Adding fever to WHO criteria for diagnosing pneumonia enhances the ability to identify pneumonia cases among wheezing children

Maria-Regina A Cardoso,1 Cristiana M Nascimento-Carvalho,2 Fernando Ferrero,3 Fátima M Alves,4 Simon N Cousens5

Abstract

Objective To examine the ability of the criteria proposed by the WHO to identify pneumonia among cases presenting with wheezing and the extent to which adding fever to the criteria alters their performance.

Design Prospective classification of 390 children aged 2–59 months with lower respiratory tract disease into five diagnostic categories, including pneumonia. WHO criteria for the identification of pneumonia and a set of such criteria modified by adding fever were compared with radiographically diagnosed pneumonia as the gold standard.

Results The sensitivity of the WHO criteria was 94% for children aged <24 months and 62% for those aged ≥24 months. The corresponding specificities were 20% and 16%. Adding fever to the WHO criteria improved specificity substantially (to 44% and 50%, respectively). The specificity of the WHO criteria was poor for children with wheezing (12%). Adding fever improved this substantially (to 42%). The addition of fever to the criteria apparently reduced their sensitivity only marginally (to 92% and 57%, respectively, in the two age groups).

Conclusion The authors’ results re affirm that the current WHO criteria can detect pneumonia with high sensitivity, particularly among younger children. They present evidence that the ability of these criteria to distinguish between children with pneumonia and those with wheezing diseases might be greatly enhanced by the addition of fever.

Pneumonia is still a leading disease in childhood in developing countries.1 2 The WHO has developed guidelines, based on simple clinical signs, for the identification and treatment of pneumonia in developing countries.3 4 Despite widespread recognition that the WHO case management strategy has helped to reduce mortality,5 there is concern that children with non-severe pneumonia are still receiving antibiotics unnecessarily. Studies have reported a lot of antibiotic treatment failure for pneumonia in children with wheezing.6 7 suggesting they constitute a special group requiring a separate management algorithm.7 8

We examined the ability of the WHO criteria to identify pneumonia among cases presenting with wheezing and how adding fever to these criteria altered their performance.

Patients and methods

We analysed data from a prospective study on children living in São Paulo, Brazil. Details of the clinical data have already been published.9

What is already known on this topic

» WHO criteria to diagnose pneumonia in children (cough or difficulty breathing plus tachypnoea) are sensitive to identify pneumonia among children with acute respiratory infection, particularly those with upper respiratory infection.

» The same WHO criteria are not sensitive to identify pneumonia among children with acute respiratory infection and wheeze.

What this study adds

The addition of fever to such WHO criteria greatly enhances their ability to identify pneumonia among children presenting with wheezing.

Study population and diagnostic definitions

Children aged between 2 and 59 months presenting to the paediatric emergency departments of five public hospitals in a 15-month period were screened by a paediatrician upon arrival. Children with acute lower respiratory tract disease (LRTD) (wheezing, rales, tachypnoea, and/or dyspnoea were considered to be signs of LRTD) whose parents gave informed consent, were recruited into the study, excluding those with: recent history of aspiration (liquid or foreign body); tuberculosis; measles; pertussis; congenital, inherited, neurological, neuromuscular or immunological diseases; cancer; or gastrooesophageal reflux.

LRTDs were classified as follows:

» Pneumonia: pulmonary infiltrate on chest x-ray (CXR) plus history and clinical findings of fever and/or respiratory complaints

» Acute bronchitis: cough and sputum after an upper respiratory tract infection (UTI) of less than 3 weeks’ duration, without wheezing and no previous diagnosis of asthma

» Acute bronchiolitis: cough, breathlessness, tachypnoea, wheezing, crepitations and pulmonary hyperinflation on CXR, following URTI in children aged <2 years

1 Department of Epidemiology, Faculty of Public Health, University of São Paulo, São Paulo, Brazil
2 Department of Paediatrics, Federal University of Bahia School of Medicine, Salvador, Brazil
3 Hospital de Niños Elizalde, Buenos Aires, Argentina
4 Secretariat of Health of the State of São Paulo, São Paulo, Brazil
5 Infectious Disease Epidemiology Unit, London School of Hygiene and Tropical Medicine, London, UK

Correspondence to
Professor Maria-Regina A Cardoso, Department of Epidemiology, Faculty of Public Health, University of São Paulo, Av. Dr. Arnaldo 715, São Paulo 01246-904, Brazil; rcardoso@usp.br

Accepted 12 August 2010
Published Online First 23 September 2010
Wheeze: children with their first or second episode of wheeze, without other characteristic signs or symptoms

Recurrent wheeze: children with wheeze and with a history of at least two similar episodes in the past.

Data collection
Children were prospectively recruited into the study when a full clinical history was taken and a thorough examination was performed by a paediatrician. Those with respiratory distress received appropriate medical care (ie, salbutamol) before examination. Respiratory rate was assessed twice by observing the thorax for 60 s when the child was awake, calm and without fever (nurses assessed their temperature and, when necessary, gave them an antipyretic before examination). CXRs were taken for all suspected cases of pneumonia and acute bronchiolitis, and when exclusion criteria needed investigating.

Using the history and clinical findings recorded by the paediatrician and the CXRs, a paediatric chest physician recorded a diagnosis for each child, blinded to the paediatrician’s diagnosis. The CXRs were evaluated by a paediatric radiologist, blinded to any other data. For children with a CXR the final diagnosis was that agreed by two of the above professionals and, in the absence of a CXR, that given by the examining paediatrician (figure 1).

The study protocol was approved by the institutional Ethics Committee.

Analysis
In addition to the diagnoses they received according to the criteria described above, children were classified as with or without pneumonia according to WHO criteria (rapid breathing or lower chest indrawing).5

We also examined a modification to the WHO criteria by adding mother’s report of fever or presence of fever (axillary temperature ≥37.5°C) on admission (WHO criteria+fever).

The sensitivity and specificity of the original WHO criteria and of the WHO criteria+fever for the diagnosis of pneumonia were calculated, taking radiographic diagnosis of pneumonia as the gold standard.

RESULTS
A total of 410 patients were examined and 20 were excluded because of gastro-oesophageal reflux, sickle cell disease, HIV positivity and lack of data on breathing pattern. CXRs were available for 153 of the remaining 390 children. A total of 167 (43%) children were aged between 2 and 11 months, 98 (25%) were between 12 and 23 months and 125 (32%) were between 24 and 59 months. The male:female ratio was 1.38:1.

Diagnoses were acute bronchitis in 28 (7%) children, acute bronchiolitis in 7 (2%), wheezing in 117 (30%), recurrent wheezing in 168 (43%) and pneumonia in 70 (18%) (15 of them with recurrent wheezing). Agreement between the paediatricians’ and the paediatric chest physicians’ diagnoses was high (κ=0.86, 95% CI 0.82 to 0.90).

The validity of WHO criteria with and without fever is presented in table 1. When only children with a CXR were considered in the analysis, WHO criteria showed similar sensitivity to WHO criteria+fever (84%, 95% CI 73% to 92% vs 81%, 95% CI 70% to 90%) but lower specificity (14%, 95% CI 8% to 24% vs 33%, 95% CI 23% to 45%).

We also examined the performance of both sets of criteria in children with and without wheezing at the physical examination, both sets of criteria being more specific in children without wheezing (table 2).

DISCUSSION
Our results indicate that WHO criteria have high sensitivity to detect pneumonia, particularly among children aged <24 months. Their specificity, however, was low in all age groups and very poor in wheezing children. Adding fever to the WHO criteria improved specificity substantially, with very little loss in sensitivity, avoiding the risk of undertreating children with pneumonia.

The diagnostic criteria used in this study were standardised and compliance with them was carefully evaluated.9 All children were walk-in patients without referral from primary healthcare clinics, and thus represented cases of community-
acquired pneumonia in the whole city. Proportionally, recurrent wheezing was most common during the summer with the incidence of infectious respiratory diseases (acute bronchitis, acute bronchiolitis or pneumonia) and wheezing peaking in winter.

In the 1990s, several studies examined the validity of WHO guidelines for detecting childhood pneumonia. However, these investigations excluded wheezing children and reveal that WHO criteria are sensitive and specific only for distinguishing pneumonia from URTIs, and concerns have been raised over the unnecessary use of antibiotics in cases of non-bacterial disease. However, in urban emergency departments, likewise those studied in investigations performed at the same time for each patient was not possible for ethical reasons. Nonetheless, objective parameters such as respiratory rate and wheezing auscultation were used in this study and this should have minimised the subjectivity of the diagnosis. This study involved children presenting to urban hospital settings rather than to health facilities in rural areas and this could limit the external validity of our findings as it can be difficult for healthcare workers to measure temperature in resource-poor settings. However, our definition of fever (axillary temperature ≥37.5°C or mother’s report of fever) is compliant with the WHO definitions and with common practice. Our results reaffirm that the current WHO criteria detect pneumonia with high sensitivity, particularly among younger children. They also present evidence that the ability of these criteria to distinguish between children with pneumonia and those with wheezing diseases might be greatly enhanced by the addition of fever.

**Acknowledgements** The authors thank the participating families who made this study possible.

**Funding** This research was funded by the International Development Research Centre (IDRC) – Canada.

**Competing interests** None.

**Ethics approval** This study was conducted with the approval of the University of São Paulo.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**REFERENCES**

8. Hazir T, Gazi S, Nisar YB, et al. Assessment and management of children aged 1–59 months presenting with wheeze, fast breathing, and/or lower chest
Adding fever to WHO criteria for diagnosing pneumonia enhances the ability to identify pneumonia cases among wheezing children

Maria-Regina A Cardoso, Cristiana M Nascimento-Carvalho, Fernando Ferrero, Fátima M Alves and Simon N Cousens

Arch Dis Child 2011 96: 58-61 originally published online September 23, 2010
doi: 10.1136/adc.2010.189894

Updated information and services can be found at:
http://adc.bmj.com/content/96/1/58

These include:

References
This article cites 24 articles, 4 of which you can access for free at:
http://adc.bmj.com/content/96/1/58#BIBL

Email alerting service
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Topic Collections
Articles on similar topics can be found in the following collections

- Pneumonia (infectious disease) (220)
- Pneumonia (respiratory medicine) (201)
- TB and other respiratory infections (643)

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/