The effect of training in Integrated Management of Childhood Illness (IMCI) on the performance and healthcare quality of pediatric healthcare workers: a systematic review

Efeitos do treinamento na estratégia de Atenção Integrada às Doenças Prevalentes na Infância (AIDPI) sobre o desempenho dos profissionais de saúde na qualidade do atendimento às crianças: uma revisão sistemática

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Abstract

Objectives: to analyze the effect of training in Integrated Management of Childhood Illness (IMCI) on the quality of case management by healthcare workers based on a systematic review of the literature.

Methods: the authors searched the databases MEDLINE, LILACS, PAHO and WHOLIS for the search terms Integrated Management of Childhood Illness (IMCI), and analyzed documents published by Pan American Health Organization, World Health Organization and the Brazilian Ministry of Health between January 1993 and July 2006. The quality of the methodology was assessed using the criteria developed by Downs and Black.

Results: thirty-five papers were reviewed. Twelve of these validated the IMCI algorithm and found the sensitivity to be high and the specificity to be over 80% for major illnesses. Twenty-three papers assessed the performance of healthcare workers, eight of these with no control group. The present study shows clear evidence of improvement in the performance of healthcare workers employed at healthcare facilities with IMCI. The main methodological weaknesses of the study were lack of control of confounding factors and lack of information regarding statistical power.

Conclusions: the performance of healthcare workers tends to improve at public healthcare facilities when IMCI is introduced.

Key words *Integrated Management of Childhood Illness, Child Health Sevices, Child health*

Resumo

Objetivos: analizar o efeito do treinamento na estratégia de Atenção Integrada às Doenças Pevalentes na Infância (AIDPI) na qualidade do manejo de casos pelos trabalhoadores de saúde, com base em uma revisão sistemática de literatura.

Métodos: foram revisados estudos nas bases de dados MEDLINE, LILACS, PAHO e WHOLIS com as palavras-chave: Atenção Integral às Doenças Prevalentes na Infância (AIDPI); além de documentos da Organização Pan-americana da Saúde, Organização Mundial da Saúde e do Ministério da Saúde do Brasil, de janeiro de 1993 até julho de 2006. A qualidade metodológica dos artigos foi avaliada pelos critérios de Downs e Black.

Resultados: trinta e três artigos foram identificados. Desses, 14 tinha como objetivo validar os algoritmos do AIDPI obtendo altos níveis de sensibilidade e especifici-dade para as principais doenças. Dez artigos avaliaram o desempenho do trabalhador de saúde sem incluir um grupo externo de comparação, e nove artigos compararam o desempenho de trabalhadores da saúde treinados e não treinados na estratégia. Os estudos mostraram evidência significativa de melhora no desem-penho dos trabalhadores de saúde em unidades com AIDPI. Os principais problemas metodológicos encon-trados foram a falta de controle de fatores de confusão e a falta de registro do poder estatístico.

Conclusões: há evidências científicas de melhoria do cuidado às crianças em unidades com profissionais capacitados em AIDPI, o que foi evidenciado particular-mente nos estudos realizados com melhor qualidade metodológica.

Palavras-chave *Atenção Integral às Doenças Prevalentes na Infância, Serviços de saúde da criança, Saúde da criança*

Introduction

The Integrated Management of Childhood Illness (IMCI) strategy was drawn up by the World Health Organization (WHO) in collaboration with the United Nations Children's Fund (UNICEF) with the aim of improving child health indicators. The global strategy was launched in 1993[1,2] and was introduced in Brazil in 1996, initially in the North and Northeast states where conditions for child health are the least favourable.[3]

The IMCI strategy includes training of health workers in the management of diseases common in childhood, with emphasis on diarrhea, respiratory infections, malaria, measles and malnutrition. It also includes support for health services that deal with the prevention of specific diseases and health promotion. The IMCI training course originally lasted 11 days, but in a number of countries and locations the course has been reduced to seven or eight days.[4]

Although the IMCI strategy has already been introduced in more than 100 countries,[5] so far no systematic review of the literature has evaluated whether there has been an improvement in the performance of health workers subsequent to the introduction of this strategy. Such information would be extremely useful for planners and policy-makers in the area of child health. The present review summarises the literature on the quality of case management by health workers trained in IMCI.

Methods

The systematic review of the literature on the IMCI strategy included studies directly or indirectly dealing with the question of whether the training of health workers in IMCI has resulted in an adequate performance in the management of the main health problems arising in childhood.

The publications were located and selected using electronic medical science databases - MEDLINE (National Library of Medicine) and LILACS (Latin American Literature on Medical Science) - in addition to the databases of the international organizations PAHO (Pan American Health Organization) and WHO (World Health Organization), using the following key words: AIDPI (Atenção Integrada às Doenças Prevalentes da Infância), IMCI (Integrated Management of Childhood Illness) and AIEPI (Atención Integrada a las Enfermedades Prevalentes de la Infancia). The review was broadened to include other sources. Thus, officials from health institutions (PAHO, WHO and the Brazilian Ministry of Health)

provided references for additional studies on IMCI, and unpublished articles of acceptable quality were included. The search covered the period from January 1993 (when IMCI was launched) to July 2006.

Studies were included if they contained quantitative data comparing the performance of healthcare workers trained in IMCI to that of workers with no such training. Uncontrolled studies on the performance of health workers trained in IMCI were also eligible. Studies measuring the impact of IMCI on health indicators but not the performance of health workers were not included. Also excluded were studies using an exclusively qualitative methodology, manuals, technical information packs and reports providing no evaluation of the strategy.

Analytical experimental or observational designs were included. The outcome parameters included performance indicators of health workers in evaluation, classification, treatment and counseling of mothers.

Subsequently a critical evaluation of the selected articles was carried out, using the 27 quality criteria proposed by Downs and Black, including communication, external validity, internal validity (bias), internal validity (confounding factors) and statistical power.[6] These criteria relate to positive, partially positive or negative responses to questions on the methodological features of the article, such as whether the statistical tests used to measure the main results were adequate.

The responses to the 27 quality criteria were entered into an Excel spreadsheet. A methodology score was used to indicate the quality of each article with regard to the strength of the evidence by dividing the number of positive items by the number of items evaluated.

Data collection was carried out using an article extraction form requesting the following information: reference, key words, country, aims, outline, sample size, outcome, main results and comments. This last item included a brief analysis of the methodology and the implications of the study in terms of decision-making and future research.

To facilitate the analysis, the articles were divided into: 1) preliminary studies on the IMCI algorithm; 2) studies with no external control group ("before and after" type) and 3) studies with an external control group.

Results

Four hundred and thirty documents in the MEDLINE, LILACS, WHOLIS and PAHO data-

bases contained the key words AIDPI, IMCI or AIEPI. In addition, seven documents published by the WHO and PAHO between January 1993 and July 2006 were included.

Of these documents (manuals, technical information packs, reports and articles) 33 met the inclusion criteria of the study. The studies had all been carried out by researchers working in developing countries (17 in Africa where the strategy was first tested and put into practice).

A list of these 33 articles can be found in Table 1 (preliminary studies evaluating the IMCI algorithm with a view to validation), Table 2 (studies evaluating the performance of healthcare workers trained in IMCI with no external control group) and Table 3 (studies with an external control group evaluating the performance of healthcare workers trained in IMCI).

The principal methodological problems encountered included failure to control for confounding factors in studies with control groups and failure to determine the statistical power of most of the uncontrolled studies. Given the variety of problems detected, the methodology score for the articles varied from 0.50 to 1.00.

Fourteen articles dealt with the validation of specific aspects of the IMCI algorithm, comparing the diagnostic studies carried out by health workers trained in the strategy with the gold standard set by experienced pediatricians. These studies showed levels of sensitivity and specificity above 80% for most illnesses (Table 1).[7-20] The main exception was the low sensitivity of pallor in the palms as an indicator of anemia.[10,16] Two authors reported low specificity for signs indicating the need for hospital referral,[11,18] while another[17] observed a specificity of 74%.

Nine articles evaluated the performance of health workers without reference to an external control group.[21-29] Some cross-sectional studies measured performance after training and reported absolute levels of adequacy,[21,23-26] with, for example, 80% of healthcare workers asking about immunizations. Others compared the performance of the same health workers before and after training.[28,29] Generally, these studies showed high levels of satisfactory performance, with a number of exceptions, including the correct treatment for anemia,[23,24] evaluation of general danger signs,[21,23] evaluation of the health of carers,[26,27] or the need to return immediately to the health unit.[21,23]

The study conducted by Kelley *et al*.[22] in Uganda, which also falls into this category, compared the performance of healthcare workers

who received training in IMCI plus immediate feedback from other trained workers to the performance of trainees not receiving such feedback, showing that feedback improves performance.

Out of ten articles evaluating the performance of healthcare workers in comparison with an external control group,[30-39] five were of high quality with a methodology score above 0.9,[31-35] the others receiving scores between 0.5 and 0.86. [30,33,36,37]

The studies with an external control group included both studies of efficacy, in which healthcare workers were specially trained by the researchers and subsequently evaluated, and studies of effectiveness, in which previously trained workers were evaluated under routine medical care conditions. All the studies (Table 3) provide significant evidence of improvement in the performance of trained health workers in terms of recognition of general danger signs,[34] verification of vaccination status,[32,34] advice on eating habits,[31] knowledge of carers regarding children's health,[32] performance of health workers at the facility,[32,34,37,38] adequate prescription of antibiotics[34-36,39] and communication with mothers.[33-35]

The study in Uganda showed a significant impact on several of the items studied, but differences between trained and untrained healthcare workers were slight.[38] This may be attributed to the short duration of the training process and/or the use of poorly qualified instructors in an attempt to achieve as wide a coverage as possible.[38]

Table 1

Studies involving preliminary evaluation of the Integrated Management of Childhood Illness (IMCI) algorithm. Comparison of diagnoses given by IMCI-trained health workers and a gold standard.

Main author, country and year of publication	Design and sample size	Parameters	Results	Score
Bern C, et al.[7] Kenya 1997	Cross-sectional (validation); 1202 children with severe malnutrition and 1735 children under five with low weight for age.	Mortality. Sensitivity and specificity (malnutrition).	Edema in both feet and very low weight were associated with high mortality. The sensitivity for detection of low weight for height was high (74-100%). In small children, a score below three for low weight/age had a sensitivity of 89-100% for detecting children with a score below three for low weight /height.	0.50
Perkins BA, et al.[8] Kenya 1997	Cross-sectional (validation); 1795 children aged 2-59 months.	Sensitivity and specificity (pneumonia, dehydration, malaria and ear problems).	Sensitivity above 80%, except for dehydration. Specificity above 60%, except for pneumonia, malaria and ear problems.	0.71
Weber MW, et al.[9] Gambia 1997	Cross-sectional (validation); 440 children aged 2-59 months.	Sensitivity and specificity (pneumonia, dehydration, malaria, measles, middle-ear infection and malnutrition).	Sensitivity and specificity above 80% for common diseases. Some diseases, such as skin rash, mouth and eye disorders, were not covered by IMCI.	0.71
Kalter HD, et al.[10] Uganda and Bangladesh 1997	Cross-sectional without a control group; 1226 children in Uganda and 668 in Bangladesh aged 2-59 months.	Sensitivity and specificity (palmar and conjuntival pallor).	Severe palmar and conjuntival pallor, alone or combined: 10 to 50% sensitivity and 99% specificity for severe anemia. Palmar pallor was not as efficient in detecting moderate or severe anemia.	0.71
Kalter HD, et al.[11] Bangladesh 1997	Cross-sectional (validation); 234 children aged between 1 and 24 months and 668 children aged 2-59 months.	Sensitivity and specificity (need for referral).	The algorithm yielded good sensitivity (84 - 86%), but low to moderate specificity (47-51%) for evaluation of the need for referral.	0.79
Kolstad PR, et al.[12] Uganda 1997	Cross-sectional (validation); two nurse's assistants and four doctors (gold standard), 1365 children aged 2-59 months.	Sensitivity and specificity (severe pneumonia, diarrhea, dysentery, ear infections, anemia, malnutrition).	Sensitivity and specificity above 80% except for severe pneumonia (sensitivity 53%).	0.71
Gove S, et al.[13] Tanzania 1997	Cross-sectional (validation); 23 healthcare workers evaluating 9-10 hospitalized children and more than thirty outpatients.	Evaluation and treatment (general warning signs, cough, diarrhea, fever, ear disorders, malnutrition, anemia).	All three groups (medical assistants, rural healthcare workers and maternity healthcare workers) succeeded in evaluating, classifying and treating most of the sick children by the end of the course. Most knew how to give adequate advice.	0.50

Table 1

Studies involving preliminary evaluation of the Integrated Management of Childhood Illness (IMCI) algorithm. Comparison of diagnoses given by IMCI-trained health workers and a gold standard.

Main author, country and year of publication	Design and sample size	Parameters	Results	Score
Simões EA, *et al*.[14] Ethiopia 1997	Cross-sectional (validation); 6 nurses and 449 children aged 2-59 months.	Evaluation, treatment and counseling for six common illnesses.	The evaluation of common signs was adequate, but for less common signs the sensitivity was low. Most of the children were treated correctly and, when necessary, referred. Advice given was adequate.	0.57
Kolstad PR, *et al*.[15] Uganda 1997	Cross-sectional (validation); two healthcare workers; 1226 children aged 2-59 months.	Classification (19 items), referral, duration of consultation and cost.	The use of IMCI led to the hospital referral of 16.2% of patients compared with 22% for doctors using a gold standard (sensitivity: 73%). IMCI reduced costs and drug use.	0.79
Zucker JR, *et al*.[16] Kenya 1997	Cross-sectional (validation); 1666 children aged 2-59 months.	Sensitivity and specificity (anemia).	For severe anemia in hospitalized patents, the sensitivity and specificity were 53% and 77%, respectively (conjunctival pallor), 42% and 93% (tongue pallor) and 53% and 81% (palmar pallor).	0.71
Shah D, Sacholev HP.[17] India 1999	Cross-sectional (validation); 203 children aged 2-59 months.	Sensitivity and specificity (general warning signs and criteria for referral).	The algorithm covers most diseases (92%). For hospitalized cases, sensitivity for general warning signs was low (39%), while specificity was high (87%). With regard to criteria for referral, sensitivity and specificity were 81% and 74%, respectively. The IMCI algorithm reduced missed opportunities for vaccination by 50%.	0.79
Gupta R, *et al*.[18] Índia 2000	Cross-sectional (validation); 129 children aged 2-59 months.	Sensitivity and specificity (bacterial infection, diarrhea, immunization, breastfeeding).	The criterion for referral was quite sensitive, but the specificity was low. Sensitivity for identification of severe bacterial infection was high, with low specificity.	0.71
Factor SH, *et al*.[19] Bangladesh 2001	Cross-sectional (validation); 669 sick children aged 2-59 months.	Treatment, sensitivity and specificity (fever).	The combination of fever and mother's perception of short breath resulted in a more sensitive criterion than that of the present model for detecting cases of bacterial infection. Antibiotics were prescribed to 78% children with bacterial infection.	0.57
Pluong CXT, *et al*.[20] Vietnam 2004	Cross-sectional (validation); 1250 children aged between 2 months and 10 years.	Classification, sensitivity and specificity (pneumonia, diarrhea and dengue fever).	Sensitivity greater than 60% and specificity greater than 85%. For the classification of dengue fever, the specificity was between 50 and 55% in children with serum testing positive for dengue.	0.79

Table 2

Studies of the performance of Integrated Management Childhood Illness (IMCI) trained healthcare workers without an external control group.

Main author, country and year of publication	Design and sample size	Parameters	Results	Score
Ecuador. Ministry of Public Health,[21] Ecuador 2000	Cross-sectional without a control group; 28 healthcare workers and 195 children aged 2-59 months at 41 health facilities. Re-examination of children using a gold standard.	Evaluation, classification, treatment and counseling.	The healthcare workers performed well with regard to management of illnesses, except for evaluation of general warning signs (34.5%). Advice to return to the health facility immediately was not given adequately (33.9%).	0.50
Kelley E, et al.[22] Niger 2001	Quasi-experimental. Evaluation of the effect of feedback on healthcare workers trained in IMCI; 483 children aged 2-59 months.	17 evaluation indicators, treatment and counseling.	Performance was adequate in terms of recognition of general danger signs, confirming vaccination status and evaluation of sick children. The feedback had a significant effect on the performance of healthcare workers.	0.74
Amaral JJF, et al.[23] Brazil 2002	Cross-sectional without a control group; 164 children aged 2-59 months evaluated by staff trained in IMCI. Re-examination of children using a gold standard.	Evaluation, classification and treatment.	The performance of healthcare workers was adequate with regard to management of illnesses, except for treatment of anemia (20%) and evaluation of warning signs (23.8%).	0.50
Zamora GAD, et al.[24] Bolivia 2002	Cross-sectional without a control group; 36 health facilities, 102 children under five, 101 mothers and 54 healthcare workers. Re-examination of children using a gold standard.	Evaluation indicators, classification, treatment, communication and structure.	Staff performed better, except for correct treatment of anemia (21%). When the findings were compared for 3 indicators with a study prior to baseline, evidence was found for significant improvement in terms of investigation of warning signs, main symptoms and unnecessary prescription of antibiotics.	0.50
Arabic Republic. Egypt. Ministry of Health.[25] Egypt 2003	Cross-sectional without a control group; 296 children aged 2-59 months; 292 interviewed at 50 facilities. Re-examination of children using a gold standard.	Evaluation, classification, treatment, counseling and infrastructure.	Performance was adequate with regard to vaccination, respiratory problems, anemia, diarrhea and ear disorders. For 73% of the children the diagnosis and the gold-standard evaluation carried out by a qualified pediatrician concurred. The treatment was adequate for need of hospital referral, prescription of antibiotics and diarrhea.	0.50
Freitas MGSM, et al.[26] Brazil 2003	Cross-sectional without a control group; 203 children aged under 59 months evaluated by healthcare workers trained in IMCI. Re-examination of children using a gold standard.	Evaluation, classification, treatment and infrastructure.	Performance of staff was good with regard to management of illnesses, except for evaluation and treatment of extreme weight loss (18%) and maternal health (7%).	0.50

Table 2   conclusion

Studies of the performance of Integrated Management Childhood Illness (IMCI) trained healthcare workers without an external control group.

Main author, country and year of publication	Design and sample size	Parameters	Results	Score
Karamagi CAS, et al.[27] Uganda 2004	Cross-sectional without a control group; 37 healthcare workers trained in IMCI.	Adherence to items included in IMCI; 20 evaluation indicators and counseling.	Staff showed a high degree of adherence to the algorithm for most of the items studied. Performance was weak for advice on medication and asking questions about the mothers' health problems.	0.79
Anand K, et al.[28] India 2004	Longitudinal study without an external control group (before and after); 948 medical records from before and after the introduction of IMCI were analyzed.	Evaluation of performance of healthcare workers. Infant mortality rate in the study area.	The knowledge of trained staff improved only during the early stages. Classification and management were unsatisfactory for pneumonia and for sick newborns. The performance was better in the case of fever, measles, dysentery and diarrhea.	0.52
Chopra M, et al.[29] South Africa 2004	Longitudinal study without an external control group (before and after); 21 nurses observed before and after IMCI training.	Evaluation indicators, classification and treatment.	There was a significant improvement in the evaluation of general warning signs, rational prescription of medication and early treatment at the clinic. There was no change in terms of advice on mediation or on when to return to the health facility. The health facilities had good infrastructure.	0.83

Table 3

Studies of improvements in the performance of Integrated Management of Childhood Ilness (IMCI) trained healthcare workers, with an external control group.

Main author, country and year of publication	Design and sample size	Parameters	Results	Score
Dávila M, et al.[30] Peru 1999	Cross-sectional; 90 health facilities (60 with and 30 without IMCI), 428 children aged 2-59 months (294 with IMCI and 134 without), 202 healthcare workers (148 with IMCI and 54 without).	Evaluation, classification, treatment, communication, structure (28 indicators).	Healthcare workers trained in IMCI performed better in terms of various indicators relating to the management of common diseases. The infrastructure was similar for both types of health facility (77-76%), but more vaccination equipment was available at facilities with IMCI.	0.50
Santos IS, et al.[31] Brazil 2002	Randomized trial; 28 health facilities (14 with intervention and 14 controls) with 33 qualified physicians, each evaluating 12 to 13 patients under 18 months.	Evaluation of the item nutritional counseling: knowledge of physicians and adherence of mothers to recommendations	Compared to the control group, there was a significant improvement in the performance of staff, mothers' knowledge and paractices, and weight gain in children.	1.00

Table 3

Studies of improvements in the performance of Integrated Management of Childhood Ilness (IMCI) trained healthcare workers, with an external control group.

Main author, country and year of publication	Design and sample size	Parameters	Results	Score
Schellenberg J, et al.[32] Tanzania 2004	Cross-sectional; 75 health facilities (39 with IMCI and 34 without); 419 children under five. Re-examination of children using a gold standard.	Evaluation indicators, classification, treatment, counseling, structure and referral.	The performance of healthcare workers was notably better in facilities with IMCI. The structure of two groups of facilities was similar.	0.93
Gilroy K, et al.[33] Mali 2004	Randomized trial. 182 children under 59 months (182 in the intervention group and 182 in the control group). Five facilities with IMCI were compared to five without IMCI.	10 parameters relating to communication between healthcare workers and mothers.	Communication was better in the IMCI group. Information on drug dosage was more adequate, carers understood the counseling given and the prescribed dosage.	0.85
Amaral J, et al.[34] Brazil 2004	Cross-sectional; 48 health facilities with IMCI and 48 without; 653 children aged 2-59 months. Re-examination of children using a gold standard.	20 parameters including evaluation, classification, treatment and counseling.	IMCI was associated with improvements in the evaluation and classification of children, and in counseling mothers; The algorithm had a moderate effect on indicators relating to adequate treatment. Supervision was inadequate in most states.	0.93
Arifeen S, et al.[35] Bangladesh 2004	Randomized trial; 10 facilities with IMCI and 10 without; around 600 children under five examined at baseline and 18 months after treatment. Re-examination of children using a gold standard	Adequate evaluation index and correct treatment and counseling index.	There were no differences between the groups at baseline; 18 months after training the average evaluation index was 73 for the IMCI group and 17 for the control group (out of a maximum of 100).The corresponding treatment and counseling index was 54 and 9.	1.00
Gouws E, et al.[36] Brasil, Tanzania and Uganda 2004	Cross-sectional; 419 children under five in Tanzania, 516 in Uganda and 653 in Brazil. Re-examination of children using a gold standard.	Adequate treatment with antibiotics.	The children evaluated by staff trained in IMCI had a greater likelihood of receiving adequate prescriptions of antibiotics than children treated by the control group.	0.86
Bryce J, et al.[37] Tanzania 2005	Cross-sectional; 419 children under five (231 seen by staff trained in IMCI and 188 by staff without IMCI). Re-examination of children using a gold standard.	Treatment and counseling indicators.	Training in IMCI was significantly associated with improvements in healthcare for various illnesses at the health facilities. There was no significant difference in the management of diarrhea with dehydration and ear disorders.	0.81

Table 3   conclusion

Studies of improvements in the performance of Integrated Management of Childhood Ilness (IMCI) trained healthcare workers, with an external control group.

Main author, country and year of publication	Design and sample size	Parameters	Results	Score
Pariyo GW, et al.[38] Uganda 2005	Cross-sectional; 10 districts with different levels of implementation of IMCI evaluated in 2000, 2001 and 2002. Children evaluated: 516 (2000), 332 (2001) and 211 (2002). Re-examination of children using a gold standard.	Indicators for evaluation, treatment, vaccination, essential equipment and supplies.	Healthcare workers trained in IMCI had a significantly better performance than those without training, but the absolute levels of performance quality were low in both groups.	0.93
Naimoli JF, et al.[39] Morocco 2006	Cross-sectional; two provinces with intervention and two controls; 467 children under five. Re-examination of children using a gold standard.	Indicator = adherence to treatment.	The quality of care was better in provinces with intervention than in provinces without, according to the index of adherence and adequate prescription of antibiotics.	0.93

Discussion

The studies reviewed fall basically into three categories: 1) studies for initial validation of the IMCI algorithm, 2) studies without an external control group, evaluating the performance of trained healthcare workers and 3) studies with a control group, comparing trained and untrained healthcare workers.

The first studies carried out were validation studies, as it was necessary to evaluate the discriminatory power of the IMCI algorithm before introducing it into other countries. These studies provided evidence of the ability of IMCI to detect nutritional problems[7] and to identify unvaccinated children[17] and seriously ill children in need of referral,[11,15,18] and showed IMCI to be useful in the management of the main childhood health problems[9,13,14,19] with adequate levels of sensitivity and specificity.[8,12] The main exception was the diagnosis of anemia based on palmar pallor which was associated with low to moderate accuracy.[10,16] These preliminary studies were very useful in that they laid the foundations for the strategy and gained respectability for the algorithm in the medical community, which was initially somewhat skeptical of some of the procedures included in the IMCI, such as the diagnosis of pneu-

monia based on breathing frequency, without the use of radiology or auscultation.

The second category of studies was carried out to evaluate the performance of health workers with or without a control. The uncontrolled studies evaluated the adequacy of the performance,[40] that is, whether IMCI-trained healthcare workers had high levels of performance for the evaluation, classification and counseling of children and their carers. These studies provided evidence of adequate performance levels among healthcare workers trained in IMCI,[7] showed that feedback from other trained staff improved performance further,[21,23-26] and that IMCI is important for counseling carers.[27] One study suggested that the IMCI improves care for sick children, but only if the health facility has a good infrastructure.[29]

These findings were confirmed in studies involving an external control group, where the methodology is more sophisticated and allows to determine the likelihood of the observed effect being due to IMCI training.[40,41] These studies provided evidence of improved performance among healthcare workers trained in IMCI,[30,32,34,37-39] a positive effect of IMCI on nutritional status,[31] better communication in the group trained in IMCI[33] and adequate

use of antimicrobial agents.[36]

There was considerable variation between the studies with regard to study design, outcome parameters, target population and sample size. It was therefore not possible to obtain an overall average using meta-analytical techniques. However, this did not significantly alter the fact that most of the studies showed a positive association between IMCI training and performance, including those studies with a high methodology score. Two of the studies described here[36,37] included overall analyses of investigations carried out for the Multi-Country of IMCI Evaluation, which are tantamount to a meta-analysis.

It is important to point out that many different types of healthcare workers were trained in IMCI. In African countries, most were intermediate-level medical or nursing assistants belonging to various categories with more than 18-36 months training. A recent evaluation showed that training in IMCI improved the performance of healthcare workers at all levels, including qualified physicians.[42] In Brazil, nurses trained in IMCI had a performance equal to or better than that of doctors trained in IMCI.[34]

All but six studies were English language publications.[21,23,24,26,30,31] It is possible that non-native English-speaking authors preferred to publish in that language, as clearly shown in one case.[34] It should also be borne in mind that some publishers of English-language periodicals discriminate against work submitted by researchers from under-developed countries.[43]

One problem to be considered is the bias of the publication, given that there is a greater likelihood of articles being accepted if they present positive rather than negative results.[44] It should be noted that this review identified three unpublished studies, all presenting positive results.[21,25,30]

As for the methodological problems encountered, according to the criteria developed by Downs and Black, failure to describe the statistical power and failure to control for confounding factors were the most common. Although their statistical power was not specified, the studies that evaluated performance used samples of more than 100 children, and, therefore, are sufficiently powerful statistically to detect important differences. It should be pointed out that, among the control studies where adjustments were made for confounding factors, there was evidence of improvement in the performance of healthcare workers at the health facilities using IMCI.[31-36]

In conclusion, the studies evaluated show scientific evidence of improvement in child healthcare in facilities with staff trained in IMCI in terms of advice on nutrition, weight gain, knowledge of children's health, correct treatment, evaluation of general danger signs, and correct prescription of antibiotics. More studies are required to clarify whether this is also the case for treatment of diarrhea plus dehydration, detection and treatment of anemia and earache. Localities where IMCI has not yet been introduced, or has been only partially introduced, should be encouraged to adopt the strategy.

In view of the conclusions of this systematic review, some recent developments in Brazil give cause for reflection. The first is the reduction in the pace of implementation of IMCI in the country owing to a change in the priorities of the Children's Health Department of the Ministry of Health. The second relates to the directive that medicines be prescribed only by a qualified physician, with nurses being responsible for health promotion and detection of signs of disease (or of the risk of disease). Finally, much effort is currently being invested in the establishment of adequate healthcare for children integrating of primary care health workers in a more complex system of reference.

Healthcare policies should be strongly based on scientific knowledge. In that respect, the findings of the present systematic review of the literature show that training in IMCI has led to significant improvements in children's health in Brazil.

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