Evaluation of an algorithm for the integrated management of childhood illness in an area with seasonal malaria in the Gambia

M.W. Weber,[1,2] E.K. Mulholland,[1] S. Jaffar,[1] H. Troedsson,[3] S. Gove,[3] & B.M. Greenwood[1]

Most of the 12.4 million deaths occurring every year among under-5-year-olds in developing countries could be prevented by the application of simple treatment strategies. So that health professionals who have had limited training can identify and classify the common childhood diseases, WHO developed a treatment algorithm (the Integrated Management of Childhood Illness (IMCI) or Sick Child algorithm), a prototype of which was tested in 440 Gambian children aged between 2 months and 5 years. The children were first assessed by a trained field worker using the algorithm, and then by a paediatrician whose clinical diagnosis was supported by laboratory investigations and, when indicated, a chest X-ray.

Compared with the paediatrician's diagnosis, the sensitivity and specificity of the draft IMCI algorithm were, respectively, 81% and 89% for the detection of pneumonia, 67% and 96% for dehydration, 87% and 8% for malaria parasitaemia (any level), 100% and 9% for malaria parasitaemia (above 5000 parasites/μl), 100% and 99% for measles, 31% and 97% for otitis media, and 89% and 90% for malnutrition. Among the children admitted by the physician, 45% had been recommended for admission by the algorithm. Intermittent fever, chills and sweats did not help in discriminating between malaria and non-malarious fevers; shivering or shaking of the body had a sensitivity of only 35%. While the algorithm dealt with the majority of presenting complaints, the most common problems not addressed by the chart were skin rashes (21%), mouth problems (8%), and eye problems (6%).

The draft IMCI algorithm proved to be effective in the diagnosis of pneumonia, gastroenteritis, measles and malnutrition, but not malaria where its use without microscopy would result in considerable over-treatment, especially in a low transmission area or during a low transmission season in countries with seasonal malaria. The current algorithm would benefit from expansion to cover management of localized infections as well as skin, mouth and eye problems.

Introduction

About 12.4 million children under the age of 5 years die every year in developing countries (*1*). The main causes of death, after the neonatal period, are respiratory infections, diarrhoea, measles, malaria and malnutrition (*2–6*). Some of the potentially fatal acute infectious diseases of childhood, such as measles, can be prevented by immunization, and it is estimated that the Expanded Programme on Immunization (EPI) currently prevents about 2 million deaths in children each year (*7*). However, prevention of death from many other common childhood infections can be achieved only by effective case management, which depends upon an accurate diagnosis by staff who, in most parts of the developing world, have had only limited training. For this reason, protocols for the management of diarrhoea and acute respiratory tract infections have been developed by WHO to help peripheral health care workers in the diagnosis and management of these conditions (*8*, *9*).

Recently there has been increasing realization that many children present with more than one condition, and that there are major overlaps in the presenting symptoms and signs of several common infectious diseases of childhood, such as malaria and pneumonia (*10*). Therefore, there is a danger that children who appear in a primary health care facility may be assigned to an incorrect disease-specific management protocol, with potentially disastrous consequences. Thus, efforts have been made by WHO, UNICEF and others to devise an integrated management protocol covering all common and potentially

[1] Medical Research Council Laboratories, PO Box 273, Fajara, Banjul, Gambia. Requests for reprints to Dr M. W. Weber at this address.

[2] Children's Hospital, Hanover Medical School, Hanover, Germany.

[3] Division of Diarrhoeal and Acute Respiratory Disease Control, World Health Organization, Geneva, Switzerland.

Reprint No. **5817**

life-threatening diseases in children in developing countries, which can be used effectively by peripheral health care staff with limited training. This collective effort is known as Integrated Management of Childhood Illness (IMCI), often referred to as the Sick Child Initiative (*8*, *9*), the success of which could have a major impact on mortality in children throughout the developing world.

One consequence of this initiative is a prototype IMCI algorithm, which has been evaluated in Gambian children aged between 2 months and 5 years. The results are described in this article.

Materials and methods

Patients

The study was performed at the outpatient department of the Medical Research Council (MRC) Laboratories in Fajara, Gambia, between May 1993 and April 1994. The Gambia has two distinct seasons, a dry season from December to June, and a rainy season from July to November. Cases of malaria occur throughout the year but the intensity of transmission is highest between the months of August and December. Approximately 200 unreferred patients, mainly from the neighbouring peri-urban area, are seen at the MRC clinic daily.

For the first 2 months of the study, the first seven children between 2 months and 5 years of age who presented at the MRC clinic were enrolled each day from Monday to Friday. For the remaining 10 months of the study, enrolment was once a week. After children had been registered and weighed, the mothers were questioned specifically about their children's complaints. A standardized examination using the algorithm was performed by a field assistant and documented in a standardized fashion. The child was then seen by the study paediatrician, who took a history and performed a clinical examination without referring to the field assistant's findings and made a provisional clinical diagnosis. Subsequently the temperature, arterial haemoglobin oxygen saturation, heart rate, a blood film for malaria parasites and haemoglobin concentration were obtained. A chest radiograph was recorded if the respiratory rate, counted by either the field assistant or the physician, was $\geq$40 for children >1 year of age, or $\geq$50 for infants under 1 year of age, or if there was any abnormal physical sign on examination of the chest. After these investigations had been evaluated, the paediatrician revised his diagnosis and examined the field assistant's form for discrepancies with his own findings. Each child received treatment according to standard medical practice; those in need of admission were admitted to the MRC hospital. Children not admitted were asked to return for follow-up after 1 week.

The IMCI algorithm

The IMCI algorithm is a simplified system of diagnosis and treatment that is designed for use by health workers with limited training. Each child is evaluated in the following manner. First, enquiries are made about danger signs such as inability to drink, convulsions or abnormal sleepiness. A positive response to any of these questions leads to referral to the next level of health care. Four key questions are then asked to determine whether the child has cough, diarrhoea, fever or an ear problem. If cough is reported, the presence of a significant lower respiratory tract infection is sought by counting the respiratory rate and looking for lower chest wall indrawing. If diarrhoea is reported, the presence of dehydration is sought by looking for six signs of dehydration. Persistent diarrhoea and dysentery are diagnosed by a history of diarrhoea for more than 14 days or diarrhoea with blood, respectively. In children with fever, malaria, meningitis and measles are considered by looking for key symptoms and signs. Children with an ear problem are examined for discharge or mastoiditis. Finally, all children are assessed for malnutrition and their immunization status is reviewed.

At the end of the procedure, children with the following conditions are referred to the next higher level of care: presence of any danger sign, severe pneumonia, severe dehydration (if not corrected immediately), persistent diarrhoea with dehydration, signs of cerebral malaria or meningitis, mastoiditis, and severe malnutrition. Children not referred are treated according to their diagnosis. The treatment options of the algorithm were not evaluated in the present study, except for referral of children for admission to hospital.

Malaria symptoms and assessment of temperature and pallor

A history of intermittent fever, chills, sweats or shaking of the body was sought from the carers of children with fever to evaluate the usefulness of these symptoms in the detection of malaria. To measure pyrexia, both the field worker and the physician laid a hand on the child's abdomen and recorded whether or not it felt "hot"; their findings were compared with the rectal temperature which was measured using a digital thermometer. Pallor of the conjunctiva, tongue, palms and nailbed was graded as none, mild, moderate or severe. These assessments were compared with

the haemoglobin concentration (Hb) measured colorimetrically (HemoCue AB, Aengelholm, Sweden).

Definitions

The following clinical definitions were used in the evaluation of the IMCI algorithm.

Pneumonia — paediatrician's diagnosis based on the review of a chest radiograph and the physical findings.

Malaria — fever or history of fever together with a parasite count of *Plasmodium falciparum* of $\geq$5000/µl.

Measles — clinical diagnosis by the paediatrician.

Gastroenteritis — a history of diarrhoea given by the carer.

Dehydration — detection of any degree of clinical dehydration by the paediatrician.

Dysentery — a history of diarrhoea with blood given by the carer.

Otitis media — a red inflamed eardrum on otoscopy.

Malnutrition — weight-for-age below 80% of the NCHS standard or the presence of oedema in the absence of heart failure or proteinuria.

Anaemia — a haemoglobin concentration of less than 10g/dl.

Grounds for admission were a need for specialized nursing skills (e.g. feeding by nasogastric tube, intravenous fluids, oxygen therapy), frequent reassessment (e.g. management of severe dehydration or convulsions), or treatment with an injectable drug (e.g. crystalline penicillin for lobar pneumonia).

Ethical issues

The study was approved by the Gambian Government/MRC Laboratories and WHO Ethical Committees. Verbal consent was obtained from the carer of each child on enrolment. All treatments given corresponded to the best medical care available in the Gambia.

Statistical analysis

The findings of the field worker using the IMCI algorithm were compared with those of the paediatrician using the definitions given above as the standard. Sensitivity and specificity of individual clinical signs, and for the diagnostic categories given by the algorithm, were calculated using this standard. Frequencies were compared using the χ^2 test or Fisher's exact test as appropriate. Normally distributed continuous variables were compared between groups using Student's *t*-test, while those which were not normally distributed were compared using the Wilcoxon rank sum test.

The predictors of malaria were assessed using multiple logistic regression models. First, univariate logistic regression was fitted to find the most influential variable. This was entered into the model and each remaining variable was added to find the next most influential variable. This was continued until no further variables reached statistical significance. Then, from the final model, each variable was omitted one by one to determine whether it was still significant in the presence of the other terms. Models were compared between one another using the likelihood ratio test. Analyses were performed using the SPSS for Windows, SAS for Windows, and Epi-Info software packages.

Results

A total of 440 children were assessed — 210 (48%) girls and 230 (52%) boys, with a median age of 14.5 months (range, 2 to 58 months); 347 (79%) were seen from January to July, and 93 (21%) from August to December (malaria season). The most commonly volunteered complaints were fever (66%), cough (36%), diarrhoea (29%), chest pain (28%), vomiting (24%), skin problems (15%), abdominal pain (13%), difficulties in feeding (8%), headache (5%), and eye problems (5%). On direct questioning, the following symptoms were stated by the carer to be present: inability to drink (1, 0.2%), history of convulsion (14, 3%), sleepiness or difficulty in waking up the child (1, 0.2%), cough (360, 82%), diarrhoea (198, 45%), fever (407, 93%), and an ear problem (33, 8%).

Final diagnoses according to the IMCI algorithm, with which more than one diagnosis could be made, were pneumonia (110, 25%), acute diarrhoea (180, 41%), persistent diarrhoea (18, 4%), dehydration (23, 5%), malaria (404, 92%), measles (8, 2%), and malnutrition (152, 35%). Final diagnoses made by the paediatrician were upper respiratory tract infection (126, 29%), anaemia (121, 28%), gastroenteritis (109, 25%), pneumonia (72, 16%), otitis media (53, 12%), skin infection (52, 12%), malarial parasitaemia (positive blood film) (31, 7%), and scabies (21, 5%). A total of 79 children were admitted to the ward for inpatient care. Three children died: one with congenital heart disease, one with human immunodeficiency virus (HIV) infection, and one with gastroenteritis and dehydration. Another child died from septicaemia

Table 1: **Numbers of children with a particular diagnosis made by a physician and by a field worker according to the IMCI algorithm. Sensitivities and specificities are calculated using the physician's diagnosis made with the help of laboratory investigations as "gold" standard**

	No. positive by fieldworker/ No. positive by physician	No. negative by fieldworker/ No. negative by physician	Sensitivity (%)	Specificity (%)
Pneumonia	67/83	318/357	81	89
Dehydration	8/12	413/428	67	96
Parasitaemia	27/31	32/409	87	8
Malaria	17/17	36/423	100	9
Measles	4/4	432/436	100	99
Otitis	16/53	374/387	30	97
Malnutrition	111/124	285/316	89	90
Referral or admission	36/79	335/361	45	93

one week after having been assessed. Two children were referred to the government hospital for transfusion. During the dry season, 4.3% of all children seen had a positive blood film for *P. falciparum* and 1.7% had a parasitaemia of >5000/μl, a threshold usually associated with symptoms in Gambian children. From August to December, however, 17% had a positive blood film and 12% a parasitaemia of above 5000/μl.

Concordance of physician's and field worker's diagnoses

Table 1 shows the number of diagnoses made in each of the categories by the physician and the field worker. While 61 children were referred according to the IMCI algorithm, 79 were actually admitted by the physician. The proportions of children admitted who were referred with a particular sign and the frequency of those signs are shown in Table 2. The principal diagnoses for all three possible combinations for referral, i.e. referred by both physician and field worker or referred by only one of the two, are shown in Table 3. The signs and symptoms of children who were referred by the algorithm but who were not admitted by the physician were as follows: chest wall indrawing (12 children); a history of convulsion (4); severe wasting and oedema (2 each); and inability to drink, abnormal sleepiness, repeated vomiting, mouth ulcers, and severe pallor (1 each).

Assessment of temperature and pallor

Fig. 1 shows the impression of the physician and field worker as to whether a child felt hot to touch. Detec-

Table 2: **Number of sick children, according to a sign or symptom, for referral to a higher level of care by the IMCI algorithm, the number of those referred who were actually admitted by the physician, and the percentage of children admitted by the physician**

	No. referred by the algorithm	No. admitted by the physician	% admitted by the physician/ referred by the algorithm
All referrals	61	36	59
Inability to drink	1	0	0
History of convulsions	14	10	71
Abnormally sleepy	1	0	0
Pneumonia	38	22	58
Dehydration	5	3	60
Fever	3	2	67
Malnutrition	16	12	75

Table 3: **Primary diagnosis of children referred by algorithm and/or by the physician**

Referred by *both* algorithm *and* the physician:		Referred by algorithm but *not* by the physician:		*Not* referred by algorithm but admitted by the physician:	
Diagnosis	*n*	Diagnosis	*n*	Diagnosis	*n*
Pneumonia	18	URTI[a]	8	Pneumonia	19
Malnutrition	5	Gastroenteritis	3	Gastroenteritis	8
Bronchiolitis	4	Asthma	3	Sepsis/PUO[a]	4
Gastroenteritis	4	Malnutrition	3	Osteomyelitis/ septic arthritis	3
Sepsis	2	Bronchiolitis	2	Cellulitis	3
Osteomyelitis	1	Upper airway obstruction	2	Malaria	3
Malaria	1	Malaria	1	Malnutrition	1
Anaemia	1	Anaemia	1	Intestinal obstruction	1
—		Measles	1	Congenital heart disease	1
—		Normal	1	—	
Total	36	Total	25	Total	43

[a] URTI: upper respiratory tract infection. PUO: pyrexia of unknown origin.

tion of a 'hot' child by the physician had a sensitivity of 79% and a specificity of 75% for detection of a temperature ≥38 °C, whereas the field worker had a sensitivity of 65% and a specificity of 67%. The distribution of palmar and conjunctival pallor in relation to Hb is shown in Fig. 2. Only two children had an Hb <4 g/l. One was rated 'severe pallor' at all sites by both field worker and physician. The other had an assessment of moderate pallor of the palms and mild pallor of the conjunctiva. A total of nine children had an Hb <6 g/l.

Fig. 1. **Feeling hot to touch: physician's and field worker's impressions when touching the abdominal skin compared with the measured temperature in steps of 0.5 °C.**

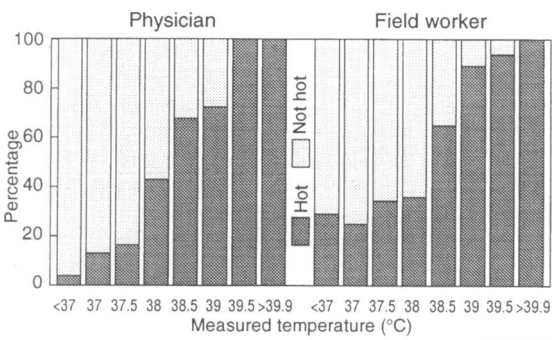
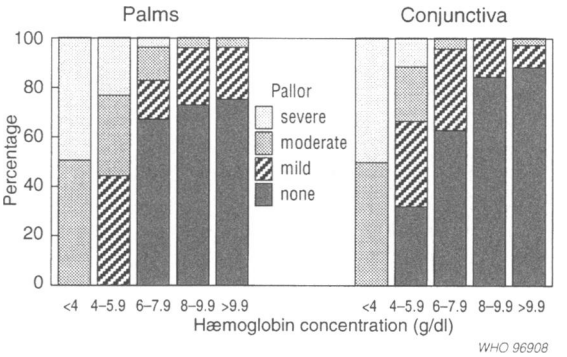


Fig. 2. **Pallor of palms and conjunctiva, classified as none, mild, moderate or severe, compared with the measured haemoglobin concentration.**



Predictive signs for malaria

The prevalence of a history of intermittent fever, chills, sweats, or shaking in children with a history of fever is shown in Table 4. Patients without intermittent fever were more likely to have a positive blood film or clinical malaria than those with this symptom. Associations with chills and sweats were not statistically significant; shaking significantly predicted clinical malaria, but the sensitivity was only 35%.

Among the study children, the effects of age, temperature, splenomegaly, pallor of the conjunc-

Table 4: **Prevalence of a history of intermittent fever, chills, sweats, and shaking of the body in children with positive and negative blood films for malaria and in children with a parasitaemia >5000/μl**

	Parasitaemia (any level)			Parasitaemia (>5000/μl)		
	Positive	Negative	*P*-value	Positive	Negative	*P*-value
Intermittent fever	20/28	339/379	0.01	9/17	350/390	<0.0001
Chills	9/28	97/379	0.44	5/17	101/390	0.75
Sweats	16/28	263/379	0.18	12/17	267/390	0.85
Shaking	6/28	55/379	0.30	6/17	56/390	0.019
Chills, sweats *or* shaking	25/27	307/380	0.20	16/17	316/390	0.33

tiva, respiratory rate, history of cough, history of diarrhoea and nasal discharge were assessed as predictors of malaria using multiple logistic regression. Age, splenomegaly, pallor of the conjunctiva and respiratory rate were all associated significantly with malaria, whereas a history of cough, diarrhoea and nasal discharge were not ($P > 0.1$ in each case). Temperature was significant only in a model without respiratory rate. The adjusted odds ratio of splenomegaly was 5.9 (95% confidence interval (CI) = 2.3–15.2; $P = 0.0004$) for a positive blood film and 3.3 (95% CI = 0.95–11.7; $P = 0.07$) for clinical malaria. Mild pallor had an adjusted odds ratio of 3.2 (95% CI = 1.2–8.5; $P = 0.0001$) for parasitaemia and 4.2 (95% CI = 1.2–15.3; $P = 0.001$) for clinical malaria; severe pallor had an adjusted odds ratio of 26.5 (95% CI = 5.5–128) and 23.8 (95% CI = 4.2–137) for parasitaemia and clinical malaria, respectively. The logarithm of the odds of a positive blood film and clinical malaria increased at a rate of 0.055 (95% CI = 0.025, 0.086) and 0.067 (95% CI = 0.026, 0.11) per month increase in age, respectively. Thus the respective odds ratios are 1.74 and 1.95 for a 1-year-old child and 3.39 and 4.34 for a 2-year-old relative to a 2-month-old child. In the case of temperature, the logarithm of the odds of a positive blood film and of malaria increased at a rate of 0.46 (95% CI = 0.034, 0.90) and 0.95 (95% CI = 0.39, 1.52) per °C, respectively. Thus the respective odds ratios are 1.59 and 2.59 for a temperature of 38.5°C and 2.53 and 6.73 for a temperature of 39.5°C relative to a temperature of 37.5°C.

A measured temperature above 38°C and/or a palpable spleen and/or moderate to severe pallor had a sensitivity for the presence of parasitaemia of 77% and a specificity of 51%, whereas for malaria, the sensitivity of this combination was 88% and the specificity 51%. In both cases, the sensitivity decreased with age, but the specificity increased.

Problems not addressed by the IMCI algorithm

Presenting problems not addressed directly by the IMCI algorithm included: vomiting (28%), poor feeding (25%), skin rashes or sores (21%), abdominal pain (15%), sore mouth (8%), and eye problems (6%). Final diagnoses not made with the IMCI algorithm included skin infection (12%), scabies (5%), mouth problems (thrush or sores) (4%), and abscess (3%). Serious conditions not covered by the IMCI algorithm, which led to admission, were osteomyelitis/septic arthritis in 3 children and cellulitis in a further 3 children.

Discussion

Most of the problems presented by the mothers or carers of sick children at the Gambian general clinic were addressed by the IMCI algorithm. The main problems not covered were localized infections and skin, eye and mouth complaints. Future versions of the chart may require modification to take into account these common presenting complaints. Comparison of the field workers' diagnoses using the algorithm with those of a paediatrician supported by laboratory and radiological investigations gave acceptable levels of sensitivity and specificity for the diagnosis of pneumonia, dehydration, measles and malnutrition, in keeping with the results of previous studies on the use of simple algorithms in the diagnosis of pneumonia (*11*, *12*). Diagnosis of otitis media was missed by field workers in a substantial proportion of children with this condition as might have been anticipated, since otoscopy is not included as a component of the IMCI algorithm. Mastoiditis was diagnosed by the field workers in two children who had an abscess behind the ear.

The main failure of the algorithm was in the diagnosis of malaria, which was based on a history of

fever. The specificity of fever in the diagnosis of malaria was only 9%, so that reliance on this symptom to diagnose malaria would have led to massive overtreatment with antimalarials, especially in the low transmission dry season, as has been noted from other countries with a similar transmission pattern of malaria (*13*, *14*). When chloroquine, a cheap and safe antimalarial, could be used confidently to treat malaria, overtreatment of malaria was less of a concern than is now the case when more expensive and potentially more toxic antimalarials must be used as first-time treatment in many malaria-endemic areas. Several attempts have been made to improve the specificity of the diagnosis of malaria by peripheral health workers by using additional symptoms and signs, in addition to that of fever. In the present study, a history of chills or sweats proved of no value to discriminate between children with malaria and nonmalaria fevers, while shaking of the body was significant for clinical malaria, but had a low sensitivity, and intermittent fever was inversely related with the presence of malaria, in contrast to findings from the Philippines and the United Republic of Tanzania (*15*, *16*). Whether there is an appropriate local word to describe rigors is likely to be an important factor in determining the diagnostic usefulness of these symptoms.

The clinical signs which had the strongest predictive value for malaria were pallor, a raised respiratory rate and splenomegaly, the latter being a better predictor of parasitaemia than clinical malaria. Both field workers and the study physician did reasonably well in predicting anaemia and pyrexia on clinical examination. Only a few children with severe anaemia were available for evaluation. As noted previously (*10*), many children with malaria had a raised respiratory rate. Because of the difficulty of diagnosing malaria on the basis of signs and symptoms alone, microscopy should be used whenever possible. In situations where microscopy is not available, a simple antigen detection test, such as a dipstick, might prove useful in a primary care setting (*17*), provided that the cost is in the same range as that of treatment. No patient with meningitis or mastoiditis was seen, and only few children had measles and severe anaemia. The assessment of signs for these diagnoses is therefore limited. However, it is noteworthy that, using the algorithm, the field workers picked up all cases of measles.

Evaluation of the treatment modules included in the IMCI algorithm was not part of the present study, but a comparison was made between the recommendations for hospital admission advocated by the algorithm with the actual practice of the study paediatrician. More children were admitted by the paediatrician than would have been the case had the algorithm alone been followed. The biggest discrepancy lay in admissions for pneumonia. Some of the children with pneumonia admitted by the physician could have been managed as outpatients, although their recovery might have been delayed. Six children with cellulitis, septic arthritis and osteomyelitis required admission; their symptoms and signs would be addressed only under the heading of "Other problems" in the IMCI algorithm. Together with skin infections and abscesses, mouth problems and conjunctivitis, these could form another category of "local infections", which could be added to the chart as a separate module. Since all these conditions are clearly visible to the patients, they can judge the success of the treatment themselves. Failure of the algorithm to deal satisfactorily with these obvious conditions could interfere with its acceptance by patients and clinical staff.

During this first clinical assessment, the IMCI algorithm performed well in most areas. Even in its present form its use would probably improve standards of management of sick children in many peripheral health clinics in developing countries. However, to achieve a greater impact, further work is needed to refine some of the modules.

Acknowledgement

We thank Mariama Madi and Fatou Bah for performing the assessments with the IMCI algorithm, Kebba Jobe for helping in the evaluation of the patients, and the nursing staff and physicians of the MRC ward for taking care of the study's inpatients.

This study was supported by the WHO Programme for the Control of Acute Respiratory Infections.

Résumé

Evaluation d'un algorithme pour la prise en charge intégrée des maladies de l'enfant dans un secteur à paludisme saisonnier en Gambie

La plupart des 12,4 millions de décès qui surviennent chaque année chez les moins de 5 ans dans les pays en développement pourraient être évités grâce à des stratégies simples de traitement. Afin que les personnels de santé qui ont une formation limitée puissent identifier et classer les maladies infantiles fréquentes, l'OMS a mis au point un algorithme de traitement (algorithme pour le traitement de l'enfant malade), dont un prototype a été testé chez 440 enfants gambiens de 2 mois à 5 ans. Les enfants ont tout d'abord été examinés au moyen de l'algorithme par l'agent de santé formé,

puis par un pédiatre dont le diagnostic clinique s'est appuyé sur des analyses de laboratoire, et le cas échéant sur une radiographie thoracique.

Comparées au diagnostic du pédiatre, la sensibilité et la spécificité de l'algorithme étaient respectivement de 81% et 89% pour le dépistage des pneumopathies, 67% et 96% pour la déshydratation, 87% et 8% pour la parasitémie palustre (quel que soit son degré), 100% et 9% pour la parasitémie palustre au dessus de 5000 parasites/µl, 100% et 99% pour la rougeole, 31% et 97% pour l'otite moyenne, et 89% et 90% pour la malnutrition. Parmi les enfants hospitalisés par le médecin, 45% avaient fait l'objet d'une recommandation d'admission par l'algorithme. La fièvre intermittente, les frissons et les sueurs n'ont pas permis de distinguer les fièvres palustres des autres fièvres; le tremblement, même important, n'avait une sensibilité que de 35%. Si la plupart des signes d'appel étaient envisagés par l'algorithme, restaient des problèmes exclus par le tableau, et parmi les plus fréquents les rashs cutanés (21%), les affections de la bouche (8%) et des yeux (6%).

L'algorithme pour le traitement de l'enfant malade s'est montré efficace pour le diagnostic des pneumopathies, de la gastroentérite, de la rougeole et de la malnutrition, mais pas du paludisme; l'utilisation de l'algorithme sans recourir à l'examen microscopique entraînerait un surtraitement considérable, soit dans les secteurs à faible transmission, soit en dehors du pic saisonnier dans les pays à saisonnalité palustre. L'algorithme actuel gagnerait à être étendu pour couvrir la prise en charge des infections localisées et des affections de la peau, de la bouche et des yeux.

References

1. **The World Bank.** *World development report 1993.* New York, Oxford University Press, 1993.
2. **Garenne M, Ronsmans C, Campbell H.** The magnitude of mortality from acute respiratory infections in children under 5 years in developing countries. *World health statistics quarterly*, 1992, **45**: 180–191.
3. **Snyder JD, Merson MH.** The magnitude of the global problem of acute diarrhoeal disease: a review of active surveillance data. *Bulletin of the World Health Organization*, 1982, **60**: 605–613.
4. **Bern C et al.** The magnitude of the global problem of diarrhoeal disease: a ten-year update. *Bulletin of the World Health Organization*, 1992, **70**: 705–714.
5. **Orenstein WA et al.** Worldwide measles prevention. *Israel journal of medical science*, 1994, **30**: 469–481.
6. **De Onis M et al.** The worldwide magnitude of protein-energy malnutrition: an overview from the WHO Global Database on Child Growth. *Bulletin of the World Health Organization*, 1993, **71**: 703–712.
7. **Henderson RH.** Vaccinations in the health strategies of developing countries. *Scandinavian journal of infectious diseases* (Suppl.), 1990, **76**: 7–14.
8. *WHO Programme for control of diarrhoeal diseases. Ninth programme report 1992–1993.* Unpublished report WHO/CDD/94.46, 1994 (available upon request from Division of Child Health and Development, World Health Organization, 1211 Geneva 27, Switzerland).
9. *WHO Programme for control of acute respiratory infections. Sixth programme report 1992–1993.* Unpublished report WHO/ARI/94/33, 1994 (available upon request from Division of Child Health and Development, World Health Organization, 1211 Geneva 27, Switzerland).
10. **O'Dempsey TJD et al.** Overlap in the clinical features of pneumonia and malaria in African children. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 1993, **87**: 662–665.
11. **Simoes EA, McGrath EJ.** Recognition of pneumonia by primary health care workers in Swaziland with a simple clinical algorithm. *Lancet*, 1992, **340**: 1502–1503.
12. **Mulholland EK et al.** Standardized diagnosis of pneumonia in developing countries. *Pediatric infectious diseases journal*, 1992, **11**: 77–81.
13. **Rougemont A et al.** Epidemiological basis for clinical diagnosis of childhood malaria in endemic zone in West Africa. *Lancet*, 1991, **338**: 1292–1295.
14. **Olivar M et al.** Presumptive diagnosis of malaria results in significant risk of mistreatment of children in urban Sahel. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 1991, **85**: 729–730.
15. **Gomes M et al.** Symptomatic identification of malaria in the home and in the primary health care clinic. *Bulletin of the World Health Organization*, 1994, **72**: 383–390.
16. **Rooth I, Bjorkman A.** Fever episodes in a holoendemic malaria area of Tanzania: parasitological and clinical findings and diagnostic aspects related to malaria. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 1992, **86**: 479–482.
17. **Beadle C et al.** Diagnosis of malaria by detection of *Plasmodium falciparum* HRP-2 antigen with a rapid dipstick antigen-capture assay. *Lancet*, 1994, **343**: 564–568.