





CLINICAL INVESTIGATION

Evaluation and disposition of older adults presenting to the emergency department with abdominal pain

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Abstract

Background: Abdominal pain is the most common chief complaint in US emergency departments (EDs) among patients over 65, who are at high risk of mortality or incident disability after the ED encounter. We sought to characterize the evaluation, management, and disposition of older adults who present to the ED with abdominal pain.

Methods: We performed a survey-weighted analysis of the National Hospital Ambulatory Medical Care Survey (NHAMCS), comparing older adults with a chief complaint of abdominal pain to those without. Visits from 2013 to 2017 to nationally representative EDs were included. We analyzed 81,509 visits to 1211 US EDs, which projects to 531,780,629 ED visits after survey weighting. We report the diagnostic testing, evaluation, management, additional reasons for visit, and disposition of ED visits.

Results: Among older adults (≥ 65 years), 7% of ED visits were for abdominal pain. Older patients with abdominal pain had a lower probability of being triaged to the “Emergent” (ESI2) acuity on arrival (7.1% vs. 14.8%) yet were more likely to be admitted directly to the operating room than older adults without abdominal pain (3.6% vs. 0.8%), with no statistically significant differences in discharge home, death, or admission to critical care. Ultrasound or CT imaging was performed in 60% of older adults with abdominal pain. A minority (39%) of older patients with abdominal pain received an electrocardiogram (EKG).

Conclusions: Abdominal pain in older adults presenting to EDs is a serious condition yet is triaged to “emergent” acuity at half the rate of other conditions. Opportunities for improving diagnosis and management may exist. Further research is needed to examine whether improved recognition of abdominal pain as a syndromic presentation would improve patient outcomes.

KEYWORDS

abdominal pain, emergency medicine, older adults

INTRODUCTION

The emergency department (ED) plays an increasingly central role in the American healthcare system, especially for older adults.¹ Patients over 65 years old visited EDs 22.4 million times in 2017—nearly one visit for every two adults ≥ 65 .² Although there is general recognition in EDs that older adults are at higher risk for significant disease, the optimal management of many disease processes has yet to be refined to better align the treatment goals of older adults and the care delivered in EDs.³

Abdominal pain is the most common chief complaint among patients over 65 presenting to the ED, representing 1.4 million visits in 2017.² It has been highlighted in the clinical literature as a high-risk condition specifically in older patients.^{4–6} In a retrospective chart review conducted at an academic hospital in 1998, 5.3% of geriatric abdominal pain patients died within 60 days; 8.3% experienced new chronic disability.⁷ In a prospective 2002 chart review, 5.0% of abdominal pain patients ≥ 60 died within 2 weeks, and 40% experienced a hospital admission 3 days or longer, an operation, or death.⁸

Abdominal pain in older adults presenting to EDs is distinct from that in younger patients. Greater prevalence of frailty and multimorbidity at advanced age⁹ leads to increased susceptibility to a given insult.¹⁰ Some underlying causes of abdominal pain seen in older patients are rarely seen in younger patients, such as stercoral colitis, mesenteric ischemia, and abdominal aortic aneurysm (AAA).^{6,11} Others present with greater prevalence and lethality in older adults, such as myocardial infarction, diverticulitis, and small bowel obstruction.^{12,13} Atypical presentations are also more frequent in older patients. For instance, ischemia is the leading cause of death among Medicare patients not admitted to the hospital who were evaluated and discharged from the ED with a diagnosis of abdominal pain.¹⁴

Despite evidence that CT scan utilization has become more common nationally and is a useful modality in diagnosing significant acute pathology in older patients,¹⁵ there has been no systematic evaluation of national patterns of diagnostic testing for abdominal pain in nearly two decades.¹⁶ Over this period, CT has become more available,^{17,18} with higher speed, lower dose, and improved image quality^{19–21}; evidence has emerged suggesting abdominal X-ray is potentially ineffective for many etiologies²²; and more emergency medicine physicians have been trained.²³ This analysis provides recent, nationally representative data on variation in use of frequently ineffective testing (e.g., abdominal X-ray^{22,24–26}) and potentially effective testing (e.g., laboratory investigations, CT scan, ultrasound, and electrocardiogram [EKG]).

Key Points

- Patients over 65 years old were half as likely to be triaged as high acuity compared with non-abdominal pain patients, yet were more likely to be surgically managed.
- Nearly one in six ED patients over 65 years old with a chief complaint of abdominal pain received only an X-ray for radiologic evaluation.
- A minority (39%) of older patients with abdominal pain received an EKG.

Why Does this Paper Matter?

Abdominal pain in older adults is thought to be a high mortality and morbidity condition yet has significant practice variation in its management.

To characterize the prevalence, evaluation, and management of abdominal pain in older adults in EDs, we described ED patients aged ≥ 65 with abdominal pain as a chief complaint using the National Hospital Ambulatory Medical Care Survey (NHAMCS) database, a nationally representative ED chart abstraction.

METHODS

Study design, setting, and participants

We conducted a retrospective analysis of 2013–2017 data from the NHAMCS, a nationally representative chart abstraction of ED visits to acute care hospitals in 50 states and Washington, DC (excluding federal, military, and Veterans Affairs hospitals). Each year approximately 350 EDs are sampled and asked to participate. Then, 60–80 charts are abstracted from each participating ED by the National Center for Health Statistics (NCHS). ED participation rates average 60%–80%. The design and response rates are fully described elsewhere.²⁷

NCHS uses an established reason for visit classification scheme to encode the free text recorded in the chart into one of 5449 standardized chief complaints. We included visits from patients ≥ 65 years old who recorded a chief complaint of abdominal pain as defined below at the time of arrival to the ED. We excluded patients triaged to an Emergency Severity Index (ESI) of 1 (“Immediate”) as the acuity of these patients often

hinders the reliable ascertainment of a chief complaint (e.g., patients presenting to the ED in cardiac arrest). We defined “older adults” as patients ≥ 65 years old, and the “oldest old” as those ≥ 85 years old. Our primary comparison was between older adult ED patients with and without a chief complaint of abdominal pain. Our secondary comparison was between the oldest old adult ED patients with and without a chief complaint of abdominal pain.

Defining a chief complaint of abdominal pain

We defined a chief complaint of abdominal pain as the patient's primary reason for visit being a pain-like symptom of either the abdomen broadly, or of any abdominal internal organ. A health services researcher (ATC) and attending emergency physician (ABF) independently selected chief complaint codes meeting this definition. A search of each internal organ combined with a pain-related term (“pain,” “discomfort,” “cramp,” “spasm,” “distension,” “full,” “hernia”) was conducted to identify additional terms. We excluded cervicitis/vaginitis (four cases) as these are unlikely to have the same clinical import nor be confused with internal abdominal pain. Primary analyses excluded constipation. The vast majority of cases came from the code “Abdominal pain, cramps or spasms not otherwise specified” (Table S4).

Variables and measurement

Age, sex, sociodemographic factors (payer type, homeless status and residence), and clinical status (ESI status, multimorbidity, disposition) were used as described in NHAMCS documentation. Race and ethnicity were combined into four levels based on NHAMCS chart abstraction: Non-Hispanic White, Non-Hispanic Black, Hispanic, and Other. The “died during care episode” variable was constructed from NHAMCS variables “dead on arrival,” “died in ED,” and “died during hospitalization.”

Outcomes

Diagnostic testing included the percentage of patients receiving EKG, X-ray, ultrasound, laboratory investigations, and CT scan. We defined “frequently ineffective testing” as abdominal X-ray^{24,28,29} versus “potentially effective testing” defined as laboratory investigations, CT scans, ultrasound, and EKG.¹³ Receipt of any analgesic was defined by code 058 (“Analgesics”) in Level 2 of the Multum classification of therapeutic drug classes, and

further refined by Level 3 classification (see Appendix S1).

The second and third reasons for visit beyond the chief complaint were analyzed without regard to the order in which they appeared. Therefore, percentages can reach 200% if a reason for visit appears in both. Reasons for visits beyond the third were excluded due to low prevalence in the data. Disposition and diagnosis at discharge are described in Appendix S1.

Statistical analysis

Standard descriptive statistics were used to report the characteristics of patient visits. We used the NCHS-provided four-level probability-based sample weights to allow nationally representative estimates. The Rao–Scott scaled chi-squared distribution for the log-likelihood from a binomial distribution was used to provide confidence intervals surrounding weighted proportions. All 95% confidence intervals were based on two-sided statistics and survey-weighted standard errors. To calculate the smallest reliably detectable difference in death during care episode for abdominal versus non-abdominal pain patients, a post hoc power analysis was conducted for death rates using a simulation-based design with survey weights, assuming death rate was independent and identically distributed from other covariates, with power of 80%. This indicated the abdominal pain death rate would need to be 1.9 percentage points higher to detect a difference at 80% power. Analyses were conducted in R version 3.6.1. This study was determined to be exempt by the University of Pennsylvania institutional review board under 45 CFR 46.104, category 4.

RESULTS

Population characteristics and prevalence of a chief complaint of abdominal pain

After applying exclusion criteria, across all chief complaints, there were 16,440 visits from older adults (≥ 65 years) to 1137 EDs recorded in the NHAMCS data from 2013 to 2017, an average of 14.5 visits per hospital per year. Using survey weights, these sampled visits project to an estimated 5-year incidence of 108,354,709 older adult ED visits nationally for all chief complaints. Based on these projections, an estimated 7,524,043 of these visits from older adults (≥ 65 years) were for a chief complaint of abdominal pain, representing 6.9% (95% CI: 6.4–7.6%) of all ED visits by older adults. Abdominal pain chief complaints were less prevalent in the oldest old

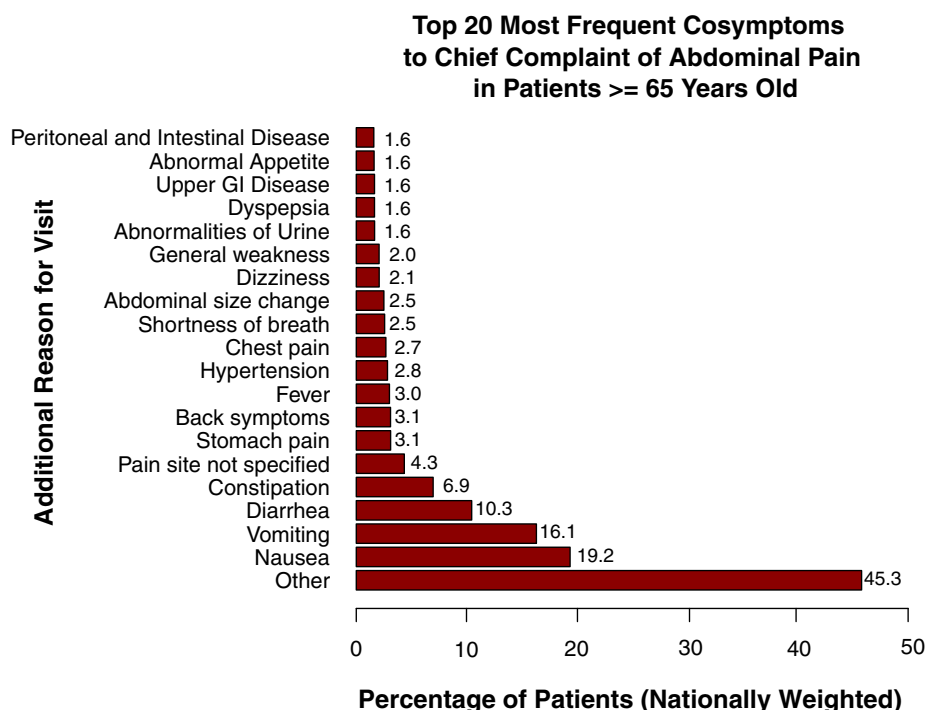


FIGURE 1 Top 20 most frequent additional reasons for visit (co-symptoms) among patients 65 years and older with a chief complaint of abdominal pain. Percentage of visits for older adults with abdominal pain with listed additional reasons for visit. Because, with the exception of nausea and vomiting, additional reasons for visit rarely appeared together, the second and third reasons for visit beyond the chief complaint were analyzed separately, without regard to the order in which they appeared. Therefore it is possible for the “None” and “Other” reason for visit percentages to reach a maximum of 200%, reflecting the possibility that each reason for visit appears in both the second and third reasons for visit. Reasons for visit beyond the third (NHAMCS RFV 4 and 5 variables) were excluded due to a lack of availability in 2013 and low prevalence in the data

(≥ 85 years): 7.2% for patients 65–84 years old versus 5.7% for patients ≥ 85 years old.

Additional reasons for visit

Patients ≥ 65 years presenting with a chief complaint of abdominal pain reported a variety of additional reasons for visit (Figure 1). Abdominal pain was the sole reason for visit in 37.5% (95% CI: 31.0–44.1%) of abdominal pain visits by older adults. The top five co-symptoms reported included nausea and/or vomiting in 25.0% (95% CI: 20.1–29.8%) of visits, diarrhea in 7.5% (95% CI: 4.8–10.1%), constipation in 5.7% (95% CI: 4.0–7.5%), back symptoms in 3.8% (95% CI: 2.3–5.4%), and fever in 1.9% (95% CI: 0.9–3.0%). Additional co-symptoms, representing 145 distinct codes, are listed in Figure S1.

Characteristics of visits for abdominal pain among older patients

Visits from older adults for a chief complaint of abdominal pain were less likely to be from a nursing home than

non-abdominal pain visits but were otherwise demographically similar (Table 1). Compared with patients with all other (non-abdominal pain) chief complaints, patients with a chief complaint of abdominal pain were less likely to have multimorbidity at baseline.

Older patients with abdominal pain had a lower probability of being triaged to the “Emergent” (ESI2) acuity on arrival compared with those without abdominal pain (7.1% vs. 14.8%, Table 2). This lower rate of triage to ESI2 persisted in the oldest old (≥ 85 years old), with 9.9% of patients with abdominal pain compared with 15.4% without abdominal pain triaged to the “Emergent” category (Table S1).

Evaluation and management of older adults with abdominal pain in EDs

Table 3 describes the prevalence of common evaluation and management strategies among ED visits for older patients with a chief complaint of abdominal pain. Imaging was common, with 75.8% of patient visits receiving any form of imaging. A total of 15.8% (95% CI: 12.7–19.6%) of all older abdominal pain patients

TABLE 1 Personal characteristics of older adults (65+) presenting to US EDs, comparing survey-weighted visits for a chief complaint of abdominal pain to other visits in NHAMCS, 2013–2017

Variable	Other chief complaint (n = 15,398)	Abdominal pain chief complaint (n = 1042)	p value
Weighted 5-year incidence of ED visits (N)^a	100,830,667	7,524,043	
Age (years), M (SD)	76.7 (8.2)	76.2 (7.7)	0.12
Race/Ethnicity, % ^b			0.29
Non-Hispanic White	76.3	73.1	
Non-Hispanic Black	12.6	14.2	
Hispanic	8.3	9.6	
Other	2.8	3.1	
Female %	57.8	61.0	0.08
Payer type, %			0.16
Medicare	79.1	81.1	
Private insurance	8.0	6.1	
Unspecified/Other	7.4	6.1	
Medicaid	4.1	5.4	
Self-pay	1.2	1.2	
Worker's compensation	0.2	5.4	
No charge/Charity	0.0	0.1	
Residence type, %			0.003
Private residence	86.3	90.7	
Nursing home	8.5	4.5	
Unspecified/Other	5.1	4.6	
Homeless	0.2	0.1	
Multimorbidity, % ^c	58.8	53.8	0.03

Abbreviations: ED, emergency department; M, mean; N, number of visits; n, number of observations; NHAMCS, National Hospital Ambulatory Medical Care Survey; SD, standard deviation.

^aEstimate of number of ED visits nationally, using survey weights provided by the nationally representative survey NHAMCS. All estimates and percentages in this table are similarly nationally representative.

^bNHAMCS estimates are derived from electronic health record data and therefore may not fully reflect patient self-reported race/ethnicity.

^cTwo or more chronic diagnoses at the time of presentation to the ED.

received X-ray without additional imaging and 60.0% (95% CI: 54.9–65.1%) received either a CT scan or an ultrasound. Fewer older patients with abdominal pain received an EKG (39.3%) compared with non-abdominal pain patients (44.5%). More older patients with abdominal pain received labs (88.5%) compared with non-

TABLE 2 Clinical characteristics and disposition of older adults (65+) presenting to US EDs, Comparing survey-weighted visits for a chief complaint of abdominal pain to other visits in NHAMCS, 2013–2017

Variable	Other chief complaint (n = 15,398)	Abdominal pain chief complaint (n = 1042)	p value
Weighted 5-year incidence of ED visits (N)^a	100,830,667	7,524,043	
Triage status, % ^b			<0.001
Emergent (ESI 2)	14.8	7.1	
Urgent (ESI 3)	38.4	56.2	
Semi-urgent (ESI 4)	15.3	9.3	
Nonurgent (ESI 5)	2.2	1.2	
Unspecified/Other	29.4	26.2	
Wait time (minutes), mean	30.9	36.4	0.068
Discharged from ED, % ^c	65.9	65.7	0.99
Admitted to operating room, %	0.8	3.6	<0.001
Admitted to critical care, %	4.0	2.2	0.21
Died during care episode, % ^d	1.2	0.9	0.5

Abbreviations: ED, emergency department; M, mean; N, number of visits; n, number of observations; NHAMCS, National Hospital Ambulatory Medical Care Survey; SD, standard deviation.

^aEstimate of number of ED visits nationally, using survey weights provided by the nationally representative survey NHAMCS. All estimates and percentages in this table are similarly nationally representative.

^bVisits from patients triaged to ESI 1 are excluded as they are of sufficient acuity as to not systematically afford patients time to state a chief complaint.

^cIncludes patients fully evaluated and discharged, as well as patients transferred to a nursing home.

^dDead on arrival, died in ED, or died during hospitalization. Power is limited due to the small number of observations. For instance, a post hoc power analysis indicated that abdominal pain death rate would need to be 1.9 percentage points higher to detect a difference at 80% power.

abdominal pain patients (65.9%). The oldest old were statistically significantly more likely to receive a CT scan or EKG, less likely to receive ultrasound, and no more or less likely to receive X-ray without further imaging or labs (Table S2).

An analgesic was received by 52.4% (95% CI: 48.3–56.5%) of abdominal pain visits in older patients, with the majority being opiate analgesia, at 43.4% (95% CI: 39.3–47.5%) of all abdominal pain visits from older patients (Table 3). This was not statistically significantly different in the oldest old (Table S2). Tables S5–S7 additionally

TABLE 3 Evaluation and management strategies for ED visits older patients with a chief complaint of abdominal pain, comparing survey-weighted visits for a chief complaint of abdominal pain to other visits in NHAMCS, 2013–2017

Variable	Other chief complaint (n = 15,398)	Abdominal pain chief complaint (n = 1042)	p value
X-ray without ultrasound or CT, % (SE)	47.4 (0.9)	15.8 (1.8)	<0.001
Abdominal CT, % (SE)	6.5 (0.3)	55.0 (2.6)	<0.001
Ultrasound, % (SE)	3.8 (0.3)	8.2 (1.4)	<0.001
Ultrasound or CT, % (SE)	9.9 (0.4)	60.0 (2.6)	<0.001
EKG/ECG, % (SE)	44.5 (1.0)	39.3 (2.0)	0.01
Labs, % (SE)	65.9 (1.0)	88.5 (1.2)	<0.001
NSAIDs, % (SE)	7.3 (0.4)	9.3 (1.2)	0.07
Proton pump inhibitors, % (SE)	3.4 (0.3)	9.4 (1.3)	<0.001
Acetaminophen, % (SE)	8.6 (0.4)	5.3 (1.1)	0.02
Opiates, % (SE)	21.9 (0.7)	43.4 (2.1)	<0.001
Any analgesic, % (SE)	37.7 (1.0)	52.6 (2.1)	<0.001
IV fluids, % (SE)	38.0 (1.2)	58.7 (2.1)	<0.001

Abbreviations: ED, emergency department; M, mean; n, number of observations; SE, standard error.

Source: NHAMCS, National Hospital Ambulatory Medical Care Survey.

stratify the evaluation, management, and disposition of older patients with a chief complaint of constipation.

Principal diagnosis at discharge

There were 78 distinct principal diagnoses among discharged patients (Table S3). Four diagnosis codes (uncomplicated diverticular disease and three nonspecific abdominal pain codes) were common between the 10 most prevalent principal diagnoses for discharged and non-discharged (transferred or admitted to floor, the operating room, or critical care), as listed in Table 4.

Outcomes and disposition

Older adults with abdominal pain were more likely to be admitted directly to the operating room than older adults without abdominal pain (3.6% vs. 0.8%, Table 2). Oldest old patients presenting with a chief complaint of

TABLE 4 Principal diagnosis among patients 65 and older with a chief complaint of abdominal pain, by discharged status

ICD10 Code	Percent	Diagnosis
Discharged from ED		
R109	15.4	Unspecified abdominal pain
R101	10.9	Pain localized to upper abdomen
R103	7.4	Pain localized to other parts of lower abdomen
N390	6.7	Urinary tract infection, site not specified
N200	4.5	Calculus of kidney
R108	4.0	Other abdominal pain
K579	2.8	Diverticular disease of intestine, part unspecified, without perforation, or abscess
K529	2.8	Noninfective gastroenteritis and colitis, unspecified
K590	2.6	Constipation
M549	2.0	Dorsalgia, unspecified
Not discharged from ED		
K566	11.1	Other and unspecified intestinal obstruction
K26-	9.3	Duodenal ulcer
R109	8.8	Unspecified abdominal pain
N189	6.3	Chronic kidney disease, unspecified
A047	5.5	Enterocolitis due to <i>Clostridium difficile</i>
K579	4.7	Diverticular disease of intestine, part unspecified, without perforation, or abscess
K859	4.0	Acute pancreatitis, unspecified
R108	3.7	Other abdominal pain
R101	3.6	Pain localized to upper abdomen
N184	3.2	Chronic kidney disease, stage 4 (severe)

Note: Principal diagnosis from discharged versus non-discharged (including admissions, transfer, admitted to operating room, admitted to critical care) ED visits for older adults with abdominal pain. Top 10 diagnoses in each category are included. To avoid coding across the transition from ICD9 to ICD10, only 2016 and 2017 data are used. ICD10 codes appearing in both discharged and non-discharged patients are in bold.

abdominal pain also had a higher probability of being admitted to the operating room (6.4% vs. 0.9%) compared with oldest old patients without abdominal pain (Table S1). Older adults and oldest old adults with abdominal pain did not display statistically significant differences in discharge home or in-hospital death compared with patients of the same age groups without

abdominal pain (Tables 2 and S1). Unlike all older adults, oldest old adults with abdominal pain had a significantly lower rate of admission to critical care (0.9% vs. 4.2%, Tables 2 and S1).

DISCUSSION

Previous findings from earlier studies demonstrated that presenting to an ED with a chief complaint of abdominal pain is a high-risk condition among older patients,^{4,7,8} with high mortality even for those admitted to the hospital.³⁰ This analysis builds upon these by providing the first published, nationally representative description of the evaluation, management, and disposition of older adults with and without abdominal pain.

The optimal evaluation and management of patients presenting to the ED with a chief complaint of abdominal pain should rely on clinical judgment and shared decision-making,³¹ particularly absent patient-centered randomized evidence.³² This is particularly true for patients with chronic abdominal pain or recurrent presentations of acute abdominal pain, where prior imaging and history may provide reassurance against severe, intervenable disease without re-imaging. Nevertheless, our analysis demonstrates patterns that may suggest persistent areas of potential improvement.

Researchers have previously documented a national trend toward greater use of cross-sectional imaging in EDs.¹⁷ In an unpublished analysis of the 1997–2000 NHAMCS, 11% of non-traumatic abdominal pain patients ≥ 60 received a CT scan, 37% an abdominal X-ray, 8% an ultrasound, and 37% were admitted.¹⁶ Despite differences in case definition, we find similar admission rates and ultrasound utilization rates, higher CT and lower X-ray usage. Despite greater reliance on CT scans, nearly 16% of ED patients ≥ 65 years of age with a chief complaint of abdominal pain still received only X-rays, a test that can provide false reassurance.^{24,28} Lewis et al. found 25% of patients received an abdominal X-ray without CT, suggesting modest de-adoption over the subsequent decade.⁸

In our data, 40% of older patients presenting to EDs with abdominal pain did not receive CT scan or ultrasound, suggesting a strong reliance on clinical judgment regarding these patients. For instance, clinicians might rely on clinical judgment based on their overall gestalt, for a return visit after recent imaging, or when an alternative etiology is apparent (e.g., pancreatitis).

Whether this reliance is justified by outcomes is outside the scope of this study, given data limitations. Future studies using linked mortality data (e.g., Medicare) should assess whether clinicians who rely more on

clinical judgment than imaging or labs in this population have similar outcomes after discharge and identify situations of under- or over-imaging relative to outcomes. Such a patient-centered study could identify opportunities for reducing over-testing while further increasing recognition of abdominal pain in older adults as conveying a high pre-test probability of significant acute pathology.^{33,34} Meta-analyses and/or decision rules using a three-part (no test/test/treat) approach focused on select individual diagnoses across different age groups have been conducted and developed.^{25,26,35–37} Future studies should consider focusing on the decision to obtain CT imaging in older adults with abdominal pain across all potential serious diagnoses simultaneously, to guide clinicians in identifying a sufficiently low-risk population to avoid testing and its attendant harms, as well as higher-risk populations not currently being tested who would benefit from imaging and/or treatment.

Strikingly, given previous findings that ischemia is the leading cause of death among discharged ED Medicare abdominal pain patients,¹⁴ the majority of older patients with abdominal pain did not receive an EKG in the ED. Although this also would benefit from outcomes-driven future research on the balance of clinical judgment versus protocolized care, there are potential opportunities for care improvement. EKGs in abdominal pain may identify atypical cardiac ischemia, arrhythmias predisposing to mesenteric ischemia (thereby altering imaging decisions towards CT angiography), and QT prolongation (potentially preventing complications of antiemetics). These benefits should be counterbalanced against the potential harms of overdiagnosis.

Another potential care improvement highlighted by these findings relates to triage. Patients over 65 years old with abdominal pain were triaged to the highest acuity studied (ESI 2, “Emergency”) at approximately half the rate of non-abdominal pain patients, yet were had 4.5 times greater admission directly to the OR despite a lower prevalence of multiple chronic conditions. Triage aims to account for both resource utilization and acuity, which raises concern that there may be a systematic underestimation of both age and abdominal pain chief complaints.³⁸

Previous literature demonstrated that older patients are triaged to lower-priority levels relative to their clinical outcomes than are younger patients.^{39–41} Our findings illustrate that even among ED patients ≥ 65 , chief complaints of abdominal pain are de-prioritized (by triage level) relative to outcomes. This “under-triage,” is an association rather than a causal relationship. Future studies should look for natural experiments in which to assess whether triage patterns directly affect outcomes. Nevertheless, these findings are suggestive of clinically

important differences because triage level has implications for the rapidity and resources (e.g., treatment area of the ED) with which the patient is seen, and may encode judgment about the triage staff's perception of the patient's complaint, which may prejudice care.

Our findings on triage are particularly notable since our definition of abdominal pain deliberately excludes "constipation." The decision to label a chief complaint "constipation" versus "abdominal pain" may imply judgment by triage staff that a patient's abdominal pain is lower risk, which was borne out in our data. The data on additional reasons for visit demonstrate several patterns, hinting that future work might be able to identify syndromic classifications of abdominal pain presentations to aid the development of clinical pathways and standardize research. For instance, abdominal pain with back symptoms might imply a need for either CT angiogram (if suggestive of an aortic pathology) or ultrasound (if the presentation suggests pancreatitis), whereas abdominal pain with fever might indicate the need for additional diagnostic testing such as blood culture and admission to monitor fever curves.

Although the proportion of non-abdominal pain ED visits from ≥ 65 year-old women (57.8% of such ED visits) mirrored the overall percentage of women in the population ≥ 65 (55.9%⁴²), women were overrepresented in those ≥ 65 presenting with abdominal pain, comprising 61.0% of ED visits for abdominal pain. This may reflect the additional diagnostic possibilities in the female abdomen, including ovarian and uterine pathologies, as well as anatomical differences leading to greater prevalence of shared diagnoses, such as urinary tract infections. These results parallel the available evidence on gender differences in acute abdominal pain in older patients from a single study of 131 patients.⁴³

The role of cognitive aging in presentations of acute abdominal pain remains unknown. Our finding that fewer nursing home patients present with abdominal pain provides one clue that communication barriers may hamper diagnosis, given high rates of cognitive aging among nursing home patients.^{44,45} Similarly, frailty increases the susceptibility to high-risk conditions such as abdominal pain in older adults, yet is poorly captured by databases and emergency clinicians alike; consistent approaches to identify cognitive aging, frailty, and their overlap are needed.⁴⁶

Prior studies that motivated this analysis found high post-discharge mortality.^{4,7} Data in NHAMCS are not available to track mortality after discharge. Our power analysis suggested limited ability to detect clinically important differences in in-hospital death rates. Unsurprisingly, then, we found no difference in in-hospital mortality between abdominal and non-abdominal presentations. Because earlier studies did not report whether

adverse outcomes occurred in-hospital or after discharge, we are unable to differentiate between care having improved mortality for abdominal pain over time, a change in the composition of abdominal pain visits favoring less severe presentations, or simply measuring different time periods (in-hospital vs. 30-day mortality) compared with previous studies.

A finding that could be translated directly into clinical care without further study is that nearly half of older patients presenting with abdominal pain received no pain medication. In some instances, this may reflect patient preference. In others, given findings from single-center studies of analgesia in older patients,⁴⁷ this may reflect underestimation and under-treatment of older patients' pain. Opiates also have risks in older patients such as constipation or delirium,⁴⁸ however non-opiate analgesics are now widely available.

The long tail of the distribution of diagnoses suggests substantial clinical complexity. That the majority of diagnoses of discharged older patients had nonspecific final diagnoses suggests substantial uncertainty as to the etiology and may also reflect malpractice concerns as well as a desire to avoid diagnostic anchoring. Nonspecific abdominal pain diagnoses were the second and fourth most prevalent diagnoses codes among admitted patients as well. Therefore, were a pathway to be developed to guide geriatric abdominal pain management, iterative pathway development will be necessary to avoid cognitive biases leading to over- and under-testing.

Limitations

This study has limitations. First, NHAMCS does not record whether X-rays imaged the abdomen or chest. In some circumstances, a chest X-ray may have revealed pneumonia adjacent to the diaphragm, causing abdominal pain. However, the majority of X-rays for a chief complaint of abdominal pain are likely of the abdomen. Second, whether a liver function test was ordered was only available after 2015 and so was excluded. Third, NHAMCS can measure multimorbidity but not frailty. Fourth, we have limited power to detect differences in death rates. Fifth, NHAMCS does not record post-discharge outcomes.

A final limitation involves the diagnostic tests included in this analysis. Ideally, we would determine "effective testing" by the results of randomized trials involving patient-centered outcomes. Such trials are rare,³² and do not exist for the diagnostic modalities and diagnoses we study. Given the high rate of morbidity and mortality after an ED visit for abdominal pain among older adults; the availability of interventions such as hospitalization, procedures, antibiotics, and surgery for

many etiologies potentially diagnosed with labs, imaging, and EKG, and the relatively strong test characteristics (sensitivity, specificity, and likelihood ratios) of these diagnostics, we refer to these diagnostics as “potentially effective testing” in this manuscript.

Conclusion

Older patients presenting with abdominal pain are at high risk of poor outcomes leading to death or disability. This study provides the first published, nationally representative data on the management and evaluation of abdominal pain. Our findings highlight several areas crucial for future study and quality improvement: triage decisions, diagnostic testing, disposition (admission vs. discharge), and pain management. These areas are amenable to potential interventions through clinical pathway development and education specifically focused on the management of geriatric populations in the ED.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

Ari B. Friedman, Angela T. Chen, Rachel Wu, Norma B. Coe, Scott D. Halpern, Ula Hwang, Rachel R. Kelz, and Anne R. Cappola contributed to the design and implementation of the research, to the analysis of the results, and to the writing of the manuscript. The authors gratefully acknowledge the input of David Asch and Sarah Kagan in the early phases of this work.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

Appendix S1. Supporting Information.

Figure S1. Frequency of top 15 additional reasons for visit for ED visits with a chief complaint of abdominal pain from patients 65 years and older.

Table S1. Clinical characteristics and disposition of oldest old adults (85+) presenting to US EDs, by abdominal pain chief complaint and overall in NHAMCS, 2013–2017.

Table S2. Common evaluation and management strategies for ED visits with a chief complaint of abdominal pain, by age group and overall.

Table S3. ICD10 diagnosis among patients 65 and older with a chief complaint of abdominal pain discharged from the ED.

Table S4. Reasons for visit included in “abdominal pain” chief complaint.

Table S5. Personal characteristics of older adults (65+) presenting to US EDs, comparing survey-weighted visits for a chief complaint of abdominal pain to constipation and other visits in NHAMCS, 2013–2017.

Table S6. Clinical characteristics and disposition of older adults (65+) presenting to US EDs, comparing survey-weighted visits for a chief complaint of abdominal pain to constipation and other visits in NHAMCS, 2013–2017.

Table S7. Evaluation and management strategies for ED visits older patients with a chief complaint of abdominal pain, comparing survey-weighted visits for a chief complaint of abdominal pain to constipation and other visits in NHAMCS, 2013–2017.

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