Pneumonia is one of the leading causes of morbidity and mortality among children in many developing countries. According to the estimates of the United Nations and the World Health Organization (WHO), 12.9 million children younger than 5 years of age died worldwide in 1990. One-third of these deaths—4.3 million—were attributed to respiratory infections, with pneumonia implicated particularly often [1]. More than 90% of deaths due to childhood pneumonia occurred in developing countries, and more than one-half of all persons in developing countries who died of pneumonia were children younger than 5 years old [2].

To tackle this public health problem, a standard case management program for pediatric pneumonia, including its diagnosis and treatment, has been developed by WHO [3]. The standard criteria for the clinical diagnosis of patients with cough are summarized in table 1. This approach, which mainly entails an evaluation of chest movement and a determination of respiratory rate, is practical for diagnosis at the primary health care level in developing countries, where human resources and equipment are limited. Etiologic studies have shown that the pathogens most often causing community-acquired pneumonia in children in this setting are *Streptococcus pneumoniae* and *Haemophilus influenzae* [4].

Only mild pneumonia (with fast breathing) is treated with trimethoprim-sulfamethoxazole (4 mg of trimethoprim and 20 mg of sulfamethoxazole/kg orally twice daily for 5 days), procaine penicillin (50,000 U/kg intramuscularly once daily for 5 days), ampicillin (25 mg/kg orally four times daily for 5 days), or amoxicillin (15 mg/kg orally three times daily for 5 days).

Severe pneumonia with chest indrawing is treated for at least 3 days with either benzylpenicillin (50,000 U/kg intramuscularly four times daily) or ampicillin (50 mg/kg intramuscularly four times daily). After clinical improvement of the child with severe pneumonia, therapy is switched to intramuscular procaine penicillin, oral ampicillin, or oral amoxicillin, in the dosages given for mild pneumonia, for at least 5 days. Antimicrobials are given for 3 days after the child is well [5].

The main components of WHO’s control program for pediatric pneumonia are the training of health care workers, the health education of parents, and the assurance of a supply of antimicrobial agents for use at health care facilities in the community. A national training program usually starts with a seminar conducted by leading pediatricians and medical officers and continues with hands-on training of doctors at referral hospitals for several days and of workers at the primary health care level for 1 or 2 days. Health education, which is most often provided to mothers or families by health care workers at maternal and child health clinics and other outpatient clinics, includes information on the signs of pneumonia and on methods of home care for acute respiratory infections [6].

In a rural area of China, the main reason for the lack of presentation of children to a hospital before death due to pneumonia was found to be the inability of parents to recognize the signs of pneumonia [7]. It was therefore hypothesized that education regarding these signs in children would result in the earlier use of health care facilities when children became severely ill, which in turn would lead to the reduction of infant and child mortality. The purpose of this study was to test this hypothesis by evaluating the effectiveness of pneumonia control programs in three counties in China and in the Western Division of Fiji. Mortality was monitored in China but not in Fiji since the infant mortality rate (IMR) in Fiji was only 19.8 deaths per 1,000 live births in 1986 (before the outset of the program) [8], and the expected change in the number of infant deaths in Fiji was considered to be too small to detect (low power of comparison).
onward, 60 breaths per minute for infants younger than 2 months old, 50 breaths per minute for infants 2–12 months old, and 40 breaths per minute for children 1–4 years old.

Methods

Fiji (Western Division)

Doctors (university graduates) in subdivisional hospitals and health centers of the whole Western Division were trained in standard case management during the second half of 1988. Subsequently, health education of the populace on the important signs of pneumonia (i.e., fast breathing and chest indrawing) and on home treatment was provided primarily in two ways: through face-to-face communication between health care workers and mothers and through the mass media (e.g., newspapers). Routine records of outpatients at Western Division facilities (including information on signs, symptoms, diagnosis, and treatment) were used to monitor the standard case management program from its initiation in July 1988 until March 1991. Patients’ records were reviewed, and supervision and advice were provided on a regular basis by subdivisional medical officers and the divisional medical officer. In the Ba Subdivision of the Western Division (total population of 59,444, including 8,445 children younger than 5 years of age) [9], the first visit of children with pneumonia to health care facilities was monitored by supervisors, and the duration of fast breathing and/or chest indrawing was recorded for the period 1989 to 1991.

China (Nanbu, Shifang, and Shunyi Counties)

Training and supervision of doctors. Initial training in the case management of patients with cough and cold or pneumonia was provided to doctors in villages and at township hospitals in 1987. The qualifications of village doctors in China consist of the attainment of a certain educational level (usually graduation from primary or secondary school) and at least 1 year’s training in medicine. In Shifang and Nanbu Counties, village doctors were tested (by questionnaire) before and after this initial training. They were then given registers in which to keep records of their patients’ signs, symptoms, diagnosis, and treatment. These records were used to evaluate medical practice in two townships in each of three counties: Shifang and Nanbu Counties in Sichuan Province and Shunyi County in Beijing Municipality. Demographic figures for these counties before the start of the standard case management program are shown in table 2. The program was monitored and supervised on a regular basis by the staffs of the respective county health departments and the Capital Institute of Pediatrics in Beijing, and doctors’ practices were adjusted in consultation with supervisors as necessary. All other conditions reflected the existing health care system in China.

Education of parents. After the completion of a program of health education for parents in Nanbu County on the signs of cough and cold and pneumonia and on home care for children with these signs, tests on this information were administered. The results for parents who had received education on these topics were compared with the results for those who had not.

Monitoring of mortality. In each township studied, the information on routine death reports (which was usually incomplete) was supplemented from 1986 or 1987 onward with data on births and on deaths of children younger than 5 years of age that were collected (by questionnaire) in an annual household survey by health staff and medical students. The cause of each death, and signs and symptoms before death, was determined on the basis of information obtained by interview. To rule out the possibility of an apparent but false reduction in pneumonia mortality as the result of an unintentional shift of diagnosis from pneumonia to other causes, deaths due to all causes were also evaluated, and the following values were calculated: total IMR (with infants defined as children younger than 1 year of age), IMR from pneumonia, total child mortality rate among those younger than 5 years of age, and child mortality rate

Table 1. Signs of acute respiratory infections in children younger than 5 years of age and recommendations for case management at the primary health care level: the World Health Organization’s standard case management program.

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Cough</th>
<th>Fast breathing*</th>
<th>Chest indrawing†</th>
<th>Instructions to health care workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cough and cold</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>Do not administer antimicrobial treatment</td>
</tr>
<tr>
<td>Mild pneumonia</td>
<td>+</td>
<td>+</td>
<td>–</td>
<td>Administer antimicrobial treatment</td>
</tr>
<tr>
<td>Severe pneumonia</td>
<td>+</td>
<td>or –</td>
<td>+</td>
<td>Administer antimicrobial treatment and refer patient to hospital</td>
</tr>
</tbody>
</table>

NOTE. + = present; – = absent.

* Fifty breaths per minute for children younger than 5 years old; from 1989 onward, 60 breaths per minute for infants younger than 2 months old, 50 breaths per minute for infants 2–12 months old, and 40 breaths per minute for children 1–4 years old.

† Intercostal and/or subcostal retraction in the inspiratory phase.

Table 2. Demographic characteristics of Shunyi County (Beijing Municipality) and of Shifang and Nanbu Counties (Sichuan Province) in China in 1986.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Shunyi</th>
<th>Shifang</th>
<th>Nanbu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population (thousands)</td>
<td>501</td>
<td>407</td>
<td>1,239</td>
</tr>
<tr>
<td>No. of townships</td>
<td>29</td>
<td>20</td>
<td>82</td>
</tr>
<tr>
<td>No. of villages</td>
<td>432</td>
<td>253</td>
<td>1,088</td>
</tr>
<tr>
<td>Gross domestic product per person (yuan*)</td>
<td>8,712</td>
<td>5,658</td>
<td>424</td>
</tr>
<tr>
<td>Annual income per capita (yuan)</td>
<td>1,000</td>
<td>600</td>
<td>200</td>
</tr>
</tbody>
</table>

* Currency unit.

<table>
<thead>
<tr>
<th>County</th>
<th>Total IMR</th>
<th>IMR from pneumonia</th>
<th>Total U5MR</th>
<th>U5MR from pneumonia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nanbu</td>
<td>1986</td>
<td>67.6</td>
<td>28.4</td>
<td>78.3</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>45.2*</td>
<td>12.4*</td>
<td>49.7*</td>
</tr>
<tr>
<td>Shifang</td>
<td>1987</td>
<td>51.6</td>
<td>18.4</td>
<td>56.6</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>18.8*</td>
<td>5.1*</td>
<td>32.5</td>
</tr>
<tr>
<td>Shunyi</td>
<td>1987</td>
<td>18.7</td>
<td>7.9</td>
<td>21.7</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>10.6*</td>
<td>4.5*</td>
<td>10.6*</td>
</tr>
</tbody>
</table>

NOTE. IMR = infant mortality rate (with infants defined as children younger than 1 year of age); U5MR = mortality rate among children younger than 5 years of age per 1,000 live births.

* P < .05.
\( ^* \) P < .01.
\( ^1 \) P value not statistically significant.

China

In Nanbu County, ~70% of the parents provided with health education on signs of pneumonia and on home care for acute respiratory infections scored \( \geq 60 \) of 100 points on subsequent testing. In contrast, only 30% of parents not provided with this information scored this high. The scores of village doctors in

Figure 1. Duration of signs of pneumonia (fast breathing and/or chest indrawing) at the time of the first consultation at a health care facility: Western Division, Fiji, 1989–1991. \( \square = <3 \) days; \( \square = 3–7 \) days; \( = \geq 7 \) days.

Figure 2. Proportion of cases of acute respiratory infection (ARI) in children younger than 5 years of age who were treated with antimicrobial agents: Western Division, Fiji, 1988–1991. \( \square = \) cough and cold; \( \bullet \bullet \bullet \bullet \bullet \bullet \bullet = \) pneumonia; \( \bullet \bullet \bullet \bullet \bullet \bullet \bullet = \) all ARI cases.
all three counties on tests of their knowledge of the standard diagnosis and treatment of pneumonia increased from 44 of 100 points before the training course to 79 of 100 points immediately afterward.

From 1986–1987 to 1990, total infant mortality, pneumonia-specific infant mortality, total mortality among children younger than 5 years of age, and pneumonia-specific mortality among children younger than 5 years of age were reduced in all three counties (table 3). In Nanbu and Shifang Counties, the reductions in all four mortality categories were statistically significant. In Shunyi County, only the reduction in total mortality among children younger than 5 years of age was statistically significant.

Discussion

Fiji

In Fiji, all medical care except that provided in private clinics is basically free; in some subdivisions, a nominal fee for drugs is charged by health care centers to alleviate recent budgetary constraints. No financial incentive to use antimicrobial agents is offered to health care workers. Through constant supervision at the divisional and subdivisional levels, the pneumonia control program clearly improved case management for acute respiratory infections in terms of the rational use of antibiotics. A progressive decrease in the duration of signs and symptoms of pneumonia in children at the first consultation indicated that mothers were able to recognize these signs and take action earlier—a clear effect of health education. The results show that the program’s information on signs of pneumonia can be understood by women educated only through primary school.

China

Compared with the national average for China, the average per capita income is much higher in Shunyi County, about the same in Shifang County, and much lower in Nanbu County. Moreover, transportation is most convenient in Shunyi County (a flat area), is somewhat more difficult in Shifang County (a combination of flat and mountainous areas), and is most problematic in Nanbu County (a mountainous area). These conditions were reflected in IMRs at baseline (i.e., before the pneumonia control program was started): 18.7 deaths per 1,000 live births in 1987 in Shunyi County, 51.6 per 1,000 in 1987 in Shifang County, and 67.6 per 1,000 in 1986 in Nanbu County. The efficacy of the WHO standard case management program in reducing infant and child mortality from pneumonia was clear in both Shifang and Nanbu Counties. The findings at these locations demonstrated that such a program—if well supervised—can reduce childhood mortality from pneumonia even when implemented through the existing health care system in a relatively poor area.

In Shunyi County, despite the liberal use of antimicrobial treatment, the reduction in mortality was marginal because mortality was already low. The control program for childhood pneumonia obviously has less impact on mortality in this setting, in which pneumonia accounts for a smaller proportion of deaths.

Evaluation of the control program showed that even those parents whose highest educational level was primary-school graduation or less were able to acquire an understanding of the signs of pneumonia. Furthermore, village doctors who were primary-school or secondary-school graduates were able to follow the guidelines for case management properly.

In 1990 and 1991, the control program described here was introduced in 27 counties in 13 provinces. Overall, the IMR from pneumonia in the 27 counties was reduced from 40.1 deaths per 1,000 live births in 1990 to 31.8 per 1,000 in 1991. During the same interval, the rate of death from pneumonia among children at home was reduced from 64.4% to 51.6%, and the rate of death from pneumonia among children who had not received medical attention within the preceding 24 hours was reduced from 31.5% to 25.1% [10]. These changes support the hypothesis that education regarding the signs of pneumonia in children results in the earlier use of health care facilities when children become severely ill, which in turn leads to the reduction of child mortality. Most children with pneumonia do not die if their condition is recognized early by their parents, if they are brought promptly to health care facilities, and if they are treated early enough with the effective antimicrobial agents available (free, at a fixed nominal fee, or at market price, depending on the county) at all village health stations.

Other Studies

Seven intervention studies similar to those described herein have been conducted in various locations worldwide; their results have been summarized elsewhere [11–18]. All seven studies documented a remarkable reduction in mortality among infants and among children younger than 5 years of age. However, six of the seven investigations were based on active case findings (i.e., trained health care workers visited households on a regular basis to identify patients who had pneumonia with fast breathing or chest indrawing). In such studies, the success of the program is attributable mainly to the competence of the health care workers and not to the training of mothers, which is required for early medical attention in the absence of an active case finding. Furthermore, such regular household visits are not conducted routinely under ordinary circumstances in any developing country. The remaining study [15] used passive case findings in the setting of the existing health care system, thus relying on the recognition of signs of pneumonia by the patient’s family and proper diagnosis and treatment by health care workers.

Conclusion

The data presented herein prove that the WHO standard case management program for pneumonia can be implemented
successfully through existing health care systems, even in poor areas. The factors important in the success of this program include improved recognition of the signs of childhood pneumonia by parents, earlier presentation of children with these signs to health care facilities, availability of antimicrobial agents at the primary health care level, and rational decisions by health care workers about the use of these agents.

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References