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Improving quality and efficiency of facility-based child health care through Integrated Management of Childhood Illness in Tanzania

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Objectives: To assess the effect of Integrated Management of Childhood Illness (IMCI) relative to routine care on the quality and efficiency of providing care for sick children in first-level health facilities in Tanzania, and to disseminate the results for use in health sector decision-making.

Design: Non-randomized controlled trial to compare child health care quality and economic costs in two intervention (>90% of health care workers trained in IMCI) and two comparison districts in rural Tanzania.

Participants: For quality measures, all sick children presenting for care at random samples of first-level health facilities; for costs, all national, district, facility and household costs associated with child health care, taking a societal perspective.

Results: IMCI training is associated with significantly better child health care in facilities at no additional cost to districts. The cost per child visit managed correctly was lower in IMCI than in routine care settings: $4.02 versus $25.70, respectively, in 1999 US dollars and after standardization for variations in population size.

Conclusion: IMCI improved the quality and efficiency of child health care relative to routine child health care in the study districts. Previous study results indicated that the introduction of IMCI in these Tanzanian districts was associated with mortality levels that were 13% lower than in comparison districts. We can therefore conclude that IMCI is also more cost-effective than routine care for improving child health outcomes. The dissemination strategy for these results led to adoption of IMCI for nationwide implementation within 12 months of study completion.

Key words: child survival, IMCI, efficiency, child health

Introduction

The world's leaders adopted the millennium declaration in September 2000, committing their countries to a set of quantified goals to be achieved by 2015 (United Nations 2001). One of these Millennium Development Goals (MDGs) is to reduce mortality among children under 5 years of age by two-thirds over 2000 baseline rates. This MDG, as well as a series of papers on child survival published in *The Lancet* in 2003 (Bellagio Study Group on Child Survival 2003), have generated renewed attention to questions about the relative effectiveness and cost of approaches to the delivery of child health care in developing countries.

The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) developed the Integrated Management of Childhood Illness (IMCI) strategy in the late 1990s to reduce child mortality in developing countries (Tulloch 1999). IMCI responded to evidence that a small number of diseases were responsible for most child deaths, that co-morbidity was highly prevalent, that effective interventions were available, and that there were many missed opportunities for prevention (Claeson and Waldman 2000; Victora et al. 2004). At the heart of the strategy is a set of clinical guidelines for the case management of sick children who present to first-level health facilities. These guidelines consist of a set of locally adapted tasks to be performed by health workers,

including a comprehensive assessment of the child, classification of the child's conditions leading to a determination of treatment, and counselling of caretakers about how to administer medicines, provide appropriate home care, and the conditions under which the child should be brought back to the facility. WHO developed a generic IMCI training course based on these guidelines (Tulloch 1999). The training emphasizes supervised clinical practice and recommends that each participant receive a follow-up visit from their trainer within 4 to 6 weeks after the initial training in order to reinforce their new skills. The larger IMCI strategy extends beyond improving health worker skills to strengthening health systems support and family practices related to child health.

IMCI has now been introduced in the majority of developing countries (WHO Department of Child and Adolescent Health and Development 2004). The IMCI case management guidelines represent the 'gold standard' for facility-based care in countries where the major causes of under-five deaths include pneumonia, diarrhoea, malaria, measles and undernutrition. Ministries of Health and their partners in child survival now need information about the effect of IMCI on the quality of care, as well as its costs and efficiency compared with the more vertical and disease-specific training approaches still used widely in developing countries. This information is needed urgently to inform decisions about how to scale-up child survival programmes and achieve the MDGs.

The Multi-Country Evaluation of IMCI Effectiveness, Cost and Impact (MCE) includes sites in five countries: Bangladesh, Brazil, Peru, Tanzania and Uganda (Bryce et al. 2004). Observation-based surveys of care received by children and counselling of their caregivers in primary care facilities in Bangladesh (Arifeen et al. 2005), Brazil (Amaral et al. 2004), Tanzania (Armstrong Schellenberg et al. 2004b) and Uganda (Pariyo et al. 2005) have all reported significant improvements in the quality of care received by children in settings where Ministries of Health have trained health workers in IMCI case management (Gouws et al. 2004). Analysis of the efficiency gains or losses, however, required the availability of cost data and the development of a single valid measure of the quality of case management that could be used in both IMCI and non-IMCI settings. This paper presents the first attempt to link the quality of care provided to sick children with the associated costs to the district, drawing on the MCE data from Tanzania.

Methods

Study setting and design

The MCE in Tanzania compares two districts in which the Ministry of Health introduced IMCI in 1997 ('IMCI districts') with two districts where IMCI was not introduced until 2002 ('comparison districts'). All four districts had health services that were functioning reasonably well at the time of the study, comparable levels of per-capita health expenditure, high utilization rates in government health facilities and high population coverage for some child survival interventions such as the Expanded Programme on Immunization (Schellenberg et al. 2003). Large numbers of governmental and non-governmental health actors were involved in health worker training and community activities in the districts, although their coverage of the district populations was patchy (Mbuya et al. 2003). The Ministry of Health had not implemented specific IMCI activities to improve family practices related to child health at the community level in any of the four districts. The two IMCI districts had engaged in activities designed to strengthen district management skills, and had authority for priority setting and control over their health budgets (de Savigny et al. 2002). Over 90% of health workers managing children in primary care facilities in these districts had been trained in IMCI, and over 50% had received the recommended follow-up visit by trainers (Mbuya et al. 2003). More detail about the study setting and IMCI as implemented in Tanzania can be found on the MCE website at [http://www.who.int/imci-mce].

Data on the quality of case management were collected in 2000 using a health facility survey protocol reflecting best paediatric practice. Teams of trained surveyors visited random samples of government health facilities stratified by type of facility (dispensary and health centre) selected from the two intervention and two comparison districts. Teams spent one full day at each facility, where they observed the case management of ill children, followed by a repeat assessment by a 'gold standard' surveyor. Tasks assessed covered all measurable elements of the guidelines, including the assessment, classification and treatment of the child, and counselling of the child's caretaker about how to continue care at home and when to return to the facility. Further detail on the survey methods and results are available elsewhere (Armstrong Schellenberg et al. 2004b).

Costs of under-five care in both types of districts were collected from the societal perspective and included costs incurred in the district by national and district-level authorities to establish and support child health programmes (called national-level and district-level costs), those incurred in delivering care at health facilities (facility-level costs) and those incurred by households in seeking care (household-level costs). All cost data except household costs were collected using standard MCE interviews and record reviews. Data at facility level were collected through a survey in 2000 that included a time and motion study of staff time allocation to under-five care in the sampled facilities. Household costs were collected through an MCE household survey carried out in the four districts in 1999 (Schellenberg et al. 2003).

The start-up costs of introducing IMCI in the two intervention districts were collected for 1996–97, adjusted to reflect costs for a 1-year period, and inflated to 1999

values using GDP deflators and a discount rate of 3% (Drummond et al. 1997; World Bank 2001). Data on the costs of maintaining IMCI were collected in 1999 in all four districts and reflect the annual costs of child health care in the district. Cost components during the start-up period included orientation and planning meetings, adaptation and preparation of IMCI training materials, and IMCI training. Post-start-up maintenance costs included ongoing training costs related to under-five care (IMCI or other), drugs and vaccines, annualized shares of capital items, the opportunity cost of staff time spent in visits with under-fives, and administrative time of staff at district and national levels spent in attending meetings and performing supervision visits related to child health. Household costs included travel and out-of-pocket expenditures to obtain care for under-fives at government primary care facilities. Costs were summed across all levels to obtain the total cost to the district of providing child health care (Adam et al. 2004, 2005). All costs are presented in 1999 US dollars.

Developing a single measure of care quality

For the purpose of linking costs to quality of care, a single measure of quality was needed that was equally valid in both IMCI and non-IMCI settings. We therefore developed a new summary measure using only variables judged by the authors to be characteristic of good paediatric practice, independent of the IMCI guidelines. This measure produces a score from zero to 100 reflecting the proportion of ill children presenting to first-level health facilities within a district who are managed correctly.

The new summary measure, 'correct management of childhood illness', was defined as the proportion of children managed correctly for all presenting conditions as determined by the gold-standard surveyor. Correct management is defined as provision of the correct drug, in the correct formulation (amount, times per day, number of days) and for which the health worker explained correctly to the caretaker how the drug should be administered at home. Not prescribing an antibiotic for a child who did not need one was also considered as a task performed correctly, as was not prescribing inappropriate anti-diarrhoeals.

We defined the denominator for the summary index as all sick children presenting for care at the study facilities. Alternative options using subgroups of children based on illness severity (life-threatening or 'priority' conditions *versus* non-life-threatening or 'non-priority' conditions) or need for referral to a higher-level facility (yes/no) were evaluated using MCE health facility survey data from Bangladesh, Brazil, Tanzania and Uganda. Inferences from these analyses were similar and we therefore adopted the simplest approach of using all presenting children as the standard denominator for the summary index. The proportion of sick children managed correctly in the study facilities was assumed to reflect the overall quality of care in the district over the course of 1 year.

Estimating the cost per child visit managed correctly

The cost per child visit managed correctly was estimated as the total cost of providing under-five care in the district (the sum of costs incurred at household, facility, district and national levels) divided by the total number of children visiting the district government facilities during the same period who were managed correctly. The number of children managed correctly was estimated by multiplying the proportion of children managed correctly by the total number of annual under-five visits at government facilities. The total district costs and number of visits were standardized to a total population size of 300 000, including 50 000 under-five children, to permit comparisons among the study districts. Visits and out-of-pocket costs incurred in careseeking were limited to governmental health facilities to allow comparability with data on care quality.

Results

Quality of child health care in first-level facilities

The items included in the index of correct management are listed in the leftmost column of Table 1 for priority and non-priority classifications. Table 1 presents the number of children classified by the gold-standard surveyor as having a particular condition for whom the tasks in the index of correct management were performed correctly by the health worker, in IMCI and comparison districts. The totals add to more than the total number of children observed because 68% of children presented with more than one condition (mean number of conditions 2; range 0–5).

Figure 1 presents the proportion of children with all presenting conditions, with at least one priority condition and without a priority condition who were managed correctly in IMCI and comparison districts. IMCI was associated with significantly better case management than existing training approaches in Tanzania across all three groups of children ($p < 0.001$).

Costs of child health care

Table 2 summarizes the district cost per child of providing child health care at national, district, facility and household levels in IMCI and comparison districts, as well as the difference in the costs per child in IMCI versus comparison districts (here called incremental costs). In 1999, the total cost per child in the two IMCI districts was US$7.86. This is 6% lower than the cost per child in the comparison districts ($8.34).

National-level costs were higher in IMCI than in comparison districts due to the start-up costs of IMCI. However, the difference is only 2% of the total district cost per child in IMCI districts (Table 2). District-level costs of providing child health services were 12% lower in IMCI than in comparison districts (Table 2). The comparison districts spent more on travel for supervision

Table 1. Number of children observed during case management in primary care facilities who were classified by gold-standard surveyors as having a specific condition for which correct treatment was given and whose caretakers received correct advice in two IMCI and two comparison districts in Tanzania, 1999

	Children observed in		
	IMCI districts (n = 231)	Comparison districts (n = 188)	p-value
Priority diseases			
Pneumonia			
n	*62*	*52*	
Prescribe antibiotic	49	43	
Prescribe antibiotic correctly (amount, times per day, number of days)	45	21	
Explain how to administer antibiotic	48	32	
Correct management (all of above)	*45 (73%)*	*19 (37%)*	<0.001
Diarrhoea with dehydration			
n	*5*	*3*	
Prescribe ORS	5	3	
Administer ORS at facility	1	0	
Explain how to administer ORS	4	2	
Correct management (all of above)	*1 (20%)*	*0 (0%)*	0.625
Dysentery			
n	*8*	*5*	
Prescribe antibiotic	7	5	
Prescribe antibiotic correctly (amount, times per day, number of days)	7	3	
Explain how to administer antibiotic	7	5	
Correct management (all of above)	*7 (88%)*	*3 (60%)*	0.315
Malaria			
n	*178*	*141*	
Prescribe or administer antimalarial	164	102	
Prescribe antimalarial correctly	155	35	
Explain how to administer antimalarial	163	73	
Correct management (all of above)	*154 (87%)*	*32 (23%)*	<0.001
Measles			
n	*1*	*0*	
Administer or prescribe vitamin A	0		
Correct management (same as above)	0		
Non-priority diseases			
Cough/cold			
n	*86*	*60*	
n (excluding diseases for which antibiotics should be prescribed)	81	58	
Did not prescribe antibiotic	70	25	
Correct management (same as above)	*70 (86%)*	*25 (43%)*	<0.001
Diarrhoea with no dehydration			
n (total)	*48*	*42*	
n (excluding children with other conditions for which antibiotics should be prescribed)	*25*	*42*	
Did not prescribe antibiotic	20	18	
Correct advice given on providing extra fluid/continued feeding	22	1	
Correct management (all of above)	*17 (68%)*	*1 (3.5%)*	<0.001
Acute ear infection			
n	*5*	*4*	
Prescribe antibiotic	4	4	
Prescribe antibiotic correctly	4	3	
Explain how to administer drug	4	3	
Correct management (all of above)	*4 (80%)*	*2 (50%)*	0.524
Chronic ear infection			
n	*1*	*1*	
n (excluding children with other conditions for which antibiotics should be prescribed)	*0*	*1*	
Did not prescribe antibiotic		1	
Correct management (same as above)		*1*	
Anaemia			
n	*65*	*26*	
Prescribe iron	44	3	
Malaria area:			
Prescribe antimalarial	53	19	
Prescribe antimalarial correctly	51	6	
Explain how to administer antimalarial	53	12	
Prescribe Mebendazole (children older than 2 years)	3/13	0/3	
Correct management (all of above)	*35 (54%)*	*1 (4%)*	<0.001

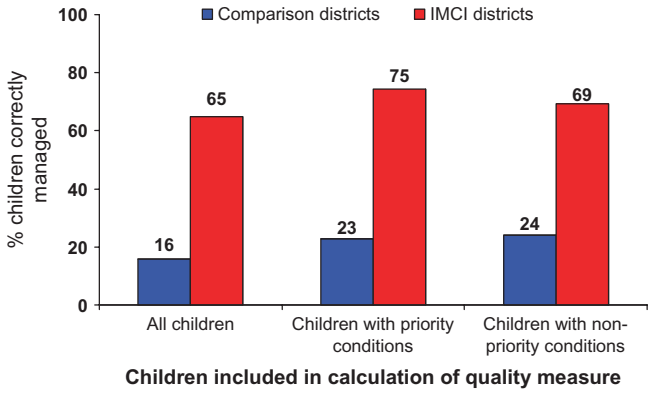

Figure 1. The proportion of all children, children with at least one priority classification, and children with no priority classifications who were managed correctly in primary care facilities in two IMCI and two non-IMCI comparison districts in Tanzania, 1999

Table 2. Standardized* costs per child of health care in 1999 US dollars, by source of expenditure in two IMCI and two comparison districts in Tanzania

Source of expenditure	IMCI districts $ (% of total)	Comparison districts $ (% of total)	Incremental costs of IMCI ($)
National level	0.17 (0.02)	0.04 (0.00)	0.13
District level	2.30 (0.29)	3.39 (0.41)	−1.09
Facility level	3.16 (0.40)	3.31 (0.40)	−0.15
Household level	2.24 (0.29)	1.60 (0.19)	0.64
Total cost per child	7.86	8.34	−0.47

*Costs have been standardized to a district with 50 000 children under age five.

and on drug distribution than the IMCI districts, but these differences are unlikely to be linked to IMCI (data not shown). IMCI and comparison districts had roughly equivalent health worker training costs during the study period; in comparison districts, health workers received training on immunization, the case management of malaria, use of insecticide-treated bednets and the use of forms for the district-level health information system. Health workers in the IMCI districts received a similar package of training, with the addition of IMCI case management training with subsequent follow-up after training. Training in malaria case management was not provided in the IMCI districts during the study period, probably because it was included as a part of the IMCI training.

Costs of providing services in primary care facilities represented about 40% of district health care costs in all four districts. The observed cost per child visit (including both sick child and immunization visits) tended to be lower in IMCI facilities than in comparison facilities (mean $1.39 and $1.61 respectively, $p = 0.45$). This was mainly due to higher visit volume in IMCI districts (3.28 visits per child per year) than in comparison districts (2.49 visits per child per year). Although the cost per child was less in IMCI districts, the estimates for the four districts appear similar because government facilities in IMCI districts have both a lower cost per visit and a higher number of visits per child per year than in comparison districts.

Table 3. Calculating the cost per child visit managed correctly in two IMCI and two comparison districts in rural Tanzania, 1999

Measure	Districts IMCI	Comparison
Input data:		
Standardized* total annual district cost for child health care (US$)	393 193	416 825
Quality measure (proportion of child visits managed correctly)	0.65	0.16
Standardized* annual under-five visits at government primary care facilities	150 745	101 991
Number of child visits managed correctly	97 834	16 217
Cost per child visit managed correctly (US$)	4.02	25.70

*Visits and costs have been standardized to a district with 50 000 children under age five.

At household level, families in IMCI districts reported higher annual out-of-pocket costs for child health care from government facilities than families in comparison districts (Table 2). More detailed analysis showed that this difference was due primarily to the fact non-government health facilities were widely available in one of the four districts, and in that district the out-of-pocket expenditures at government facilities were therefore lower. When out-of-pocket expenditures at non-government facilities are included in the analysis, expenditures in this comparison district are roughly equivalent to those in the other three districts.

Cost per child visit managed correctly

Table 3 combines the information on the proportion of child visits that were correctly managed and the total district costs of child care to report the cost to the district per child visit correctly managed, standardized for a district population of 50 000 under-five children and presented in 1999 US dollars. The cost per child visit managed correctly in the IMCI districts was $4.02 compared with $25.70 in the comparison districts. This is due to a four-fold increase in the proportion of children managed correctly in districts with IMCI, at the same level of resource use as in districts with routine care. This is a clear indication that IMCI leads to considerable efficiency gains in the use of resources available to districts.

Discussion

IMCI improves the efficiency and quality of child health care in first-level facilities

In four rural districts in Tanzania, training health workers in IMCI case management led to a four-fold increase in the proportion of child visits managed correctly relative to the routine care provided in comparison districts. Improvements in the quality of child health care without increases in costs, as found for IMCI in this analysis, indicates improved efficiency, and can help districts and countries make the most of their scarce public health resources.

Another paper in this volume (Manzi et al. 2005) reports findings from the same study, indicating significantly lower out-of-pocket payments by families for child visits in primary care facilities with IMCI relative to those without, both in government-owned facilities and in those owned by non-governmental organizations. Reduced household-level payments are less visible in the results reported here because we limited the analysis to government-owned facilities, where the higher volume of consultations per child per year in districts with IMCI masks the lower out-of-pocket payments per visit in those districts.

These findings should be generalized with care, because both Tanzania and the districts chosen for this study of IMCI implementation have special characteristics. First, Tanzania has high utilization rates for government health facilities, and there are few alternative non-government health care providers (Mbuya et al. 2003). Household surveys conducted in 1999 and 2002 as a part of the larger MCE study found that 42% and 36% of ill children, respectively, sought care from an appropriate health care provider (Armstrong Schellenberg et al. 2004a). This contrasts with pre-IMCI baseline rates of 8% for Bangladesh (El Arifeen et al. 2004) and 15% for Uganda (Multi-Country Evaluation of IMCI Effectiveness, Cost and Impact 2002). Secondly, IMCI training was planned and carried out with high levels of energy and quality by the health management teams in the Tanzania study districts (Mbuya et al. 2003). Thirdly, efforts to strengthen district health management were implemented either before or concurrent with the introduction of IMCI. In short, these results demonstrate that IMCI is highly efficient in the presence of high-quality training and adequate management capacity at district level.

Effective dissemination promotes use of results in policy making

This study demonstrates how an effective dissemination strategy can contribute to the rapid uptake of research findings by policy makers. The results indicated that IMCI-based care was affordable within current district budgets in Tanzania, was associated with significant improvements in child case management, and therefore was a more efficient use of resources than the routine care offered in the comparison districts. MCE investigators worked with the Government of Tanzania and child health partners at country level to interpret the study results and consider their implications for child health policies and programmes. In 2003, the Minister of Health in Tanzania recommended that all district health teams give high priority to IMCI case management training in developing their work plans. In 2004, a multilevel dissemination process resulted in the inclusion of IMCI in the Comprehensive Health Plan of every district in the country.

A standard measure for the quality of child health care

MCE investigators used data collected through health facility surveys to develop and evaluate a set of summary indices reflecting the quality of care received by ill children in first-level facilities, including indices of the completeness of the integrated assessment of the child's condition, the availability of drugs and vaccines, and health worker knowledge (Gouws et al. 2005). One of the methodological contributions of this work is the development of a single index of the quality of child case management in primary care facilities. This measure can be used to support analyses linking costs to quality of care outcomes, providing useful information on the efficiency gains or losses associated with different child health strategies.

We were concerned that children observed in IMCI settings might be more likely than children in non-IMCI settings to be assigned multiple diagnostic classifications, resulting in a higher number of tasks to be performed by the health worker and therefore lower scores on the index of correct management. We investigated this possibility using MCE health facility survey data sets from Bangladesh, Brazil, Tanzania and Uganda, and found no differences in the frequency of multiple classifications between IMCI and non-IMCI facilities (data not shown).

Translating improved quality into mortality impact

Over a 2-year period after introduction of IMCI in the two intervention districts in Tanzania, child mortality levels were 13% lower in IMCI than in comparison districts, corresponding to a rate difference of 3.8 fewer deaths per 1000 children per year (Armstrong Schellenberg et al. 2004a). This change is attributable to the introduction of IMCI in health facilities, accompanied by efforts to strengthen district management (de Savigny et al. 2002), suggesting that in this context improved service quality as measured by the proportion of child visits that are correctly managed is a good proxy for mortality impact.

This study demonstrates that intermediate indicators for efficiency analysis, such as the estimation of the cost per child visit managed correctly, can answer fundamental questions posed by policy makers and programme planners. Although our study supports the scaling up

of IMCI-based child health care at health facilities in Tanzania and similar settings, it is important to ensure that the observed gains in quality due to IMCI can be maintained during periods of rapid scale-up.

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Biographies

Jennifer Bryce was working as a Scientist at the Department of Child and Adolescent Health and Development, World Health Organization (WHO), Geneva, Switzerland at the time this work was initiated. She developed and coordinated the Multi-Country Evaluation of IMCI Effectiveness, Cost and Impact supported by WHO and the Bill and Melinda Gates Foundation, and provided technical support for child health epidemiology and child health and poverty work within the Department. She received her doctorate in education from Columbia University, and completed postdoctoral training in policy analysis with the Vanderbilt University Institute for Public Policy Studies. She has worked in public health programme evaluation for various institutions and agencies since 1983, including the US Centers for Disease Control and Prevention, WHO, the American University of Beirut and the Michigan State Health Department.

Eleanor Gouws is a statistician currently working for the Joint United Nations Programme on HIV/AIDS in Geneva, Switzerland. At the time of the study she was employed by WHO as statistician

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