Management of acute diarrhea in the emergency department of a tertiary care university medical center

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Abstract

Objectives: To examine the management of acute diarrhea in the emergency department (ED) of a large university medical center.

Methods: Retrospective cross-sectional study over a 10-month period of adult patients (age ≥ 18 years) presenting to the ED with acute diarrhea.

Results: Data for 780 patients were reviewed; 101 met the exclusion criteria. Of the 679 patients with acute community-acquired diarrhea, 582 (85.7%) were discharged home and constituted the study cohort of mostly healthy adults (mean age: 32.5 ± 14.5 years). The rate of antibiotic prescription at discharge was 26%. Inappropriate use of antibiotics occurred in 28% of the patients. The presence of fever (odds ratio (OR) = 3.52), leukocytosis (OR = 1.72), and older age (OR = 1.16) were predictors of antibiotic prescription. Patients with dehydration, comorbidities, or bloody diarrhea were more likely to receive antibiotics. Microbiological studies and cross-sectional imaging were ordered in 12.4% and 11.7% of the patients, respectively, but provided very low yield (<10% for both) resulting in significantly higher visit charges. Inappropriately prescribed antibiotics at discharge resulted in higher charges in the ED compared with no antibiotic prescription.

Conclusion: Acute diarrhea management in our ED is suboptimal and does not adhere to practice guidelines, resulting in unnecessary antibiotic prescriptions, investigations, and cost.

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Introduction

Acute infectious diarrhea is a common health problem and a leading cause of both outpatient visits and inpatient hospitalizations.[1] According to the Centers for Disease Control and Prevention, an estimated 47.8 million cases of diarrhea occur annually in the United States, with an approximate cost of 150 million US dollars to the healthcare economy.[1,2] Acute diarrhea can be defined as the new onset of loose stools usually accompanied by crampy abdominal pain, and at times, nausea and vomiting (some definitions require the abrupt onset of ≥ 3 liquid stools above baseline in a 24-h period).[3] According to the American College of Gastroenterology (ACG) clinical guidelines, the routine use of antibiotics for community-acquired diarrhea should be discouraged as epidemiological studies suggest that most community-acquired diarrhea is viral in origin (rotavirus, norovirus, and adenovirus), and the disease duration is not shortened by the use of antibiotics (strong recommendation, very low level evidence).[1] Moreover, specific investigation is not normally required in the majority of cases although a modified diagnostic and therapeutic approach may be required in immunocompromised or elderly patients, or in the presence of so-called red flags, such as high-grade fever, dehydration, prolonged or persistent symptoms, and when the diagnosis is unclear or unexpected physical findings are noted.[1,4] Despite these recommendations, considerable guidelines-inconsistent practices remain in the management of community-acquired diarrhea in adults, particularly in resource-rich countries and settings.[5–7] These include the routine use of tests and bacterial cultures, as well as the common use of antibiotics in the ambulatory setting, including uncomplicated visits to urgent care clinics or the emergency department (ED).

In this study, we investigated the clinical practice and management of acute community-acquired gastroenteritis in adults in the ED of a tertiary care center. We examined the practice patterns and resource utilization, namely diagnostics, admission rates, use of antibiotics, and cost.

Methods

This was a retrospective cross-sectional study involving a cohort of adult patients (aged ≥ 18 years) who presented to the ED of the American University of Beirut Medical Center with a diagnosis of acute gastroenteritis or acute diarrhea during a 10-month period from 1 November 2018 to 31 August 2019. The diagnosis of acute gastroenteritis was based on a history of increased frequency of bowel movements and/or change in stool consistency, with associated symptoms of abdominal pain, nausea, and vomiting. Patients with chronic diarrhea (>4 weeks), underlying inflammatory bowel disease (IBD), prior history of bowel resection, or hospitalization within the previous 14 days were excluded from the study.

The collected data comprised the patients' characteristics (age, comorbidities, immunosuppression), severity of disease (frequency, associated fever, hypovolemia), diagnostic tools (stool studies, blood cultures, radiological imaging), as well as treatment, admission rates, and antibiotic use. All patients' details have been de-identified. Using SPSS (version 19.0; IBM Corp., Armonk, NY, USA), descriptive analyses as well as logistic regression models were used to analyze the data. The Institutional Review Board at the American University of Beirut approved this study (approval number: BIO-2019-0327). The need to obtain informed consent was waived because of the retrospective nature of the study. The reporting of this study conforms to the STROBE guidelines.[8]

To understand the risk factors for hospitalization as well as the appropriate use of antibiotics, the study population was divided into two groups: patients admitted to the hospital, and those who were discharged home. Comparing the two groups allowed the identification of risk factors for admission, whereas analysis of the group that was discharged home provided the opportunity to investigate the appropriateness of the use of empirical antibiotics. We used the ACG and the Infectious Diseases Society of America (IDSA) guidelines to define the appropriate use of empirical antibiotics in the following situations: elderly patients (age >70 years) with comorbidities, presence of bloody diarrhea, concomitant fever (defined as body temperature >38.2°C), or severe diarrhea associated with significant hypovolemia, defined as persistent tachycardia despite rehydration, presence of hypotension, or evidence of kidney injury on blood tests.

Results

During the study period, 780 patients presented to our ED with the chief complaint of diarrhea. After excluding patients with underlying conditions predisposing to chronic diarrhea, 679 patients were included (Figure 1). The baseline demographic and clinical characteristics of the patients for whom admission was advised and for those who were discharged are shown in Table 1. Most patients were treated as outpatients (85.7%) (Figure 1). The discharged population was younger than those who were admitted, with a mean age of 32.5 ± 14.6 years, and only 0.8% had comorbidities, such as heart or kidney disease. The majority of the patients were
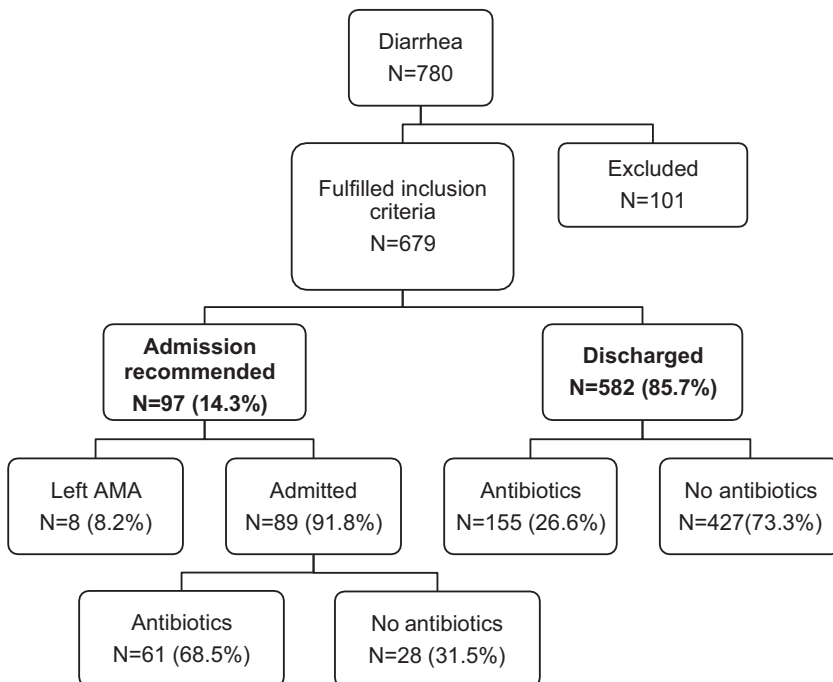

Figure 1. Flowchart of patient enrollment.
AMA, against medical advice.

Table 1. Baseline characteristics of the patients (N = 690).

Demographics	Admitted N = 97 N (%)	Discharged N = 582 N (%)
Age (mean ± SD), years	57.4 ± 19.8	32.5 ± 14.5
Female	55 (56.7)	314 (54)
Comorbidities	18 (18.6)	5 (0.8)
Immunocompromised patients		
Chemotherapy	15 (15.5)	3 (0.5)
Neutropenia	1 (1.0)	0
Systemic corticosteroids	0 (0)	4 (0.7)
Special Populations		
Pregnant	0 (0)	8 (1.4)
Cancer	29 (27.8)*	13 (2.2)
Characteristics at presentation		
Duration of diarrhea (mean ± SD), days	1.94 ± 1.7	1.6 ± 1.25
Abdominal pain	63 (64.9)	449 (77.1)
Vomiting	46 (47.4)	325 (55.8)
Fever	33 (34)*	83 (14.3)
Bloody diarrhea	5 (5.2)	8 (1.4)
Dehydration	24 (24.7)*	18 (3.1)
Recent travel history	6 (6.2)	84 (14.4)

*$p < 0.05$.
SD, standard deviation.

immunocompetent (98.8%). All patients **in the discharged population** had acute diarrhea with a mean duration of symptoms of 1.6 ± 1.25 days. Associated symptoms were abdominal pain (77.1%) and vomiting (55.8%) (Table 1). Older patients (odds ratio (OR) = 1.066), patients with cancer (OR = 7.6), and patients who presented with a fever (OR = 3.53) or with symptoms of dehydration (OR = 5.28) were more likely to be admitted to the hospital.

The rate of antibiotic prescription at discharge was 26%. Inappropriate use of antibiotics was identified in 28% of the patients (prescribed when not indicated: 16% or not prescribed when indicated: 12%) (Figure 2). The most commonly prescribed antibiotics at discharge from the ED were quinolones with or without metronidazole, and rifaximin (Figure 4). On multivariate analysis, the predictors of antibiotic prescription were the presence of a fever (OR = 3.52;

$p < 0.001$), leukocytosis (OR = 1.72; $p = 0.042$), and older age (OR = 1.16; $p = 0.029$) (Table 2). Patients with dehydration, comorbidities, or bloody diarrhea were more likely to receive antibiotics than those without these conditions. Microbiological studies and cross-sectional imaging were ordered in 12.4% and 11.7% of the patients, respectively, but these tests provided very low yield (<10% for both) and resulted in significantly higher visit charges than those for patients who did not undergo these tests ($p < 0.01$) (Figure 3). Patients who were inappropriately prescribed antibiotics incurred higher charges (excluding the cost of the prescribed antibiotic(s)) compared with those who appropriately received/did not receive antibiotics (mean cost: $472 ± 207 vs. $413 ± 207, respectively; $p = 0.002$) (Table 3). Patients who underwent unnecessary additional cross-sectional abdominal imaging
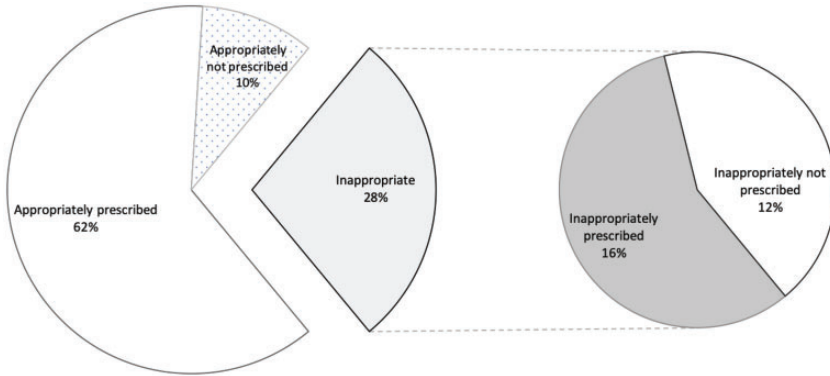
Figure 2. Percentage of antibiotics appropriately/inappropriately prescribed in accordance with clinical practice guidelines.[1,2]
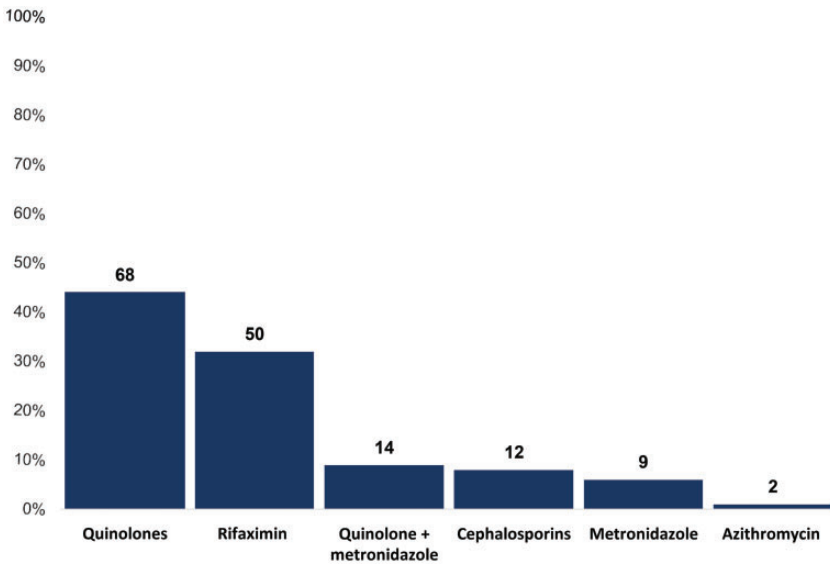

Figure 3. Antibiotics prescribed at discharge.

and microbiological studies experienced higher costs ($587.5 ± $225.6) compared with those who did not undergo these tests ($378.5 ± $130.9) (p < 0.001). In total, 220 patients (28%) had ≥1 unnecessary additional test and/or received inappropriate antibiotics, resulting in direct additional costs in excess of $28,342. Moreover, indirect costs were associated with a longer stay in the ED, radiation exposure, and the cost and adverse events associated with antibiotics, including the covert but important risk of antibiotic resistance.

Discussion

Acute infectious diarrhea is a common global health problem and a leading cause of outpatient visits, ED admissions, and hospitalization, accounting for significant cost and use of healthcare resources.[1] Surprisingly, and despite management

Table 2. Predictors of antibiotic use.

Characteristic	Univariate Analysis		Multivariate analysis	
	Odds Ratio (95% confidence interval)	P-value	Odds Ratio (95% confidence interval)	P-value
Age (mean $\pm$ SD)	36.07 $\pm$ 15.97		1.016 (1.002–1.029)	**0.025**
Leukocytosis	1.84 (1.11–3.02)	**0.016**	1.97 (1.16–3.27)	**0.011**
Immunosuppressed	0.89 (0.18–4.50)	0.895		
Comorbidities	4.10 (0.679–24.77)	0.096		
PPI use	1.52 (0.86–2.71)	0.151		
Fever	3.31 (2.07–5.3)	**<0.001**	3.53 (1.92–6.00)	**<0.001**
Symptoms of dehydration	1.25 (0.47–3.36)	0.652		
Bloody discharge	2.74 (0.68–11.08)	0.141		

P-values marked with bold indicate statistically significant p-values.
SD, standard deviation; PPI, proton-pump inhibitor.
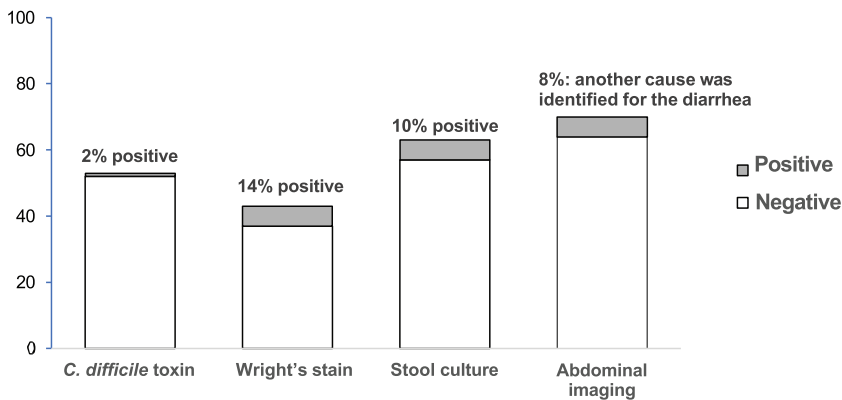
Figure 4. Yield of the diagnostic tests performed in the emergency department.

Table 3. Charges for the procedures performed in the emergency department (p < 0.01 for all comparisons).

Procedure	No	Yes
Abdominal imaging	$391 $\pm$ 249 (379–403)	$657 $\pm$ 206 (598–716)
Inappropriate antibiotics	$413 $\pm$ 207 (397–428)	$472 $\pm$ 207 (433–512)
Stool culture	$411 $\pm$ 172 (396–426)	$531 $\pm$ 210 (397–428)
Stool PMN	$413 $\pm$ 172 (398–427)	$566 $\pm$ 209 (500–633)

Costs are presented in US dollars and as mean $\pm$ standard deviation (range).
PMN, polymorphonuclear cells.

guidelines by expert scientific societies, such as the ACG and the IDSA, there is a paucity of real-life information on the management of this common problem in adults in clinical practice. To the best of our knowledge, this is the first study examining the management of acute diarrhea in adults in the ED. Other studies have tackled the general overuse of antibiotics in the ED, calling for antimicrobial stewardship amid the emergence of significant antimicrobial resistance.[9,10] However, our study is the first to look specifically at the management of acute diarrhea in the adult population and examine the pitfalls in both antibiotic prescription and the overuse of resources. Our results showed that in our large university medical center, the management of acute diarrhea in the ED, although largely commendable, remains partly inconsistent with current guidelines. This inconsistency led to a marked increase in unnecessary investigations, treatment, and costs. We believe this practice is common worldwide and in different clinical practice settings and may be more accentuated in small or community hospitals and urgent care clinic settings.[11] Our study showed that the use of healthcare resources and the prescription of antibiotics are often inconsistent with current guidelines. This practice leads to unnecessary increases in healthcare expenditures as well as other potential untoward consequences, most serious of which are the development of antibiotic resistance in the community and the risk of *Clostridioides difficile* infection.[6]

The decision to use antibiotics in patients with acute diarrhea presenting to the ED is admittedly complex.[7] Proper decision-making requires adequate understanding of disease pathophysiology, recognition of alarm signs and symptoms, identification of patient-specific risk factors for complications, and up-to-date knowledge of the relevant guidelines. However, clinically, the decision whether to prescribe antibiotics is often further clouded by the lack of sensitive clinical criteria for the diagnosis of bacterial enteritis (as opposed to viral infection), the heterogeneity of patients and their presentations, patient expectations, practice-specific and/or cultural considerations, and medicolegal concerns.[7] While some clinical features, such as fever, bloody diarrhea, and the presence of leukocytes in stools may indicate a bacterial etiology, none of these features is pathognomonic.[12] Additionally, the rate of positive stool cultures for bacterial pathogens, which may assist in proper tailoring of treatment, is usually low, and the delay in obtaining the culture results impacts point-of-care decision making.[4,13] This concern was supported by our findings, where only 10% of all stool cultures identified a pathogen.

Our study showed that 16% of the patients were inappropriately treated with antibiotics, and another 12% were not prescribed an antibiotic when indicated. Predictors of antibiotic prescription were fever, leukocytosis, and older age, in accordance with current guidelines. Immunosuppression was not an independent predictor in our multivariate analysis, and this is likely because of the small number of immunocompromised patients in our study population. In one study performed in Japan, the rate of antibiotic prescription was 30% for patients with gastrointestinal infections, which is three times higher than the rate (10%) in the US, with 80% of the antibiotic prescriptions deemed inappropriate.[6,11] The overuse of antibiotics is well reported in children. A recent study performed in Nigeria showed that up to 86.5% of children less than 5 years of age presenting with acute diarrhea were treated with antibiotics even though the pathogens retrieved in 98.6% of the population were either rotavirus or *Cryptosporidium*.[14,15] Similar numbers of inappropriately prescribed antibiotics for

children with diarrhea and common cold were reported in Addis Ababa, Tanzania, Tehran, and China.[16–18] Regarding the adult population, inappropriate antibiotic use has been repeatedly documented in ambulatory care clinics as well as in EDs in the USA.[6,19,20] A study based on the national ambulatory medical care survey in 2015 showed that up to 43% of antibiotics prescribed in ambulatory care were potentially inappropriate (25% given inappropriately and 18% given without a documented indication).[20] As a result of high numbers of inappropriate antibiotic prescriptions, many studies have investigated the optimal approach to improve antibiotic prescribing by healthcare providers.[21] No single overriding strategy was identified, but multifaceted interventions involving patients, physicians, and community education have been shown to achieve a change in prescribing behaviors.[21] One particular intervention is to delay antibiotic prescription to allow time for natural resolution of the infection. This approach appears to achieve common ground between the satisfaction of patients coming to the ED and appropriate antibiotic prescription.[21]

Finally, the economic burden conferred by the additional diagnostic tests, namely stool studies and imaging, along with inappropriate antibiotic prescriptions should be considered because addressing this issue provides the opportunity for considerable cost reduction (the direct cost savings in our study exceeded $28,000). In addition to abiding by current guidelines, we propose that physicians' knowledge of the value as well as the cost of ordered tests may aid in preventing unnecessary expenses. A recent study by Tainter et al. demonstrated poor insight by ED residents regarding costs, which increases the economic burden on healthcare systems.[22] Although addressing this issue is not currently applicable to our setting where the cost of a test is not visible to the ordering physician, making costs visible can be easily adopted in ED settings to control the cost of care. Importantly, continuous training and education about the immeasurable damage of the inappropriate use of antibiotics in the community should be prioritized given the increasing rates of antimicrobial resistance worldwide.

Our study has some limitations. First, this was a retrospective study that was limited to a single institution and may be subject to selection bias, incomplete documentation, and specific practice patterns. Additionally, given the nature of the study, we could not confirm the clinical status of each patient in the ED. For example, a patient may appear hypovolemic without significant changes in vital signs or evidence of end-organ damage. Furthermore, orders for abdominal imaging may have been attributable to unusual symptoms and signs that may have warranted imaging, although the low yield argues against this possibility. Despite its potential limitations, we believe our study identifies an important opportunity to improve healthcare resource use and reduce costs without compromising quality of care in the ED.

Conclusion

Acute infectious diarrhea is a leading cause of both outpatient visits and ED admissions. Our study showed that the management of acute diarrhea in our ED is suboptimal, with incomplete adherence to practice guidelines. This resulted in unnecessary prescription of antibiotics, significant use of healthcare resources, and increased costs. Staff training and education may lead to substantial savings as well as improved patient care.

review of the manuscript. SJ contributed to the data collection, data analysis, and manuscript drafting. AEM contributed to the data collection, data analysis, and drafting of the manuscript. LAK contributed to the data collection and drafting of the manuscript. All authors read and approved the final manuscript.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

Data availability statement

The data upon which this study is based are available from the corresponding author upon reasonable request.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

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