

Prevalence of Viral Pathogens Among Pediatric Patients Admitted for Pneumonia In a Local Tertiary Hospital

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ABSTRACT

In the Cordillera Administrative Region, pneumonia has been the second most common cause of morbidity. In Baguio General Hospital and Medical Center (BGHMC) pneumonia has been the number one cause of morbidity and one of the top three causes of mortality among pediatric patients since 2002; these were all treated as bacterial pneumonia. However, the epidemiology of viral pneumonia has not yet been studied.

OBJECTIVES: The goal of this study was to determine the prevalence of viral pneumonia among pediatric patients admitted from May 2009 to April 2010.

METHODS: A chart review was performed to provide data on (1) all patients' ages 0 to 18 years old admitted in the institution for pneumonia; (2) those enrolled in the SARI epidemiological surveillance from May 2009 to April 2010; (3) only patients admitted on Sundays or Wednesdays; and (4) those swabbed within 24 hours of admission (This is the schedule agreed upon by the involved groups on the oropharyngeal and nasopharyngeal swabbing at the institution for the SARI surveillance which is done during Mondays and Thursdays); (5) those who recently have not taken any antiviral medications; and (6) those who were not subjected to oropharyngeal or nasopharyngeal swabs prior to admission. the prevalence of viral pneumonia among pediatric patients admitted from May 2009 to April 2010 (indicate Baseline characteristics such as age, sex, clinical symptoms, and co-morbid diseases, course and length of hospital stay; and outcome data was gathered.

RESULTS: A total of 982 pediatric patients were admitted for pneumonia. Of the three-hundred-seventy-seven patients tested for viral isolates, 28.1% were positive and most of the cases with viral isolates were in October. In all ages, Respiratory Syncytial Virus (RSV) was the most prevalent (87.74%). Subjects who were less than one year old showed a higher detection rate of virus. There were more patients from the viral isolate negative group who presented with signs of respiratory distress. Most of the patients of both groups were discharged after one-to-three hospital days.

CONCLUSION: RSV was the most common virus isolated. Children less than one year old had the highest detection rate of a virus.

INTRODUCTION

Respiratory tract infections represent the most common acute illness evaluated in the outpatient setting. These range from the common cold to life-threatening illnesses such as epiglottitis and pneumonia. These also account for nearly 3.9 million deaths every year globally. On the average, a child has five-to-eight attacks of respiratory infection annually.^{1,}

² Though mostly self limiting, they can be recurrent causing subsequent complications such as pneumonia, which burdens the children, their families and the society.

In 2004, the World Health Organization (WHO) reported the occurrence of pneumonia in developing countries to be at about 150 million episodes every year among children less than five years old, which accounted for more than 95% of all new cases worldwide.³ In 2006, A WHO Child Health Epidemiology Reference Group publication cited the incidence of community-acquired pneumonia among children younger than 5 years in developed countries as approximately 0.026 episodes per child year.⁴

The United Nations Children's Fund (UNICEF) estimated that three million children die worldwide from pneumonia each year. Although most of these fatalities occur in developing countries, like the Philippines, pneumonia remains a significant cause of morbidity in industrialized nations.³

According to the 2007 Field Health Service Information System of the National Epidemiology Centre Annual Report, Acute Lower Respiratory Tract Infections (ALRI) and pneumonia are the top leading causes of morbidity in the country with 605,471 cases and a rate of 718.0 per 100,000 population. In the Cordillera Administrative Region alone, ALRI and pneumonia remain to be the second most common cause of morbidity with 33,334 cases and a rate of 2192.0 per 100,000 population.⁵

At BGHMC, a local tertiary hospital, pneumonia has been reported to be the number one cause of morbidity and one of the top three causes of mortality among pediatric patients for six consecutive years or from 2002 to 2008.⁶

The etiology of pneumonia in an individual is often difficult to determine because direct culture of lung tissue is invasive and rarely performed. But nowadays, using state of the art diagnostic testing, a bacterial or viral cause of pneumonia can now be identified in 40%-to-80% of children with community acquired pneumonia (CAP). Among the bacterial causes of pneumonia, literature states that *Streptococcus pneumoniae* is the most common bacterial pathogen. Respiratory viruses, particularly influenza virus and respiratory syncytial virus (RSV) are the major pathogens especially in children less than three years old. According to Behrman, et al, viruses, are responsible for 45% of the episodes of pneumonia identified in hospitalized patients in Dallas.⁷ Influenza, RSV, adenoviruses and other viral infections increase the incidence of pneumonia, as well as, other lower respiratory tract infections that affect all ages; these, in turn, cause increased rates of consultations, hospitalizations and worse, mortality.

Community-acquired pneumonia has traditionally focused little on viral causes, and few studies have done an extensive and appropriate evaluation for viral cause. As previously mentioned, our institution has reported pneumonia to be the number one cause of morbidity among pediatric patients, all of whom have been treated for bacterial pneumonia. The epidemiology of viral CAP, however, has not been studied yet. It is from the results of the SARI surveillance, specifically the results of patients admitted in our institution that the data of this research was taken from. : to determine the prevalence of viral pneumonia among the pediatric patients admitted from May 2009 to April 2010 (where)

MATERIALS AND METHODS

A retrospective chart review was performed to provide data on the prevalence of viral pneumonia among pediatric patients admitted from May 2009 to April 2010 (indicate where). Inclusion criteria were: all patients' ages 0 to 18 years old admitted in the institution for pneumonia; those enrolled in the Severe Acute Respiratory Infection (SARI) epidemiological surveillance from May 2009 to April 2010; only patients admitted on Sundays or Wednesdays; those swabbed within 24 hours of admission (This is the schedule agreed upon by the involved groups on the oropharyngeal and nasopharyngeal swabbing at the institution for the SARI surveillance which is done during Mondays and Thursdays); those who recently have not taken any antiviral medications; and those who were not subjected to oropharyngeal or nasopharyngeal swabs prior to admission. The following is the case definition for SARI and thus were enrolled in the surveillance: 1) for children more than 5 years must have sudden onset of fever over 38°C, cough or sore throat, AND shortness of breathing or difficulty breathing, AND with hospital admission; for children less than 5 years old must have been clinically suspected of having pneumonia, severe or very severe pneumonia with hospital admission. Exclusion criteria include: (1) presence of severe immunosuppression; (2) on immunosuppressive therapy; (3) admitted due to aspiration pneumonia; (4) had prior admissions due to pneumonia within the previous month; and (5) no consent given. Records of pediatric patients admitted for pneumonia and enrolled in the SARI epidemiological surveillance (ANNEX 4) were reviewed. Data were collected when each chart was reviewed in accordance to the following: (1) baseline characteristics such as age, sex,

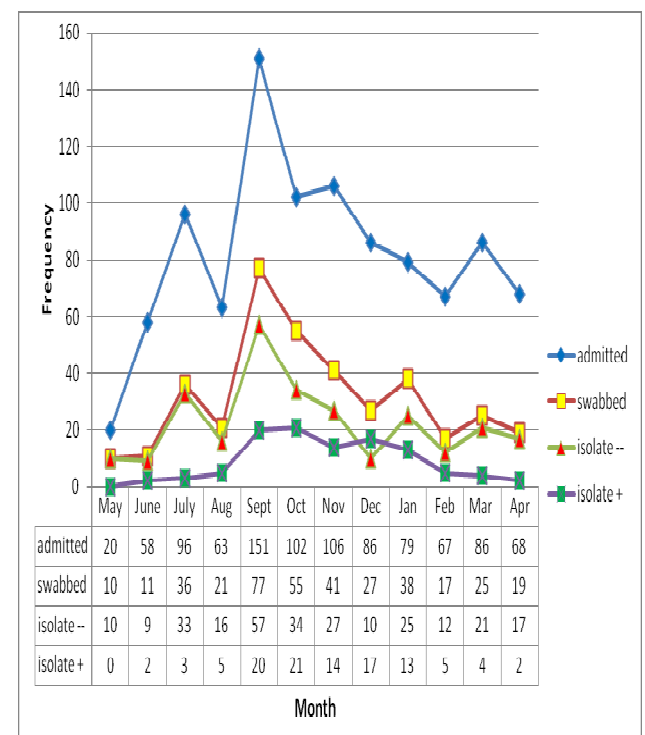
clinical symptoms, and co-morbid diseases; (2) course and length of hospital stay; and (3) outcome.

Statistical analysis included the frequency count denoting the number of cases. Values were also expressed in percentage denoting the ratio of the frequency to the total number of cases.

RESULTS

From May 2009 to April 2010, there were 982 patients admitted for pneumonia. Based on the schedule provided for swabbing, 377 (38.40%) patients were swabbed during the course of the study

Figure 1 shows the distribution of pneumonia cases from May 2009 to April 2010. One-hundred-six (28.1% of 377) were positive for viral isolates. The rate of admission for pneumonia started to increase in the month of July and it peaked on September 2009. The most number of cases with viral isolates were seen in the month of October which reported 21 cases (5.57%), and followed by the month of September which reported 20 cases (5.3%).



Of the 377 patients swabbed, there were 232 (61.5%) males and 145 (38.5%) females. Fifty-two percent (52.25%) of the patients who were swabbed belonged to the less-than-one year old age group. Age and sex distribution is shown in and Table 1.

TABLE 1. Age and Sex Distribution of Patients Who Were Swabbed (N=377)

AGE in yrs	Male (%)	Female (%)	Total
< 1	122 (32)	75 (20)	197 (52)
1	47 (12)	38 (10)	85 (22)
2	22 (6)	11 (3)	33 (9)
3	11 (3)	6 (2)	17 (5)
4	5 (1)	3 (1)	8 (2)
5	7 (2)	4 (1)	11 (3)
6 to 10	12 (3)	5 (2)	17 (5)
11 to 15	5 (1)	1 (<1)	6 (2)
16 to 18	1 (<1)	2 (<1)	3 (1)
Total	232 (62)	145 (38)	377 (100)

Of the 377 patients swabbed, 106 (28.1%) were positive for a viral isolate, and 271 (71.9%) had negative results.

Table 2 shows the different viruses isolated from the study population and their distribution according to sex.

TABLE 2. Sex Distribution of Patients with Confirmed Viral Isolates (N=106)

Isolate	Male (%)	Female (%)	Total (%)
RSV	58 (55)	35 (33)	93(88)
Flu A	1 (1)	3 (3)	4 (4)
Flu B	2 (2)	4 (4)	6 (6)
A(H1N1)	2 (2)	0	2 (2)
Flu B+RSV	1 (1)	0	1 (1)
Total	64 (60)	42 (40)	106 (100)

There were more females at 28.9% (42 of 145) than males at 27.5% (64 of 232) who were positive for a viral isolate. Among the viruses isolated, RSV was more common in males (54.72%); it was also the most prevalent among the viruses isolated with a total of 93 cases

(87.74%), followed by Influenza B (5.66%) and then by Influenza A (3.77%).

TABLE 3. Age Distribution of Patients with Confirmed Viral isolates (N=106)

Age in years	Viral Isolate					Total
	RSV	Flu A	Flu B	Flu A (H1N1)	Flu B+RSV	
<1	64	1	2	2	1	70
1	21	3	3	0	0	27
2	5	0	0	0	0	5
3	2	0	0	0	0	2
4	0	0	0	0	0	0
5	1	0	0	0	0	1
6	0	0	0	0	0	0
7	0	0	1	0	0	1
8 to 18	0	0	0	0	0	0
TOTAL	93	4	6	2	1	106

Sixty-six per cent (66%) of the total number of positive isolates came from the under-one age group, followed by the one-to-two years old age group (25.4%). Subjects less than one year old showed a higher detection rate of virus than the other age groups. On the other hand, there were no isolates noted in patients in the following ages: 4, 6 and 8 to 18 years old.

Figure 5 shows the associated signs and symptoms of patients included in the study. Aside from cough and fever, these are runny nose, difficulty of breathing (DOB), retractions, wheezes, tachypnea, and cyanosis. All subjects, whether positive or negative for a viral isolate, presented with cough, whereas, 79.2% of those who tested positive presented with fever, compared with 94.5% of the subjects who tested negative for a viral isolate. Moreover, there were more patients from the viral isolate negative group who presented with DOB (88.9%), retractions (90.4%) wheezing (38.4%), tachypnea (79.3%) and cyanosis (24.7%), when compared to patients with a confirmed viral isolate.

All patient were given antibiotics during their admissions. The antibiotics were given

depending on several factors such as age, severity of disease, and history of antibiotic intake prior to admission.

Figure 1. Comparison of Associated Signs and Symptoms among Children with Positive versus Negative Viral results

Figure 3. Comparison of the Duration of Hospital Stay among Children with Positive viral Isolates versus Negative Viral Isolates

A total of 46% of the patients from both groups were discharged after one-to-three hospital days. Although as shown in Figure 6, patients positive for a viral isolate had a shorter hospital stay compared to those who were viral isolate negative.

In summary, of the 377 patients swabbed, 106 (10.8%) patients were positive for viral isolates. One-hundred-five were sent home improved, while one (0.95%) with RSV died due to respiratory failure. On the other hand, out of the 267 patients who were negative for a viral isolate, three (1.1%) died due to respiratory failure and sepsis.

DISCUSSION

Community-acquired pneumonia is one of the most common serious infections in children, with an annual incidence rate of 2192.0 per 100,000 population in the Cordillera Administrative Region.⁵ Pneumonia has traditionally focused little on viral causes, and few studies have done an extensive and appropriate evaluation for viral cause. Viruses cause a large variety of respiratory diseases, which previously have been assumed to be bacterial only. Etiologic studies of viral infections are becoming increasingly important, with the emergence of new antiviral drugs, vaccines and viral subtypes. The introduction of better quality diagnostic tests, have markedly improved our ability to detect multiple viral pathogens.¹¹

Over the observation period of one year, 377 children were screened with an oro/nasopharyngeal swab for the presence of viruses. Of those who were screened, 106 (10.8%) had a positive viral isolate, and the rest of the population who had no isolates were presumed to be bacterial. As expected, rates of admission of pneumonia and SARI cases, as well as, the viral positivity rate increased during the rainy season and continuously increased until the cold months of January and February. The highest numbers of viruses isolated were in September and October of 2009. This correlates with the most number of SARI cases seen based on the SARI surveillance done in the city.

This seasonal correlation was also observed in a study done in Bhaktapur, Nepal by Klugman, et al, from July 2004 to June 2007. Nasopharyngeal aspirates from 2,230 cases of pneumonia in children 2-to-35 months were examined using a multiplex reverse transcriptase polymerase chain reaction (PCR) assay. The specimens were examined for RSV, influenza virus type A (Inf A) and B (Inf B), parainfluenza virus types 1, 2 and 3 (PIV1, PIV2, and PIV3), and human metapneumovirus (hMPV). From the specimens taken, 334 (15.1%) yielded RSV, 164 (7.4%) Inf A, 129 (5.8%) PIV3, 98 (4.4%) PIV1, 93 (4.2%) hMPV, 84 (3.8%) Inf B, and 17 (0.8%) PIV2. The largest peaks of pneumonia occurrence coincided with peaks of RSV infection, which occurred in epidemics during the rainy season and in winter.¹²

Aside from the season, the increase in morbidity may also be due to improved case finding and reporting.

Sixty-six percent of the total number of positive isolates came from the under-one age group, which is comparable to the surveillance report of the RITM in 2006 where majority of the isolates were from the under-two age group: these accounted for 37.3% of the total number of positive isolates; these were followed by the two-to-five age group (35.9%).¹⁰ Results of the

SARI surveillance from April 2009 to April 2010 done in the city also showed that the most number of SARI cases belonged to the under-one age group (32.64%), followed by children aged one-to-two years old (16.5%).¹³ Similar results are noted in a study in France, done from 2001-2004 to assess the prevalence of RSV and other important respiratory viruses in children aged eight days to 16 years. Results revealed that a virus was found in 464 of 1208 patients. RSV was isolated more often than any other virus. It was identified in 375 patients, 74% of them younger than 6 months and diagnosed with bronchiolitis. In patients aged 24 months or older, influenza and RSV were identified in the same frequency. Overall, influenza virus was found in 53 patients, adenoviruses in 24 and para-influenza viruses in 11.¹⁴ These observations may be due to the greater incidence of infection with respiratory pathogens as a whole in these age groups.¹⁵

With modern diagnostic tools, viral causes can be established in patients with pneumonia. In this study, the viruses identified were RSV, influenza A and B virus, and the novel Influenza AH1N1. RSV was the most frequent (87.7% of isolates or 24.67% of swabbed patients), with the under one age group having the most (60.4%), which is similar to studies done in several Asian countries, where RSV was the most frequent isolate among the pediatric age group.^{12,16,17} A study done in China showed that RSV was also the most frequent (19.3%) and which showed a higher detection rate (71.3%) of virus for infants aged 1 to 6 months than the other age groups.¹⁶

Influenza B was the second most common virus which was isolated in six patients (1.59%), three of whom were one year old. Influenza A was the third most common with four cases (1.06%). These are similar to the SARI surveillance reports from April 2009 to 2010 in the locality where Flu B (1.37%) and Flu A (1.15%) are the second and third most common isolates, respectively.¹³

Other isolates found were A (H1N1) with two cases (0.53%), and one case where two viruses were isolated (Flu B and RSV). Several studies also mention having mixed infections in cases of viral pneumonia.^{14, 15, 18}

Patients with pneumonia usually present with a constellation of symptoms and signs that include cough, dyspnea, and fever, although nonrespiratory symptoms such as vomiting, poor oral intake, and seizures may also predominate. Classically, it has been considered that signs and symptoms cannot predict the etiologic agent.¹⁹ In this study, aside from fever and cough, patients also presented with several signs, all of which were seen more in the viral isolate negative group: retractions, wheezes, tachypnea, and cyanosis. Although some clinical findings may be more frequent with a viral infection like wheezes, no clear-cut clinical signs have been shown to be predictive of specific cause.

During their hospital stay, three (2.8%) of those with a viral isolate were intubated compared to ten patients (3.6%) who were seen negative for a viral isolate. In terms of duration of hospital stay, a larger percentage of patients with a viral isolate (58.5%) were discharged after one-to-three hospital days compared with those who were isolate negative (45.8%), although discharges of patients after more than three hospital days were noted to be higher in the negative group.

CONCLUSIONS

In this study conducted from May 2009 to April 2010, nasopharyngeal aspirates of patients admitted for pneumonia were screened for viral isolates. A total of 377 (38.40%) patients were swabbed. There were more males than females who were swabbed (61.56%) and who were positive for a viral isolate (60.3%). Most of the patients who were swabbed belonged to the <1 year old age group (52.25%). From the specimens taken, 106 (28.1%) virus isolates were noted and RSV was the most common.

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