes were made to the questionnaire before printing.

The questionnaire consisted of the following modules: breastfeeding; nutrition counselling; mosquito nets; vaccination; vitamin A; miscellaneous morbidity; two-week morbidity; and anthropometry and anaemia measurement. For under-fives who had been ill in the two weeks before the survey additional modules covered drugs, medical supplies and their costs, and for under-fives who had been taken to a 'formal-care' health care provider (i.e., Village Health Workers, dispensary, health centre, hospital or private doctor) further modules covered issues of follow-up, referral, and the cost of visiting the provider. Separate modules for the first child for a

mother/guardian and any subsequent child for a mother/guardian were developed to avoid repeating questions to the interviewee.

Field work was carried out in July and August 1999. Four teams of interviewers and a supervisor carried out the interviews and measurements. A team stayed for two weeks in a district. One day was spent interviewing in each village.

3.Costs included

As explained above, the household questionnaire, administered for each child in the household, included items on under-five illness episodes in the previous two weeks, as well as on multiple provider visits for the same episodes.

Included in this analysis are household medical and non-medical costs incurred for care-seeking from formal-care providers as well as for drug purchases without care-seeking. They include consultation fees, travel cost and costs of medical and non-medical supplies and drugs purchased at government facilities and from private practitioners, pharmacies or traditional healers.

Annex 5. Methods of valuation and cost allocation

1. National-level costs

1.2. Cost valuation

Start-up costs are annualized over a period of 10 years –an arbitrary assumption of the time span of the start-up activities of the IMCI strategy. Other capital costs, e.g., those of buildings and equipment, are valued at their replacement cost and annualized on the basis of their estimated useful life. See Annex 6 for the list. The discount rate used is 3%.

Opportunity cost of personnel time is valued according to the basic salary (gross of tax), monetary and non-monetary allowances of those personnel engaged in providing care for under-fives, as defined above. The opportunity cost of personnel of international organizations is valued according to international wage rates. Daily allowance paid for IMCI-related meetings and training is valued at the rate specified by the funding organization for these activities – mostly this was WHO in Tanzania or at headquarters in Geneva.

1.2. Methods of allocating costs

Costs are allocated in two steps:

i. Classification of the total national cost of under-five care into two categories – one for IMCI districts and one for comparison districts:

National costs for *IMCI districts* include start-up and post-implementation cost of IMCI, annual cost of EPI, and a proportion of annual cost of activities related to malaria control and nutrition. National cost for *comparison districts* include annual cost of EPI; and a proportion of annual cost of activities related to malaria control and nutrition. The proportion of annual cost of malaria control and nutrition activities is estimated by the ratio of visits of under-fives to total visits.

ii. Estimation of the proportion of national cost allocated to a standard IMCI district and a comparison district:

The basic assumption is that relevant cost of under-five care at the national level are considered to be fixed costs irrespective of population size. Therefore, the proportion of national cost allocated to a standard IMCI district is apportioned as 1/number of IMCI districts in the country. The same applies to standard comparison districts.

2. District-level costs

2.1 Cost valuation

Start-up cost are annualized over a period of 10 years –an arbitrary assumption of the time span of the start-up activities of the IMCI strategy. Other capital costs, such as those of building and equipment, are valued at their replacement cost and annualized on the basis of their estimated useful life. See Annex 6 for the list. The discount rate used is 3%.

Opportunity cost of personnel time is valued according to the basic salary (gross of tax) and allowance, monetary or in-kind, granted to personnel providing care for under-fives. Daily allowance for attending training courses, undertaking supervision visits or distributing drugs is valued at the rate specified by the funding organization for these activities.

2.3. Methods of allocating costs

1. The full cost of IMCI training and follow-up after training were included;
2. The full cost of EPI training, and part of the cost of malaria training were included— according to the proportion of under-five to total visits in the district;
3. For IMCI supervision visits in 1999 (excluding follow up after training visits, which is covered in cost of training), a proportion of the salary of supervisors is allocated to the cost of under-five care on the basis of the number of days supervisors spend on IMCI supervision. In addition, the daily allowance paid for these visits is fully charged to the cost of under-five care in IMCI districts.
4. For other general-purpose supervisory visits in 1999, for all ages (such as supervision for drug availability or completion of HMIS forms), the opportunity cost of supervisors' time and the proportion of daily allowance paid are estimated on the basis of the ratio of under-five to total visits in the district.
5. The proportions of the salaries of the district officers and their assistants are determined from information obtained from interviews with the district medical officer or the staff concerned, indicating the proportion of their time given to under-five care. The corresponding proportions for supervisors other than the cold-chain and MCH staff, and for drivers assigned to supervision or drug-distribution duties, are based on the number of days employed in their respective activities.

3. Primary health facility costs

3.1. Cost valuation

3.1.1 Personnel

The gross salaries, including tax, insurance and benefits (monetary and in-kind), were obtained for each individual employed at the sampled health facilities. The basic salaries were obtained from the district personnel and payroll department and the allowance from the facilities. A shadow wage rate is estimated for volunteer time, which is valued at the average wage of a salaried staff member with similar skills.

3.1.2. Drugs

The cost of drugs to the provider (government and donors) was obtained from the national medical stores department. It includes the central level administration costs of drugs and their distribution from the national stores to the district medical office. Not included is the cost of distributing drugs from the district to health facilities, which is part of district-level transport costs, as described above.

3.1.3 Capital items

Capital costs are estimated on the basis of their annualized replacement cost. The useful life of capital items is estimated by the health ministry's departments of building and construction and of hospital equipment. Estimated useful life per item is listed in Annex 6. The discount rate used is 3%.

3.2 Methods of allocating costs

3.2.1 Personnel

The aim of this analysis is to allocate a proportion of staff salaries to under-five care at the first-level facilities. A different method is applied to clinical and non-clinical staff as described below. The main principles are:

1. All the time of staff totally engaged in providing care for under-fives is included.
2. None of the time of staff totally engaged in providing care for over-fives is included.

3. Part of the time of staff who provide care for both over-fives and under-fives is allocated to under-fives, as follows:
 - Time spent treating patients is allocated partly to under-fives and to over-fives. The facility-costing protocol requires that observers measure the time taken to treat a sample of over-fives and under-fives (25;26). This measurement is used to estimate the average minutes spent in contact (a visit) with under-five and over-five patients. Taken together with the number of over-fives and under-fives treated overall (*sick visits only*), this average is used to allocate the clinical staff time partly for over-fives and partly for under-fives. See Box 2 for details of the method of analysis of the time-and-motion study.
 - Time spent in other productive and non-productive activities is allocated on the basis of the proportion of total number of under-five visits to total number of all visits (i.e., sick and preventive visits).
4. The time of staff members who do not treat patients is allocated to under-fives on the basis of the proportion of total number of under-five visits to total number of all visits (i.e., sick and preventive visits).

Those principles require that the facility costing tools are used to collect data on variables such as blocks of time spent treating under-fives and over-fives. This is also why the timing of provider interactions with under-fives and over-fives was collected through the time-and-motion study; it takes into account the possibility that under-fives take more (or less) time than over-fives, and that IMCI might change the average amount of time spent with under-fives or over-fives.

Box 2. Method of analysis of time-and-motion study

Time and motion study

Objectives

The aim of the time-and-motion study was to record the time that health workers who examine sick under-fives spend on the different activities in health facilities. The activities are classified under three main categories: contact time, non-contact productive time, and non-productive time (26). Contact time, which is the time spent with patients (or healthy people for preventive services such as immunization) is further divided into time spent caring for over-fives and for under-fives. The activities under each category are described in Annex 8.

Methods of analysis of the time-and-motion study

The following measures were calculated:

1. *Average minutes spent by type of patient contact and age group:* Used, together with the annual number of under-five outpatient visits, to allocate the proportion of contact (clinical) time* that the health worker (who undertakes case management) spends with under-fives
2. *Proportion of total contact time spent with under-fives:* Taking into account the number of visits to each facility, this measure provides an assessment of the total time spent with under-fives compared with total contact time
3. *Proportion of contact time to total time:* Used to compare the proportion of contact time in IMCI and in comparison facilities
4. *Proportion of productive to non-productive time:* The results of this measure are not presented, owing to the bias introduced by the Hawthorne effect, which is caused by the short observation time at each facility (half a day).

* Other non-contact time (productive and non-productive time) is allocated on the basis of the proportion of under-five visits to total visits

3.2.2. *Drugs*

The top-down method of estimating drug costs is used (27;28). Drug costs are allocated to under-fives by sampling from patient registers to estimate the proportion of drugs provided to under-fives. The method used was to stratify the year into three periods of four months. One month from each period were selected randomly for each facility to account for seasonal variation in types of illness and patterns of care-seeking. A systematic sample of 120 prescriptions was chosen from those three months. The selected prescriptions were noted down if they included one of the ten most common drugs prescribed for both under-fives and over-fives: acetylsalicylic acid tablets, amoxicillin capsules, chloroquine tablets, chloroquine for injection, cotrimoxazole tablets, mebendazole tablets, metronidazole tablets, oral rehydration salt sachets, paracetamol tablets, procaine penicillin fortified for injection. The drugs prescribed to either under-fives only or over-fives only were not included as their costs are fully allocated to the respective age group. This approach to sampling was adopted after extensive pilot-testing of various approaches. The original MCE proposal of sampling 12 days from each month could not be adopted as most health workers do not routinely record the date of the patient contact. See Annex 7 for more detail on the sampling method.

3.2.3 *Capital items*

The proportion of annualized capital cost allocated to under-fives is estimated as follows:

1. Full allocation of the cost of items used exclusively for under-five care;
2. No allocation of the cost of items used exclusively for adult care;
3. Allocation of the cost of items used for both under-five and over-five care according to the ratio of visits of under-fives to total visits in the facility (curative and preventive).

4. **Household health-care costs**

4.1. **Valuation**

1. Out-of-pocket payments for drugs and consultations at government facilities are not included in the estimates of cost per visit at government facilities described above. They are included, therefore, as part of household costs to supplement the cost of providing under-five care at government facilities from a societal perspective. These out-of-pocket

payments are considered as a discretionary source of funds²⁵ for government health facilities and are used to purchase drugs or to pay for maintenance and repair services at the facility.

2. Time spent in obtaining care, e.g., in waiting or travel or owing to illness, is presented separately in physical units of time rather than as a monetary value.

²⁵ There was no evidence from the household survey of any unofficial payments made to health providers.

Annex 6. Useful life of capital items

Vehicles	<i>Useful life</i>
Toyota Land Cruiser	5
Motorcycle	4
Bicycle	3
Furniture	<i>Useful life</i>
Wooden chair	1
Metal chair	3
Wooden table	10
Wooden benches	10
Large medicine-cupboard	10
Hand washbasin	5
Examination bed	10
Inpatient bed	10
Delivery bed	10
Mattress	1
Drip stand	5
Screen	3
Stool	3
Sink	10
Plastic bucket >100 litres	0.5
Metal filing cabinet	10
Medicine trolley	10
Bedside locker	5
Equipment	<i>Useful life</i>
Sterilizer/stove 4 burner	5
Refrigerator	5
Weighing , adults	5
Weighing , babies	5
Sphygmomanometer	5
Stethoscope	5
Clock /watch	2
Microscope	5
Dental chair	20
Centrifuge	5
Suction machine	5
Fetoscope	10
Wheelchair	10
Building	<i>Useful life</i>
Iron sheets/ mud and bricks	50

Annex 7. Sampling method to estimate the proportion of drugs used by under-fives and over-fives

The cost questionnaire requires that surveyors sample a number of days from the patient records to determine the proportion of drugs dispensed to under-fives and over-fives to the total amount dispensed in the health facility in a year. The Tanzania proposal for sample calculation provided for 12 days to be selected. One difficulty was to determine precisely the beginning and end points of patient records on a given day, as the health workers commonly use the same records page as long as there is space; they then enter the date at the top of the next page and continue recording. Also, it took some time to collect the required average number of records in the selected 12 days, especially at health centres seeing up to an average of 60 patients a day.

For sampling purposes, patient records were used rather than whole days, as suggested by the generic MCE tools. Sample size was calculated from the data collected during training, from about 590 patient records. The probability of obtaining at least five observations per drug was calculated and some uncommonly prescribed drugs were removed from the list. Drugs prescribed exclusively for over-fives or under-fives were also removed, as their cost would be totally attributed to over-fives or under-fives, respectively. The list of drugs was thus reduced from over 30 to 12. From the 590 records, around 120 prescriptions were needed to obtain at least five observations for each of the 12 listed drugs.

This method will determine the number of observations needed per facility, which will not depend on utilization rates. Hence, the information can be readily collected from facilities with high rates of utilization. The cost surveyors, however, must then calculate the n th patient record in order to select a sample in each visited facility representative of the utilization rate for that facility. The data will be collected for three months, one month selected randomly from each third of the year. A detailed and simplified description of this method was prepared and explained to the surveyors and to the team supervisors. The method was also made part of the data collection tool, for guidance and reference.

Annex 8. Time-and-motion study

The following is a description of the different activities included in the three main categories of a health worker's time.

1. Contact time (CT)

5. Description:

- History taking;
- Physical examination;
- Writing prescriptions;
- Supplying contraceptives (pills, condoms and intra-uterine devices);
- Immunization;
- Maternal health services (ANC, PNC, Delivery);
- Laboratory test (done) in the examination room.(e.g., dipstick);
- Dispensing drugs in the examination room;
- Discussion on price and service charge of medicines;
- Receiving money;
- Patient counselling;
- Health education.

2. Non-contact productive time (NCPT)

Description:

- Preparation for work e.g., sterilizing immunization equipment, arranging empty medicine bottles, arranging medicines in the medical store;
- Cleaning rooms;
- Taking water to the bathroom;
- Looking for anything necessary to the office (inside or outside) in or out of the office);
- Distributing medicines to the providers;
- Professional interaction (discussion, supervision, instruction);
- Attending planning or supervision meetings;
- Managing inventory of drug stocks Drugs stocks inventory management;
- Calling the patient (for her/himself or for others);
- Receiving service charges;
- Record keeping (in absence of the patient);
- Arranging finance;
- Preparation for closing the facility at end of working day;
- Arranging medicines for outreach visits;

- Keeping records, making action plans, and other office work such as writing official letters, calculating holidays, providing files to the staff etc.

3. Non-productive time (NPT)

Divided into unavoidable NPT and rest of NPT

6. Description:

Unavoidable non-productive time

- Having meals;
- Going to the toilet

Rest of non-productive time:

- Resting doing nothing while awaiting next patient after departure of previous patient;
- Reading a newspaper;
- Making tea, or serving tea to office staff;
- Chatting.

Activity codes

For activity 1: Contact time:

1. Home visit to sick person.
2. Immunization
3. Maternal and child health care (ANC, PNC)
4. Inpatient care
5. Health education / motivation / group discussion
6. Family planning
7. Delivery of infant
8. Laboratory test
9. Other; specify

For activity 2: Non-contact productive time

10. Only one code is used for this category

For activity 3: Non-productive time

11. Unavoidable non-productive time
12. Other non-productive time

Annex 9. Detailed results

1. Summary of costs at all levels

Table 21. Cost of under-five care per child in a standard¹ district with 50,000 under-fives in 1999 Tanzania shillings and US \$ (Societal perspective)

Level	IMCI districts				Comparison districts			
	Morogoro		Rufiji		Kilombero		Ulanga	
	Cost per child Tsh US\$)	%	Cost per child Tsh (US\$)	%	Cost per child Tsh (US\$)	%	Cost per child Tsh (US\$)	%
National	129 (0.17)	2	129 (0.17)	1	55 (0.07)	0	55 (0.07)	0
District	944 (1.21)	14	2,625 (3.38)	24	1,847 (2.38)	15	3,362 (4.33)	27
Hospital	1,869 (2.41)	28	1,869 (2.41)	24	6,899 (8.88)	54	4,486 (5.77)	36
Primary health facility *	1,743 (2.24)	26	3,151 (4.06)	30	1,091 (1.40)	9	3,475 (4.47)	28
Household **	1,988 (2.56)	30	1,874 (2.41)	20	2,800 (3.60)	22	933 (1.20)	8
Total cost	6,674 (8.59)	100	10,716 (13.79)	100	12,693 (16.34)	100	12,312 (15.85)	100
Total costs excluding hospital	4805 (6.18)		8099 (10.42)		5794 (7.46)		7826 (10.07)	

Source: MCE of IMCI in Tanzania

¹ standard district with 50,000 under-fives

* Only for government facilities. Tsh (US\$)

** At government (not included above) and non-government facilities

Table 22. Average number of outpatient visits* and hospital bed-days per child per year

	IMCI districts		Comparison districts	
	Morogoro	Rufiji	Kilombero	Ulanga
Outpatient visits **	2.7	4.9	2.5	2.4
bed-days ***	0.37	0.27	1.01	0.64

* These include visits to non-government formal-care providers. It does not include visits to non formal-care providers such as traditional healers.

** Estimated from HMIS forms and the HHS 1999 (4).

*** Estimated from the HHS 1999 (4)

2. At the district level

Table 23. Annual “unstandardized” district-level cost¹ of under-five care in 1999 Tanzanian shillings (US \$ in parentheses)

District	Administration (e.g., salaries and drug distribution) Tsh (US\$)	Training on under- five related activities Tsh (US\$)	Supervision of primary care facilities on under- five related activities Tsh (US\$)
IMCI district	24,699,347 (31,788)	5,118,193 (6,587)	15,869,026 (20,423)
comparison district	21,465,596 (27,626)	3,449,555 (4,440)	20,019,509 (25,765)

Source: Data collection at district level

¹These estimates constitute the annualized start-up and post- implementation costs in IMCI and comparison districts without standardizing for under-five population size. Start-up costs are annualized over a period of 10 years using a discount rate of 3%.

3. At hospital level

Table 24. Total costs of under-five hospitalization at the district level in 1999 Tanzanian shillings and US\$

IMCI districts		Comparison districts	
Morogoro Tsh (US\$)	Rufiji Tsh (US\$)	Kilombero Tsh (US\$)	Ulanga Tsh (US\$)
93,460,280 (120,283)	130,844,391 (168,396)	355,149,062 (457,077)	224,304,671 (288,680)

Source: Alonso et al. 2000 (1), HHS report 2000 (4) and IHRDC paediatric inpatient surveillance system 1994-2000 (15).

4. At primary-facility level

Table 25. Average number of visits* per health worker¹ per day at government health facilities in 1999.

Category	IMCI district			Comparison district		
	Mean (SD)	Median	Range	Mean (SD)	Median	Range
Government dispensaries*	23 (14)	21	2–62	24 (18)	18	2–78
Government health centres**	27 (15)	29	5–48	22 (12)	18	12–45
Average	24 (15)	21	2–62	24 (16)	18	2–78

*all visits to health facilities (curative and preventive)

Source: HFS 2000 and HMIS forms

¹ Only health workers who reportedly examine patients

* t test (IMCI vs comparison dispensaries): P=0.8

** t test (IMCI vs comparison health centres): P=0.5

Table 26. Average time spent per consultation visit at government facilities

Category	IMCI district			Comparison district			P*
	Mean	SD	N	Mean	SD	N	
(1) Dispensaries							
Under-five	7.9	4.7	89	6.9	3.4	97	p =0.1
Over-five	4.1	3.4	396	4.9	2.4	308	p =0.0004
(2) Health centres							
Under-five	8.9	5.7	41	4.4	2.8	34	p =0.0001
Over-five	3.8	2.7	84	3.4	2.6	88	p =0.4
(3) Average (dispensaries and health centres)							
Under-five	8.2	5.1	130	6.3	3.4	131	p =0.0003
Over-five	4.1	3.3	480	4.6	2.5	396	p =0.008

Source: Time-and-motion study

t test (IMCI vs comparison)

5. At household level

Table 27. Household average out-of-pocket cost per cost-category in 1999 Tanzanian shillings

	IMCI district				Comparison district			
	Morogoro (IMCI)		Rufiji (IMCI)		Kilombero (comparison)		Ulanga (comparison)	
	Mean cost per visit (SD)	N	Mean cost per visit (SD)	N	Mean cost per visit (SD)	N	Mean cost per visit (SD)	N
(i) Episodes for which care was sought at a formal-care provider								
1. Travel cost	96.4 (468)	75	25 (191)	131	120 (438)	137	0 (0.0)	102
2. Consultation cost								
<i>a) At government facility</i>	55 (292)	47	5 (47)	116	107 (419)	49	10 (26)	62
<i>b) At non-government facility</i>	44 (166)	24	10 (32)	10	452 (1066)	54	296 (602)	26
3. Drug costs								
<i>a) At government facility</i>	167 (506)	44	115 (467)	115	394 (523)	45	42 (126)	63
<i>b) At non-government facility</i>	910 (1216)	22	1250 (615)	10	1151 (1793)	45	718 (827)	23
4. Additional drugs*	110 (286)	161	59 (185)	181	160 (312)	228	91 (233)	189
5. Medical supplies	17 (92)	236	12 (0)	271	43 (143)	263	12 (82)	275
6. Non-Medical supplies**	162 (324)	92	144 (906)	136	227 (900)	155	90 (469)	111
(ii) Episodes for which care is not sought at a formal-care provider								
1. Drugs and Medical supplies	88 (192)	137	75 (219)	121	203 (347)	130	92 (205)	149

Source: HHS 1999

* Through self medication or drugs supplied by pharmacists.

** Includes purchase of food and drinks or for spending the night away from home in the process of seeking care.

Table 28. Household out-of-pocket health care cost per " child" per year in 1999 Tanzanian shillings (US\$ in parentheses)

	IMCI district		Comparison district	
	Morogoro (IMCI)	Rufiji (IMCI)	Kilombero (comparison)	Ulanga (comparison)
	Mean cost per child (US\$)	Mean cost per child (US\$)	Mean cost per child (US\$)	Mean cost per child (US\$)
(i) Episodes for which care was sought at a formal-care provider				
1. Travel cost	260 (0.33)	122 (0.16)	155 (0.20)	0 (0.00)
2. Consultation cost				
<i>a) At government facility</i>	133 (0.17)	23 (0.03)	200 (0.26)	22 (0.03)
<i>b) At non-government facility</i>	13 (0.02)	2 (0.00)	264 (0.34)	65 (0.08)
3. Drug costs				
<i>a) At government facility</i>	403 (0.52)	540 (0.70)	497 (0.64)	93 (0.12)
<i>b) At non-government facility</i>	259 (0.33)	252 (0.32)	597 (0.77)	158 (0.20)
4. Additional drugs*	297 (0.38)	289 (0.37)	265 (0.34)	221 (0.28)
5. Medical supplies	46 (0.06)	59 (0.08)	71 (0.09)	29 (0.04)
6. Non-Medical supplies**	437 (0.56)	706 (0.90)	557 (0.72)	219 (0.28)
(ii) Episodes for which care is not sought at a formal-care provider				
1. Drugs and Medical supplies	143 (0.18)	185 (0.24)	195 (0.25)	126 (0.16)
(iii) Total	1,988 (2.56)	2,178 (2.80)	2,800 (3.60)	933 (1.20)

Source: HHS 1999

* Through self medication or drugs supplied by pharmacists.

** Include purchases of food and drinks or for spending the night away from home in the process of seeking care.

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