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Original article

Acute diarrhea, a significant burden to Thailand's universal health care system: a nationwide database

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Background: The burden of acute diarrheal diseases is a major problem in Thailand. The mortality rate is 0.5% of admissions in the 2010 Nationwide Hospital Admission Data. Data from the Global Burden of Diseases, Injuries, and Risk Factors Study in 2010 showed that the mortality rate of diarrheal disease was 2.65% of all deaths globally.
Objectives: To examine the burden of adult acute diarrhea in Thailand using nationwide data in 2010.
Methods: There were 820,735 admissions of patients aged ≥19 years with a diagnosis of digestive diseases (ICD10-K00-K93) and acute diarrhea (ICD10-A09). About one-third of admissions (214,722 admissions; 26%) were for acute diarrhea with a mean patient age 51.5 (SD 15.3) years.
Results: Approximately two-thirds of the 214,722 admissions were for acute diarrhea (59%) in patients 19–60 years old, and the remaining 41% were elderly patients >60 years old. Approximately 0.5% of admitted patients (1,048 patients) died. The complications during hospitalization were septicemia (2.2%), mechanical ventilation (0.6%), and renal failure requiring hemodialysis (0.14%). The predictors of mortality were patients >60 years old at admission, male sex, and the presence of complications. The total cost for management of acute diarrhea in Thailand in 2010 was 905,784,298 baht or 30,035,807 USD for 214,722 admissions.
Conclusions: Acute diarrheal diseases accounted for 26% of the digestive diseases in the 2010 Thai nationwide data with high expenditure.

Keywords: Acute diarrhea, burden, database, Thailand, universal health care system

Diarrheal disease remains a major global health problem. Data from the 2010 Global Burden of Diseases, Injuries, and Risk Factors Study showed that there were 52.8 million deaths globally as a result of diarrheal diseases. The study also showed there was a reduced mortality rate for diarrheal disease that decreased from 2.5 million deaths in 1990 to 1.4 million deaths (2.65%) in 2010 [1]. Diarrheal disease results in high health care expenditures. A population based study from Germany showed that acute gastroenteritis accounted for 24.5 million outpatient visits [2]. Improvements of water and sanitation quality in developing countries showed a significant reduction in disease burden particularly in children <5 years old [3]. The mortality rate from gastroenteritis in the United States (US) from 19992007 averaged 39/1,000,000 person-years (11,255 deaths per year) and showed an increasing trend [4], especially in the elderly [5]. In Thailand, the Universal Health Care Act was passed in 2002 and is administered by the National Health Security Office (NHSO), an autonomous organization. The responsibility of the NHSO is to create health security for every Thai citizen, develop an easily accessed service system, and an effective information system for communication between hospitals and administrative health care teams. In 2010, there was a report on the burden of acute diarrhea in children <5 years old by the Thai Universal Coverage Schemes. This report showed there were 3.7 million episodes with 756,552 outpatient-visits and 124,403 admissions. The mortality rate in children was 1:77,685 (48 deaths) [6]. Data regarding diarrheal disease burden in Thai adults is not available. Therefore, we used the 2010 National Admission Data to determine the burden of acute diarrhea in Thailand. In addition, we explored disease outcomes including the mortality rate and complications of Thai patients with universal health care coverage.

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Materials and methods

Study design

This was a cross-sectional study of the inpatient medical expenses from the fiscal year 2010 Nationwide Hospital Admission Data (October1, 2009 and September 31, 2010) provided by the National Health Security Office (NHSO), Thailand. These data were derived from 815 district hospitals, 77 provincial hospitals and 36 hospitals in Bangkok.

Study population

This retrospective observational study was approved by the Institutional Review Board (IRB) of the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand (IRB. No. 464/57). We included data from hospitalized adult patients with a diagnosis of digestive diseases and intestinal infectious diseases coded by the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) (Infectious diarrhea: ICD10 A00-A09 and K00-K93). All patients from whom data was included were ≥19 years old, and their anonymity was protected. The patient baseline characteristics and clinical outcomes were analyzed according to the main health insurance schemes including Universal Coverage (UC), Social Security Fund (SSF), and Civil Servant Medical Benefits Scheme (CSMBSE). We analyzed the number of hospitalizations, mortality rate, complications, length of hospital stay, comorbidity, and medical expenses per hospitalization. All of these variables were recorded in the data management system of the NHSO.

Inclusion criteria

We included data from 4,863,935 admissions in the year 2010 and 747,709 from the 2010 Nationwide Hospital Admission Data provided by the National Health Security Office (NHSO) of Thailand. Of the 4,863,935 admissions in the year 2010, 820,735 (16.9%) were for a diagnosis of digestive diseases (ICD10-K00-K93) and acute diarrhea or infectious gastroenteritis and colitis, unspecified by ICD10-A09. About one-third of the diagnoses of digestive diseases and intestinal infectious diseases (214,722 admissions; 26%) were for acute diarrhea.

Study definitions

The 3 major health insurance systems in Thailand are the Universal Coverage (UC), Social Security Fund (SSF), and the Civil Servant Medical Benefits Scheme (CSMBSE). In 2010, the UC, CSMBS, and the SSS covered 76.8%, 12.7%, and 10.6% of all admissions for the 23 major ICD-10 diseases, respectively. The total number of hospitalized adults ≥19 years old was 3,876,792 patients and there were 4,863,935 admissions, which accounted for about 90% of hospitals in Thailand.

The primary care hospital is usually the first point of contact unit individuals seeking medical care and the medical services of health prevention and promotion [7].

The diagnosis of acute diarrhea and the comorbidities and complications were based on the ICD-10. The diagnoses, the comorbidities, and complications included the following: acute diarrhea: A09, coronary artery heart disease: I251; congestive heart failure: I500; chronic kidney disease stage1-5: N181-N185; chronic obstructive pulmonary disease (COPD), unspecified: J449; history of stroke, not specified as hemorrhage or infarction: I64; diabetes mellitus: E149; sepsis: A419; ICD9 procedure; renal failure requiring dialysis: 3995; respiratory failure requiring ventilation for <96 consecutive hours: 96.71; respiratory failure requiring ventilation for more than 96 consecutive hours: 96.72.

The outcome measurements were the mortality rate, the proportion of complications, the length of hospital stay, and the factors influencing mortality rate.

Statistical analyses

The patients were categorized into 3 groups according to their health insurance source, which were Universal Coverage (UC), Social Security Fund (SSF), and Civil Servant Medical Benefits Scheme (CSMBSE). The differences between the 3 groups were compared by using ANOVAs for continuous variables and were tested by the χ^2 test for proportions. Continuous outcomes are presented as the mean (standard deviation, SD), and categorical data are presented as numbers (%). In this study, two-sided $P < 0.05$ were considered significant. We used the SPSS statistical software package for Windows, version 13 (SPSS Inc, Chicago, IL, USA) for analysis.

Results

Baseline characteristic data of acute diarrhea patients

This study included 214,722 admissions for acute diarrhea in patients with a mean age of 51.5 (SD 15.3) years. The male to female ratio was 1:1.7.

Approximately two-thirds of admissions (59%) were for patients 19-60 years old, and the remaining of 41% were for elderly patients >60 years old. Additionally, approximately two-thirds of admissions (63%) were diagnosed and received treatment at primary care hospitals. Their baseline characteristics and comorbidities were classified into 3 groups according to their main health insurance schemes (**Table 1**). The majority of admissions (72%) were of patients in the Universal Coverage (UC) group, and 15% of patients were in the Social Security Fund (SSF) group. The remaining 13% of admissions were of patients were in the Civil Servant Medical Benefits Scheme (CSMBSE).

Clinical outcomes of acute diarrhea

During 1 year of follow-up, there were deaths in 1,048 admissions (0.5%). The mortality rate of patients in the UC and the CSMBSE group was higher than that for patients in the SSF group (0.6%, 0.6% vs 0.1%). The complications encountered during hospitalization were septicemia (n = 4675; 2.2%), on mechanical ventilation (n = 1249; 0.6%), and renal failure requiring hemodialysis (n = 294; 0.14%). The HIV infection rate was 1.4%. The mean length of hospital stay was 2.5 days. The patients who stayed in the hospital longer than 3 days varied from 14% in the UC group to 34% in the CSMBSE group (**Table 2**).

Predicting mortality

The patients who died (n = 1,048 admissions; 0.5% of total) were significantly older (age >60 years old on admission), were more often male, and had a higher rate of complications including congestive heart failure, septicemia, and respiratory failure ($P < 0.001$; **Table 3**). In addition, patients who died were admitted in secondary and tertiary level hospitals. These patients more commonly lived in central regions than those who survived ($P < 0.001$). The total cost for management of acute diarrhea in Thailand in 2010 was 905,784,298 baht or 30,035,807 USD for 214,722 admissions (140 USD per admission; exchange rate 1 Thai baht equals about 0.03316 USD (December 31, 2010 US Federal Statistical Release year end; rate fluctuates daily).

Table 1. The baseline characteristics and the comorbidities of patients with acute diarrhea classified into 3 groups according to their health insurance from the 2010 Nationwide Hospital Admission Data of Thailand

Group of patients with acute diarrhea (Total = 214,722 admissions)	Universal Coverage (UC) (n = 154,582)	Social Security Fund (SSF) (n = 32,402)	Civil Servant Medical Benefits Scheme (CSMBS) (n = 27,738)	*P*
Age, mean (SD) years	55.8 (18.7)	35 (10.5)	63.8 (16.6)	<0.001
Age >60 years (%)	45.3%	2%	60.9%	<0.001
Sex (%female)	63.7%	64.2%	62.7%	>0.05
Hospital (H) level (%)				<0.001
Community H.	75.7	2.5	62.3	
General H.	14.0	16.7	21.3	
Tertiary care H.	7.6	14.6	16.2	
Private H.	2.7	66.2	0.2	
Region				<0.001
Central	26%	75%	30.9%	
Northeast	40%	10%	35.6%	
Other	34%	15%	33.5%	
Comorbidities				
Atherosclerotic heart disease	0.2%	0.1%	0.6%	
Congestive heart failure	0.7%	0.1%	0.7%	
COPD	1.5%	0.1%	1.5%	
Diabetes Mellitus	0.2%	0.3%	0.4%	
Stroke	0.1%	0.0%	0.2%	

COPD = Chronic obstructive pulmonary disease

Table 2. The disease outcome including the mortality rate and complications of patients with acute diarrhea classified into 3 groups according to their health insurance from the 2010 Nationwide Hospital Admission Data of Thailand

Group of patients with acute diarrhea (Total = 214,722 admissions)	Universal Coverage (UC) (n = 154,582)	Social Security Fund (SSF) (n = 32,402)	Civil Servant Medical Benefits Scheme (CSMBS) (n = 27,738)	*P*
Outcome: death, n (%)	859 (0.6%)	31 (0.1%)	158 (0.6%)	<0.001
Complications n (%)				
Infection following procedures	19 (0.0%)	2 (0.0%)	4 (0.0%)	
Septicemia	3943 (2.6%)	145 (0.4%)	587 (2.1%)	
AKI Requiring HD	121 (0.1%)	26 (0.1%)	147 (0.5%)	
Respiratory failure on ventilator <96 h	627 (0.4%)	18 (0.1%)	209 (0.8%)	
Respiratory failure on ventilator ≥96 h	224 (0.1%)	11 (0.0%)	160 (0.6%)	
Length of stay (days)	2.3 ± 2.4	2.7 ± 1.7	3.7 ± 5.9	<0.001
Length of stay >3 days (%)	13.6%	15%	34.4%	<0.001
Hospital charge (baht)*	3529 ± 8199	6507 ± 9881	5387 ± 20870	<0.001

AKI = Acute kidney Injury, HD = Hemodialysis, *1 Thai baht equals about 0.03316 USD (December 31, 2010 US Federal Statistical Release year end; rate fluctuates daily)

Table 3. Multivariate logistic regression model showing odds ratios (OR) (95% confidence intervals, CI) of predictors for death in patients with acute diarrhea from the 2010 Nationwide Hospital Admission Data of Thailand.

Multivariate analysis; variables	OR	95% CI	*P*
Hospital level			
Secondary + Tertiary	2.9	1.8–4.6	<0.001
Primary	0.6	0.4–1.0	
Private	1		
Region			
Central	1.94		
Northern	1.27	1.5–2.6	<0.001
Northeast	0.80	0.9–1.7	>0.05
Southern	1	0.6–1.1	>0.05
Insurance Group			
Universal Coverage	3.1	1.9–4.8	<0.001
Government Welfare Medical Expense	2.6	1.6–4.2	
Social Security Fund	1		
Sex, male	1.6	1.4–1.9	<0.001
Age on admission >60 years old	1.8	1.52.2	<0.001
Length of stay >3 days	0.8	0.7–1.02	>0.05
Complications			
Congestive heart failure	2.7	1.6–4.5	<0.001
Septicemia	20.2	16.5–24.9	<0.001
Respiratory failure requiring continuous invasive mechanical ventilation	31.3	24.8–39.4	<0.001

Discussion

We found that the burden of acute diarrheal diseases is a major problem in Thailand and accounts for 26% of admissions for digestive diseases and intestinal infectious diseases. The mortality rate is 0.5% of admissions in the 2010 Nationwide Hospital Admission Data. Diarrhea is a major cause of death worldwide and accounts for 842,000 deaths in 2012. However, the death rates vary widely as shown in **Table 4** [8].

Table 4. The diarrheal disease burden and the pathogens

Authors, year/country	Number of patients with acute diarrhea	Age mean (SD)	Pathogen
Thomas et al., 2013/ Canada [27]	4.0 Million episodes/year of domestically acquired foodborne illness in 2006	No data	Norovirus (1 million), *C. perfringens* (177,000), *Campylobacter* spp. (145,000), nontyphoidal *Salmonella* spp. (88,000)
Wilking et al., 2013/ Germany [2]	0·95 Episodes/person per year during 2008–2009 or 64·9 million episodes/year	Median age 46 years (IQR, 35–60 years)	13.8% of population provided stool sample tests
Hou et al., 2013/China [26]	n = 800 in 20 hospitals (Beijing, Shaanxi), in 2001	37.0 (16.3) years	Stool culture for *Vibrio cholera* = 57.5% of patients, Stool culture for nonvibrio bacteria = 11.4%

The different incidence rates between the countries may be inherent in the study design and the data base resource, therefore the comparison of outcomes between countries is difficult. The low rate of HIV infection rate in our study may be a consequence of under-reporting because there was no policy to test anti-HIV infection for all hospitalization. The risk factors associated with high mortality include virulent bacterial pathogens (e.g., enteropathogenic *Escherichia coli*, *Vibrio cholera*), age <5 years old, being elderly, or having low health care accessibility [9, 10]. There is a high risk of fecal contamination in drinking water sources in developing countries [11]. Recent data confirm that 60% of 1.8 billion people are drinking contaminated water, which is determined by the presence of >10 *E. coli* or thermotolerant coliforms/100 mL [11]. Contaminated drinking water is prevalent in Africa and Southeast Asia (53% and 35%, respectively) [11]. One of our limitations is the lacking data on the results of bacterial cultures in data management systems of the NHSO, Thailand during the study period. Previous studies showed that several pathogens such as rotavirus and norovirus may play important roles in causing gastroenteritis in children <5 years old worldwide [12-15]. In adults, the common causes of bacterial infection leading to diarrhea were *Shigella* infection, *Campylobacter* spp., *Salmonella* spp., shiga toxin-producing spp., and *E. coli* [16, 17]. A study from Qatar used a new technology to identify acute gastroenteritis pathogens in 288 patients and found viral and bacterial pathogens were the two most common pathogen types (46% and 12%, respectively) [18]. These findings are consistent with our local data of stool cultures from tertiary care hospitals, e.g. Vichaiyut hospital in Bangkok, Thailand. Patients with acute diarrhea accounted for approximately 10% of all admissions in each year in this hospital and acute diarrhea was ranked as one of the most common inpatient diseases. The data for 10,931 stool culture specimens from Thai inpatients presenting with diarrhea during the 10-year period (2004-2013) at this hospital are shown in **Table 5**.

The results show that 21% of stool cultures contained bacterial pathogens. The most common bacterial pathogens were *Salmonella* spp., *Plesiomonas shigelloides*, *Aeromonas* spp., and *Vibrio* spp. Similarly, results from real-time polymerase chain reaction assays identified bacterial pathogens in 8.3% of patients compared with 5.6% of patients using culture techniques [17]. Recent information suggests that the policy of improving drinking water and sanitation may reduce the risk of diarrhea [8, 11, 19, 20]. Therefore, improving health-related behavior such as increasing proper hand washing with soap and running water before meals and after defecation, avoiding raw seafood, and not contaminating food by using the same chopping block or chop sticks when processing raw and cooked food may all reduce the occurrence of diarrhea [21].

Our data show that a higher proportion of patients with complications or severe acute diarrhea lived in the central region than patients that survived. This result may be explained by the geography of the central region of Thailand, which has major seafood sources and coastal provinces popular for tourism. The current

Table 5. Result of stool culture for bacteria during the 10-year period (2004–2013) from Vichaiyut hospital, Bangkok, Thailand (local data)

	Data from 2004-2014 (n = 10,931) n (% of stool culture of patients with acute diarrhea)	**Data 2010 (n = 1,270) n (% of stool culture of patients with acute diarrhea)**
Salmonella spp	711 (6.5%)	91 (7.2%)
Plesiomonas shigelloides	573 (5.3%)	92 (7.2%)
Aeromonas spp	538 (4.9%)	70 (5.5%)
Vibrio spp	504 (4.6%)	73 (5.7%)
Shigella sonnei	23 (0.21%)	4 (0.3%)
Edwardsiella tarda	9 (0.09%)	-
Shigella flexneri	5 (0.05%)	1 (0.1%)
Shigella boydii	2 (0.02%)	-
Total Identified pathogens (n; %)	**2,365 (21.6%)**	**331 (26.1%)**

management for acute diarrhea in Thailand does not recommend identifying the pathogen causing acute diarrhea in all patients. We recommend preventing the chance of infection by hand washing, eating properly cooked food, and promoting good hygiene. The long-term consequences of infectious diarrhea include symptoms of irritable bowel syndrome (IBS) and have been reported by approximately 10% of patients with IBS [22].

The disease outcomes of patients with acute diarrhea in the 3 different health care coverage programs in Thailand showed that patients in the SSF group had a lower mortality and shorter length of hospital stay. This result may be explained by the younger age of this group of patients. The economic burden of acute diarrhea in Thailand was high at 30,035,807 USD or USD 140 per admission. The cost of food borne disease in the United States is 1068-1626 USD per patient. However, this average range of costs includes the basic cost, the productivity loss, and functional disability [23]. Our results are consistent with previous data showing diarrheal deaths or poor outcomes had 6-fold higher average cost per admission than surviving patients. Based on the low mortality rate of 0.5%, we conclude that our national health care coverage program may reduce costs and improve the quality and accessibility of health care. A national policy in Thailand is to educate our health care team to identify patients with severe acute diarrhea at high risk, and rapidly provide these patients intravenous fluid rehydration, empirically prescribed antibiotics, and stool examination with culture [24]. These steps are especially critical for elderly or immunocompromised patients [25]. Recently, data from China showed that the prescription of antibiotics in adult patients with acute diarrhea was about 61%, and nearly half received an inappropriate prescription [26].

The main strength of our study is the inclusion of data from cases of diarrhea included in the 2010 Nationwide Hospital Admission Data, which represents the disease burden and clinical outcomes of a developing country in Southeast Asia. Our study has some limitations. First, only the data from the patient discharge summary were collected, and the summary was not designed to include the details of demographic data, clinical data, indication for hospitalization, or causative agents. Second, most of our patients in Social Security Fund were younger than those in other health insurance schemes, including the Universal Coverage, and the Civil Servant Medical Benefits Scheme. Thus, we cannot determine the reason for the different treatment outcomes. Third, we did not include patients <19 years old. Approximately a quater of all hospitalized adults ≥19 years old were admitted more than once.

The current study is important because it provides findings for health policy makers to decrease the burden of acute diarrhea in Thailand. We support providing health education to the public to improve sanitation and food preparation to avoid infections. It is also important to perform bacterial cultures from stool samples to identify the disease causes and determine the sensitivity to antimicrobial agents.

Conclusion

The burden of acute diarrheal diseases is a major problem in Thailand and accounts for 26% of admissions for digestive and intestinal infectious diseases. The mortality rate was 0.5% of admissions in the 2010 Nationwide Hospital Admission Data. The patients with a high risk of death those >60 years old at admission, male, and patients with complications. Promoting public health education to improve hygiene and sanitation may avoid infections.

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Conflict of interest statement

The authors declare that there is no conflict of interest in this research.

Authors' contributions

The roles of each author are summarized as follows: Sombat Treeprasertsuk: proposition of the study concept and design, interpretation of data, and drafting and critical revision the manuscript; Kaewjai Thepsuthammarat and Bubpha Kitsahawong: data acquisition, data analysis and interpretation, drafting the manuscript; Kamthorn Phaosawasdi: suggestion of the study concept and critical revision of the manuscript. All authors approved the submitted version and take responsibility for all statements made in the manuscript.

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