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Etiological profile of community-acquired pneumonia (CAP) and immunization status among children < 5 years in public and private sector

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Abstract

Background: Childhood pneumonia is the leading cause of morbidity in children < 5 years with most cases occurring in India (43 million). Pneumonia contributes to 27.5% of total under five year mortality in India.Streptococcus pneumonia, Hemophilus influenza and respiratory syncytial virus have been identified as responsible pathogens. India's multi-year plan for immunization highlights need for accelerated introduction of new and underutilized vaccines against diseases with significant morbidity and mortality. Pneumococcal Conjugate Vaccines (PCV) have been licensed in India since 2006. The objective of this study was to document the etiology and immunization status of children < 5 years who were newly diagnosed cases of CAP in private and public sector.

Material/Methods: This study was a retrospective review of inpatient records (n=532) of children <5 years diagnosed with CAP in 2 hospitals- one private and other public multispecialty hospital that had pediatric ward, pediatric ICU (Intensive Care Unit) and NICU (Neonatal Intensive Care Unit) in Mumbai, India. Cases where primary diagnosis was not clearly documented were confirmed for diagnosis with laboratory reports and X-rays. Using the electronic case report form, baseline demographic and clinical characteristics such as age, gender, date of diagnosis, primary diagnosis on admission, prior immunization, diagnostic and laboratory test, treatment during inpatient stay and advice on discharge were extracted.

Results: The average age at admission was 1.95 ± 1.45 years in private hospital and 1.51 ± 1.17 years in public hospital. Etiology was not established in a majority of the clinical diagnosed CAP cases i.e. 92/105 (93.13 %) in private hospital and 62/67 (92.54 %) in public hospital. Considerable morbidity due to CAP with the average length of stay 5.87 ± 3.50 days in private hospital versus 7.97 ± 4.74 days in public hospital was observed. Also 100 % of the children in private hospital received antibiotics versus 95.52 % in the public hospital. The mean duration of antibiotics in private hospital was 4.38 ± 4.61 days and in public hospital 2.1 ± 3.26 days. The number of unvaccinated children or children whose immunization status is not known was significantly higher in the public hospital (34.33 %) than the private hospital (20.59 %) (p=0.0465)

Conclusions: A greater proportion of cases of CAP were classified as unspecified pneumonia due to lack of adequate diagnostic facilities which act as an impediment in establishing etiology of CAP in Indian setting leading to considerable antibiotic use. An important way forward for India would be to consider a possible timeline to achieve universal childhood immunization through introduction of vaccines directed against pneumonia in the national immunization program across the country in the remaining states.

Keywords: Community acquired pneumonia, Etiology, Immunization, children < 5 years.

Background

Childhood pneumonia is the leading cause of morbidity in children < 5 years with most cases occurring in India (estimated 44 million)[1]. Pneumonia contributes to 27.5% of total under five year mortality in India [2].Streptococcus pneumoniae, Hemophilus influenza and Respiratory Syncytial Virus have been identified as responsible pathogens[3]. India's multi-year plan for immunization, highlights need for accelerated introduction of new and under-utilized vaccines against diseases with significant morbidity and mortality [1, 2]. Pneumococcal Conjugate Vaccines (PCV) have been licensed in India since 2006 [1, 2].

Objectives

The objective of this study was to document the etiology profile and immunization status of children < 5 years who were newly diagnosed cases of CAP in private and public sector.

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Methods

This study was a retrospective review of inpatient records (n=532) of children <5 years diagnosed with CAP in 2 hospitals- one private and other public multispecialty hospital that had pediatric ward, pediatric ICU (Intensive Care Unit) and NICU (Neonatal Intensive Care Unit) in Mumbai, India. As the study is descriptive, no formal sample size calculations were performed. The aim was to recruit approximately 150-200 patients to achieve a representative spread of patients. Statistical analyses were conducted using SAS© version 7.0. Continuous variables were reported using mean, median, and standard deviation. Categorical variables were summarized by frequency. A total of 10 (7 private and 3 government) hospitals that met our inclusion criteria were identified. Of these, two hospitals from Zone 3 (Ward H and K) namely, Dr. BalabhaiNanavati Hospital (private) and Dr. R N Cooper Municipal General Hospital (government) agreed to participate in the study. Dr BalabhaiNanavati Hospital is a private multispecialty hospital with a total of 352 beds, 74 beds in the critical ward, 8 ORs and over 7 leading pediatricians. Dr. R. N. Cooper Hospital is a large government/municipal hospital providing care at a subsidized rate to patients. The criteria outlined to identify and select hospitals for this study are mentioned in Table 1. After receiving Institutional Review Board (IRB) approval, the study team along with the Principal Investigator at each site identified all patients using patient Identification numbers with a diagnosis for lower respiratory infection during the study period. Cases where primary diagnosis was not clearly documented were confirmed for diagnosis with laboratory reports and X-rays. The cases that were included in the study where patients < 5years of age, with a diagnosis of Lower respiratory track infection (LRTI) or pneumonia diagnosed within 48 hours of hospitalization, between January 1, 2012 through January 1, 2014. Only patients with complete chart records and a confirmed diagnosis of CAP [obtained via radiographic evidence or confirmed by the study principal investigator (PI)] were included in the study). The patients whose charts were included patients who were more than 5 years of age at the time of diagnosis, or had a primary diagnosis of other respiratory conditions such as hospital acquired pneumonia, asthma, chronic obstructive pulmonary disease, bronchiolitis, or common cold, and those who were transferred from another hospital. Using the electronic case report form, baseline demographic and clinical characteristics such as age, gender, date of diagnosis, primary diagnosis on admission, prior immunization, diagnostic and laboratory test, treatment during inpatient stay and advice on discharge were extracted. If the immunization status of the child was not known (could not be obtained on the case record form; recorded as mother could not remember regarding the immunization in the inpatient charts or in the presence of any other confounding factors) the child was considered as not immunized with the

Table 1 : Criteria outlined to identify and select hospitals for the study.

Parameters	Criteria outlined to identify and select hospitals for this study
Hospital Type	Large private and government multispecialty hospitals within each zone that had a pediatric ward, pediatric ICU and NICU
Bed Size	>10 beds in the pediatric ward
Medical Chart records	Availability and access within each hospital
Principal Investigator	Pediatricians: Qualification (specialization); >10 years' experience; well published in the area of pneumonia; key member on pediatric association committees who agrees to participate in the study
Approval Processes	Hospital EC – DCGI approved
	EC approval process

Table 2: Demographic characteristics

Demographic Characteristics	Nanavati Hospital (N = 102) Mean ± SD /%	Cooper Hospital (N = 67) Mean ± SD /%
Age	1.95 ± 1.45 years	1.51 ± 1.17 years
Weight	9.95 ± 3.91 kg	7.71 ± 2.43 kg
Gender		
Female	48.04%	40.30%
Male	51.96%	59.70%

Table 3: Clinical characteristics

Clinical Characteristics	Nanavati Hospital (N = 102) N (%)	Cooper Hospital (N = 67) N(%)
Primary Diagnosis		
Mycoplasmic pneumonia	4 (3.92%)	-
Viral pneumonia	3 (2.94%)	-
Bacterial pneumonia	-	5 (7.46%)
Other/unspecified pneumonia	95 (93.13%)	62 (92.54%)

Table 4: Length of stay

Parameter	Private Hospital (N=102)	Public Hospital (N= 67)
Length of stay by wards [Days (Mean ± SD)]		
ICU (NICU/PICU)	0.75 (± 2.67)	0.19 (± 1.59)
General ward	4.63 (± 2.18)	7.59 (± 4.41)
Other ward	0.50 (± 1.73)	-
Overall length of stay	5.87 (± 3.50)	7.97 (± 4.74)

vaccine under consideration. Child was considered as fully immunized if it received BCG, DPT, OPV and measles; as unimmunized if received none of these vaccines and Partially Immunized if some dose given but immunization not complete.

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Table 5: Medications during inpatient stay

Type of Drug	Nanavati Hospital (N = 102) % User	Cooper Hospital (N = 67) % User
Antibiotics	100%	92.52%
Analgesics	85.87%	-
Anticholinergic	52.17%	2.98%
Anti – inflammatory	41.30%	-
Antiviral	7.61%	-
Mucolytic	11.96%	7.46%
Steroid/Corticosteroid	21.17%	-
Adreno-agonist	13.04%	
Antihistamine	13.04%	7.46%
Antiemetic	27.17%	1.49%
Antacid	61.96%	-

Table 6: Medications post discharge

Type of Drug	Nanavati Hospital (N = 102) % User	Cooper Hospital (N = 67) % User
Antibiotics	84.78% (Mean days: 4.38 +/- 4.61 SD)	53.73% (Mean days: 2.1 +/- 3.26 SD)
Analgesics	50.00%	-
Anticholinergic	13.04%	-
Anti – inflammatory	30.43%	-
Antiviral	2.17%	-
Mucolytic	36.96%	17.91%
Steroid/Corticosteroid	5.43%	-
Adreno-agonist	3.26%	-
Antihistamine	17.39%	10.45%
Antiemetic	5.43%	-
Antacid	2.17%	-

Table 7: Immunization Status of the Children

Clinical Characteristics	Nanavati Hospital (N = 102) N (%)	Cooper Hospital (N = 67) N(%)
Immunization		
Immunization done	81 (79.42%)	44 (65.67%)
Unknown	17 (16.67%)	7 (10.45%)
Immunization not done	4 (3.92%)	16 (23.88)
Immunization not done / Immunization status unknown	21 (20.59%)	23 (34.33%)

Result

169 patient records were included in the analyis; n= 102 from private hospital (Nanvati) and n= 67 from public hospital (Cooper). The average age at admission was 1.95 ± 1.45 years in private hospital and 1.51 ± 1.17 years in public hospital (Table 2).Etiology was not established in a majority of the clinical diagnosed CAP cases i.e. 95/105 (93.13 %) in private hospital and 62/67 (92.54 %) in public hospital (Table 3). Considerable morbidity due to CAP with the average length of stay 5.87 ± 3.50 days in private hospital versus 7.97 ± 4.74 days in public hospital was observed (Table 4).100 % of the children in private hospital received antibiotics versus 95.52 % in the public hospital (Table 5). The mean duration of antibiotics in private hospital was 4.38 ± 4.61 days and in public hospital 2.1 ± 3.26 days (Table 6). The number of unimmunized children or children whose immunization status is not known was significantly higher in the public hospital (34.33 %) than the private hospital (20.59 %) (p=0.0465). While in the private sector immunization was done for 79.42 % of the patients included in the study; in the public sector it was done for 65.67 % of the patients included in the study. There were no partially immunized children in the study. Since the private hospital Nanavati hospital drains patients from all economic strata some would have taken Universal Immunization program vaccines (UIP) whereas some would have received vaccines from private doctors as per IAP (indian academy of pediatrics) schedule. In the public hospital most patients would have received the Universal Immunization program vaccines (UIP). Pneumococcal immunization data could not be obtained for most patients and hence it is presumed that that the coverage of pneumococcal immunization was very low.

Disucssion

Acute respiratory infection (ARI) is the largest cause of morbidity and mortality among children under five years of age in developing as well as developed countries and is the commonest cause of hospitalization [5] According to a report by United Nations Children's Emergency Fund (UNICEF) and Public Health Foundation of India (PHFI) pneumonia is the single most important cause of death among children in the post neonatal period, contributing as much as 27.5% of total under five year mortality [2] Our study shows that a greater proportion of cases of pneumonia are due to unspecified pneumonia (pneumonia with not a clear bacterial, viral or mycoplasma as etiology)

with 92/105 i.e. 93.13 % in the private hospital and 62/67 i.e. 92.54 % in the public hospital diagnosed with unspecified pneumonia. Several studies and population-based surveillance following immunization with PCV7 and PCV13 across the world have demonstrated reductions in all cause hospitalizations, community acquired pneumonia, complicated pneumonia and empyema in both inpatient and out-patient settings in the pediatric population [6-9]. Our study had a few limitations. It is a retrospective study and that too in two different hospitals, and therefore there may be interpersonal variations in diagnosis in the two hospitals. In the era of Pulse Polio where house to house immunization is being targeted; such a high percentage of unimmunized children is alarming. Our study clearly identifies the need to increase awareness about the importance of immunization. India has one of the largest Universal Immunization Program (UIP) in the world, targeting 27 million infants and 30 million pregnant women every year. However, the average coverage of UIP vaccines at the national level is only 65 % with a great heterogeneity amongst states. [10] WHO considers the inclusion of pneumococcal vaccine in national immunization programs as particularly high priority in countries with under 5 mortality >50 per 1000 live births, or greater than 50,000 child deaths annually. With an infant mortality rate of >60 per 1000 live births and over 400,000 child deaths per year, India meets the WHO's criteria for countries where pneumococcal immunization should be a priority for introduction[11]. According to recent estimates, with support from the GAVI Alliance, these vaccines could be added to India's immunization program at an additional cost of about twenty-one rupees or fifty cents per child each year [12]. Interventions targeted at risk factors like malnutrition and low birth weight to reduce the incidence of pneumonia are effective in the long-term as they are related to poverty and social-cultural factors. Hemophilus Influenzae (Hib) vaccine is already a part of the National Immunization Program. Thus, currently pneumococcal vaccines seem to be the only public health tool capable of reducing the burden of pneumococcal diseases in developing countries including India. The introduction of a new vaccine may actually improve routine immunization coverage by increasing awareness and demand among parents.

Conclusion

A greater proportion of cases of CAP were classified as unspecified pneumonia due to lack of adequate diagnostic facilities which act as an impediment in establishing etiology of clinically diagnosed CAP in Indian setting leading to considerable antibiotic use. There is a need to increase awareness regarding immunization in India. An important way forward for India would be to consider a possible timeline to achieve universal childhood immunization through expanding PCV usage to the remaining states in the National Immunization Program.

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