Public Health Classics

This section looks back to some ground-breaking contributions to public health, reproducing them in their original form and adding a commentary on their significance from a modern-day perspective. In this month's *Bulletin*, Antonio Pio reviews the article by Frank Shann, Kate Hart & David Thomas on criteria selection for the treatment of children with acute lower respiratory tract infections. This paper was originally published in the *Bulletin of the World Health Organization* in 1984.

Standard case management of pneumonia in children in developing countries: the cornerstone of the acute respiratory infection programme

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In the early 1980s, acute respiratory infections (ARIs) had not yet emerged from the obscurity reported 15 years earlier (*1*). Although the overall incidence of ARIs was similar in developed and developing countries, there were wide differences in the frequency and severity of pneumonia. Prospective community studies indicated the annual incidences of pneumonia in children aged under 5 years to be 2–4 per 100 in developed countries and 10–20 per 100 in developing countries. However, incidences exceeding 50 per 100 have been reached in settings with high prevalences of malnutrition and high HIV infection rates in children (*2–4*).

In 1977, WHO undertook to expand tuberculosis control activities to the control of other respiratory diseases (*5*). The most serious problem was that of high ARI mortality in young children in developing countries, mostly attributable to bacterial pneumonia. It was concluded that the central strategy of an ARI programme should involve case management to prevent mortality (*6*).

It became necessary to define the technical content of this strategy. At a meeting convened in 1980 (*7*), Shann, on the basis of work done in Papua New Guinea, proposed using the minimum necessary criteria to decide treatment and the minimum necessary treatment to reduce mortality in regions of high mortality. Children presenting with cough or difficult breathing in outpatient facilities were to be dealt with in one of three ways: referral to hospital if chest indrawing was observed; antibiotic treatment at home if respiratory movements indicated fast breathing; and only home care if neither chest indrawing nor fast breathing was present.

Following further work, Shann et al. published a paper that has become the cornerstone of the current case management strategy for the control of ARIs in children (*8*). This paper showed that chest indrawing was a reliable sign whereby children aged 0–4 years with cough could be admitted to hospital for intensive antibiotic treatment and supportive care for severe pneumonia. It also suggested that, among other children with cough, a respiratory rate of more than 50 breaths per minute was a reliable basis for prescribing antibiotics at home for non-severe pneumonia. It stimulated research that led to adjustments of the definition of fast breathing as a sign of non-severe pneumonia, to refinement of the characterization of chest indrawing for the identification of severe pneumonia, and to intervention studies on the effectiveness of the simple ARI clinical protocol in reducing childhood mortality. Other studies validated the definitions of fast breathing and chest indrawing in infants aged under 3 months and examined the overlapping of the clinical protocols for malaria and pneumonia. WHO and UNICEF organized projects for the development of sounding timers with which to count respiratory rates accurately and of videotapes for training health workers to count respiratory rates and recognize chest indrawing (*9*).

The paper emphasized that fast breathing was an indicator of non-severe pneumonia in children with cough or difficult breathing. In the absence of the latter signs, fast breathing suggested other conditions, particularly dehydration, acidosis or anaemia. The auscultation of crepitations was used in the 1984 Papua New Guinean study to validate the signs of pneumonia. More objective and reliable criteria were employed in subsequent studies: radiology (*10*, *11*), a combination of radiological and clinical data (*12*, *13*) and the clinical judgement of paediatricians with access to radiology (*14*). All of these studies suggested that a single threshold of 50 was unsatisfactory as a sign of pneumonia in children aged under 5 years. The best combination of sensitivity (78–82%) and specificity (73–89%) was achieved by using thresholds of 50 and 40 breaths per minute for children aged 2–11 months and 1–4 years, respectively. A multicentre study indicated that the best threshold for predicting pneumonia in infants aged under 2 months was 60 breaths per minute (*15*).

The age-related definition of fast breathing was resisted by Shann, who argued that the technical advantages were marginal and would be neutralized by the errors of health workers following a complex guideline (*16*). Moreover,

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community intervention studies indicated that the use of the single definition of 50 or more breaths per minute would have a significant impact on mortality from childhood pneumonia. However, WHO introduced the three age-related definitions into the ARI protocol in order to ensure the treatment of at least 80% of children with pneumonia. It was considered likely that the 20% of children with radiological or clinical pneumonia but without fast breathing would have less severe disease. A low false-negative rate (high sensitivity) was more important than a low false-positive rate (high specificity).

The WHO definitions remained independent of any other variable that might modify the respiratory rate, such as the body temperature, the nutrition status and the geographical altitude. The respiratory rate, to some extent, depends on body temperature in children with febrile illnesses. Studies in the Gambia showed that the mean respiratory rate increased by 2.5 breaths per minute with every rise in temperature of 1 °C in children with cough (*17*). The corresponding increase was 3.7 breaths per minute in children with pneumonia or malaria (*18*). This possibly explained some of the false-positive cases of pneumonia detected on the basis of the WHO definitions of fast breathing.

Malnourished children may not have the strength to increase the respiratory rate adequately if their lungs are affected by pneumonia. For a given sensitivity and specificity they produce about 5 breaths per minute fewer than well-nourished children (*19*). The lower temperature in malnourished children with pneumonia may also contribute to their lower respiratory rate. However, WHO judged that it would be impractical to introduce changes in the definitions of fast breathing for malnourished children. It was decided that all such children with cough or difficult breathing should be treated with antibiotics.

At over 2500 metres above sea level in Colombia (*20*) and Peru (*21*), fast breathing was less useful than at low altitudes as an indicator of radiographic pneumonia because of physiological adaptation to low oxygen pressure at the age of 3 or 4 years. Low oxygen saturation, as measured by pulse oximetry, predicted the presence of pneumonia more accurately than fast breathing and other physical signs. WHO therefore recommends that national programmes adjust the criteria for the diagnosis of childhood pneumonia at high altitudes.

The 1984 paper also indicated that chest indrawing was the best indicator of children with severe pneumonia who should be admitted to hospital for intensive care. The authors defined chest indrawing as sternal recession. Work in the Philippines and Swaziland made it possible to improve the definition of chest indrawing as a sign of severe pneumonia (*14*). Only intercostal or supraclavicular retractions, which may be common in children with other conditions, are not signs of severe pneumonia. Chest indrawing is present if, in a calm child, the lower part of the chest moves in or retracts when inhalation occurs. The correct term, therefore, is "lower chest wall indrawing"; "subcostal indrawing" and "subcostal retraction" are inappropriate expressions (*22*).

Shann showed that children with lower chest wall indrawing were at higher risk of death from pneumonia than children with pneumonia in which this sign was absent (*23*). There is considerable variation between observers in the identification of chest indrawing at first-level facilities, even where health workers have received satisfactory training. In some Integrated Management of Childhood Illness (IMCI) programmes, chest indrawing was the reason for the referral of many sick children for whom admission to hospital was unnecessary. A study in Bangladesh suggested that chest indrawing defined on the basis of the presence of both lower chest wall retraction plus intercostal or suprasternal retractions was more specific as a sign of severe pneumonia (*24*).

Widespread acceptance by public health professionals of the simple protocol designed in Papua New Guinea for identifying childhood pneumonia emerged in response to intervention studies conducted in Bangladesh, India, Indonesia, Nepal, Pakistan, the Philippines, and the United Republic of Tanzania (*9*, *25*). These studies confirmed that the protocol was applicable by properly trained health workers even in the poorest rural areas and that it produced an epidemiological impact despite differences in designs and methods (*26*). A significant effect on pneumonia-specific mortality was reflected in reduced overall childhood mortality.

By the end of 1994 the original Papua New Guinean guidelines on the case management of pneumonia in children, as recommended by WHO and UNICEF, had been adopted, with slight modifications in some cases, by ARI programmes in 130 developing countries (*27*). WHO integrated the ARI guidelines, without changes, into the clinical protocol of IMCI (*28*). The studies that validated the whole IMCI protocol showed levels of sensitivity and specificity for the identification of pneumonia comparable to or higher than those found in previous work on the specific ARI protocol (*29–32*). By the end of 2000 the IMCI protocol had been adopted by 81 developing countries (*33*) and recommended by WHO for teaching in medical schools (*34*).

What began as a modest protocol in a provincial town of a small low-income country thus became the technical core of the global strategy for the control of ARI mortality in children. ■

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