

ACUTE RESPIRATORY TRACT INFECTIONS: EPIDEMIOLOGICAL DATA, GUIDED CASE MANAGEMENT AND OUTCOME IN A PEDIATRIC HOSPITAL IN RIYADH

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Acute lower respiratory tract infection (ALRTI) is the major cause of morbidity and mortality (25%-50%) in developing countries.¹⁻⁶ For the proper management of patients with ALRTI, a history, clinical examination, chest x-ray⁷ and identification of the offending organism and its sensitivity to antimicrobial medications are recommended. Facilities for identifying various organisms are almost lacking in underdeveloped countries, and are only available to some extent in rich developing countries. For countries with inadequate medical facilities, WHO has initiated a program for the clinical management and control of acute respiratory infections^{5,6} which has resulted in the reduction of ALRTI mortality rates by 25%-67%.⁴ For developing countries, guidelines for diagnosis and management of ALRTI based on chest x-ray and minor laboratory facilities are required. The objective of this study was to assess the epidemiological data, guided low-cost case management protocol and outcome of treatment of ALRTI. This study was done in Suleimania Children's Hospital (SCH), which is a referral and teaching pediatric hospital in Riyadh.

Materials and Methods

ALRTI is the most common cause of admission to our hospital, especially for those under the age of four years. We estimate that 13.7% of the total hospital admissions are in this age group. The hospital emphasizes general guidelines regarding admission and management of cases with ALRTI. A summary of these guidelines is as follows:

Admission Policy

Patients above the age of one month and below the age of one year with respiratory symptoms are admitted if their respiratory rate is ≥ 50 breaths/min (patients of any age are admitted if they are sick-looking and/or distressed).

Diagnosis

Different clinical diagnoses were defined as follows: Bronchiolitis was defined as the first episode of cough, ronchi, crepitations, and fever with hyperinflation documented, with consolidation or heart failure excluded radiologically.⁴ Pneumonia was defined as cough, tachypnea, crepitations, and fever with radiological evidence of consolidation and/or pulmonary peripheral linear opacities or infiltrates.⁹ Tachypnea was defined as a respiratory rate >50 breaths/min. in a child above the age of one month and below the age of one year. For children above this age, tachypnea was defined according to standard reference. Fever was defined as a temperature of $>38.5^{\circ}\text{C}$ measured rectally for patients below one year of age or $>38.0^{\circ}\text{C}$ measured axillary for patients over one year of age.

Chest x-ray, complete blood count, urea, and electrolyte investigations must be done for all patients. Blood culture must be done for sick-looking patients, neonates, high-grade fever or severely distressed patients. Viral study is done only when necessary. Culture for pleural effusion and/or tracheal aspirate for intubated patients is recommended. Other investigations, such as bronchoscopy, lung biopsy, and CT scan are individualized.

Treatment

Empirical antibiotic is indicated for all patients with radiological evidence of pneumonia, sick-looking patients and all neonates, after performing the necessary investigations. The main antibiotic used is cefuroxime. Gentamicin is added for infants below the age of three months, and patients with neuromuscular disorders or congenital heart diseases. Floxacillin is added to cefuroxime if *Staphylococcus aureus* is suspected. Erythromycin is recommended for patients suspected to have atypical pneumonia. For patients with hospital-acquired infections, aminoglycosides plus piperacillin or ceftazidime are advised after taking the necessary cultures. Antibiotics are given for patients with severe or rapidly deteriorating bronchiolitis (15% of patients diagnosed as bronchiolitis received systemic antibiotics). Antibiotics have to be revised according to culture results.

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TABLE 1. Number of patients with acute lower respiratory tract infection (ALRTI) admitted and/or expired through the years of the study.

| | '91-'92 | '92-'93 | '93-'94 | '94-'95 | '95-'96 | Total |
|--------------------------|---------|---------|---------|---------|---------|--------|
| Admissions | | | | | | |
| Pneumonia | 1040 | 824 | 784 | 787 | 901 | 4336 |
| Bronchiolitis | 105 | 436 | 318 | 350 | 372 | 1581 |
| ALRTI | 1145 | 1260 | 1102 | 1137 | 1273 | 5917 |
| Total adm.* | 10,382 | 9325 | 8689 | 7475 | 7296 | 43,167 |
| % of ALRTI | 11% | 13.50% | 12.70% | 15.20% | 17.40% | 13.70% |
| Deaths | | | | | | |
| Pneumonia | 10 | 8 | 8 | 8 | 7 | 41 |
| Bronchiolitis | 2 | 0 | 0 | 0 | 0 | 2 |
| ALRTI | 12 | 8 | 8 | 8 | 7 | 43 |
| % of deaths** | 1.05% | 0.60% | 0.73% | 0.70% | 0.55% | 0.73% |
| % of deaths [†] | 0.12% | 0.09% | 0.09% | 0.11% | 0.10% | 0.10% |

*Total hospital admissions; **deaths among ALRTI cases admitted; [†]deaths among total hospital admissions.

Discharge

Patients with pneumonia should be discharged as early as possible after the disappearance of fever and respiratory distress, and placed on oral antibiotics with follow-up in the clinic. The diagnosis must be clearly documented in the file by the treating consultant, irrespective of admission diagnosis. The diagnosis should be stored in the computer by its international disease code (according to International Classification of Diseases, 1974, edited by World Health Organization).

For the purpose of the study, all patients' files with the diagnosis of pneumonia and bronchiolitis were retrieved using the International Classification of Diseases (ICD) code. Patients with non-infectious pneumonia were not included. Retrieving records by using the ICD criteria can result in over- or underestimation of patients. To overcome this problem, treating physicians were asked to ensure accuracy in filling out the ICD codes. Patients above the age of four years were not included in the study. Records that did not fulfill the aforementioned definitions or hospital guidelines for management of ALRTI, or those which were improperly coded were excluded from the study. The total number of patients accepted in the study was 5917. Patients were classified according to age into four groups: 0-6 months, 6-12 months, 12-24 months, and 24-48 months. The period of the study was five years.

Results

A total of 5917 patients below the ages of 48 months were admitted to the hospital for ALRTI between June 1991 and May 1996 (after exclusion of 98 patients who did not fulfill the criteria of this study). Pneumonia accounted for 4336 patients (73.3%) and bronchiolitis for 1581 patients (26.7%). ALRTI admissions constituted 13.7% of the total hospital admissions (Table 1). Forty-two percent, 65%, and 87% of pneumonia cases were below the age of six months, one year, and two years, respectively, and 83%, 93% and 97% of bronchiolitis cases were below the age of six months, one year, and two years, respectively

(Table 2). Male to female ratio was 1.3:1 in cases of pneumonia, and 1.6:1 in cases of bronchiolitis, with an overall ALRTI male to female ratio of 1.4:1. The weather in Riyadh area follows two seasons per year, a cold season with some rain from October through March and the hot season from April through September. Admissions during the rainy season consisted of 77.5% of pneumonia cases (3360 patients) and 83.5% of bronchiolitis cases (1320 patients), with a peak in January (Table 3). The average duration of hospitalization was comparable in bronchiolitis (6.4 days) and pneumonia (6 days). The duration of hospitalization included the day of admission and day of discharge or death. All patients with radiological evidence of pneumonia were given antibiotics (Table 1). Forty-three patients (0.73% of all ALRTI admissions and 0.1% of total hospital admissions) all below the age of four years died due to ALRTI: 41 patients (95.4%) died due to pneumonia, and two patients (4.6%) due to bronchiolitis (both had congenital heart disease). This represents 0.97% and 0.13% of patients admitted due to pneumonia and bronchiolitis in this age group, respectively. Most of the deaths (31, or 72%) were below the age of six months—of these, two patients died of bronchiolitis and 29 of pneumonia (Table 2). All patients who died because of ALRTI had some underlying and/or associated cause, making their deaths unavoidable (Table 4). Although ALRTI admissions to total hospital admissions increased by 6.4% (from 11% to 17.4%) during the period of the study, the percentage of ALRTI deaths to both ALRTI admissions and total hospital admissions decreased from 1.05% to 0.55% and 0.12% to 0.1%, respectively (Table 1).

Discussion

The main aims of our guidelines for admission and management of ALRTI are as follows: 1) to increase the number of admissions in young infants with mild to moderate respiratory distress, as they are more liable to higher morbidity and mortality. This was simplified for our junior physicians by defining a respiratory rate of more than 50 breaths/min. in infants outside the neonatal period as an indication for at least chest x-ray and possibly for admission. 2) To decrease the cost of management by guiding the investigations and treatment. Regarding this item, we appreciate a report in a Papua New Guinea study that 63% of severe pneumonia episodes were caused by the bacteria *Streptococcus pneumoniae* and *Hemophilus influenzae*,¹⁰ and that up to half of all children admitted to hospitals with proven ALRTI were found to have evidence of a concurrent respiratory viral infection.¹¹⁻¹³ No clinical parameters were found to be reliable indicators for bacterial cause of ALRTI in a study by Ghafoor et al.¹¹ Chest x-ray is considered necessary to confirm the diagnosis of pneumonia.⁹ Taking into consideration that chest x-ray alone cannot differentiate between viral and

TABLE 2. ALRTI admissions and mortality in different age groups.

| | <6 months | 6-12 months | 12-24 months | 24-48 months | Total |
|----------------------|-----------|-------------|--------------|--------------|-----------|
| Pneumonia | | | | | |
| Admissions | 1801 | 1018 | 959 | 558 | 4336 |
| (%) | (41.50) | (23.50) | (22.21) | (12.87) | (100) |
| Deaths (%)* | 29 (67.5) | 5 (11.6) | 5 (11.6) | 2 (4.7) | 41 (95.3) |
| Bronchiolitis | | | | | |
| Admissions | 1307 | 162 | 59 | 53 | 1581 |
| (%) | (82.67) | (10.31) | (3.74) | (3.29) | (100) |
| Deaths (%)* | 2 (4.7) | 0 | 0 | 0 | 2 (4.70) |
| Total | | | | | |
| Admissions | 3108 | 1180 | 1018 | 611 | 5917 |
| (%) | (52.5) | (20) | (17.2) | (10.3) | (100) |
| Deaths (%)* | 31 (72.1) | 5 (11.6) | 5 (11.6) | 2 (4.6) | 43 (100) |

*Calculated from total ALRTI deaths.

TABLE 3. Relation of ALRTI to temperature and rainfall.

| | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May |
|-----------------|-----|-----|------|-----|------|-----|-----|-----|-----|------|------|-----|
| Min. temp. °C | 23 | 24 | 23.3 | 20 | 15.2 | 11 | 7.7 | 6.5 | 8.5 | 12.5 | 17.1 | 21 |
| Rainfall by mm* | 0 | 0 | 0 | 0 | 2 | 3 | 8 | 9 | 10 | 24 | 16 | 7 |
| Pneumonia | 193 | 125 | 105 | 170 | 327 | 552 | 577 | 865 | 616 | 423 | 236 | 147 |
| Bronchio-litis | 45 | 24 | 24 | 60 | 80 | 173 | 301 | 385 | 205 | 156 | 86 | 42 |

*According to Ministry of Agriculture and Water Resources in Kingdom of Saudi Arabia.

bacterial pneumonia,¹⁴⁻¹⁶ the higher incidence of bacterial or mixed viral/bacterial pneumonia in developing countries might be explained by the following factors: 1) purulent nasal discharge frequently seen in children in developing countries that may descend to the lower respiratory tract;⁴ 2) poor nutritional status in developing countries in general,^{17,18} and 3) a higher incidence of bacterial colonization in the upper respiratory tract (30% of children below the age of five in North America are colonized,⁷ compared to 90%-95% in Papua New Guinea¹⁹ in the same age group). With this in mind, all patients with radiological evidence of pneumonia and 15% of patients with bronchiolitis were given antibiotics. The Antibiotic Policy was considered according to the predominant organisms in this area and their susceptibility to antibiotics. There have been increasing incidences of *Streptococcus pneumoniae* and *Hemophilus influenzae* which are resistant to penicillin and ampicillin in our area.^{20,21}

Admission because of ALRTI in children below the age of four years accounted for 13.7% of the total hospital admissions. This is in the lower range of 12%-45% reported in other developing countries.^{5,11,23} Pneumonia and bronchiolitis accounted for 10% and 3.7% of total hospital admissions, respectively. Pneumonia accounted for 4336 patients (73.3% of ALRTI admissions) (Table 2), which is lower than the 86.5% reported in a Bangladesh study.²⁴ Bronchiolitis accounted for 1581 patients (26.7%

of ALRTI admissions), which is lower than the 35% and 54% reported earlier in South India²⁵ and Riyadh,²⁶ respectively. Better immunization, nutrition, socio-economic and educational status at present could explain the lower incidence of both pneumonia and bronchiolitis in our study, compared to eight years ago when these two studies were performed (from 1985 to 1987). The higher male to female ratio (1.4:1) in this study has been reported in other studies.^{18,24-26}

Although bronchiolitis and pneumonia have been shown in this study to be present throughout the year, there is a clear correlation with the rainy season starting in our area in October through March, with a peak in January (Table 3). This is consistent with earlier studies from other tropical and Western countries.²⁸⁻³⁰ Perhaps the fact that more people remain indoors during this period, resulting in overcrowding, could explain this.²⁵ The peak season was different in Hong Kong²⁷ and Bangladesh,²⁴ possibly because of a different rainy season.

The total duration of hospitalization due to ALRTI was 36,774 days. The average hospital stay for pneumonia was six days and for bronchiolitis 6.4 days. The total cost of admission for ALRTI was approximately around 22,064,640 Saudi Riyals or US\$6 million, and 70% of the cost was for the treatment of pneumonia. The cost for treatment of each patient for an average of six days was 3,600 SR (\$1000), which is less than the \$3,511 reported in the US.³⁰ The cost was calculated according to Ministry of Health (MOH) approximation of the cost of each bed per day in MOH hospitals in Saudi Arabia, which is equal to 600 SR.

Below the age of two years, our ALRTI mortality rate was 0.69% of all ALRTI hospitalized, which is nearly double the rate of 0.36% reported in New York,³¹ but is lower than the 6.8% reported from Bangladesh.²⁴ It is worth mentioning that overall mortality rates in developing countries, estimated by some investigators, are 10-50 times greater than those of developed countries.^{5,32,33}

We consider that our acceptable ALRTI outcome (regarding cost and mortality) is mainly due to: 1) our immunization rate reaching up to 90% for the seven main diseases (tuberculosis, hepatitis B, poliomyelitis, diphtheria, pertussis, tetanus and measles) by the age of six months; 2) following an accelerated vaccination program where the first DPT and OPV doses are given at the age of six weeks and first measles dose at the age of six months; 3) nutrition, economy, prenatal care and education have dramatically improved in the last few years, so patients presented earlier in their illness, thereby allowing better health care to be provided for them; and 4) our guiding policy in diagnosis and management of ALRTI, especially early admission of small infants. Our new major target should, therefore, be the early detection and aggressive treatment of pneumonia in high-risk patients such as young infants, patients with underlying cardiorespiratory, neuromuscular and immunodeficiency disorders.

TABLE 4. Associated and/or underlying causes of death in 41 patients who died due to ALRTI.

| | Number of patients | % |
|------------------|--------------------|------|
| Cardiac | 12 | 29.2 |
| Neuromuscular | 7 | 17.0 |
| Prematurity | 6 | 14.6 |
| Respiratory | 4 | 9.8 |
| Immunodeficiency | 3 | 7.3 |
| Hematological | 3 | 7.3 |
| Others | 5 | 12.1 |

Some of the patients had more than one underlying and/or associated cause(s) of death.

We realize that this study, as it was retrospective, has certain limitations, such as a lack of standardized management protocols and data on the sensitivity of isolates to commonly used antibiotics.

We are looking forward to a periodic, controlled, prospective multi-center study in different parts of the country to determine the etiological agents causing ALRTI, and its sensitivity to antibiotics, and thus maintain proper policy guidelines for the management of ALRTI and other infections at the lowest possible cost.

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