Acute Diarrhea in Under Five-Year-Old Children Admitted to King Mongkut Prachomklao Hospital, Phetchaburi Province

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Abstract

A prospective epidemiological and clinical study of acute diarrhea in children under 5 years old was done at King Mongkut Prachomklao Hospital in order to provide baseline data for health officers to make a strategic plan to reduce the diarrheal mortality and morbidity, which is one of the mid-decade goals for children. There were 105 cases of acute diarrhea patients admitted to the Pediatric ward between May 1995 and April 1996. Seventy-six per cent of them were in the younger age group (>1 month - 2 years old) while 23.8 per cent were in the older age group (2 - 5 years old). Causative pathogens were identified in 64 patients (61%). Younger patients had a higher percentage of identifiable pathogens (66.7%) than older patients (44.4%). Rotavirus was the most common pathogen isolated (17.2%). The other common pathogens identified were *Eschericia coli* (14.1%), *Campylobacter jejuni* (14.1%), *Shigella* (12.5%), *Entamoeba histolytica* (7.8%) and *Salmonella* (3.1%). Mixed infections were reported in 31.3 per cent of these patients. Clinical presentations and stool characteristics were difficult to distinguish from most of the pathogens. However, Rotavirus was highly suspected if a younger child presented with fever, watery to loose stool with the predominant symptom of vomiting. Mucous, mucous-bloody stool gave a clue to the diagnosis of *Shigella* and *Entamoeba histolytica*. Most cases had at least mild to moderate dehydration, so oral rehydration solution (ORS) was successfully given in only 31.4 per cent of patients. Antibiotics were prescribed to 51.4 per cent of patients in this study. Healthcare personnel should emphasize to parents and caretakers about good hygienic behavior to reduce the episodes of diarrhea and the use of ORS every time when their children have diarrheal episodes to reduce the disease severity.

Acute diarrhea is one of the major public health problems in children in Thailand. It ranks first for morbidity in children under 5 years old and ranks second for mortality[1]. The overall incidence of acute diarrhea has increased every year from 800/100,000 population in 1984 to 1,489/100,000 population in 1993. The incidence is highest in children under 5 years old, 5,804/100,000 population. The mortality rate ranges from 0.05-0.07 per cent[2]. Diarrheal illness, most of it attributable to infection

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by a wide variety of enteropathogens, including bacteria, viruses and parasites. The common causative agents of gastroenteritis are[3]

Bacteria : *Aeromonas* sp., *Campylobacter jejuni (C. jejuni), Clostridium deficile, Escherichia coli (E. coli), Plesiomonas shigelloides, Salmonella, Shigella, Vibrio cholerae, Vibrio parahemolyticus, Yersinia enterocolitica*

Viruses: Astrovirus, Calcivirus, Coronavirus, Enteric adenovirus, Norwalk virus, Rotavirus

Parasites : *Cryptosporidium, Cyclospora* spp., *Entamoeba histolytica (E. histolytica), Giardia lamblia, Isospora belli* and *Strongyloides stercoralis.*

Clinical manifestations depend on the organism, host and the environment. A presumptive etiologic diagnosis can be made from epidemiologic clues, clinical manifestations, physical examination and knowledge of pathophysiologic mechanism of enteropathogens. The causative agents of acute diarrhea vary by geographic region.

The Government of Thailand and the Ministry of Public Health signed the declaration and plan of action adopted at the World Summit for Children, held in New York in 1990, and committed to develop national programs of action for achieving Child's Summit goals by the year 2000. Ten of these health goals was declared by Office of the Prime Minister and the Ministry of Public Health in January 1994, to be achieved by the year 1995. One of the mid-decade goals is to reduce the childhood acute diarrhea mortality by 50 per cent, morbidity by 25 per cent and increase the use of oral rehydration solution (ORS) to 80 per cent[4].

In Phetchaburi province, the incidence of acute diarrhea in under 5 year old children is high, 3,824/100,000 population[5], a little lower than the country figure (5,804/1,000,000 population)[2]. In order to reduce the diarrheal mortality and morbidity in children younger than 5 years old, (which is one of the worldwide and government's health policies), we planned this prospective study in order to find the specific epidemiological and clinical characteristics of diarrheal diseases in children in Phetchaburi province so that this baseline data would help physicians and healthcare providers to plan specifically for the prevention and treatment of acute diarrhea in children in Phetchaburi province and ultimately, we will reach this diarrheal health goal by the year 2,000.

MATERIAL AND METHOD

Subjects

Children who had acute diarrhea and were admitted to the pediatric ward at King Mongkut Prachomklao Hospital, Phetchaburi province from May 1995 to April 1996 and who fulfilled the following inclusion criteria were enrolled :

- age >1 month - 5 years
- had no other systemic diseases e.g. pneumonia,
- had no chronic underlying diseases
- parents or guardian agreed to participate in the study

Exclusion criteria

- had diarrhea symptoms for more than 3 weeks
- had other associated infections
- had chronic underlying diseases

All patients had history taking, physical examination and treatment by pediatricians at King Mongkut Prachomklao Hospital.

Stool specimen collection

Every patient would have first diarrheal stool specimen of at least 10 grams collected after admission to the ward and the specimens would be sent immediately to the laboratory and the specimens would be prepared for

- Light microscope to look for parasites : *E. histolytica, Giardia lamblia,*
- Rotavirus using Rotalex (Latex agglutination test)
- Culture using the following media
  - Thiosulphate-Citrate-Bile-Salt (TCBS) media for *Vibrio cholerae, Vibrio parahemolyticus*
  - Sterile F broth for *Salmonella*
  - ✧ *Salmonella-Shigella* (SS) agar for *Salmonella, Shigella, E. coli* and others
  - ✧ XLD agar for *Salmonella, Shigella* and others
  - ✧ MSA (Manitol salt agar) for *Staphylococcus aureus*
  - ✧ Blood agar (by using special filter paper under microaerophillic condition) for *C. jejuni*

Data collection

All data was collected in special study forms for each patient.

Data Analysis

Descriptive data were expressed by per cent and proportion. Chi-square test with Mantel-Haenszel correction or Fisher exact test (if an expected cell was < 5) were used for categorial variable and Student *t*-test was used for continuous variables.

RESULTS

Demographic data

There were 105 diarrheal patients aged >1 month - 5 years old admitted to King Mongkut Prachomklao Hospital between May 1995 and April 1996 and enrolled in this study. The male to female ratio was 1 : 1. Eighty of them aged >1 month - 2 years (76.2%) and the male to female ratio was 1 : 1.2 while 25 patients aged 2-5 years (23.8%) and the male to female ratio was 1.5 : 1.

Etiologic agents

The etiologic agents of acute diarrhea could be identified in 64 patients (61%), 36 of them were male while 28 were female. The percentages of identifiable pathogens were not different between male (69.2%) and female (52.8%) patients (p=0.09). The percentage of identifiable pathogens was significantly higher in younger patients aged >1 month-2 years (66.7%) than in older patients aged 2-5 years (44.4%) (p=0.04).

Rotavirus was the most common pathogen found in this study and it was identified in 11 patients (17.2%). *E. coli* and *C. jejuni*, each was found in 9 patients (14.1%). *Shigella* was identified in 8 patients (12.5%), *E. histolytica* in 5 patients (7.8%) and *Salmonella* in only 2 patients (3.1%). Twenty patients (31.3%) had more than one etiologic agents identified. The incidence of Rotavirus, *E. coli, Salmonella, Shigella, E. histolytica* and mixed infections in male and female patients were not significantly different (p>0.05). *C. jejuni* was found significantly higher in male patients than in female patients (p=0.02).

There were no cases of *Aeromonas* sp., *Plesiomoas shigelloides, Vibrio cholerae, Vibrio parahemolyticus, Yersinia enterocolitica, Cryptosporidium, Giardia lamblia* and *Stongyloides stercoralis* identified in this study.

Among 20 patients with mixed infections, 18 (90.0%) had 2 pathogens identified and 2 (10.0%) had 3 pathogens identified. There were no specific pathogens in mixed infections. All pathogens were found frequently in mixed infections. There was no difference between male (9) and female (11) in the incidence mixed infections (p= 0.25).

Each of the diarrheal pathogens identified were not significantly different between the younger (>1 month-2 years old) and older (2-5 years old) patients (p>0.05) (Table 1).

Table 1. Number and percentage of pathogens classified by age.

Pathogen	>1-24 mo.	>24-60 mo.	Total (%)	p-value
Rotavirus	10	1	11 (17.2)	0.51
E. coli	9	0	9 (14.1)	0.23
Salmonella	2	0	2 (3.1)	0.73
Shigella	6	2	8 (12.5)	0.32
C. jejuni	8	1	9 (14.1)	0.62
E. histolytica	4	1	5 (7.8)	0.55
Mixed	15	5	20 (31.3)	0.13
Total	54	10	64 (100.0)	

Clinical manifestations

The average duration of diarrheal symptoms before admission to the hospital were 2.6 ± 0.9 days (range 1-4 days) for Rotavirus, 2.1 ± 1.4 days (range 1-5 days) for *E. coli*, 2.0 days for *Salmonella*, 1.8 ± 1.2 day (range 1-4 days) for *Shigella*, 1.7 ± 0.9 days (range 1-4 days) for *C. jejuni*, 1.8 ± 0.4 days (range 1-2 days) for *E. histolytica* and 2.2 ± 1.6 days (range 1-6 Days) for mixed infections. The average duration of diarrheal symptom for patients with non-identifiable pathogens was 2.9 ± 3.2 days (range 1-15 days). There were no significant differences between the duration before admission for these various pathogens (p>0.05).

In this study, 92.2 per cent of acute diarrheal patients had fever (50% low grade and 42.2 per cent high grade fever). Most patients with Rotavirus, *Shigella, C. jejuni, E. histolytica* and mixed infections had fever while about half of patients with *E. coli* and *Salmonella* had fever. Eighty per cent of patients with E. histolytica and about half of patients with Rotavirus, *Salmonella* and mixed infections tended to have high grade fever (Table 2).

Dehydration was found in 84.4 per cent of acute diarrheal patients (75% mild to moderate, 9.4% severe dehydration) (Table 2).

Table 2. Clinical signs and symptoms in acute diarrheal patients who had identifiable pathogens.

Signs & Symptom	Rota (%) n = 11	*E.coli* (%) n = 9	*Salmonella* (%) n = 2	*Shigella* (%) n = 8	*C. jejuni* (%) n = 9	*E. hist* (%) n = 5	Mixed (%) n =20	Total (%) n = 64
Fever	10	6	1	8	9	5	20	59
	(90.9)	(66.7)	(50.0)	(100.0)	(100.0)	(100.0)	(100.0)	(92.2)
-Low	4	4	0	7	7	1	9	32
	(36.4)	(44.4)		(87.5)	(77.8)	(20.0)	(45.0)	(50.0)
-High	6	2	1	1	2	4	11	27
	(54.5)	(22.3)	(50.0)	(12.5)	(22.2)	(80.0)	(55.0)	(42.2)
Abdo. pain	0	0	0	2	1	1	10	14
				(25.0)	(11.1)	(20.0)	(50.0)	(21.9)
Vomiting	8	4	1	3	3	2	5	26
	(72.7)	(44.4)	(50.0)	(37.5)	(33.3)	(40.0)	(25.0)	(40.6)
Dehydration	8	6	2	8	9	4	17	54
	(72.7)	(66.7)	(100.0)	(100.0)	(100.0)	(80.0)	(85.0)	(84.4)
-moderate	7	6	1	8	9	3	14	48
	(63.6)	(66.7)	(50.0)	(100.0)	(100.0)	(60.0)	(70.0)	(75.0)
-severe	1	0	1	0	0	1	3	6
	(9.1)		(50.0)			(20.0)	(15.0)	(9.4)

Vomiting and abdominal pain were found less frequently, 40.6 per cent and 21.9 per cent respectively (Table 2). A few patients with *Shigella, C. jejuni, E. histolytica* and half of patients with mixed infections had abdominal pain while patients with Rotavirus, *E. coli* and *Salmonella* did not complain of it. Patients with Rotavirus had a higher incidence of vomiting (72.7%) ($p<0.05$) than other patients.

Younger patients (aged >1 month-2 years) with or without identifiable pathogens had no significant difference in the symptom of abdominal pain compared to older patients (aged 2-5 years), 7.4 per cent *vs* 20 per cent and 38.5 per cent *vs* 13.3 per cent, respectively ($p=0.31$ and 0.46). Abdominal pain was found more often in patients without identifiable pathogens than in patients with identifiable pathogens (29.3% *vs* 9.4%) ($p=0.01$).

Characteristic of stool

Most patients with Rotavirus, *E. coli, Shigella, C. jejuni* and patients with no identifiable pathogens had watery to loose stool. Two *Salmonella* patients had loose stool. All patients with *E. histolytica* had mucous and mucous-bloody stool. Patients with mixed infections had all kinds of stool, from watery, loose, mucous and mucous-bloody (Table 3).

Treatment

ORS was the only fluid treatment in 31.4 per cent of patients in this study. The rest of the patients (68.6%) had intravenous fluid administration.

Antibiotics were prescribed initially in 54 of 105 patients (51.4%). Patients with Rotavirus, *E. coli, Salmonella, Shigella, C. jejuni, E. histolytica,* mixed infection and no pathogen identified received antibiotics 27.3, 55.6, 50, 62.5, 77.8, 80, 85 and 29.3 per cent respectively.

Duration in hospital

Patients who had ORS as the only fluid therapy had significantly shorter duration in hospital than patients who required intravenous fluid administration (2.3 *vs* 3.6 days, respectively) ($p < 0.05$).

DISCUSSION

There were 105 cases of acute diarrhea admitted to King Mongkut Prachomklao hospital during this one year study period. These cases represented more severe cases of childhood diarrhea that needed hospital admission. Among these admitted diarrhea cases, 76.2 per cent were children under 2 years of age. This higher incidence in younger children is the same as reported by Waravid et al[6] and Harikul et al[7]. There is no sex dif-

Table 3. Characteristic of stool in acute diarrheal patients.

Pathogen	Watery (%)	Loose (%)	Mucous (%)	mu.+bl. (%)	mu.+loo (%)
Rotavirus	3	7	1	0	0
n = 11	(27.7)	(63.6)	(9)		
E. coli	5	3	1	0	0
n = 9	(55.5)	(33.3)	(11.1)		
Salmonella	0	2	0	0	0
n = 2		(100.0)			
Shigella	1	3	1	3	0
n = 8	(12.5)	(37.5)	(12.5)	(37.5)	
C. jejuni	3	4	2	0	0
n = 9	(33.3)	(44.4)	(22.2)		
E. histolytica	0	0	4	1	0
n = 5			(80.0)	(20)	
Mixed	5	4	2	5	4
n = 20	(25.0)	(20.0)	(10.0)	(25.0)	(20)
No pathogen	10	20	9	0	2
n = 41	(24.4)	(48.8)	(22.0)		(4.8)

mu = mucous; loo = loose

ference in diarrheal patients (although there is a slightly higher male than female ratio in children 2 - 5 years old, male to female ratio was 1.5 : 1) as in other studies[6,7].

Causative infective agents were identified in only 61 per cent of patients. This figure may be lower than expected because in this study, only one stool specimen from each patient was sent to the laboratory. However, infections are the most common causes of acute diarrhea in children in Petchaburi as elsewhere in Thailand and in other developing countries[1,3,6,7].

Diarrheal pathogens were identified in younger children aged >1 month - 2 years (66.7%) more than in older children 2-5 years old (33.3%). The following reasons may explain why younger children are more susceptible to diarrhea than older children. Younger children sometimes introduce the infective agents from the environment into their mouth through their own hands and their host defenses are not as good as in older children, especially in formula-fed infants who do not receive additional secretory IgA and other protective factors from breast milk. In addition, formula-fed infants are more likely to have infections if their caretakers do not have good hygienic behavior e.g. do not boil the milk-bottles every time after use, do not wash their hands before preparing milk or food, do not wash their hands after going to the toilet,...

Rotavirus was the most common pathogen identified in this study and most of them were found in children less than 2 years as found elsewhere[3]. The other common pathogens were *E. coli, Salmonella, Shigella, C. jejuni* and *E. histolytica*. These pathogens were found both in male and female ; older and younger children with no difference in frequency except *C. jejuni* that was found more in males than females. This may be because male children have more chance to expose themselves to animal waste that contain *C. jejuni* than female children. Similarly, Phetchaburi children have a greater chance than Bangkok children to expose themselves to animal waste so that the incidence of *C. jejuni* is higher in Phetchaburi (14.1%) than in Bangkok (4-6%)[8]. The number of identifiable pathogens (64) in this study may not be large enough for us to see the differences between the causative diarrheal agents in younger and older age group patients.

It should be noted that many common diarrheal pathogens reported in other areas of Thailand were not found in this study, e.g. *Aeromonas* sp., *Plesiomonas shigelloides, Vibrio cholerae, Vibrio parahemolyticus, Yersinia enterocolitica, Cryptosporidium, Giardia lamblia and Strongyloid stercoralis*. This may reflect regional differences in the causative agents of acute diarrhea in children or we may have to increase our effort to find those pathogens especially *Giardia lamblia*, which is very common elsewhere in Thailand. Other common

infective pathogens that were not reported in this study included *Staphylococcus aureus* and *Clostridium deficile*. This is due to the lack of the toxin detection test to identify them.

In this study, 31.3 per cent of children had mixed infections. This is very high and has never been reported before. Most of these children had 2 pathogens identified, only 2 patients had 3 identified pathogens. The percentage of mixed infections in younger and older children are not different, but those 2 children who had 3 organisms identified were under 2 years old. *E. histolytica* and *Salmonella* which were found in 6 children with mixed infections might not be the causes of acute diarrhea in those patients. They may be asymptomatic cyst passers or excreters of those organisms. These patients with mixed infections should be carefully examined for the predisposing factors for diarrhea and followed for evidence of immune deficiency if there were recurrent or persistence of these multiple organisms.

The average duration of diarrheal symptoms before admission was not different among acute diarrheal patients in this study (range 1.7 - 2.9 days), no matter it the causative organisms were identified or not, no matter what the causative organisms were. Because the disease severity of all these diarrheal pathogens is not much different, this average duration before coming to the hospital may be due to the general feeling of mother and/or the caretakers that if their children had no improvement of diarrheal symptoms within a few days, they should take their children to the hospital.

ORS were given to only 42.9 per cent of patients before admission (data not shown) and 84.4 per cent of patients had mild to moderate dehydration on admission. This high percentage of patients with dehydration might be due to the lower than expected use of ORS by their parents and/or caretakers. However, ORS was successfully given to 31.4 per cent of patients after admission. Another 68.6 per cent of patients required intravenous fluid administration. The percentage of patients who received ORS only was less than expected because most of these cases were more severe and needed admission.

The average duration of hospitalization was less in patients who received only ORS as the fluid treatment, 2.3 days, compared to 3.6 days for patients who required intravenous treatment. Of course, this is because the patients who had ORS treatment only had milder illnesses.

ORS is the key to the success in reducing diarrheal morbidity and mortality so we should emphasize our team to give health education to mothers and caretakers about the use of ORS when their children have diarrhea and provide an oral rehydration (ORT) corner at the out-patient clinic (OPD) for observation of acute diarrheal patients, so that the severity of the disease, the admission rate and the need for intravenous fluid administration will be much less. More importantly, hygienic behavior should be stressed to parents and caretakers because this really prevents diarrheal diseases occuring in their children.

Clinical signs and symptoms of childhood diarrhea and characteristics of stool findings were not strikingly different between each causative pathogen. However, younger children with Rotavirus infections were easily recognized because most of them had fever and predominant symptoms of vomiting with watery to loose stool. *Shigella* and *E. histolytica* patients also had characteristic mucous or mucous-bloody stool with occasional abdominal pain. In some cases of *Shigella* diarrhea, if the patients came early, they would have watery to loose stool instead of mucous/mucous-bloody stool. These specific characteristic findings help physicians when considering antibiotic treatment, i.e. not giving in Rotavirus and giving in *Shigella* and *E. histolytica*. The rest of the pathogens that had no specific characteristic findings, *E. coli, Salmonella* and *C. jejuni* had no absolute indications for antibiotics. It should be emphasized here that fluid and electrolyte management is of utmost importance in the management of acute diarrheal patients, not the administration of the antibiotic.

In this study, most of the cases were prescribed antibiotics appropriately, 62.5 per cent for *Shigella*, 80 per cent for *E. histolytica* and 85 per cent in mixed infections. The cases in which antibiotics were questionable for their efficacy, were prescribed 55.6 per cent for *E. coli*, 50 per cent for *Salmonella* and 77.8 per cent for *C. jejuni*. The cases which had no antibiotic indications, were prescribed in only 27.3 per cent for Rotavirus and 29.3 per cent for non-identifiable pathogens.

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โรคอุจจาระร่วงเฉียบพลันในเด็กอายุ 5 ปี ณ โรงพยาบาลพระจอมเกล้า เพชรบุรี

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ได้ศึกษาระบาดวิทยาและอาการทางคลินิกของโรคอุจจาระร่วงเฉียบพลันในเด็กอายุต่ำกว่า 5 ปี ณ โรงพยาบาลพระจอมเกล้า จังหวัดเพชรบุรี เพื่อหาข้อมูลพื้นฐานในการที่จะวางแผนลดอัตราป่วยและอัตราตายของโรคอุจจาระร่วงเฉียบพลันในเด็ก อันเป็นการสนองนโยบายปีกึ่งทศวรรษพัฒนาเด็กไทย ระหว่างเดือนพฤษภาคม 2538–เมษายน 2539 พบมีผู้ป่วยเด็กอุจจาระร่วงเฉียบพลัน 105 ราย ร้อยละ 76.2 อายุ > 1 เดือน– 2 ปี ร้อยละ 23.8 อายุ 2 – 5 ปี สามารถหาสาเหตุของอาการอุจจาระร่วงได้ทั้งหมด 64 ราย คิดเป็นร้อยละ 61 ในเด็กกลุ่มอายุน้อยหาสาเหตุได้ร้อยละ 66.7 ซึ่งมากกว่าในกลุ่ม เด็กโตที่หาสาเหตุได้ร้อยละ 44.4 พบ Rotavirus เป็นสาเหตุที่พบมากที่สุดคือร้อยละ 17.2 เชื้ออื่นๆ ที่พบบ่อยได้แก่ *Eschericia coli* ร้อยละ 14.1 *Campylobacter Jejuni* ร้อยละ 14.1 *Shigella* ร้อยละ 12.5 *Entamoeba histolytica* ร้อยละ 7.8 *Salmonella* ร้อยละ 3.1 พบผู้ป่วยที่ติดเชื้อหลายชนิดร้อยละ 31.3 จากอาการอาการแสดงทางคลินิกและลักษณะของอุจจาระของผู้ป่วยไม่สามารถจะบอกได้ชัดเจนว่าเป็นการติดเชื้อเฉพาะชนิดใดชนิดหนึ่งได้ อย่างไรก็ตาม ถ้าผู้ป่วยอายุน้อยกว่า 2 ปี มีอาการไข้และถ่ายเป็นน้ำและมีอาการอาเจียนอย่างมาก ก็น่าจะคิดถึง Rotavirus และถ้าผู้ป่วยมีอาการถ่ายเป็นมูกปนเลือดก็ชี้บ่งถึงการติดเชื้อ *Shigella* และ *Entamoeba histolytica* ผู้ป่วยส่วนใหญ่ที่รับไว้ในโรงพยาบาลจะมีภาวะขาดน้ำระดับน้อยถึงปานกลาง ดังนั้นจะเห็นว่าการรักษาโดยให้สารละลายเกลือแร่รับประทานอย่างเดียว โดยไม่ต้องให้น้ำเกลือทางหลอดเลือดดำประสบความสำเร็จถึงร้อยละ 31.4 ในการศึกษานี้มีการให้ยาปฏิชีวนะในผู้ป่วยร้อยละ 51.4 การให้คำแนะนำแก่บิดามารดาและผู้ดูแลเด็กในเรื่องสุขอนามัยและความสะอาดในการเตรียมนมและอาหารสำหรับเด็กเป็นสิ่งสำคัญที่เราควรจะเน้น อันจะทำให้เราสามารถลดอัตราป่วยของโรคอุจจาระร่วงลงได้ นอกจากนี้การให้คำแนะนำในการใช้สารละลายเกลือแร่รับประทานในผู้ป่วยอุจจาระร่วงทุกรายจะช่วยลดความรุนแรงของโรคได้

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