

ORIGINAL RESEARCH

Infectious Disease

Emergency department visits in the United States by adults with a complaint of diarrhea (2016–2021)

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Abstract

Objectives: For adults with a complaint of diarrhea presenting to United States emergency departments (EDs) from 2016 to 2021, we examined the: (1) occurrence and temporal trends in these ED visits, (2) frequency with which services were provided (laboratory testing, radiologic imaging, and intravenous fluids (IV fluids) administration) and patients were admitted; and (3) factors associated with service provision and admission.

Methods: Data from the National Hospital Ambulatory Medical Care Survey (2016–2021) were analyzed. Multivariable logistic regression modeling was employed to examine factors associated with service provision and admission, according to patient demographic characteristics, healthcare insurance status, and associated clinical symptoms; ED geographic location; and type of ED medical staff who evaluated the patient.

Results: From 2016 to 2017, there were 3.3–3.7 million ED visits/year by adults with a complaint of diarrhea (3.1% [95% CI 2.9–3.3] of all adult US ED visits). Services were provided and patients were admitted per these frequencies: complete blood count (80%; 95% CI 76–83); blood culture (8%; 95% CI 6–9); metabolic panel (94%; 95% CI 86–97); ultrasound (8%; 95% CI 7–10); abdominal/pelvic CT (33%; 95% CI 29–35); IV fluids (63%; 95% CI 50–66); and admission (16%; 95% CI 14–18). Factors associated with receipt of these services and admission included other presenting symptoms (abdominal pain, vomiting, and nausea), ED geographic location, ED medical staff member evaluating the patient, race, Hispanic ethnicity, and type of health insurance.

Conclusion: For adult patients presenting to US EDs with a complaint of diarrhea, US EDs highly utilized selected laboratory tests and radiologic imaging. Differences in utilization raise concerns about equitable healthcare delivery and call for further

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investigation into the underlying reasons, as well as the development and adoption of standardized care pathways.

KEYWORDS

clinical laboratory services, diagnostic imaging, diarrhea, emergency service, National Hospital Ambulatory Medical Care Survey

1 | INTRODUCTION

1.1 | Background

Based on United States (US) population-based surveys and other sources from 2000 to 2008, among all age groups, there were an estimated 47.8 million cases annually of acute diarrheal illnesses just from domestically acquired foodborne illnesses.^{1–3} Other causes (eg, non-US travel-related food and water illnesses, chronic illnesses, non-foodborne illnesses, noninfectious causes) contribute to even more cases. Adults suffering from diarrhea commonly seek medical evaluation in emergency departments (EDs) in the US. ED evaluations for adults with a complaint of diarrhea might include laboratory testing (eg, metabolic panels, complete blood counts [CBC], and blood cultures). Also, they could include radiographic imaging (eg, abdominal/pelvic computed tomography [CT] scans, ultrasound) to help discern specific diagnoses that require management different from ordinary symptom relief and treatment. Intravenous (IV) fluids might be administered for dehydration from diarrhea and concern of shock or sepsis. Patients with conditions that require further evaluation and treatment, as well as those with severe dehydration or otherwise unable to care for themselves adequately, could be observed in the ED or admitted. However, estimates of US ED visits by adults with a complaint of diarrhea and utilization of laboratory testing and radiologic imaging, IV fluids administration, and hospital admission are unknown.

1.2 | Importance

To our knowledge, no published study describes recent temporal trends in visits to US EDs by adults presenting with a complaint of diarrhea. Also, despite its common presentation, the frequency with which these patients undergo laboratory testing and radiologic imaging, receive IV fluids, and are admitted has not been estimated. In addition, unknown are factors (eg, demographic characteristics, healthcare insurance, ED geographic location, type of ED medical staff evaluating the patient, and associated clinical symptoms) that might affect utilization of these services and hospital admission. Monitoring trends in ED visits by adults with a complaint of diarrhea helps healthcare facilities anticipate and prepare for expected demand, allocate resources effectively, and ensure adequate care for those affected.

1.3 | Goals of this investigation

In this investigation, we assessed temporal trends in US ED visits by adults presenting with a complaint of diarrhea from 2016 to 2021. We also examined the frequency with which laboratory testing and radiologic imaging were performed, IV fluids were administered, and patients were admitted among adults who presented to US EDs with a complaint of diarrhea. We further assessed factors associated with providing these services, according to patient demographic characteristics, healthcare insurance status and associated clinical symptoms, the geographic location of the ED, and the type of ED medical staff member who evaluated the patient.

2 | METHODS

2.1 | Study design

This study examined data collected through the National Hospital Ambulatory Medical Care Survey (NHAMCS) for US ED visits with a complaint of diarrhea from 2016 to 2021. The study is a secondary analysis of this dataset.

2.2 | Study settings

The US Centers for Disease Control and Prevention and the National Center for Health Statistics conduct the NHAMCS-ED, which is an annual, nationally staged, cross-sectional panel survey of US ED visits that consists of geographic primary sampling units, hospitals within sampling units, and patient visits within emergency service areas.^{4,5} NHAMCS-ED results from the collection of existing data for which participants cannot be identified. NHAMCS-ED data are publicly available. Under the Code of Federal Regulations, no Institutional Review Board approval is required to analyze NHAMCS-ED data.⁶

2.3 | Selection of participants (ED visits and exposures)

We restricted the NHAMCS-ED 2016–2021 database to visits by patients ≥ 18 years old with a complaint of diarrhea. Visits were

identified by the mention of diarrhea in any of the maximum number (five) of recorded patient complaints in the database. Patient complaints are not recorded in any order, and thus a “chief complaint” cannot be determined, nor can the prominence or importance to the patient of the complaint be assessed.

2.4 | Measurements

We first stratified the data according to the years from 2016 through 2021. We summarized the frequency and proportion of ED patient visits with a complaint of diarrhea by the following factors: patients' demographic characteristics, healthcare insurance payer type, the ED's US geographic region, the professional role of ED medical staff involved in the visit, and patients' associated complaints. We reported utilization of abdominal/pelvic CT scan, ultrasonography, CBC, metabolic panel, blood cultures, and IV fluids, or if hospital admission occurred as dichotomous variables (present/absent). We identified these tests and services from the respective sections of the NHAMCS-ED database of the ED patient record: laboratory tests (CBC, blood cultures, and metabolic panels), imaging (abdominal/pelvic CT and ultrasound), procedures (IV fluids), and disposition (hospital admission). The NHAMCS-ED dataset does not specify the ultrasound body part examined, so the type of ultrasound performed was not stated. The metabolic panel includes glucose, calcium, sodium, potassium, bicarbonate, chloride, blood urea nitrogen, and creatinine. We categorized ED medical staff into five groups, considering the combinations of ED medical staff recorded in the database who were involved in the patient's care team (eg, attending ED physician only, attending physician with a resident physician, attending physician with a nurse practitioner [NP] or physician assistant [PA], etc).

2.5 | Outcomes

As our primary objective, we estimated temporal trends in the frequency of ED adult visits with a complaint of diarrhea from 2016 through 2021. We also measured how often laboratory tests (CBC, blood cultures, metabolic panels) and radiographic imaging (abdominal/pelvic CT and ultrasound) were obtained, IV fluids were administered, and patients were admitted. For the secondary objective, we identified factors associated with utilizing these services.

2.6 | Data analysis

We summarized the proportions and corresponding 95% confidence intervals (CIs) of US ED patient visits by adults with a complaint of diarrhea for 2016–2021 according to the following: patient demographic characteristics; patient healthcare insurance payer type; geographic region of the US where the ED visit occurred; ED medical staff categorizations; and patient associated complaints. We also summarized the proportions and corresponding 95% CIs of the services provided

The Bottom Line

Diarrhea is a common reason for emergency department (ED) visits. This analysis of 2016–2021 data from the National Hospital Ambulatory Medical Care Survey confirmed that there are over 3 million ED visits annually with a chief complaint of diarrhea. There were high uses of computed tomography (CT) imaging (33%) and intravenous fluids (63%) and 16% were admitted to the hospital. Care varied with geographic location, race, ethnicity, and healthcare insurance status. These results underscore the burden of diarrheal illnesses on EDs in the US.

to these patients (laboratory testing, radiologic imaging, IV fluids, and admission), as well as the frequencies of the five most common diagnoses rendered.

We created logistic regression models to estimate odds ratios (ORs) and corresponding 95% CIs for the usage of the aforementioned services and for hospital admission. Adjusted ORs for the usage of each service were calculated through multivariable logistic regression models using sex, race/Hispanic ethnicity, patient residence, US region, healthcare insurance payer type, ED medical staff categorization, and associated symptoms as adjusting covariates. Associated symptoms were included as adjusting covariates based on previous research or recommendations related to diarrheal illnesses evaluation and care,^{7–9} or those we believe might direct the ordering of tests and services, particularly for complications and conditions related to diarrheal illnesses: fever, vomiting, nausea, abdominal pain, and gastrointestinal bleeding.

All statistical analyses were performed with Stata (version 16.1) using the recommended statistical methods for analyzing complex survey data to produce national estimates.^{4,5,10} We produced national estimates by incorporating the NHAMCS “PATWT” (weight), “CPSUM” (sampling unit), and “CSTRATM” (strata) variables as described in the NHAMCS public use file documentation.

3 | RESULTS

3.1 | ED visits in the US by adults with a complaint of diarrhea

In the NHAMCS-ED database for 2016 through 2021, adult patients ≥ 18 years old with a complaint of diarrhea accounted for 3.1% (95% CI 2.9–3.3) of all ED visits (20,673,054 visits). Patient demographic characteristics, healthcare insurance payer type, region of the US for the ED visits, ED medical staff categorizations, and patients' associated complaints are summarized in Table 1. The year with the most frequent ED visits by adults with a complaint of diarrhea was 2017 (3,726,426 visits). There were no apparent temporal trends or patterns over time in number of ED visits. Patients who were female, non-Hispanic White,

TABLE 1 Frequency and characteristics of US ED visits by adults with a complaint of diarrhea (2016–2021).

	2016–2021 <i>n</i> = 20,673,054 % (95% CI)	2016 <i>n</i> = 3,395,371 % (95% CI)	2017 <i>n</i> = 3,726,426 % (95% CI)	2018 <i>n</i> = 3,269,520 % (95% CI)	2019 <i>n</i> = 3,580,506 % (95% CI)	2020 <i>n</i> = 3,413,939 % (95% CI)	2021 <i>n</i> = 3,287,292 % (95% CI)
Age years (median, IQR)	46 (30–63)	45 (29–62)	46 (29–66)	47 (30–65)	43 (28–63)	49 (33–63)	46 (31–63)
Sex							
Female	65 (62–67)	65 (58–71)	66 (61–70)	59 (53–65)	69 (63–75)	66 (60–71)	63 (57–70)
Male	35 (33–38)	35 (29–42)	34 (30–39)	41 (35–47)	31 (25–37)	34 (29–40)	37 (30–43)
Race and ethnicity							
Non-Hispanic White	61 (57–66)	63 (55–71)	61 (52–69)	59 (53–66)	58 (48–67)	60 (51–67)	67 (59–74)
Non-Hispanic Black	22 (18–26)	19 (14–25)	27 (20–34)	24 (19–30)	21 (15–28)	23 (18–30)	16 (11–23)
Hispanic	14 (11–17)	13 (9–19)	9 (5–19)	14 (10–21)	18 (13–25)	12 (8–18)	15 (11–20)
Non-Hispanic other	3 (2–5)	5 (3–8)	3 (1–7)	3 (1–5)	3 (2–6)	5 (2–12)	2 (1–5)
Patient residence							
Private residence	97 (96–98)	97 (94–98)	94 (89–96)	99 (97–99.4)	98 (96–99)	98 (96–99)	97 (93–98)
Nursing facility	2 (1–3)	0.5 (0.2–1.3)	5 (2–9)	0.09 (0.01–0.5)	1.3 (0.5–3)	1.3 (0.5–3)	2.7 (1–6)
Unstably housed	1 (0.5–1.4)	2 (0.6–5)	1 (0.3–2)	1 (0.4–2.3)	0.6 (0.2–1.8)	0.9 (0.4–2.3)	0.3 (0.07–1)
Health insurance							
Private	30 (27–32)	27 (22–32)	26 (22–31)	28 (24–32)	31 (26–37)	30 (25–36)	36 (29–44)
Medicare	30 (28–33)	27 (22–33)	38 (33–44)	33 (27–39)	28 (22–34)	29 (22–37)	26 (19–35)
Medicaid	30 (26–33)	35 (30–41)	26 (19–33)	32 (26–38)	27 (20–35)	34 (25–44)	26 (20–33)
Self-pay	8 (6–10)	8 (5–12)	9 (5–16)	6 (3–9)	9 (6–14)	6 (3–11)	8 (4–17)
ED US geographic region							
South	39 (32–46)	32 (25–40)	42 (28–57)	40 (31–51)	42 (35–50)	35 (25–48)	39 (30–50)
Northeast	13 (10–16)	10 (7–16)	8 (5–14)	11 (8–16)	12 (9–17)	18 (12–25)	17 (12–23)
Midwest	24 (19–30)	24 (20–29)	36 (24–50)	22 (15–30)	20 (16–26)	23 (15–33)	17 (12–24)
West	24 (21–29)	34 (26–42)	14 (8–23)	26 (19–35)	25 (18–33)	24 (16–35)	26 (18–36)
ED medical staff							
Attending physician only	64 (59–68)	68 (60–75)	65 (54–74)	69 (62–75)	62 (54–69)	61 (52–69)	57 (48–65)
Attending physician with resident physician	7 (6–10)	4 (2.5–7)	5 (3–10)	8 (5–12)	5 (3–8)	11 (6–19)	7 (4–13)
Attending physician with NP or PA	6 (0.4–8)	9 (4.5–18)	6.6 (3–13)	13 (0.5–3)	7 (3–14)	5 (3–9)	7 (4–12)
ED resident physician only	1 (0.5–4)	2 (0.5–6)	4 (0.7–20)	0.3 (0.05–2)	1 (0.5–3)	0.2 (0.07–0.8)	—
NP or PA only	18 (15–21)	12 (8.5–16)	14.5 (10–20)	18 (13–25)	21 (16–26)	19 (13–27)	22 (15–31)
Associated symptoms							
Abdominal pain	47 (43–50)	50 (44–56)	47 (38–55)	46 (41–52)	49 (41–58)	46 (38–54)	41 (34–48)
Vomiting	48 (45–50)	52 (46–58)	51 (46–58)	48 (44–53)	50 (45–55)	41 (33–49)	38 (32–45)
Nausea	44 (40–47)	47 (40–54)	54 (48–59)	41 (36–46)	41 (35–49)	38 (30–47)	40 (32–48)
Fever	60 (55–65)	61 (53–70)	56 (49–65)	60 (53–67)	59 (50–67)	60 (49–70)	64 (55–73)
GI bleeding (hematochezia and/or melena)	4 (3–5)	4 (2–6)	4 (2–7)	8 (5–11)	2 (1–5)	4 (2–7)	3 (2–6)

Abbreviations: CI, confidence interval; ED, emergency department; GI bleeding, gastrointestinal bleeding; IQR, interquartile range; NP, nurse practitioner; PA, physician assistant.

lived in a private residence, and had Medicare or Medicaid insurance (Table 1) had the most frequent visits. ED visits with a complaint of diarrhea were most frequent in the southern US, and most involved only an attending physician as the evaluating clinician. Fever was the most prominent associated complaint. The five most frequent final diagnoses rendered at the conclusion of the ED visit were: unspecified abdominal pain, acute abdomen, vomiting, allergic and dietetic gastroenteritis and colitis, and intestinal infection (Table 2).

3.2 | Laboratory testing, radiologic imaging, IV fluids administration, and hospital admission frequency

Table 3 summarizes the frequency of laboratory testing, radiologic imaging, IV fluids administration, and hospital admission among adult patients with a complaint of diarrhea presenting to US EDs from 2016 to 2021. Metabolic panels (94%) and CBCs (80%) were obtained frequently. Ultrasound was not commonly used (8%). Approximately one-third of patients underwent abdominal/pelvic CT scanning. Almost two-thirds of patients received IV fluids. Less than one-fifth were admitted to some location in the hospital (19.6%). There were no apparent trends or patterns in usage of laboratory testing, radiologic imaging, and IV fluids nor in hospital admission over the study period.

3.3 | Factors associated with laboratory testing, radiologic imaging, IV fluids administration, and hospital admission

Per the results of the multivariable logistic regression models (Table 4), CBC was less likely to be ordered for US ED visits by non-Hispanic Black and Hispanic patients than for non-Hispanic White patients. However, CBC was more likely to be ordered when abdominal pain or nausea were reported. Blood cultures were more likely to be ordered for patients with Medicare insurance than private healthcare insurance. Metabolic panels were less likely to be ordered for patients with Medicare healthcare insurance, as compared with private healthcare insurance, and the northeast was less likely to be order them, as compared with the southern US. Metabolic panels were more likely to be ordered for patients with fever.

Ultrasound was performed less likely for patients only evaluated by an ED resident physician, as compared with when only an attending physician was involved in the ED visit. However, ultrasound was more likely to be obtained for patients with abdominal pain. Non-Hispanic Black patients were less likely than non-Hispanic White patients to undergo abdominal/pelvic CT scanning. Abdominal pain was associated with greater odds of abdominal/pelvic CT scanning.

IV fluids were less likely to be administered for non-Hispanic Black or Hispanic patients, as compared with non-Hispanic White adult patients, and when a PA or NP evaluated the patient, as compared with an attending physician only. However, they more likely to be ordered

TABLE 2 Five most frequent diagnoses among US ED visits by adult patients with a complaint of diarrhea (2016–2021).

	2016–2021	2016	2017	2018	2019	2020	2021
Diagnosis (ICD-10 code)	n = 20,673,054 % (95% CI)	n = 3,395,371 % (95% CI)	n = 3,726,426 % (95% CI)	n = 3,269,520 % (95% CI)	n = 3,580,506 % (95% CI)	n = 3,413,939 % (95% CI)	n = 3,287,292 % (95% CI)
Unspecified abdominal pain (R19.9)	31.7 (30.0–33.5)	33.3 (29.5–38.1)	35.0 (30.4–40.0)	28.3 (24.5–32.4)	32.5 (28.3–37.0)	30.4 (26.0–35.3)	30.2 (26.0–35.1)
Acute abdomen (R10.0)	24.4 (23.0–26.1)	24.0 (20.4–28.1)	26.0 (22.0–30.3)	25.1 (21.5–29.1)	27.3 (23.4–31.5)	20.0 (16.1–24.3)	23.5 (19.5–28.1)
Vomiting (R11.1)	22.5 (21.0–24.1)	26.4 (22.6–30.5)	25.0 (21.0–29.6)	18.1 (15.0–21.7)	25.2 (21.4–29.3)	19.1 (15.4–23.4)	20.6 (16.8–25.0)
Allergic and dietetic gastroenteritis and colitis (K52.2)	15.0 (13.0–16.4)	16.0 (13.0–19.5)	15.0 (12.0–19.0)	16.5 (13.4–20.0)	13.1 (10.3–16.5)	13.4 (10.3–17.3)	15.5 (12.2–19.5)
Intestinal infection (A08.8)	3.0 (2.5–3.8)	2.7 (1.6–4.6)	3.9 (2.4–6.3)	2.4 (1.4–4.2)	3.7 (2.3–5.8)	2.4 (1.3–4.6)	3.2 (1.8–5.6)

Abbreviations: CI, confidence interval; ED, emergency department.

TABLE 3 Laboratory testing, radiologic imaging, IV fluid administration, and admission for US ED visits by adults with a complaint of diarrhea (2016–2021).

	2016–2021	2016	2017	2018	2019	2020	2021
	<i>n</i> = 20,673,054	<i>n</i> = 3,395,371	<i>n</i> = 3,726,426	<i>n</i> = 3,269,520	<i>n</i> = 3,580,506	<i>n</i> = 3,413,939	<i>n</i> = 3,287,292
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Laboratory testing							
CBC	80 (76–83)	79 (73–84)	79 (74–84)	82 (77–86)	80 (74–85)	79 (70–86)	79 (70–86)
Blood culture	8 (6–9)		10 (6–15)		7 (5–10)		5 (3–9)
Metabolic panel	94 (86–97)	6 (3–9)	90 (67–98)	99 (89–99.8)	8 (6–12)	94 (84–98)	92 (72–98)
Radiologic imaging							
Ultrasound	8 (7–10)	8 (6–12)	8 (5–13)	5 (3–8)	9 (7–13)	7 (4–12)	9 (6–14)
Abdominal/pelvic CT	32 (29–35)	31 (26–38)	31 (24–38)	34 (28–40)	31 (25–36)	30 (24–37)	34 (27–42)
IV fluid administration							
IV fluids	63 (59–66)	60 (54–67)	67 (59–72)	65 (58–71)	66 (57–74)	62 (53–70)	56 (45–66)
Admission							
Hospital wards	16 (14–18)	16 (11–21)	20 (14–28)	17 (13–21)	14 (10–19)	15 (11–21)	15 (11–20)
Critical care unit	2 (1.5–3)	1 (0.5–3)	2 (0.9–6)	2 (1–5)	1 (0.6–3)	2 (1–5)	3 (2–7)
Stepdown unit	0.6 (0.3–1)	0.3 (0.08–1)	1.5 (0.4–5.5)	0.4 (0.09–2)	0.4 (0.09–1.5)	0.6 (0.2–2)	0.5 (0.06–3)
Operating room	1 (0.8–2)	2 (1–5)	2 (0.5–11)	1 (0.7–3)	0.8 (0.3–2)	0.3 (0.07–2)	1 (0.3–2)

Abbreviations: CI, confidence interval; CBC, complete blood count; CT, computed tomography; ED, emergency department; IV, intravenous.

for abdominal pain, vomiting, and nausea. Also, IV fluids were more likely to be administered in the northeastern, midwestern, and western regions, as compared with the southern US. Hospital admission was more likely as patient age increased, for patients from a nursing facility, as compared with those living in a private residence, and for those evaluated by either an attending physician with a resident physician or only by a resident physician, as compared with only an attending physician.

4 | LIMITATIONS

The NHAMCS-ED dataset has many limitations, some of which have been outlined in prior publications.^{4,11} Data collected from medical records is subject to omitted information that affects its accuracy, as well as important variables that are not available, such as clinician decision-making. Of particular importance, the database does not contain the patient's medical history, and does not specify whether the diarrhea the patient reported was acute or chronic. It cannot be verified that the patient truly met the usual criteria for diarrhea, if dehydration was present, or how prominent the diarrhea was in the patient's presentation. As such, we cannot determine whether testing, IV fluids, and admission were evidence-based or necessary. We cannot determine from the data when testing and treatment occurred, and if they were initiated prior to or after the clinician's evaluation; thus, the findings do not necessarily imply a temporal sequence or reflect the clinician's behaviors, as opposed to nurse-driven protocols. Because these data are retrospective and cross-sectional, only association and not causation can be assessed. However, one strength of using diarrhea as a complaint to identify ED visits rather than final diagnosis

codes is that the resources provided occurred after patients reported their complaint of diarrhea, thus the findings reflect the course of testing and treatment after the patient made the complaint. As noted previously, ultrasounds were not necessarily ordered for an abdominal/pelvic concern. Because a metabolic panel (94%) was obtained for the vast majority of ED visits, the precision of the estimates and associated 95% CIs for factors associated with its use might be less reliable than for the other services we examined. Although stool testing is of importance in the management of diarrheal illnesses based on its cause (*salmonella*, *shigella*, *campylobacter*, *yersinia*, *C. difficile*, and Shiga toxin *E. coli*),^{9,12} NHAMCS does not contain data nor results on stool analysis or culture isolated organisms. There also are no details on the medical care received during the admission.

5 | DISCUSSION

From 2016 to 2021, there were 3.3–3.7 million visits/year to US EDs by adults with a complaint of diarrhea (3.1% of all adult ED visits annually). CBC and metabolic panels were obtained in the vast majority, IV fluids ordered in almost two-thirds, and abdominal/pelvic CT scanning performed in nearly one-third of ED visits. As such, adult ED visits with a complaint of diarrhea involve frequent use of resources and services. However, we noted potential discrepancies in healthcare utilization. Race and Hispanic ethnicity, patient residence, health insurance, geographic region, and type of ED medical staff involved in the patient's evaluation was associated with differential usage of laboratory tests and radiologic imaging, administering IV fluids, and admission to the hospital.

TABLE 4 Factors associated with laboratory testing and radiologic imaging, IV fluid administration, and admission for US ED visits by adults with a complaint of diarrhea (2016–2021).

	CBC	Blood culture)	Metabolic panel	Ultrasound	Abdominal/pelvic CT	IV fluid	Hospital admission
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age	1.01 (0.99–1.02)	1.00 (0.98–1.01)	1.04 (1.00–1.08)	0.99 (0.97–1.00)	1.01 (1.00–1.02)	1.01 (1.00–1.02)	1.04 (1.02–1.05)
Sex							
Female	1	1	1	1	1	1	1
Male	0.99 (0.73–1.35)	1.12 (0.68–1.85)	0.73 (0.23–2.29)	0.77 (0.48–1.24)	1.22 (0.90–1.64)	1.27 (1.00–1.61)	1.10 (0.76–1.59)
Race and ethnicity							
Non-Hispanic White	1	1	1	1	1	1	1
Non-Hispanic Black	0.85 (0.42–0.80)	0.41 (0.16–0.99)	11.91 (0.85–166)	0.85 (0.47–1.55)	0.64 (0.47–0.86)	0.54 (0.38–0.78)	0.91 (0.51–1.64)
Hispanic	0.53 (0.35–0.81)	0.98 (0.40–2.37)	0.49 (0.09–2.49)	1.27 (0.67–2.38)	0.69 (0.43–1.09)	0.62 (0.42–0.92)	0.80 (0.39–1.61)
Non-Hispanic other	0.89 (0.42–1.85)	0.90 (0.24–3.30)	0.93 (0.07–11.89)	0.71 (0.23–2.15)	0.46 (0.18–1.16)	0.97 (0.54–1.76)	0.99 (0.33–2.96)
Patient residence							
Private residence	1	1	1	1	1	1	1
Nursing facility	1.53 (0.35–6.62)	1.06 (0.16–6.63)	1.00 (0.99–1.01)	0.98 (0.11–8.74)	1.36 (0.48–3.88)	1.35 (0.53–3.42)	4.31 (1.59–11.6)
Unstably housed	0.43 (0.16–1.14)	1.00 (0.99–1.02)	1.10 (0.98–1.03)	0.56 (0.12–2.57)	0.89 (0.29–2.74)	0.69 (0.24–1.69)	0.89 (0.22–3.55)
Health insurance							
Private	1	1	1	1	1	1	1
Medicare	0.86 (0.53–1.39)	2.87 (1.35–6.12)	0.03 (0.01–0.16)	0.65 (0.29–1.44)	0.93 (0.58–1.47)	0.87 (0.58–1.30)	1.56 (0.80–3.04)
Medicaid	0.84 (0.57–1.22)	0.65 (0.26–1.59)	0.35 (0.07–1.74)	0.83 (0.48–1.42)	0.79 (0.54–1.17)	0.71 (0.51–1.00)	1.26 (0.73–2.19)
Self-pay	1.14 (0.62–2.10)	0.27 (0.06–1.11)	1.00 (0.99–1.02)	1.30 (0.62–2.73)	1.24 (0.70–2.20)	0.64 (0.40–1.02)	1.34 (0.64–2.83)

(Continues)

TABLE 4 (Continued)

	CBC	Blood culture)	Metabolic panel	Ultrasound	Abdominal/pelvic CT	IV fluid	Hospital admission
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
ED US geographic region							
South	1	1	1	1	1	1	1
Northeast	0.69 (0.39–1.23)	0.87 (0.35–2.13)	0.01 (0.01–0.16)	1.04 (0.52–2.09)	0.80 (0.48–1.35)	1.89 (1.10–3.25)	0.82 (0.42–1.61)
Midwest	0.82 (0.40–1.66)	0.76 (0.39–1.49)	1.07 (0.50–22.00)	0.62 (0.32–1.19)	0.80 (0.52–1.23)	2.69 (1.58–4.59)	0.81 (0.41–1.60)
West	0.95 (0.59–1.53)	0.54 (0.25–1.16)	0.02 (0.01–0.39)	0.69 (0.36–1.30)	0.89 (0.56–1.43)	1.81 (1.08–3.06)	0.60 (0.30–1.21)
ED medical staff							
Attending physician only	1	1	1	1	1	1	1
Attending physician with resident physician	0.97 (0.49–1.93)	1.93 (0.82–4.57)	2.61 (0.58–11.74)	1.17 (0.54–2.55)	1.05 (0.71–1.56)	0.81 (0.48–1.38)	2.35 (1.49–3.68)
Attending physician with NP or PA	1.06 (0.45–2.49)	1.90 (0.78–4.62)	0.30 (0.05–1.94)	1.72 (0.74–4.05)	1.59 (0.89–2.84)	0.59 (0.33–1.08)	0.75 (0.38–1.45)
ED resident physician only	1.02 (0.44–2.37)	1.00 (0.98–1.30)	0.98 (0.87–1.58)	0.05 (0.01–0.41)	2.35 (0.50–11.00)	1.46 (0.37–5.75)	2.82 (1.21–6.55)
Associated symptoms							
Abdominal pain	2.44 (1.45–4.08)	0.75 (0.37–1.30)	1.64 (0.51–5.25)	2.50 (1.50–4.17)	2.30 (1.33–3.99)	2.08 (1.59–2.73)	1.32 (0.88–1.99)
Vomiting	1.23 (0.90–1.68)	0.89 (0.65–1.41)	3.65 (0.98–13.60)	0.92 (0.58–1.46)	1.13 (0.84–1.51)	2.24 (1.65–3.05)	1.08 (0.74–1.58)
Nausea	1.54 (1.13–2.08)	0.64 (0.38–1.06)	0.48 (0.15–1.47)	1.08 (0.70–1.65)	0.94 (0.71–1.26)	1.33 (1.02–1.75)	1.28 (0.82–1.98)
Fever	0.61 (0.45–0.85)	0.59 (0.34–1.00)	20.38 (4.78–86.70)	0.73 (0.46–1.17)	0.84 (0.61–1.15)	0.86 (0.65–1.14)	0.59 (0.39–0.91)
GI bleeding (hematochezia and/or melena)	1.68 (0.72–3.90)	0.54 (0.17–1.63)	1.00 (0.98–1.03)	0.21 (0.04–1.01)	1.54 (0.72–3.31)	0.95 (0.56–1.62)	1.74 (0.80–3.80)

Abbreviations: CI, confidence interval; ED, emergency department; GI bleeding, gastrointestinal bleeding; NP, nurse practitioner; OR, odds ratio; PA, physician assistant.

Certain variations in service provision and admission across patient groups are not surprising. For example, greater admission for patients from nursing facilities could suggest that ED medical staff were responding to concerns about serious conditions related to residence in these facilities. Residence in a nursing facility might be a proxy for factors that could not be assessed in this investigation, including the presence of comorbid conditions, previous surgical procedures, and the severity of the clinical presentation. However, differences related to patient demography should not be expected. As compared with non-Hispanic White patients, non-Hispanic Black patients and Hispanic patients were less likely to undergo laboratory testing with CBC and receive IV fluids. Non-Hispanic Black patients also were less likely to undergo abdominal/pelvic CT scanning. Patients with Medicare were less likely than those with private healthcare insurance also were less often tested with metabolic panels. These discrepancies existed despite adjusting for demographic, geographic, and clinical factors. We cannot determine the reasons behind these disparities, and it is not possible to know if factors we could not assess (eg, severity and chronicity of illness) might account for the findings. We therefore cannot assess if there was relative overutilization or underutilization of services when comparing patient groups. In concert with our study findings, Wang et al.¹³ reported in their investigation using the NHAMCS dataset (1997–2016) that non-Hispanic Black patients and Hispanic patients, as compared with non-Hispanic patients, were less likely to undergo CT and ultrasound imaging for ED visits for abdominal pain. Our Wang et al.'s¹³ findings raise a concerning possibility that racial and ethnic biases, conscious or unconscious, and the patient's type of healthcare insurance may have influenced clinical decision-making. These results highlight the need for further investigation into the underlying reasons for these identified disparities to ensure equitable delivery of services to adult patients visiting US EDs.

Adult ED patients with a complaint of diarrhea evaluated by an attending physician and a resident had a greater odds of being admitted to the hospital. The involvement of resident physicians may indicate that they were involved in the care of patients with more complexity or severity, those who required closer monitoring, or for whom a higher level of care was required. Less frequent administration of IV fluids by advanced practice providers also could reflect patients with lower acuity, given that these visits did not include an ED attending physician. The reason for the lower likelihood of ultrasound utilization for visits involving only an ED resident physician is unclear. Greater admission by patients evaluated by resident physicians only potentially could be by patients who were referred by their outpatient clinicians for admission or involved supervision by attending physicians from other medical or surgical services. It is possible that for ED visits when only a resident was involved the ED attending physician either truly did not evaluate those patients, or simply did not indicate their involvement in the medical record.

We do not know why adult ED patients with a complaint of diarrhea receiving care in the northeastern, midwestern, and western region areas of the US had higher odds of receiving IV fluids or why those in the northeastern US were less likely to have a metabolic panel

ordered. There might be regional variations in care provided to these patients or other factors that could not be accounted for in the analyses. Regardless, variations in practice also suggest a potential role for standardization of procedures and protocols for adult ED patients presenting with a complaint of diarrhea so to improve the care they receive.

It is reasonable and appropriate for clinical factors (abdominal pain, vomiting, nausea, and fever) to dictate the utilization of laboratory testing and radiologic imaging, IV fluids administration, and hospital admission. ED medical staff probably recognized the importance of conducting a more comprehensive evaluation for patients with these associated symptoms, potentially aiming to identify specific causes. IV fluids were administered more often when abdominal pain, vomiting, and nausea were present, suggesting concerns about dehydration. This finding emphasizes the significance of considering symptoms and clinical context when determining the need for diagnostic tests and tailoring healthcare interventions to suit individual patient requirements. Abdominal pain, in particular, can be an indication of underlying conditions, which may prompt ordering ultrasound and/or abdominal/pelvic CT imaging for further evaluation. Hustey et al.,¹⁴ in a prospective multicenter study assessing abdominal CT scan utilization among patients with abdominal pain, found that 57% of their CTs were diagnostic for the etiology of the pain. Larson et al.'s¹⁵ study using the NHAMCS-ED for the period of 1995–2007 demonstrated findings consistent with our study that abdominal pain was the main chief complaint associated with CT usage in US EDs.

In conclusion, we found that visits by adults with a complaint of diarrhea to US EDs from 2016 to 2021 accounted for about 3.1% of all adult ED visits, about 3.3–3.7 million visits/year, and that there were no apparent temporary trends or patterns over time in their occurrence. Selected laboratory tests and radiologic imaging were highly used, indicating the significant burden of these visits on healthcare systems. However, the utilization of services and hospital admissions was not uniform. Race, Hispanic ethnicity, geographic region, and health insurance were associated with the likelihood of receiving these services in the ED. Such differences in utilization raise concerns about equitable healthcare delivery and call for further investigation into the underlying reasons, as well as the development and adoption of standardized care pathways for these patients.

AUTHOR CONTRIBUTIONS

A. M. was responsible for conceptualization, data collection and analysis, and initial manuscript preparation. The manuscript was produced in partial fulfillment of A. M.'s Harvard Medical School Master of Medical Sciences in Clinical Investigations degree program. D. K. and S. K. were responsible for providing input on the study design and analysis and reviewing and editing the manuscript. R. C. M. was accountable for supervising the study design and analysis and the production and review of the manuscript.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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PRIOR PRESENTATION

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