

# Detection of pneumonia among children under six years by clinical evaluation

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## كشف الالتهاب الرئوي بين الأطفال دون ست سنوات بالتقييم السريري

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**الخلاصة:** قمنا بدراسة سريرية (كلينيكية) استباقية في مستشفى الملكة علياء في عمّان، الأردن، لتحديد العلامات والأعراض السريرية الأكثر فائدة في كشف الالتهاب الرئوي لدى الأطفال، وقد شملت الدراسة 147 طفلاً أدخلوا المستشفى في الفترة بين شهريّ آب/أغسطس 2002 وكانون الثاني/يناير 2003 لإصابتهم بالالتهاب الرئوي. وقد وجد أن أكثر العلامات والأعراض حساسية للتنبؤ بالالتهاب الرئوي هي السعال وسرعة التنفس التي تزيد على 50 مرة في الدقيقة، والانسحاب الداخلي لجدار الصدر. وقد لاحظنا أن وجود سرعة التنفس والانسحاب الداخلي لجدار الصدر يمكن كشفها في معظم حالات الالتهاب الرئوي، أما إذا كانت جميع العلامات السريرية سلبية فإن من غير المحتمل أن تكون صورة الصدر الشعاعية إيجابية الموجودات.

**ABSTRACT** To determine the most useful clinical symptoms and signs for detection of pneumonia in children, we carried out a prospective clinical study at Queen Alia Hospital, Amman, on 147 children admitted between August 2002 and January 2003 with clinical pneumonia. All the children had chest X-rays, which were read by the same radiologist. The most sensitive and specific signs and symptoms for prediction of pneumonia were coughing, tachypnoea (respiratory rate > 50/min) and chest wall indrawing. We found that presence of tachypnoea and lower chest wall indrawing can detect most cases of pneumonia. If all clinical signs are negative, chest X-ray findings are unlikely to be positive.

## Dépistage de la pneumonie chez des enfants de moins de six ans par évaluation clinique

**RÉSUMÉ** Afin de déterminer les symptômes et les signes cliniques les plus utiles pour le dépistage de la pneumonie chez l'enfant, nous avons réalisé une étude clinique prospective à l'hôpital Reine Alia d'Amman chez 147 enfants hospitalisés entre août 2002 et janvier 2003 pour un épisode de pneumonie avec diagnostic clinique. Tous les enfants ont eu des radiographies pulmonaires interprétées par le même radiologue. La toux, la tachypnée (rythme respiratoire > 50/min) et le tirage respiratoire étaient les signes et les symptômes les plus sensibles et les plus spécifiques pour prédire une pneumonie. Nous avons trouvé que la présence de tachypnée et d'un tirage sous-sternal permet de dépister la plupart des cas de pneumonie. Si tous les signes cliniques sont négatifs, il est peu probable que les résultats de la radiographie pulmonaire soient positifs.

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## Introduction

Acute lower respiratory tract illness (ALRI) is common among children seen in primary care [1], and accounts for slightly less than 50% of deaths in children under 1 year and about 20% of deaths in all hospitalized children under 15 years [2].

The physical differences between the chests of children and adults account for some of the differences in physical signs [3]. Small children find it difficult to take large breaths, so crackles and wheezes which may be expected only during such a manoeuvre will not be heard. In ALRI, when the history and physical examination suggest the same diagnosis, chest radiography is rarely necessary; when the 2 are inconsistent, then a radiograph may be helpful [4]. The identification of signs such as rapid breathing and chest retraction is very important in deciding who needs expensive treatment and who does not [5]. Also important is the decision to refer a child to hospital, which may be many miles away for many people living in rural areas in developing countries.

Our aim was to emphasize the importance of using simple clinical signs such as respiratory rate and chest wall indrawing in detecting ALRI, especially pneumonia, in children.

## Methods

We did a prospective clinical observation study at Queen Alia Military Hospital, Amman, Jordan over a 6-month period (August 2002–January 2003) for all children below 6 years of age admitted with clinical pneumonia (most cases admitted were below this age). All patients were admitted via the outpatient clinic at Marqa, which is about 20 km from the hospital. This clinic sees patients from areas surrounding Am-

man (suburban areas) but does not always have radiology facilities available. The paediatrician admitted all cases on a clinical basis according to World Health Organization criteria: cough with tachypnoea (respiratory rate > 50/min in infants or > 40/min in older children), indrawing or wheezing. The respiratory rate was counted for a full minute after lowering the temperature (using cold compresses or paracetamol) to < 38 °C rectally or 37.5 °C axillary and before the routine extraction of blood.

All children admitted were examined by a specialist in paediatrics and the same ear, nose and throat specialist to exclude severe upper respiratory tract infection and all had chest X-rays which were assessed by the same radiologist. No clinical findings were written on the X-ray request.

Exclusion criteria from the study were children with immune deficiency, those known to have asthma, history of foreign body aspiration or chemical pneumonitis, children with failure to thrive and malnutrition, and children with severe upper respiratory tract infection. Malnourished children were excluded because tachypnoea and lower chest wall indrawing are not sufficiently sensitive as predictors of pneumonia in these children [6].

The 147 patients in our study were divided into 2 groups according to the chest X-ray findings: those having lobar pneumonia or bronchopneumonia in 1 or more lobes, and those having normal or hyperinflated chest X-rays. The clinical signs and symptoms of the 2 groups were analysed and compared with the radiological evidence of pneumonia (gold standard) and their sensitivity and specificity calculated.

## Results

Our study included 147 children admitted with clinical pneumonia, 72 (49%) male

and 75 (51%) female. The ages of the children were: 1–12 months 92 (63%), 13–36 months 47 (32%) and 37–72 months 8 (5%). Mean duration of admission was 5 days for the first and second age groups and 2 days for the third age group.

From the chest X-ray findings, 40 children (27%) had lobar pneumonia in 1 or 2 lobes and 50 children (34%) had bronchopneumonia, a total of 90 children (61%) with pneumonia diagnosed on a radiological basis. Fifty-seven children (39%) had normal or hyperinflated chest X-rays. A family history of bronchial asthma or allergy was discovered in 15 children (10%).

Table 1 shows the overall frequency of symptoms and signs of pneumonia and Table 2 shows their sensitivity and specificity compared with radiology results (gold standard). Cough, fever, tachypnoea and chest indrawing were the most frequently observed signs and symptoms, while tachypnoea was both the most sensitive (99%) and most specific (88%) sign of pneumonia and cough the most sensitive (98%) symptom. Most of the children (146) received antibiotics; 2 patients needed a respirator (1 developed pneumotho-

rax) and 3 had pleural effusion. There were no deaths.

## Discussion

In developing countries, the case fatality rate from ALRI in children could be reduced if the most serious forms of ALRI were identified and dealt with appropriately.

Our study showed that the most sensitive symptom was cough 98%, with 70% specificity. The most sensitive signs in decreasing order were: tachypnoea (99%), chest wall indrawing (88%), and fever (78%), while the most specific were tachypnoea (88%) followed by chest wall indrawing (77%).

Anadol found that tachypnoea had a specificity of 99% and a sensitivity of 61% and was the most important sign in diagnosing pneumonia [7]. Another study showed that the best screen for pneumonia was the presence of fever along with tachypnoea [8]. A study done in China showed that tachypnoea was more reliable than auscultation in predicting pneumonia [9].

Most of our children were infants, so in our study clinical signs appear to predict pneumonia in infants more reliably than in older children. A study done by Redd et al. comparing the clinical and radiological diagnosis of pneumonia found that children with a radiographic diagnosis tended to have been ill longer and to be older because mothers may have tended to take febrile children with mild ALRI to the health centre or hospital more often than non-febrile children with mild ALRI [10]. In the absence of respiratory signs, febrile infants are unlikely to have abnormal chest radiography [11,12].

Wheezing was found in 33% of the children in our study and was not a useful sign

Table 1 Frequency of symptoms and signs in children with pneumonia (n = 147)

Clinical sign or symptom	No.	%
Cough	105	71
Fever	103	70
Tachypnoea	96	65
Chest indrawing	92	63
Poor feeding	79	54
Grunting	79	54
Diminished air entry	58	40
Crepitation	52	35
Wheezes	49	33

Table 2 Sensitivity and specificity of clinical symptoms and signs at presentation for predicting pneumonia

Clinical sign or symptom	Chest X-ray		Sensitivity (%)	Specificity (%)
	Pneumonia detected (n = 90) No. positive for symptom/sign	Normal or hyperinflated (n = 57) No. positive for symptom/sign		
Tachypnoea	89	7	99	88
Cough	88	17	98	70
Chest indrawing	79	13	88	77
Fever	70	33	78	42
Poor feeding	52	27	58	53
Grunting	52	27	58	53
Diminished air entry	30	28	33	51
Crepitation	27	25	30	56
Wheezes	20	29	22	49

for determining pneumonia in children. This is in agreement with a study done by Mahabee-Gittens et al., who found that in wheezy infants and toddlers, grunting along with oxygen saturation is highly specific and can be used to help diagnose pneumonia in wheezing infants and toddlers [13].

We did not differentiate ALRI from bronchial asthma so it is possible that children were overtreated for ALRI and undertreated for asthma. In regions where wheezing illness is prevalent, the specificity of the World Health Organization pneumonia algorithm is reduced and this may lead to unnecessary use of antibiotics or underutilization of bronchodilators [14]. Simple physical signs that require minimal expertise to recognize can be used to determine oxygen therapy and to aid in screening for referral [15–17].

There may be poor agreement, even among experienced physicians, on the presence of rales in young children, and

this was the case in our study. Subcostal or intercostal recessions (difficulty in breathing) are generally more often seen in infants than in older children because the chest wall is more compliant than that of the older child.

The most useful single factor for ruling out pneumonia in an infant is the absence of tachypnoea [18]. We found that tachypnoea and chest wall indrawing in the presence of cough can help the clinician to determine the need for chest radiography in the paediatric emergency clinic. A study done in Brazil showed that the clinical symptoms taken together contribute more than the signs and are on a par with X-ray in importance [19]. Another study found that age-specific respiratory rate (recommended by the World Health Organization, with or without chest wall indrawing) is a sensitive and specific indicator of pneumonia in almost all age groups [20]. Careful attention to specific clinical factors and use of adjunct radiographs and laboratory tests

should guide physicians in selection of antibiotics and decisions regarding hospitalization [21].

The employment of simple clinical criteria gives a good indication of pneumonia and can decrease unnecessary referral and admissions to hospital and thus result in cost-savings.

Most of the children in our study received antibiotics, which appear to be used in a high percentage of cases, even if inappropriate for the condition, because these clinical signs do not distinguish viral from bacterial pneumonia, nor do chest X-ray, temperature measurement or duration of fever [22].

Our study justifies the premise that pneumonia case detection does not require auscultation, chest X-ray or laboratory testing, and that observation of the respiratory rate and lower chest wall indrawing are the key elements of assessment in young children.

## Conclusions

Initial observation of the infant may be the most critical component for the diagnosis of pneumonia.

Tachypnoea is the most valuable of the individual clinical signs for prediction of radiological pneumonia and can be a sensitive and reasonably specific indicator of respiratory infection.

The absence of tachypnoea and chest wall indrawing can safely be used to reduce the number of chest X-rays ordered for children under investigation. These findings have relevance for assessment protocols and resulting treatment decisions when chest X-ray is not routinely available.

These methods for pneumonia case detection could be taught to primary care physicians, nurses and even mothers, allowing them to seek medical advice early. This would lead to a decrease in the pneumonia mortality rate in children.

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