

**Original Research**

# Study of the Application of Clinical Pathways in Varicella, Acute Bacillary Dysentery, Measles, Scarlet Fever, and Rubella

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In order to explore the clinical pathways that fit the actual situation of our country and department of infectious diseases, an analysis was performed to evaluate the effectiveness of clinical pathways for varicella, acute bacillary dysentery, measles, scarlet fever and rubella when compared with traditional standard medical care. Using a retrospective comparative study design, varicella, acute bacillary dysentery, measles, scarlet fever and rubella patients who were managed on a clinical pathway (clinical pathway group) were compared with a retrospective group of patients who received traditional medical care (control group) prior to the pathway's implementation. The following outcomes were measured: length of hospital stay, hospitalization costs. There was a significant reduction in the median hospitalization costs in the clinical pathway group patients in all five infectious diseases ( $P < 0.05$ ). The clinical pathway group's length of hospital stay for varicella, measles, acute bacillary dysentery and rubella were significantly shorter than the control group ( $P < 0.05$ ). The implementation of clinical pathways in varicella, acute bacillary dysentery, measles, scarlet fever and rubella might contribute to better quality of care and cost-effectiveness.

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**Key Words:** clinical pathway, varicella, acute bacillary dysentery, measles, scarlet fever, rubella

## INTRODUCTION

In the face of a changing health care environment, health care organizations must focus on improving outcomes while considering both quality of care and cost containment. Clinical pathways, also known as critical pathways, critical paths, care maps, and care paths, are a popular initiative to meet these challenges. They have gained multidisciplinary acceptance as tools intended to reduce costs while maintaining or improving quality of care. Such pathways were first developed for use in the manufacturing industry to identify and manage rate-limiting steps in production processes. Subsequently, pathways have been developed and used in many other areas, including medical care.<sup>1-3</sup>

Health outcomes research has previously focused on chronic disease states and disease states that contribute significantly to total healthcare costs such as asthma, coronary heart disease and diabetes.<sup>4-5</sup> In this study, we looked at the application and utility of clinical pathways in the management of five infectious diseases: varicella, acute bacillary dysentery, measles, scarlet fever and rubella. The details and results are reported as follows.

## METHODS

### General Data

This study was conducted at the Treatment and Research Center for Infectious Disease of 302 hospital of PLA. Using a retrospective comparative study design, varicella, acute bacillary dysentery, measles, scarlet fever and rubella inpatients who were managed via clinical pathways from April 2010 to January 2012 (clinical pathway group) were compared with a group of patients who received traditional medical care from January 2009 to March 2010 (control group) prior to the pathway's implementation. This study was conducted in accordance with the declaration of Helsinki and approval from the Ethics Committee of 302 Hospital of PLA. Written informed consent was obtained from all participants. The diagnostic criteria for varicella, acute bacillary dysentery, measles, scarlet fever and rubella were in accordance with Practice of Infectious Diseases, 3rd edition (People's Medical Publishing House) and are listed as follows:

- Acute bacillary dysentery: epidemiological data (ate food or drank water contaminated with the bacteria); clinical features (acute onset of fever and diarrhea, abdominal pain, frequent passage of blood and mucus, tenesmus, tenderness of left lower quadrant abdomen); isolated shigellae from feces by bacterial culture.

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- Rubella: acute onset of generalized maculopapular rash, fever, arthralgia, arthritis, lymphadenopathy, or conjunctivitis; epidemiological exposure to a laboratory-confirmed case of rubella; positive serologic test for rubella immunoglobulin M (IgM) antibody determination.
- Measles: history of fever for at least three days with at least one of the three C's (cough, coryza, conjunctivitis); typical measles rash or Koplik's spots; serologic positivity for measles IgM antibodies.
- Varicella: typical early "prodromal" symptoms; characteristic rash; positive serologic test for varicella IgM antibodies.
- Scarlet fever: (1) fever, sore throat, characteristic rash; (2) contact history with scarlet fever or pharyngitis/angina patient; (3) marked leukocytosis with neutrophilia and conserved or increased eosinophils; (4) positive throat culture of group A  $\beta$ -hemolytic streptococcus.

### Methods

A clinical pathway management team was established to create and strictly implement clinical pathway charts which define the process of medical treatment and nursing requirements for varicella, acute bacillary dysentery, measles, scarlet fever and rubella. Hospitalization education was the first part for patients of clinical pathway group when they were hospitalized. The hospital education provides a variety of oral verbal suggestions and written instructions that help normalize hospital stays for patients. Informed consent is obtained using a short form consent process. Medical history taking, physical examination, higher authority physician's ward round and explanation of clinical pathway contents came next. Data with variation were recorded. The patients were withdrawn from clinical pathway management when negative variation happened.

The team consisted of a chief physician, a deputy chief physician, two responsible physicians, a head nurse and a responsible advanced nurse practitioner. Responsible physicians were in charge of executing medical treatment pathways and the nursing staff was in charge of implementing clinical and nursing pathways. The chief physician and the head nurse supervised the quality of treatment protocols and nursing, including complication observation, basic nursing and health education.

A clinical pathway chart included the following 10 aspects: medical treatment measures, estimation of the severity of the disease as well as patient's sex and age, examinations and assays, activities (requirement for inpatients: bed rest, avoid exercise and strenuous exercise), treatment and nursing, diet, education, monitoring, discharge planning, and medical care results.

Compared to traditional medical care methods, the management team removed vitamin preparations and immunomodulators like thymosin and other medicines which lacked EBM to prove beneficial to the treatment but were applied in the past. From January 2009 until now, the

overnight cost, daily charges and relevant medicine prices have not been adjusted in our Hospital. Monitoring and specific treatment modalities were recorded as follows:

- Varicella clinical pathway group: intravenous drip of acyclovir at 5 mg/kg/time, q8h; liver protecting therapy for hepatic dysfunction via intravenous administration of 150 mg diammonium glycyrrhizinate once daily for adults and an appropriate dose reduction for children; antipyretics like paracetamol *were considered* when the temperature reached 38.5° C or above. Monitoring and testing utilized routine examination of blood, urine and stool samples, liver function tests and IgM anti-varicella-zoster virus serology.
- Measles clinical pathway group: radix isatidis granules 10g twice daily for adults and an appropriate dose reduction in children; a half dose of antipyretic like paracetamol *was considered* when the temperature reached 38.5° C or above; multiple doses of compound glycyrrhiza oral solution were given to patients who suffered from severe cough, symptomatic aerosol inhalation was provided: chymotrypsin 400U, hydrocortisone 25 mg and normal saline 30ml were divided into three doses; fluid infusions included ORS or intravenous fluids and 3g smecta three times daily for patients with diarrhea and dehydration (defined by no less than five episodes of diarrhea accompanied by dry mouth and hypouricrinia), and an appropriate dose reduction in children; eyedrops of rifampicin were administered several times for increased eye secretions and congestion; liver protecting therapy for hepatic dysfunction via intravenous administration of 150 mg diammonium glycyrrhizinate once daily for adults and an appropriate dose reduction for children. Monitoring and testing utilized routine examination of blood, urine and stool samples, function tests of liver and kidney, IgM anti-measles virus serology, and PA chest x-ray.
- Rubella clinical pathway group: radix isatidis granules 10g twice daily for adults and an appropriate dose reduction in children; antipyretics like paracetamol *were considered* when the temperature reached 38.5° C or above. Monitoring and testing utilized routine examination of blood, urine and stool samples, liver function tests and IgM anti-rubella virus serology.
- Scarlet fever clinical pathway group: intramuscular injection of penicillin (2.4 million-4.8 million U daily for adults or 20 thousand-40 thousand U/kg daily for children) q12h or via intravenous drip at 50 thousand-200 thousand U/kg q8h for 10 days, erythromycin was used as an alternative therapy in patients allergic to penicillin; antipyretics like paracetamol *were considered* when the temperature reached 38.5° C or above. Monitoring and testing utilized routine examination of blood, urine and stool samples, and throat swab culture. Discharge medication: a 10 day course of amoxicillin dispersible tablets at 0.5-1g three to four times daily for adults, or 50-100mg/kg three to four times daily for children; erythromycin was used as an alternative therapy in patients allergic to penicillin: a 10 day course

at 1.6g daily divided into two to four oral doses for adults, or 15-25mg/kg divided into two oral doses for children.

- Acute bacillary dysentery clinical pathway group: intravenous drip of levofloxacin 0.2g twice daily for adults, or oral calcium fosfomycin tablets 50-100mg/kg divided into three to four daily doses for patients under the age of 18; alternatives included ceftriaxone 50-80mg/kg daily by intramuscular injection, or levofloxacin hydrochloride and sodium chloride 0.2-0.3g twice daily by intramuscular injection for 3 days. Antipyretics like paracetamol were considered when the temperature reached 38.5° C or above.

Discharge standards are listed as follows: **varicella** - normothermia, scabbed over rash, no emerging rash; **measles** - normothermia, deflorescence, quarantine period expiring; **rubella** - normothermia, deflorescence, expired isolation; **scarlet fever** - normothermia, deflorescence, 3 consecutively negative throat swab cultures; **acute bacillary dysentery** - normothermia, symptom resolution, 2 consecutively negative stool cultures.

Evaluation criterion: (1) average length of hospital stay; number of overnights; (2) average hospitalization costs; diagnosis and treatment expenses during hospitalization.

Evaluation results are presented by comparing the length of hospital stay and hospitalization costs between clinical pathway groups and control groups.

### Statistics Analysis

The statistical software SPSS 13.0 was used for data processing. Hospitalization costs data managed by the normality test did not fit a normal distribution, thus they were expressed as a median (quartile range), Md (QR); those data fitting a normal distribution were expressed as  $\bar{X} \pm S$  [mean±standard deviation]. The difference between both groups was managed by a nonparametric rank-sum test, the Mann-Whitney test. The comparison between clinical pathway and control groups' data fitting a normal distribution went through an independent-samples t-test with  $P < 0.05$  defined as statistically significant.

## RESULTS

### Baseline Characteristic and Variances

There were 506 inpatients involved and the baseline characteristics of each disease are presented in **Table 1**. There was no significant difference in the findings for gender, age, illness severity, admission day of illness course and other general characteristics between clinical pathway groups and control groups, so these data were comparable.

**Table 1.** The baseline characteristics of clinical pathway and control groups for each disease.

Disease		Clinical pathway group	Control group	Exclusion number of clinical pathway group	Exclusion rate
Varicella	Case load	201	104	21	10.45%
	Average age (years old, $\bar{X} \pm S$ )	20.30±7.36	19.23±6.38		
Measles	Case load	75	104	13	17.33%
	Average age (years old, $\bar{X} \pm S$ )	17.44±14.26	15.76±13.90		
Rubella	Case load	24	35	2	8.33%
	Average age (years old, $\bar{X} \pm S$ )	21.95±6.99	20.02±5.54		
Scarlet fever	Case load	73	39	4	5.48%
	Average age (years old, $\bar{X} \pm S$ )	6.59±3.20	6.38±3.84		
Acute bacillary dysentery	Case load	133	80	15	11.28%
	Average age (years old, $\bar{X} \pm S$ )	23.63±19.28	25.73±18.37		

As shown in **Table 1**, the exclusion rates of each infectious disease are all less than 20%. There were 21 records excluded from 201 cases of the varicella clinical pathway group: 8 with basic diseases (1 patient with cerebral palsy, 1 with medulloblastoma, 1 with severe anemia, 1 with favism, 3 with lymphoma and 1 with leukemia); 8 with complications (2 patients with liver injury, 3 with bronchopneumonia, 1 with electrolyte disturbance, 1 with urinary tract infection and 1 with EBV infection); 3 patients asked for early discharge; and 2 patients with final diagnosis of non-varicella.

There were 13 records excluded from 75 cases of the measles clinical pathway group: 1 with basic disease (pre-

hospitalization moderate skin scalding); 11 with complications (6 pneumonia cases, 4 liver damage and 1 fungal infection); and 1 asked for early discharge.

There were 2 records excluded from 24 cases of the rubella clinical pathway group: 1 with psoriasis and 1 with drug eruption.

There were 4 records excluded from 73 cases of the scarlet fever clinical pathway group: 1 with electrolyte disturbance and bronchopneumonia, 1 with a basic disease (indirect inguinal hernia) and insufficient course of treatment, 2 asked for early discharge, and 1 with paronychia (staphylococcus aureus infection).

There were 15 records excluded from 133 cases of the acute bacillary dysentery clinical pathway group: 5 with basic diseases (1 with coronary heart disease, 1 with coronary heart disease and uncontrollable diabetes mellitus, 1 with hypertension and diabetes mellitus, 1 with severe anemia, and 1 with hepatic hemangioma); 4 with moderate to severe electrolyte disturbances; 6 asked for early discharge with an insufficient course of treatment but obviously improved condition.

**Table 2.** Comparison of the costs between the clinical pathway and control groups for each disease (yuan)  $M_d(QR)$ .

Disease	Varicella	Measles	Rubella	Scarlet fever	Acute bacillary dysentery
Clinical pathway group	941.20(467.53)	760.49(379.17)	512.16(451.69)	853.91(330.55)	677.49(443.82)
Control group	2072.77(1857.24)	1244.99(902.84)	882.83(617.33)	1206.60(780.98)	784.78(696.04)
Z	-8.744	-6.530	-3.082	-5.370	-2.179
P	0.000	0.000	0.002	0.000	0.029

### Average Length of Hospital Stay

As shown in **Table 3**, the average length of hospital stay of varicella, measles, rubella, scarlet fever and acute bacillary dysentery clinical pathway groups were less than the control group. The clinical pathway management of varicella, for example, resulted in a decrease in the average length of

### Hospitalization Costs

As shown in **Table 2**, the hospitalization costs of varicella, acute bacillary dysentery, measles, scarlet fever and rubella clinical pathway groups were significantly less than the control group ( $P < 0.05$ ). Among the 5 diseases, hospitalization costs of the varicella group had the largest decrease by over 50%, from 2,072.77 yuan to 941.20 yuan.

hospital stay from 7.28 days to 5.98 days. The comparison between the 2 groups for varicella, measles, rubella, and acute bacillary dysentery was statistically significant ( $P < 0.05$ ). While there was a decrease in average length of hospital stay from 5.15 days to 4.97 days for scarlet fever, it did not reach statistical significance ( $P > 0.05$ ).

**Table 3.** Comparison of the length of hospital stay between the clinical pathway and control groups for each disease ( $X \pm S$ , days).

Disease	Varicella	Measles	Rubella	Scarlet fever	Acute bacillary dysentery
Clinical pathway group	5.98±1.82	3.87±1.54	3.36±1.22	4.97±1.50	3.34±1.22
Control group	7.28±2.17	5.38±2.24	4.57±1.58	5.15±1.90	3.84±1.31
t	5.233	4.509	3.025	0.517	2.342
P	0.000	0.001	0.004	0.607	0.020

### DISCUSSION

For a long time, public hospitals in China have been harshly criticized for their random prescriptions, high prices and inadequate medical resources. Doctors were wrongly encouraged to prescribe expensive or unnecessary drugs to patients, from which hospitals usually sought profits. People still bear a relatively heavy burden in covering their medical fees for infectious diseases. Treating infectious diseases efficiently and effectively is an essential criterion in gauging a country's healthcare level. Thus, it is an important task to find ways to improve management of medical treatment quality and provide better medical service in infectious diseases with lower prices and higher quality.<sup>6-10</sup>

Clinical pathways are an important means in the modern medical management, which gives consideration to both quality and efficiency. However, there is little literature available regarding the clinical pathway management in infectious diseases.<sup>11-15</sup>

Through this study, the implementation of clinical pathways in varicella, measles, rubella, scarlet fever and acute bacillary dysentery strongly suggests their application is of great practical significance as evidenced by the decrease in hospital costs and average length of stay.

In our study, medical staff were motivated to offer quality service and dispense prescriptions more reasonably, which reduced patients' burden. Except for the scarlet fever group

the median hospitalization costs and length of hospital stay were reduced significantly with clinical pathway management.

Healthcare costs decreased and the quality of infectious disease treatment improved. The reduction in the median hospitalization costs in this study was statistically significant. The implementation of clinical pathways resulted in higher quality, higher efficiency and a lower budget by properly allocating medical resources and controlling medical expenses appropriately. Clinical pathway management regulates medical behaviors and reduces unnecessary examinations and treatment.<sup>16-19</sup> Additionally, they help avoid excessive medical spending, which may effectively curb the practice of hospitals' relying on drug sales or medical instrumentation for income. In doing so, they establish a reasonable, effective and optimized medical service system.

As soon as patients were admitted to hospital, they were told about their treatment plan, including what to do for examination and treatment, what to expect, how long the treatment would be, and how much it would cost. This explanation provided transparency of the medical process to the patients. Patients also received a version of "clinical pathways for patients" everyday, which lists anticipated hospital stay, examination programs, responsibility of medical personnel, costs and other relevant details. This enhanced patients' participation and degree of satisfaction.

The communication and cooperation between doctors, nurses and medical technicians is of strategic importance for high-quality patient care and for creating a positive work environment for all health care professionals. In our study, the medical processes in the clinical pathway management groups were defined clearly, the communication and cooperation between medical and other staff were strengthened, and team spirit was improved. These factors resulted in improved time management, work efficiency, and helped alleviate bed shortages in our hospital via increasing bed turnover. It also created a cohesive team approach which helped defuse the difficulty of hospitalization.

Clinical pathway management may also be a way to improve the departmental management in hospitals. In our study, we noticed that clinical pathway management appeared to decrease unnecessary differences of medical care, decrease the incidence of technical accidents and play a positive role in medical training. Similarly, implementation of clinical pathway management, specifically a defined team approach, may decrease medical negligence or even medical malpractice resulting from differences in individual medical staff ability.

The overall purpose of this study was to improve outcomes of infectious disease entities by providing clinical pathway management to coordinate care, reduce fragmentation and ultimately costs. Our results demonstrate that it is possible to achieve this goal. Compared with traditional standard medical care, our study suggests the implementation of clinical pathways will contribute to better quality of care and cost-effectiveness. Although controversial elements still exist, we think that clinical pathways can have a positive impact on the quality in infectious disease care.<sup>20-25</sup>

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#### CONFLICT OF INTEREST

The authors have no conflict of interest to disclose.

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