Research

Diagnosis and management of febrile children using the WHO/UNICEF guidelines for IMCI in Dhaka, Bangladesh

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Objective To determine whether the fever module in the WHO/UNICEF guidelines for the integrated management of childhood illness (IMCI) identifies children with bacterial infections in an area of low malaria prevalence.
Methods Physicians assessed a systematic sample of 669 sick children aged 2–59 months who presented to the outpatient department of Dhaka Shishu Hospital, Bangladesh.
Findings Had IMCI guidelines been used to evaluate the children, 78% of those with bacterial infections would have received antibiotics: the majority of children with meningitis (100%), pneumonia (95%), otitis media (95%) and urinary tract infection (83%); and 50% or less of children with bacteraemia (50%), dysentery (48%), and skin infections (30%). The current fever module identified only one additional case of meningitis. Children with bacteraemia were more likely to be febrile, feel hot, and have a history of fever than those with dysentery and skin infections. Fever combined with parental perception of fast breathing provided a more sensitive fever module for the detection of bacteraemia than the current IMCI module.
Conclusions In an area of low malaria prevalence, the IMCI guidelines provide antibiotics to the majority of children with bacterial infections, but improvements in the fever module are possible.

Keywords Fever/drug therapy; Bacterial infections/diagnosis/drug therapy; Meningitis, Bacterial/diagnosis/drug therapy; Pneumonia, Bacterial/diagnosis/drug therapy; Otitis media/diagnosis/drug therapy; Urinary tract infections/diagnosis/drug therapy; Bacteremia/diagnosis/drug therapy; Dysentery/diagnosis/drug therapy; Skin diseases, Infectious/diagnosis/drug therapy; Malaria/diagnosis; Antibiotic prophylaxis/utilization; Child/ Delivery of health care, Integrated; Guidelines; Evaluation studies; Bangladesh (*source: MeSH*).

Mots clés Fièvre/chimiothérapie; Infections bactériennes/diagnostic/chimiothérapie; Méningite purulente/diagnostic/chimiothérapie; Pneumonie bactérienne/diagnostic/chimiothérapie; Otite moyenne/diagnostic/chimiothérapie; Urinaire, Infection;/diagnostic/chimiothérapie; Bactériémie/diagnostic/chimiothérapie; Dysenterie/diagnostic/chimiothérapie; Dermatose infectieuse/diagnostic/chimiothérapie; Paludisme/diagnostic; Prophylaxie antibiotique/utilisation; Enfant; Distribution intégrée soins; Ligne directrice; Etude évaluation; Bangladesh (*source: INSERM*).

Palabras clave Fiebre/quimioterapia; Infecciones bacterianas/diagnóstico/quimioterapia; Meningitis bacteriana/diagnóstico/quimioterapia; Neumonía bacteriana/diagnóstico/quimioterapia; Otitis media/diagnóstico/quimioterapia; Infecciones urinarias/diagnóstico/quimioterapia; Bacteremia/diagnóstico/quimioterapia; Disentería/diagnóstico/quimioterapia; Dermatitis infecciosa/diagnóstico/quimioterapia; Paludismo/diagnóstico; Profilaxis antibiótica/utilización; Niño; Entrega integrada de atención de salud; Pautas; Estudios de evaluación; Bangladesh (*fuente: BIREME*).

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Voir page 1105 le résumé en français. En la página 1105 figura un resumen en español.

Introduction

Case management approaches for the diagnosis and treatment of childhood illness in developing countries often use a limited set of signs and symptoms and standardized measures for disease classification and treatment. For children with acute respiratory infec-

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tion and diarrhoeal disease, such approaches have been documented to reduce both cause-specific and overall childhood mortality (*1*, *2*). The success of these disease-specific approaches led WHO and UNICEF to incorporate them into a set of guidelines for the integrated management of childhood illness (IMCI), which includes modules or subsets of guidelines for the recognition and management of children with acute respiratory infections, diarrhoea, measles, malaria and other febrile illness, and malnutrition — conditions responsible for over 70% of childhood deaths in developing countries (*3*). Because children may present to a health care facility with more than one disease and different disease entities may be manifested by the same array of common symptoms, the IMCI scheme allows for the simultaneous diagnosis of more than one disease and ensures that each will receive treatment, if indicated.

The IMCI guidelines contain a module for the evaluation of febrile children that focuses on the diagnosis and treatment of malaria. In areas where malaria is highly prevalent, the high predictive value of fever for malaria makes this focus appropriate (*4*). In other regions where malaria is less common, fever may be more predictive of bacterial infection. A classification system that identifies with good sensitivity febrile children who are likely to have a bacterial infection is important to assure appropriate antimicrobial therapy. The performance of the IMCI fever module in identifying children with bacterial infection in an area of low malaria prevalence has never been evaluated. The objectives of this study were to determine how well the IMCI guidelines perform in identifying children with bacterial infections in need of antibiotics in an area of low malaria prevalence and how much the existing IMCI fever module (which identifies children as having "very severe febrile disease" in a non-malarious area) contributes to the overall IMCI performance, and to evaluate alternative fever modules for inclusion in the integrated guidelines.

Materials and methods

Study participants

The study was conducted in the outpatient department of the Dhaka Shishu Hospital (DSH), a paediatric hospital in Dhaka, Bangladesh, where the prevalence of malaria is low. The study was approved by the ethical review committees of the Dhaka Shishu Hospital, the Bangladesh Medical Research Council, the Johns Hopkins School of Hygiene and Public Health, and the United States Centers for Disease Control and Prevention.

A systematic sample of children aged 2–59 months who presented to the DSH outpatient department or emergency room during daytime operating hours between September 1994 and February 1995 were approached for enrolment in the study. Children who had been seen at the DSH within the previous week, admitted to the hospital within the previous 2 weeks, or were attending the hospital for routine immunization, physiotherapy or a prearranged appointment with the hospital specialty departments (e.g. renal, orthopaedic, cardiology) were not eligible. Strategies to enrich the study sample with acutely ill children were implemented at different points during the study period. These included preferential enrolment of children triaged to the emergency room by hospital personnel, children with abnormal temperatures ($< 35.5\ ^{o}C$ or $> 37.5\ ^{o}C$ axillary temperature)[a], and children with evidence of respiratory distress (noisy breathing, chest indrawing or elevated respiratory rate).

At DSH, the personnel responsible for triaging ill patients routinely refer patients suspected of having cellulitis or abscess to the surgical outpatient clinic. For this reason, patients with these diagnoses may be underrepresented in our study population. In the city of Dhaka, children with diarrhoea and dysentery are often taken directly to the International Centre for Diarrhoeal Disease Research, Bangladesh, rather than to the general outpatient department at DSH. This limited the number of participants with diarrhoea as a chief complaint.

Clinical and laboratory investigations

A nurse measured and recorded the weight, tactile and measured temperature, and respiratory rate for each patient. One of three study physicians interviewed parents for a complete history, performed a physical examination of the child, and recorded all findings (absent or present) on a standard data collection form. For the purposes of the research study, fast respiratory rate was defined by age as > 50 breaths per minute (2–11 months) or > 40 breaths per minute (12–59 months), and abnormal temperature defined as an axillary temperature of $< 35.5\ ^{o}C$ or $> 37.5\ ^{o}C$. A chest radiograph was ordered for any child with central cyanosis, lower chest wall indrawing, crepitations, fast respiratory rate, abnormal temperature or a clinical diagnosis of suspected pneumonia. A lumbar puncture was performed on any child whose temperature was abnormal and had one of the following: neck stiffness, an illness acuity score suggesting severe disease (young infant observation score $\geqslant 7$) (*5*), or authenticated convulsions in the absence of the typical findings of neonatal tetanus. Blood cultures were performed on a systematic sample of children with a history of fever in the previous 24 h, and for any child with an abnormal axillary temperature. Physicians ordered any other tests they believed to be medically indicated.

The physicians made treatment decisions based on the medical history, physical examination and any available laboratory data. When the results of

[a] In this study temperature was measured by rectal or axillary mode, and recorded in ^{o}F. For ease of presentation we have converted all temperatures to ^{o}C using the formula: $5(^{o}F - 32)/9 = {}^{o}C$, and to axillary temperatures (axillary temperature is equivalent to measured rectal temperature minus 0.5 ^{o}C).

all the laboratory tests became available (sometimes days later in the case of blood cultures), the study physicians recorded up to three final diagnoses in an open-ended format.

Data analysis

Evaluation of current IMCI guidelines

The following diagnoses were considered to be bacterial infections requiring antibiotic therapy: meningitis, pneumonia, bacteraemia, dysentery, otitis media, bacterial skin infections (i.e. impetigo, cellulitis and abscesses) and urinary tract infections. Meningitis was defined as a paediatrician's diagnosis of meningitis or the presence of one of the following in a cerebrospinal fluid specimen: > 100 white blood cells per high-power field, > 100 mg/dl protein, a bacterial organism seen upon Gram staining, or a positive latex agglutination test for *Haemophilus influenzae*, *Streptococcus pneumoniae*, or *Neisseria meningitidis*. Pneumonia was defined as a paediatrician's diagnosis of pneumonia or the presence of an infiltrate on a chest radiograph in a child with clinically diagnosed bronchiolitis. Bacteraemia was defined as a paediatrician's diagnosis of clinical septicaemia or the isolation of a pathogenic organism from a blood culture. Case definitions for other illnesses were based solely on a study physician's diagnosis. Children with multiple diagnoses were evaluated according to their most serious diagnosis.[b]

The IMCI module on fever indicates that in an area of low malaria prevalence children with a history of fever, who feel hot to the evaluating health worker, or have an axillary temperature of $\geqslant 37.5\ ^{o}C$ and have a general danger sign or a stiff neck should be diagnosed as having "very severe febrile disease" and be treated with antibiotics (Table 1). The other diagnostic classifications for which the IMCI guidelines indicate antibiotic therapy, along with the signs and symptoms that lead to these classifications are also shown in Table 1. Each of these diagnostic classifications is designed to identify a specific clinical syndrome often caused by bacterial infection. The category "General danger signs" is designed to identify children with meningitis or septicaemia. The guidelines draw a distinction between children with "severe pneumonia" and children with "pneumonia"; children with respiratory distress can be diagnosed with one or the other.

We determined which children with bacterial infections would be treated with an antibiotic under the existing IMCI guidelines and developed a computer program that used signs and symptoms recorded by study physicians to determine which children would fulfil the criteria for each of the seven IMCI diagnoses that indicate antibiotics.

[b] Because this study was concerned with identifying bacterial infections, severity of disease was based on the following scheme: probable bacterial etiology, probably infectious, non-bacterial etiology (including viral, parasitic or fungal), then non-infectious etiology. Diagnoses in order of their severity are listed in Table 2.

Evaluation of alternative fever modules

We measured the frequency of fever and various other signs and symptoms in children with and without bacterial infections to determine their sensitivity and specificity for identifying bacterial infections, and developed alternative fever modules using signs and symptoms we found to be sensitive for bacterial infection. To evaluate these alternative modules, we measured the overall sensitivity and specificity of the IMCI guidelines for children with bacterial infections with each of these modules in place.

Data were analysed using SAS software (*6*).

Results

Study population

A total of 699 children were enrolled in the study. Two children whose temperature had not been measured and one for whom the physician did not indicate a final diagnosis were excluded; 666 children were included in the analysis. The children ranged in age from 2 months to 59 months (median, 12 months), 74% (495/666) were under 2 years of age and 24% (157/666) were under 6 months. Boys comprised 62% (410/666) of the study population.

Pneumonia was the most common diagnosis in the study population (n = 200) (Table 2). Of the 20 children who met the case definition for bacteraemia, 17 had positive blood cultures (1 with *S. pneumoniae*, 1 with other streptococcal species, 8 with *Salmonella* (including 4 *S. typhi*), 1 with *Klebsiella pneumoniae*, 1 with *Escherichia coli*, 1 with *Pseudomonas* and 4 with *Acinetobacter*).

Evaluation of current IMCI guidelines

The sensitivity and specificity of the current IMCI guidelines for identifying children with bacterial infections and treating them with antibiotics were 78% and 47%, respectively.

Of the 12 children with meningitis, 11 (92%) fulfilled the criteria for "general danger signs" (Table 3). All 12 children with meningitis fulfilled the criteria for "very severe febrile disease" according to the fever module; with the addition of stiff neck to danger signs to make the diagnosis of "very severe febrile disease " in the fever module, all children with meningitis were identified.[c]

Of the 200 children with pneumonia, 186 (93%) fulfilled the criteria for the diagnosis of pneumonia; 152 (76%) had "severe pneumonia" and 34 (17%) had "pneumonia" (Table 3). In total, 190 (95%) of the children with pneumonia would have received antibiotics by fulfilling one or more of the seven categories that indicate antibiotics. The fever module did not identify any children with pneumonia who were not identified by another portion of the IMCI scheme.

[c] A total of 13 children in the study had a stiff neck. Of these, six had meningitis.

Of the 20 children diagnosed with bacteraemia, 10 (50%) would have received antibiotics under the IMCI guidelines. These 10 fulfilled the criteria for "pneumonia" and 6 of them fulfilled the criteria for "general danger signs." The fever module did not identify any children with bacteraemia who were not identified by another portion of the IMCI scheme.

Of the 48 children diagnosed with dysentery, only 17 (35%) fulfilled the IMCI criteria for this condition. To receive a diagnosis of dysentery by the IMCI scheme, a child must first be identified as having diarrhoea; however, only 19 of the 48 parents interviewed reported that their child had diarrhoea at the time of examination (answered "yes" to the question "Is the child currently having diarrhoea?"). Of these, 17 reported a history of blood in the stool. Among the remaining 29 children for whom there was no parental report of diarrhoea, 21 presented with a chief complaint of mucoid stool and four had a chief complaint of bloody stool. In all, only 23 (48%) of the 48 children with a physician's diagnosis of dysentery would have received antibiotics under the IMCI scheme. The fever module did not identify any children with dysentery who were not identified by another portion of the IMCI scheme.

Of the 21 children with otitis media, 17 (81%) were appropriately diagnosed by the IMCI guidelines as having acute ear infection and 20 (95%) would have received antibiotics. The fever module did not identify any children with otitis media who were not identified by another portion of the IMCI scheme.

The IMCI guidelines do not contain a module dedicated to bacterial skin infections. Of the 46 children with such infections, only 14 (30%) would have been identified as having a bacterial infection. The majority of children who would have received antibiotics fulfilled the IMCI criteria for pneumonia. The fever module did not identify any children with bacterial skin infections who were not identified by another portion of the IMCI scheme.

Of the 30 children with urinary tract infections, 28 had a positive urine culture (16 with *E. coli*, 4 with *K. pneumoniae*, 3 with *Proteus mirabilis*, 1 each with *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Citrobacter* spp., *Pseudomonas* spp. and *Proteus vulgaris*). Two did not have a urine culture performed but were diagnosed to have urinary tract infection by a physician. Of these 30 children, 4 had a history of urinary pain, 13 urinated less than normal, and 2 more than normal. None of the children had abdominal tenderness on physical examination. The IMCI guidelines do not contain a module dedicated to urinary tract infections. The majority (83%) of children with this diagnosis would have fulfilled the IMCI criteria for at least one bacterial infection and 77% fulfilled the criteria for pneumonia. The fever module did not identify any children with urinary tract infection who were not identified by another portion of the IMCI scheme.

Overall, the existing fever module would have classified and provided antibiotic treatment for two additional children (one with meningitis and one without a bacterial infection) who would not have been given another diagnostic classification for which the IMCI guidelines indicate antibiotics.

Table 1. **Diagnostic classifications for which the integrated management of childhood illness (IMCI) guidelines recommend antibiotics, with associated clinical signs, for children aged 2–59 months**

General danger signs present	Not able to drink or breastfeed, vomits everything or convulsions (all by history), or abnormally sleepy or difficult to wake up[a]
Very severe febrile disease	Fever (by history, feels hot, or axillary temperature $\geqslant$37.5 °C) *and* any general danger sign, or stiff neck
Pneumonia *Severe pneumonia or very severe disease* *Pneumonia*	Cough or difficult breathing (by history) and any general danger sign, chest indrawing, or stridor in a calm child Cough or difficult breathing (by history) and 50 breaths per minute or more in a child aged 2–11 months or 40 breaths per minute or more in a child aged 12–59 months
Dysentery	Diarrhoea and blood in the stool (by history)
Severe complicated measles	Fever (by history, feels hot, or axillary temperature $\geqslant$ 37.5 °C) *and* generalized rash *and* cough, runny nose, or red eyes, *and* any general danger sign, clouding of cornea, or deep or extensive mouth ulcers
Mastoiditis	Ear problem (by history) *and* tender swelling behind the ear
Acute ear infection	Ear problem (by history) *and* ear pain (by history) or ear discharge for less than 14 days (by history) or pus seen draining from the ear

[a] Some 8 months following the study, the IMCI guidelines were revised so that "lethargic or unconscious" replaced these signs.

Evaluation of alternative fever modules

Because children with bacteraemia, dysentery, and bacterial skin infections would not have been adequately provided with antibiotics under the IMCI guidelines, we focused on these diagnoses in devising an alternative fever module. The majority of children with bacteraemia felt hot to a physician's touch, had a measured axillary temperature of $\geqslant$ 37.5 °C, had fever by parental report and felt hot to a nurse's touch (Table 4), indicating that a fever module that defines fever in any of these ways might be helpful in identifying children with bacteraemia. "Fast breathing by parental report" was also a potentially useful sign for identifying children with bacteraemia.

Fewer than 50% of children with dysentery felt hot to a physician's touch, had a measured axillary temperature of $\geqslant$ 37.5 °C and felt hot to a nurse's touch, while a majority had fever by parental report. Fewer than 50% of children with bacterial skin infections felt hot to a physician's touch and had a measured axillary temperature of $\geqslant$ 37.5 °C, while a majority had fever by parental report and felt hot to a

Table 2. **Reference diagnoses of 666 study children (aged 2–59 months) evaluated at Dhaka Shishu Hospital, Dhaka, Bangladesh, September 1994–February 1995**[a]

Diagnosis	No. of children
Meningitis Alone (9)[b], with pneumonia (2), with bacteraemia (1)	12
Pneumonia Alone (174), with bacteraemia (4), with dysentery (5), with otitis media (2), with bacterial skin infection (3), with urinary tract infection (12)	200
Bacteraemia Alone (14), with bacterial skin infection (2), with urinary tract infection (4)	20
Dysentery Alone (40), with otitis media (2), with bacterial skin infection (4), with urinary tract infection (2)	48
Otitis media Alone (17), with bacterial skin infection (3), with urinary tract infection (1)	21
Bacterial skin infection Alone (43), urinary tract infection (3)	46
Urinary tract infection	30
Tuberculosis	1
Measles	2
Diarrhoea	71
Bronchiolitis	23
Intestinal parasites	13
Upper respiratory infection (bronchitis, cough, cold)	63
Viral syndrome	26
Candidal infections	4
Acute glomerular nephritis or renal failure	10
Malnutrition	20
Convulsions	20
Asthma	10
Anaemia	0
Dermatitis	2
Congenital abnormality	6
Other	18
Total	**666**

[a] Diagnoses are listed in order of severity according to the following scheme: probable bacterial etiology, probably infectious, non-bacterial etiology (including viral, parasitic or fungal), non-infectious etiology. Children with multiple diagnoses are listed according to their most serious diagnosis. Criteria for reference bacterial infections were: meningitis — a paediatrician's diagnosis of meningitis or the presence of one of the following in a specimen of cerebrospinal fluid: > 100 white blood cells per high-power field, > 100 mg/dl protein, a bacterial organism seen upon Gram staining, or a positive latex agglutination test for *Haemophilus influenzae*, *Streptococcus pneumoniae* or *Neisseria meningitidis*; pneumonia — a paediatrician's diagnosis of pneumonia or the presence of an infiltrate on a chest radiograph in a child with clinically diagnosed bronchiolitis; and bacteraemia — a pediatrician's diagnosis of clinical septicaemia or the isolation of a pathogenic organism from a blood culture. Case definitions for other illnesses are based solely on a study physician's diagnosis. Children with multiple diagnoses were evaluated according to the most serious diagnosis.

[b] Figures in parentheses indicate the number of children.

nurse's touch. The infrequency of measured fever among children with dysentery and bacterial skin infections suggests that fever may not be the best symptom for identifying such children.

We developed five alternative fever modules using fast breathing and different measures of fever to improve the identification of children with bacteraemia (Table 5). The first module (algorithm A) indicates antibiotic therapy for children with a measured axillary temperature of $\geqslant$37.5 °C and whose parents answered "yes" to the question, "Does your child have fast breathing?". When the current fever module was exchanged for this one, the overall sensitivity of the IMCI guidelines increased from 78% to 82% and 17 additional children with bacterial infection would have been provided with antibiotics: 7 with pneumonia, 5 with bacteraemia, 1 with dysentery, 3 with bacterial skin infection, and 1 with a urinary tract infection.

Because access to a working thermometer may be limited in settings where the IMCI guidelines are used, we evaluated a second fever module, which consisted of feeling hot to a health worker (either doctor or nurse perceived that a child felt hot) or a measured axillary temperature $\geqslant$ 37.5 °C, and parental perception of increased respiratory rate (algorithm B). The overall performance of the IMCI guidelines with this algorithm is similar to that seen with algorithm A (sensitivity 83%, specificity 40%).

A third fever module included a history of fever (parent answered "yes" when asked, "Has your child been having fever?"), feeling hot to a health worker, or a measured axillary temperature $\geqslant$ 37.5 °C, and parental perception of increased respiratory rate (algorithm C). When Algorithm C was substituted for the existing fever module, the overall performance of the IMCI guidelines was also similar to algorithm A (sensitivity 84%, specificity 37%).

If a cut-off point of measured axillary temperature of $\geqslant$ 38.0 °C was used to identify children with a bacterial infection (algorithm D), the sensitivity was 84% and sensitivity 38%.

Finally, we evaluated a fever module that included children with a measured axillary temperature of $\geqslant$ 38.0 °C and a parental report of 3 or more days of fever (algorithm E). Sensitivity was 84% and specificity 42%.

Algorithms A through E are all more sensitive than the current IMCI fever module and algorithms A and E are the most specific (42%). All the alternatives offered would provide antibiotics to all children with meningitis.

Discussion

Use of the IMCI guidelines in this region of low malaria prevalence, the majority of children with meningitis, pneumonia, otitis media and urinary tract infections would have fulfilled the criteria for at least one of the IMCI diagnostic classifications that indicate antibiotics. However, the majority of children with bacteraemia, dysentery and bacterial skin infections would not have received antibiotics. The current fever module identified only one additional case of meningitis and did not significantly improve the performance of the IMCI guidelines in identifying children with other bacterial infections. An improved fever module may increase the sensitivity of the guidelines in identifying children with bacteraemia.

Table 3. **Integrated management of childhood illness (IMCI) diagnostic classifications for study children aged 2–59 months with bacterial infections, evaluated at Dhaka Shishu Hospital, Dhaka, Bangladesh, September 1994–February 1995**

IMCI diagnostic classification	No. of children with reference diagnosis							
	Meningitis (n = 12)[a]	Pneumonia (n = 200)[b]	Bacteraemia (n = 20)	Dysentery (n = 48)	Otitis media (n = 21)	Bacterial skin infection (n = 46)	Urinary tract infection (n = 30)	No bacterial infection (n = 289)
General danger signs	11 (92)[c]	67 (34)	6 (30)	6 (13)	7 (33)	3 (7)	10 (33)	75 (26)
Very severe febrile disease	12 (100)	63 (32)	3 (15)	4 (8)	7 (33)	1 (2)	10 (33)	60 (21)
Pneumonia	10 (83)	186 (93)	10 (50)	9 (18)	8 (38)	10 (22)	23 (77)	131 (46)
Severe pneumonia or very severe disease	10 (83)	152 (76)	7 (35)	5 (10)	8 (38)	4 (9)	11 (37)	83 (29)
Pneumonia	0	34 (17)	3 (15)	4 (8)	0	6 (13)	12 (40)	48 (17)
Dysentery	0	4 (2)	0	17 (35)	0	0	1 (3)	0
Severe complicated measles	0	0	0	0	0	0	0	0
Mastoiditis	0	0	1 (5)	0	0	0	0	0
Acute ear infection	0	10 (5)	1 (5)	3 (6)	17 (81)	4 (9)	1 (3)	5 (2)
Total no. of children receiving antibiotics	**12 (100)**	**190 (95)**	**10 (50)**	**23 (48)**	**20 (95)**	**14 (30)**	**25 (83)**	**154 (53)**
Children identified as having only ''very severe febrile disease'' by the fever module	1 (8)	0	0	0	0	0	0	1 (0.003)

[a] Includes 2 with pneumonia and 1 with bacteraemia.

[b] Includes 4 with bacteraemia.

[c] Figures in parentheses are percentages.

Our study suggests that an improved fever module is unlikely to improve the provision of antibiotics to children with bacterial skin infections as such children do not often have fever. Other groups evaluating the IMCI guidelines have indicated the need for a specific module to identify and treat skin infections (*7*).

In this study, the IMCI guidelines were insensitive for diagnosing children with dysentery. The most likely explanation is a cultural difference in the perception of diarrhoeal disease. In both the IMCI algorithm and our standardized questionnaire, the parent was first asked whether the child was having soft, loose or watery stools. If the answer was "yes", the parent was asked if there was blood in the stool. This presupposes a hierarchical way of thinking about diarrhoeal disease; i.e. all soft, loose or watery stools are "diarrhoea" and there are then specific types of diarrhoea. According to a social/anthropological study of cultural perception of diarrhoea in Bangladesh, people view abnormal stools in a categorical way (*8*) and identify four distinct types of diarrhoeal disease in children in this age group: *dud haga* (loose stools attributed exclusively to breastfeeding), *ajirno* (liquid or watery stools), *daeria* (cholera-like stools) and *amasa* (mucous stools). *Rokto amasa* is a subset of *amasa* and means bloody stool. Parents believe children to have one or the other of these types. In our study, many of the parents of children with dysentery came in with a chief complaint of "*amasa*" or "*rokto amasa*", which was translated as "mucous stools". During the standard interview for our study, parents were asked if the child had "*ajirno*" or "*daeria*". If the parents said "no", no question about "*rokto amasa*" was asked and, therefore, a history consistent with dysentery was not ascertained. Further studies are needed to evaluate and possibly improve the ability of the IMCI guidelines to detect dysentery in Bangladesh.

This study differs from previous studies in that it evaluated the IMCI guidelines in both the setting and the analysis. Moreover our study was conducted in an area of low malaria prevalence, which distinguishes it from other evaluations (*7, 9, 10*). Other studies have assessed the sensitivity and specificity of individual modules in identifying specific clinical syndromes (*7, 9, 10*). Our analysis makes evident the conditions under which children with bacterial infections are likely to be classified (or misclassified) and outlines the sensitivity and specificity of various signs and symptoms in identifying children with bacterial infections. We present the overall sensitivity and specificity of the current IMCI guidelines, and the IMCI guidelines with several alternative fever modules in place, for the purpose of evaluating and recommending potential improvements in the guidelines.

Table 4. **Signs and symptoms associated with bacterial infections among study children (aged 2–59 months) evaluated at Dhaka Shishu Hospital, Dhaka, Bangladesh, September 1994–February 1995**

Signs and symptoms	No. of children with reference diagnosis							
	Meningitis (n = 12)[a]	Pneumonia (n = 200)[b]	Bacteraemia (n = 20)	Dysentery (n = 48)	Otitis media (n = 21)	Bacterial skin infection (n = 46)	Urinary tract infection (n = 30)	No bacterial infection (n = 289)
Measured temp. $\geqslant$ 37.5 °C	7 (58)[c]	103 (51)	14 (70)	13 (27)	7 (33)	14 (30)	14 (47)	106 (37)
Feels hot to physician's touch	7 (58)	110 (55)	16 (80)	17 (35)	7 (33)	18 (39)	15 (50)	109 (38)
Fever by parental report	12 (100)	159 (80)	17 (85)	32 (67)	14 (67)	30 (65)	28 (93)	187 (65)
Feels hot to nurse's touch	7 (58)	142 (71)	15 (75)	23 (48)	10 (48)	25 (54)	21 (70)	151 (53)
Fast breathing by parental report	6 (50)	167 (83)	12 (60)	10 (21)	9 (43)	13 (28)	21 (70)	130 (45)
Shaking chills by parental report	1 (8)	34 (21)	4 (24)	5 (15)	3 (20)	6 (19)	3 (11)	22 (12)
Observation								
Abnormally sleepy or difficult to wake	6 (50)	13 (7)	2 (10)	1 (2)	0	0	1 (3)	19 (7)
Restless and irritable, not consolable	0	3 (1)	0	0	0	0	1 (3)	5 (2)
Irritable, consolable	6 (50)	90 (45)	7 (35)	17 (35)	10 (48)	19 (41)	9 (30)	82 (28)
Smiles/not irritable	0	94 (47)	11 (55)	30 (63)	11 (52)	27 (59)	19 (63)	183 (63)
Parental report of fever for more than 3 days and measured axillary temp. of $\geqslant$38 °C	5 (42)	60 (30)	9 (45)	4 (8)	4 (19)	6 (13)	8 (27)	44 (15)
Stiff neck	6 (50)	2 (1)	0	0	0	0	1 (3)	4 (1)

[a] See footnote a, Table 3.

[b] See footnote b, Table 3.

[c] Figures in parentheses are percentages.

Several observations may be useful in considering how to adapt the IMCI guidelines for an area of low malaria prevalence. First, the single case of meningitis identified by the current fever module involved a child who did not have any danger signs but did have a stiff neck. The overall number of children with stiff neck (with or without fever) was small. Second, health workers may not have working thermometers available to them at all times. Fever modules that rely on measured temperature may therefore be impractical. Third, only 15 of 20 (75%) of children with bacteraemia were detected with the most sensitive alternative module.

These observations suggest that the IMCI guidelines could be simplified by removing the fever module in an area of low malaria prevalence and adding stiff neck to the list of danger signs. In our study population, all children with meningitis would have received antibiotics if this change had been in place. Four (1%) children in our population who had no diagnosed bacterial infection would have received antibiotics if stiff neck had been added to the list of danger signs and excess effort to determine whether a child has fever and to evaluate children with fever would be eliminated. Alternatively, the IMCI guidelines could be improved by retaining the fever module but improving the sensitivity of that module by examining the child for a stiff neck and danger signs, as is currently done, and asking parents if their child has an increased respiratory rate. Febrile children with a stiff neck, danger signs or parental report of increased respiratory rate would receive antibiotics. This strategy would maximize the number of children with bacteraemia who are treated with antibiotics.

Our analysis assumes that the provision of antibiotics to children with bacterial infection is critical to saving lives. This is true if the antibiotics provided by IMCI practitioners cover the likely etiological pathogens. We found a great deal of misclassification. For example, 50% of children with bacteraemia and 77% of children with urinary tract infection would be "misclassified" and treated for pneumonia. These misclassifications may lead to cure of infection, however. In this example, the antibiotics provided may be life saving if those that are used to treat pneumonia are also suitable for the treatment of the pathogens that cause bacteraemia and urinary

Table 5. **Sensitivity and specificity of integrated management of childhood illness (IMCI) and alternative algorithms for detection of bacterial infection among 666 children (aged 2–59 months) evaluated at Dhaka Shishu Hospital, Dhaka, Bangladesh, September 1994–February 1995**

Algorithm	Result	No. with bacterial infection (n = 377)	No. with no bacterial infection (n = 289)	Sensitivity (%)	Specificity (%)	No. of cases found
Current algorithm – IMCI guidelines with fever module	Yes No	294 83	154 135	78	47	12/12 meningitis 190/200 pneumonia 10/20 bacteraemia 23/48 dysentery 20/21 otitis media 14/46 local infection 25/30 UTI[a]
Algorithm A – IMCI guidelines with measured axillary temp. of $\geqslant$ 37.5 °C *and* parental perception of increased respiratory rate	Yes No	311 66	168 121	82	42	12/12 meningitis 197/200 pneumonia 15/20 bacteraemia 24/48 dysentery 20/21 otitis media 17/46 local infection 26/30 UTI
Algorithm B – IMCI guidelines with ''feels hot to doctor'', ''feels hot to nurse'' or measured axillary temp. of $\geqslant$ 37.5 °C *and* parental perception of increased respiratory rate	Yes No	314 63	174 115	83	40	12/12 meningitis 197/200 pneumonia 15/20 bacteraemia 25/48 dysentery 20/21 otitis media 19/46 local infection 26/30 UTI
Algorithm C – IMCI guidelines with history of fever, ''feels hot to doctor'', ''feels hot to nurse'' or measured axillary temperature of $\geqslant$ 37.5 °C *and* parental perception of increased respiratory rate	Yes No	317 60	183 106	84	37	12/12 meningitis 198/200 pneumonia 15/20 bacteraemia 26/48 dysentery 20/21 otitis media 20/46 local infection 26/30 UTI
Algorithm D – IMCI guidelines with measured axillary temp. of $\geqslant$38.0 °C	Yes No	316 61	180 109	84	38	12/12 meningitis 197/200 pneumonia 15/20 bacteraemia 27/48 dysentery 20/21 otitis media 19/46 local infection 26/30 UTI
Algorithm E – IMCI guidelines with measured axillary temp. of $\geqslant$ 38.0 °C and parent-reported history of fever for more than 3 days	Yes No	304 73	167 122	81	42	12/12 meningitis 194/200 pneumonia 13/20 bacteraemia 23/48 dysentery 20/21 otitis media 17/46 local infection 25/30 UTI

[a] UTI = urinary tract infection.

tract infections. Such misclassification together with "appropriate treatment" may be the reason why other studies evaluating the impact of a case management strategy for pneumonia found a decrease in overall child mortality in excess of that attributable to pneumonia alone (*11, 12*). However, misclassification may also lead to the use of the wrong antibiotic and inadequate treatment. The IMCI guidelines currently recommend two antibiotic regimens: outpatient (or initial) therapy and inpatient (or more intensive) therapy. The initial therapy is usually directed against *S. pneumoniae* and *H. influenzae*. The range of Gram-negative pathogens we found among bacteraemic children suggests that the initial therapy given may not always be appropriate for the etiologies identified.

This study has several limitations that warrant discussion. Some of these are related to the characteristics of our study population. The data are only available for one region of Bangladesh. Although parental perception of increased respiratory rate was both sensitive and specific in identifying children with severe bacterial infection in this study, the ability to discern increased respiratory rate in a child may be culturally related and therefore may not aid disease detection in other settings. The children in this study presented to an emergency room in an urban area. Children in urban areas may seek care earlier than those in rural areas because of readier access to health care facilities and hence that their spectrum of illnesses may not be representative of children who present in typical rural clinics. There may be a smaller proportion of children with diarrhoea in our study population than in the general population because children with diarrhoeal disease may have been taken preferentially to the International Centre for Diarrhoeal Disease Research, Bangladesh. Finally, attempts to enrich the study population for acute disease may have resulted in the inclusion of more children with respiratory and febrile disease than might be seen in a typical clinic population.

The distribution of blood isolates is not what would be expected given that pneumonia was the most common diagnosis. This could indicate a skewed population or insensitive laboratory methods that lack the ability to detect *H. influenzae* and *S. pneumoniae*. The ratio of severe pneumonia to pneumonia seems high, suggesting either a skewed population or overdiagnosis of chest indrawing.

Other limitations may have resulted from our analytical approach. We did not include pharyngitis as a bacterial infection in our study, although this condition may be a bacterial infection. The sensitivity and specificity of the IMCI guidelines in indicating antibiotics may have been different had we included this diagnosis. In this study, physicians performed the physical examinations. Physicians may be better at discerning signs such as stridor and chest indrawing than are other types of health workers who provide health care according to the IMCI guidelines. For the purposes of our analysis, children were assigned only one diagnosis, although many children had more than one diagnosis recorded by the examining physicians. Many children fulfilled the criteria for several different IMCI classifications. The assignments to multiple classifications may represent misclassifications or may accurately reflect the presence of more than one clinical problem (e.g. a child with pneumonia may also have had otitis media).

Despite these limitations, we believe that the alternatives we have offered to the current IMCI guidelines will improve their sensitivity in identifying children with bacterial infections. The primary focus of IMCI is assuring that children with serious bacterial infections receive potentially life-saving therapy. There is concern that overuse of antibiotics may contribute to the spread of antimicrobial resistance. Our study showed that 53% of the children without a bacterial infection would have received antibiotics according to the current IMCI scheme. The alternative modules proposed would provide antibiotics to an even greater percentage of children without bacterial infections, resulting in even greater overtreatment with antibiotics.

Overtreatment with antibiotics would also occur if these algorithms were used in settings with a lower prevalence of bacterial infections. In the present setting, the positive predictive value of the IMCI algorithm in diagnosing children with bacterial infection and treating them with antibiotics was 66%. The positive predictive value of the other algorithms lay in the range 63–65%. In a population where the prevalence of bacterial infection is much lower, the positive predictive value would fall and the proportion of children treated with unnecessary antibiotics would rise. However, data from other developing countries have suggested that there is currently widespread overuse of antibiotics in the treatment of children with upper respiratory infections (*13*). By systematizing an approach to diagnosis, the IMCI scheme is likely to decrease overall antibiotic use in these children.

Correct identification of the need for antibiotics in young children can be life saving. This study demonstrates that when applied in an area of low malaria prevalence, the IMCI scheme provides antibiotics to the majority of children with bacterial infections, but bacteraemia and bacterial skin infections are frequently missed. The performance of the scheme for detecting dysentery should be subjected to further research. This study suggests that further improvements are possible. These data are only available for one region of Bangladesh and additional studies are required before adapted guidelines could be applied at a national level in Bangladesh or in other countries. ■

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Résumé

Diagnostic et prise en charge des enfants fiévreux à Dhaka (Bangladesh) suivant les directives OMS/UNICEF pour la prise en charge intégrée des maladies de l'enfant

Objectif Déterminer si le module Fièvre des directives OMS/UNICEF pour la prise en charge intégrée des maladies de l'enfant (PCIME) permet de reconnaître les enfants atteints d'infections bactériennes dans une région de faible prévalence du paludisme.

Méthodes Des médecins ont évalué un échantillon systématique de 669 enfants malades âgés de 2 à 59 mois vus dans le service des consultations externes du Dhaka Shishu Hospital au Bangladesh.

Résultats Si les directives PCIME avaient été utilisées pour évaluer les enfants, 78 % de ceux qui étaient atteints d'infections bactériennes auraient reçu des antibiotiques : la plupart des enfants atteints de méningite (100 %), de pneumonie (95 %), d'otite moyenne (95 %) et d'infections urinaires (83 %), et au maximum la moitié des enfants atteints de bactériémie (50 %), de dysenterie (48 %) et d'infections cutanées (30 %). L'actuel module Fièvre n'a identifié qu'un cas supplémentaire de méningite. Les enfants bactériémiques étaient davantage susceptibles d'être fiévreux, chauds et d'avoir des antécédents de fièvre que ceux qui souffraient de dysenterie et d'infections cutanées. La présence de fièvre associée à l'impression de respiration rapide signalée par les parents constituait un critère plus sensible que l'actuel module Fièvre des directives PCIME pour détecter une bactériémie.

Conclusion Dans une zone de faible prévalence du paludisme, les directives PCIME traitent par des antibiotiques la plupart des enfants atteints d'infections bactériennes, mais des améliorations du module Fièvre sont possibles.

Resumen

Diagnóstico y tratamiento de los niños febriles en Dhaka (Bangladesh) mediante las directrices OMS/UNICEF para el tratamiento integrado de las enfermedades de la infancia

Objetivo Determinar si el módulo Fiebre de las directrices OMS/UNICEF para la atención integrada a las enfermedades prevalentes de la infancia (AIEPI) identifica a los niños que presentan infecciones bacterianas en una zona de baja prevalencia de paludismo.

Métodos Los médicos evaluaron una muestra sistemática de 669 niños enfermos de 2 a 59 meses que acudieron al ambulatorio del Hospital de Dhaka Shishu en Bangladesh.

Resultados Si se hubieran seguido las directrices de la AIEPI para evaluar a los niños, habría recibido antibióticos el 78% de quienes padecían infecciones bacterianas: la mayoría de los niños con meningitis (100%), neumonía (95%), otitis media (95%) e infecciones de las vías urinarias (83%); y el 50% o menos de los niños con bacteriemia (50%), disentería (48%) e infecciones cutáneas (30%). El actual módulo Fiebre identificó sólo un caso adicional de meningitis. En comparación con los que padecían disentería o infecciones cutáneas, entre los niños con bacteriemia eran más frecuentes la febrilidad, la sensación de calor y los antecedentes de fiebre. La combinación de fiebre y percepción parental de respiración rápida resultó ser un criterio más sensible que el actual módulo de la AIEPI para detectar los casos de bacteriemia.

Conclusión En una zona de baja prevalencia de paludismo, las directrices de la AIEPI prevén el suministro de antibióticos a la mayoría de los niños con infecciones bacterianas, pero es posible introducir mejoras en el módulo Fiebre.

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