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## Major article

# Health care–associated respiratory infection surveillance among Chinese children with cerebral palsy



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**Key Words:**

Cerebral palsy  
Health care–associated infection  
Respiratory tract infection  
Cost

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**Background:** To explore the characteristics and distribution of hospital length of stay (LOS) and direct hospitalization costs of children with cerebral palsy (CP) affected by health care–associated infection (HAI).

**Methods:** A prospective observational study was performed from March 2010 to February 2012 on HAI cases among hospitalized children with CP. Demographic, clinical, and HAI data were recorded. Mann-Whitney test, chi-square test, and multiple linear regressions were used for data analysis.

**Results:** Of 528 patients with CP, 151 (28.6%) suffered HAI in the form of respiratory tract infection. Male to female ratio was 2.87. About 50 patients had recurrent HAI. Upper respiratory infection and pneumonia were common infections. HAI occurring more than once contributed mainly to total LOS, and the length of HAI was >10 days in >50% of patients. Frequency of HAI was an independent predictor of LOS, and frequency of HAI and LOS were independent predictors of hospitalization costs.

**Conclusion:** Health care–associated respiratory infection significantly impacted LOS and total cost of children with CP admitted for rehabilitation. These data should assist in establishing preventive and control measures for HAI to help improve the quality of rehabilitation and survival in the long run.

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## INTRODUCTION

Cerebral palsy (CP) is a disorder of movement and posture that eventually limits activity. It is nonprogressive and attributed to insult to a developing brain in fetuses or infants, and the disability begins in early childhood and persists through the lifespan.<sup>1</sup> Despite improved obstetric techniques and advances in neuroimaging, the rate of CP has not declined; however, survival has improved. Because of the inadequate community medical services in China, most patients with CP have to be rehabilitated in hospitals.

Health care–associated infection (HAI) is one of the most common complications in hospitalized disabled patients, which may increase consumption of resources and add to cost. An HAI rate of 5%–20% has been reported.<sup>2,3</sup> Additionally, infection in children with CP impedes rehabilitation, impacts quality of life, and results in substantial economic burden from prolonged hospital stays and the need of additional diagnostic procedures and interventions.<sup>4</sup> The economic burden is not only to the health care sector, but it also extends

to patients and those who care for them. On average, HAI-affected patients remained in hospitals 2.5 times longer and had incurred hospital costs almost 3 times higher than uninfected patients.<sup>3</sup>

Respiratory tract infection (RTI) is the most frequent HAI in pediatric wards, especially among those with CP. RTI prolongs hospital stay and places a huge burden on patient safety and affects quality of life.

The objective of the present study was to identify the predisposing factors for HAI, distribution of hospital length of stay (LOS), and related costs in children with CP to encourage effective preventive measures for controlling HAI and improving quality of life.

## METHODS

### Participants and therapy

The present study was conducted in The First Affiliated Hospital of Henan College of Chinese Traditional Medicine from March 1, 2010, through February 29, 2012. This prospective observational study covers the annual respiratory virus epidemic.

All children with CP admitted in the hospital were research subjects. About 3–4 children share 1 room with their parents or caregivers. Patients were enrolled in the study according to the

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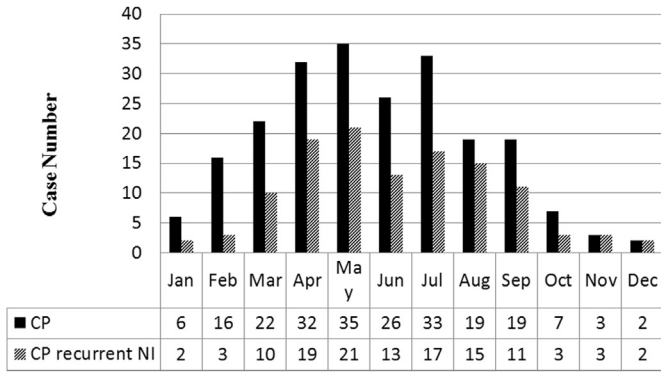


Fig 1. Month-wise distribution of HAI among patients with CP.

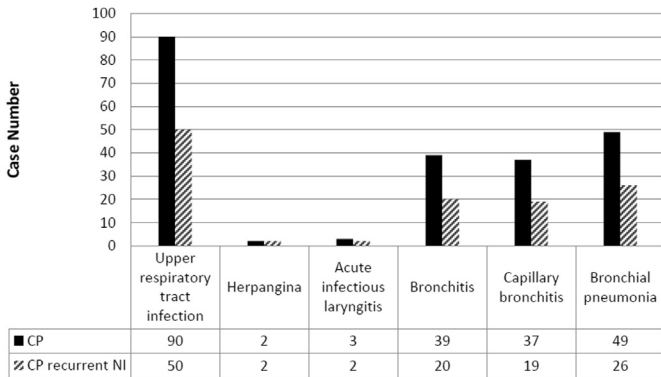


Fig 2. Distribution of hospital-associated RTI in patients with CP (person-time = 119).

Table 1  
Distribution of LOS of patients with CP who acquired HAI (n = 151)

Characteristics	Case (%)	LOS			Total LOS (%)	P value
		Mean	Median	Range		
Sex						.640
Male	112 (74.2)	77.5	63.0	11-308	8,686.0 (76.0)	
Female	39 (25.8)	70.5	63.0	18-210	2,750.0 (24.1)	
Age (mo)						.16
<1 y	96 (63.6)	71.4	60.0	16-210	6,854.0 (59.9)	
1-3 y	46 (30.5)	79.5	72.0	11-162	3,661.0 (32.0)	
>3 y	9 (6.0)	102.3	81.0	18-308	921.0 (8.1)	
Frequency of HAI						.000*
Once	101 (66.9)	65.2	59.0	11-308	6,585.0 (57.6)	
Twice	36 (23.8)	85.1	84.0	31-169	3,066.0 (26.8)	
3 times	9 (6.0)	117.0	103.0	63-177	1,053.0 (9.2)	
4 times	5 (3.3)	153.8	155.0	104-210	769.0 (6.7)	
Length of HAI						.001†
≤10 d	84 (55.6)	66.1	59.5	11-169	5,554.0 (48.6)	
>10 d	67 (44.4)	87.7	80.0	27-308	5,882.0 (51.4)	
Total	151 (100.0)	75.7	63.0	11-308	11,436.0 (100)	

\*Significant difference in proportions with the Kruskal-Wallis test, P < .01.  
†Significant difference in proportions with the Mann-Whitney test, P < .01.

following criteria: confirmed CP cases, conforming to the criteria of HAI, and acquired RTI (including upper and lower RTI).

Patients who acquired RTI before hospitalization and those who had congenital lung malformations, lung tumor, known immunodeficiency diseases, and who received mechanical ventilation were excluded.

For HAI, the specific section would supervise the type, time of occurrence, duration, laboratory evidence, and therapy.

The admitted patients were diagnosed with CP by an experienced attending physician and assessed by both the chief physician and therapist who finally developed the treatment protocols. The treatment was based on the abnormality of postural asymmetry, movement, reflexes, and associated disorders of cognition or sensation. Physical therapy, occupational therapy, hydrotherapy, speech therapy, educational training, and some complementary medicine were in the schedule.

Consents from parents/guardians were obtained, and the study was approved by the hospital ethics committee.

Clinical definitions

CP was defined as children with disorders of development of movement and posture, causing activity limitation, that are attributed to nonprogressive disturbances that occurred in the developing fetal or infant brain. The accompanied disturbances of sensation, perception, cognition, communication, behavior, and epilepsy and secondary musculoskeletal problems were also assessed.<sup>5</sup>

HAI was defined as hospital-acquired infection appearing 48 hours after admission or within 72 hours after discharge.

RTI consisted of upper RTI and lower RTI, the latter included bronchitis and pneumonia.

Length of stay (LOS) was defined as the number of days in the hospital between the day of admission and discharge.

The cost per case was defined as the total costs the patient pays to the hospital during admission to discharge or death. This cost included bed charges, nursing charges, and cost of laboratory tests, drugs, and rehabilitation services.

Data collection

During hospitalization, the attending physician monitored the health status of patients. Demographics (eg, sex, age, hospitalization time, clinical diagnosis, treatments, data on HAI) were recorded.

Statistical analysis

SPSS version 17.0 software (Chicago, IL) was used for all statistical analyses. The relationship between LOS, sex, and duration of HAI were calculated using the Mann-Whitney test, and 2-sided P values were derived. Asymptotic significance between age and frequency of HAI was calculated using the Kruskal-Wallis test. To illustrate factors influencing LOS and costs, multiple linear regression was used. A 95% confidence interval was calculated for age (per year of age) and hospitalization time (per day of hospitalization time).

RESULTS

During the study period, 151 (28.6%) of the 528 patients with CP admitted to the pediatric ward suffered HAI in the form of RTI. There was no mortality. In 50 patients, HAI occurred more than once. The male to female ratio was 2.8 (112:39). The mean age (±SD) of patients was 12.9 ± 13.6 months, and 142 (94%) of the 151 patients were <3 years old. The mean length of HAI was 11.6 days.

More HAIs occurred in the months of April, May, and July than in the other months; the least number of HAI cases was recorded in December (Fig 1). Owing to recurrent HAI, 220 person-times in total were calculated. The length of NI ranged from 1 to 50 days. Upper RTI and bronchial pneumonia were the most common health care-associated RTIs (Fig 2).

The mean and median LOS of patients with CP were 75.7 and 63 days, respectively. The total LOS of patients with CP was 11,436 days. Of all the patients, male patients (74.2% of the patients with CP) had 76% of the total LOS, and children <1 year old (63.6% of the patients

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