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ORIGINAL RESEARCH

The Practice of Emergency Medicine

Comparison of emergency department throughput and process times between male and female patients: A retrospective cohort investigation by the Reducing Disparities Increasing Equity in Emergency Medicine Study Group

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Abstract

Introduction: Health equity for all patients is an important characteristic of an effective healthcare system. Bias has the potential to create inequities. In this study, we examine emergency department (ED) throughput and care measures for sex-based differences, including metrics such as door-to-room (DTR) and door-to-healthcare practitioner (DTP) times to look for potential signs of systemic bias.

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Methods: We conducted an observational cohort study of all adult patients presenting to the ED between July 2015 and June 2017. We collected ED operational, throughput, clinical, and demographic data. Differences in the findings for male and female patients were assessed using Poisson regression and generalized estimating equations (GEEs). A priori, a clinically significant time difference was defined as 10 min.

Results: A total of 106,011 adult visits to the ED were investigated. Female patients had 8-min longer median length-of-stay (LOS) than males ($P < 0.01$). Females had longer DTR (2-min median difference, $P < 0.01$), and longer DTP (5-min median difference, $P < 0.01$). Females had longer median door-to-over-the-counter analgesia time (84 vs. 80, $P = 0.58$), door-to-advanced analgesia (95 vs. 84, $P < 0.01$), door-to-PO (by mouth) ondansetron (70 vs. 62, $P = 0.02$), and door-to-intramuscular/intravenous antiemetic (76 vs. 69, $P = 0.02$) times compared with males.

Conclusion: Numerous statistically significant differences were identified in throughput and care measures—mostly these differences favored male patients. Few of these comparisons met our criteria for clinical significance.

KEYWORDS
bias, emergency service, gender identity, hospital, length of stay, pain management, sex

1 | INTRODUCTION

1.1 | Background

Biases affect decisions and actions sometimes without awareness or intentional control. Healthcare professionals exhibit the same levels of implicit bias as the wider population in areas such as race, ethnicity, sex or gender, age, and weight.[1] Healthcare practitioners demonstrate low to moderate levels of positive implicit bias toward White people and a negative implicit bias toward people of color.[2]

1.2 | Importance

In the clinical setting, implicit bias is associated with lower quality of care.[1] Health care disparities can be reduced successfully through physician awareness and acknowledgement of implicit bias accompanied with active perspective-changing practice.[3]

1.3 | Objective

Throughput metrics are important quality metrics in emergency medicine where time to diagnosis and treatment can impact outcomes or efficiency of the system. Analyzing patient throughput in the emergency department (ED) can help identify areas where unrecognized bias may impact care delivery and outcomes. Prior studies of ED patients have reported delays in computed tomography (CT) acquisition and diagnosis of appendicitis for female patients compared to male patients,[4] as well as delayed analgesic administration and reduced rates of opioid administration for female patients with abdominal pain compared to male patients.[5,6] However, biases can differ in certain situations and do not always favor male patients.[7]

1.4 | Goals of this investigation

To our knowledge, there are a limited number of published investigations into sex-bias as it pertains to ED throughput and care. As such, the aim of this study was to identify sex-related differences in ED throughput and care measures primarily focused on length-of-stay (LOS), door-to-room (DTR), and door-to-healthcare practitioner (DTP) time between male and female patients as a marker of potential systemic sex related bias. Secondarily, we aim to examine other care measures such as time to symptom treatment, as well as evaluate if the comparisons are different during times of ED crowding.

2 | METHODS

2.1 | Study design

This is an observational cohort study of all adult patient visits to the ED of Mayo Clinic Hospital, Saint Mary's Campus, Rochester, Minnesota between July 2015 and June 2017. The study was approved by Mayo Clinic Institutional Review Board and conducted in accordance with current ethical research practices and policies. This study adheres to both the Strengthening the Reporting of Observational Studies in

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Epidemiology reporting guidelines and Sex and Gender Equity in Research guidelines.[8,9]

2.2 | Setting

The ED sees approximately 77,000 visits annually, roughly 14,000 of which are pediatric visits, using 76 universal patient care rooms, a 9-room observation unit, and a proximally located radiology area offering CT, ultrasound, and plain film radiography with on-site radiologist interpretation. The medical center is an accredited Level I trauma center and stroke center.

During the study period, the ED was continuously staffed by at least 1 board certified or board eligible emergency physician, with lowest coverage during overnight period, and up to 5 board-certified or board-eligible emergency physicians during the day and evening times. Acute care health teams include attending physicians, advanced practice nonphysician healthcare practitioners, resident physicians, nurses, patient-care assistants, emergency pharmacists, operations staff, and other support staff.

ED nurses perform triage including initiating a chart with chief concerns, assessing vital signs, and assigning an Emergency Severity Index (ESI) designation. Further, as part of ED practice, over-the-counter (OTC) analgesia and oral ondansetron can be provided to patients through a nursing-initiated protocol for people in the waiting room; ECG can also be ordered through a nursing protocol without a patient being cared for in an acute care room. Advanced analgesia beyond that which can be given OTC, as well as other antiemetic options also can be administered without a patient having to be roomed, however, would need a licensed healthcare practitioner to be involved. Additionally, the ED has a standard assessment of relative busyness—using a 3-tier system: green (under 15 patients waiting), yellow (15–29 patients waiting), and red (30 or more patients waiting).

2.3 | Study participants

We included all adult patients presenting to the ED who consented to the use of their medical records in research. Patients who were triaged as ESI level one were excluded because they would not wait to receive medical care and their throughput metrics could potentially mask or minimize the effects of systemic bias. We excluded encounters where sex was missing from the electronic health record (EHR), and where the DTR and DTP could not be assessed because of missing data. Patients with primarily psychiatric chief concerns were excluded as their throughput metrics are significantly skewed because of limited inpatient availability and by regional legalities.

2.4 | Data sources and measurement

We collected LOS, DTR, and DTP times, patient demographics including sex (patient's gender identity was not reported in the EHR at the time), chief concern, and mode of arrival. Chief concerns were entered as free text into the EHR by operations staff; KK and AWH reviewed and organized these chief concerns into categories used in other literature[10] (Table S1). Additionally, some care measures, such as when medications were ordered and administered, certain labs, imaging, and ECG were ordered and completed, were collected. The data were collected electronically directly from the electronic health record.

The Bottom Line

This study examined emergency department throughput and care measures for differences between male and female patients. We found several statistically significant differences in length of stay, door-to-room time, and door-to-healthcare practitioner time. We did find differences in the time to receive treatments for symptoms like pain (median difference of 4 min for over-the-counter treatments and 11 min for advanced treatments). Although the differences were almost uniformly in favor of male patients, very few of these differences achieved our predetermined threshold for clinical significance.

2.5 | Statistical analysis

All data were de-identified and stored on an encrypted server and all results are reported in aggregate. Data are described with medians and interquartile ranges. Confidence intervals (CIs) for the difference in medians were computed using bootstrap intervals. Differences in patient utilization between male and female patients were assessed using chi-squared tests. Follow-up pairwise comparisons were performed using chi-squared tests and *P* values were adjusted using the Benjamini-Hochberg correction. All tests were two-sided and adjusted *P* values less than 0.05 were considered statistically significant.

We used population-averaged Poisson generalized estimating equations (GEEs) with a log link function to measure any association between patient sex and LOS, DTR, or DTP. The right-skew of the time measures is handled by modeling on a logarithmic scale using a Poisson distribution. The GEEs were favored over standard regression to handle repeated visits by individual patients. Correlation between repeat visits was assumed to be constant regardless of time between subsequent visits and standard errors were computed using the Eicker-Huber-White estimator. We follow similar statistical analytic pathways as performed by Lichen et al with respect to sex in our case as opposed to body mass index (BMI).[11] We adjusted for potential confounding variables including patient BMI, age, race, ESI triage level, arrival time and method, and chief concern. Because some patients had more than one visit to the ED over the course of the study period and knowledge of a previous visit may influence behavior on the subsequent visit, we performed a sensitivity analysis by restricting data to only the first ED visit for each patient—we will refer to this sample as the First Visit sample, and a sample of all visits as the All Visit sample. Analysis using this First Visit sample was performed using Poisson regression since

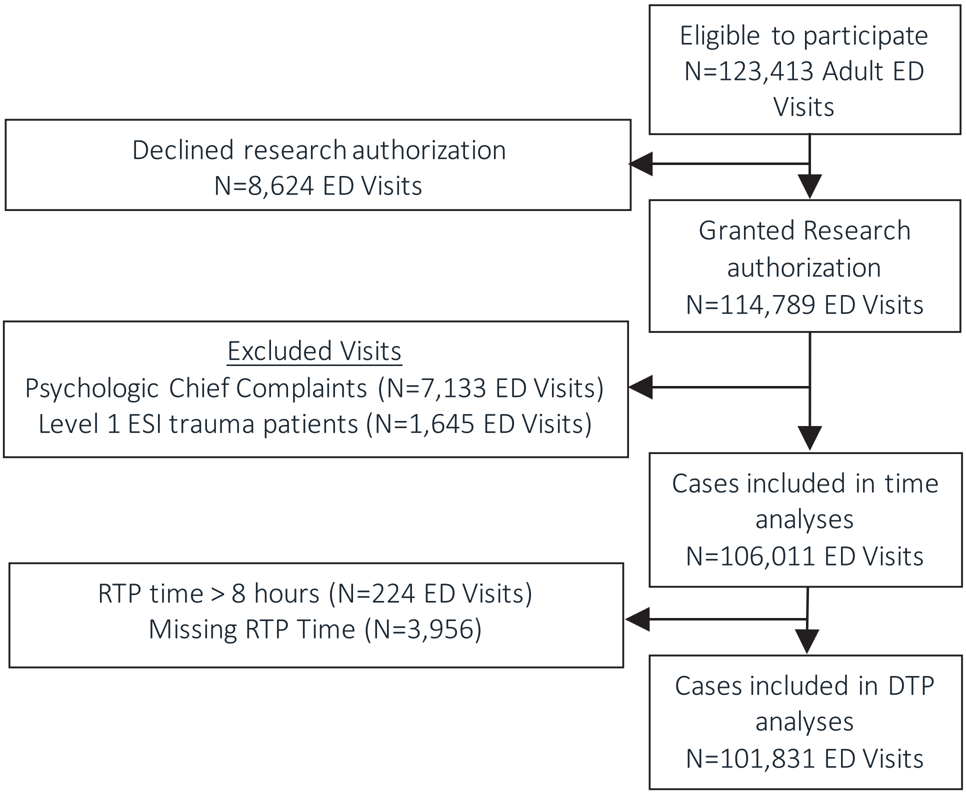

FIGURE 1 Flowchart of enrollment. ED, emergency department; BMI, body mass index; ESI, emergency severity index; DTR, door-to-room; DTP, door-to-healthcare practitioner; RTP, room-to-provide

repeated visits are not a concern for this data. Covariate adjustments were made similarly to the primary analysis. For this project, R version 3.6.2 (R Foundation, Vienna, Austria) statistical software was used for analysis.

Given the size of our study cohort, we recognized a priori that even minor differences naturally occurring would likely have statistical significance. We determined the need to identify a threshold for a time difference that would be considered beyond what is expected between 2 large cohorts, or would have some level of influence on the outcome for patients—as a team, we arrived at 10 min. 10 min has value in other clinical aspects, such as how the American College of Cardiology (ACC) expects, and literature supports that an echocardiogram (ECG) must be interpreted within 10 min of arrival for patients presenting with symptoms of ST-elevation myocardial infarction because it portends the best outcomes.[12,13] We also realize that it is not likely any significant clinical deterioration that could be expected for most delays of 10 min—yet, this time felt socially relatable and seemed to parallel certain other clinical measures, while simultaneously offering more meaning than statistical significance alone. Throughout, we will refer to this threshold as clinical significance—understanding that its value is not only directly tied to adverse outcomes but also incorporates elements of clinical experience for the patients.

3 | RESULTS

3.1 | Participant enrollment

We identified 123,413 adult visits to the ED during the study period. Patients who declined to participate in research, arrived with psychological complaints, or were assigned a triage ESI level of 1, were excluded. There were 3777 visits missing data required for DTR times and were excluded for DTR analysis. ED visits missing data required for DTP analysis or with a recorded room-to-healthcare practitioner time exceeding 8 h, which was considered erroneous, were excluded from DTP analysis (Figure 1).

3.2 | Characteristics of study participants

Of the 106,011 visits from 64,117 distinct patients (Table 1), general and unspecified chief concerns were the most frequent (25,407 visits, 24.0%) followed by digestive concerns (17,607 visits, 16.6%) and musculoskeletal concerns (15,935 visits, 15.0%). Females were sent home after their ED visit more often than males with a difference of 5.5% in both samples (Table 1).

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TABLE 1 Patients and ED visit characteristics

	Unrestricted sample–all visits			Restricted sample–first visit only		
	All adults (N = 106,011)[a]	Females (N = 55,435)[a]	Males (N = 50,576)[a]	All adults (N = 64,117)[a]	Females (N = 33,124)[a]	Males (N = 30,993)[a]
Age, y						
Mean (SD)	54.5 (20.8)	53.5 (21.4)	55.5 (20.1)	53.9 (20.4)	53.3 (20.8)	54.5 (19.9)
Median [IQR]	55 [36–71]	54 [35–71]	57 [39–72]	55 [36–70]	54 [35–70]	56 [37–70]
Race and ethnicity, No. (%)						
Asian	1563 (1.5)	889 (1.6)	674 (1.3)	1010 (1.6)	567 (1.7)	443 (1.4)
Black	5073 (4.8)	2595 (4.7)	2478 (4.9)	2498 (3.9)	1238 (3.7)	1260 (4.1)
White	84,740 (79.9)	43,978 (79.3)	40,762 (80.6)	51,274 (80.0)	26,277 (79.3)	24,997 (80.7)
Other	5659 (5.3)	3025 (5.5)	2634 (5.2)	3024 (4.7)	1574 (4.8)	1450 (4.7)
Unknown/did not disclose	8976 (8.5)	4948 (8.9)	4028 (8.0)	6311 (9.8)	3468 (10.5)	2843 (9.2)
ESI level, No. (%)						
2	21,866 (20.6)	10,237 (18.5)	11,629 (23.0)	13,119 (20.5)	6064 (18.3)	7055 (22.8)
3	66,925 (63.1)	36,282 (65.4)	30,643 (60.6)	40,445 (63.1)	21,588 (65.2)	18,857 (60.8)
4	16,374 (15.4)	8524 (15.4)	7850 (15.5)	10,152 (15.8)	5266 (15.9)	4886 (15.8)
5	753 (0.7)	352 (0.6)	401 (0.8)	338 (0.5)	180 (0.5)	158 (0.5)
Unspecified	93 (0.1)	40 (0.1)	43 (0.1)	63 (0.1)	26 (0.1)	37 (0.1)
MEW score, No. (%)						
Missing data	20,558 (19.4)	10,514 (19.0)	10,044 (19.9)	12,350 (19.3)	6207 (18.7)	6143 (19.8)
0	90 (0.1)	46 (0.1)	44 (0.1)	55 (0.1)	28 (0.1)	27 (0.1)
1	929 (0.9)	462 (0.8)	467 (0.9)	576 (0.9)	283 (0.9)	293 (0.9)
2	4927 (4.6)	2613 (4.7)	2314 (4.6)	3181 (5.0)	1670 (5.0)	1511 (4.9)
3	56,763 (53.5)	29,560 (53.3)	27,203 (53.8)	35,188 (54.9)	18,059 (54.5)	17,129 (55.3)
4	12,848 (12.1)	6839 (12.3)	6009 (11.9)	7311 (11.4)	3910 (11.8)	3401 (11.0)
5	6502 (6.1)	3622 (6.5)	2880 (5.7)	3618 (5.6)	1991 (6.0)	1627 (5.2)
6+	3394 (3.2)	1779 (3.2)	1615 (3.2)	1838 (2.9)	976 (2.9)	862 (2.8)
Arrival mode, No. (%)						
Ground ambulance	24,421 (23.0)	12,459 (22.5)	11,962 (23.7)	13,537 (21.1)	6721 (20.3)	6816 (22.0)
Law enforcement	200 (0.2)	68 (0.1)	132 (0.3)	121 (0.2)	40 (0.1)	81 (0.3)
Helicopter	656 (0.6)	272 (0.5)	384 (0.8)	574 (0.9)	239 (0.7)	335 (1.1)
All others	80,734 (76.2)	42,636 (76.9)	38,098 (75.3)	49,885 (77.8)	26,124 (78.9)	23,761 (76.7)
Length of stay (min)						
Mean (SD)	275.0 (212.2)	276.4 (199.7)	273.5 (225.0)	274.6 (216.3)	276.2 (204.3)	272.9 (228.3)
Median [IQR]	237 [159–335]	241 [163–338]	233 [155–331]	234 [156–333]	239 [159–337]	230 [152–329]
Arrival time of day, No. (%)						
Midnight–6 am	10,941 (10.3)	5520 (10.0)	5421 (10.7)	6391 (10.0)	3121 (9.4)	3270 (10.6)
6 am–Noon	28,405 (26.8)	14,612 (26.4)	13,793 (27.3)	17,182 (26.8)	8815 (26.6)	8367 (27.0)
Noon–6 pm	38,701 (36.5)	20,552 (37.1)	18,149 (35.9)	23,635 (36.9)	12,436 (37.5)	11,199 (36.1)
6 pm - Midnight	27,964 (26.4)	14,751 (26.6)	13,213 (26.1)	16,909 (26.4)	8752 (26.4)	8157 (26.3)
Arrival day of week, No. (%)						
Monday	16,295 (15.4)	8383 (15.1)	7912 (15.6)	9872 (15.4)	4977 (15.0)	4895 (15.8)
Tuesday	15,060 (14.2)	7816 (14.1)	7244 (14.3)	9153 (14.3)	4684 (14.1)	4469 (14.4)
Wednesday	15,122 (14.3)	7944 (14.3)	7178 (14.2)	9224 (14.4)	4813 (14.5)	4411 (14.2)
Thursday	14,762 (13.9)	7695 (13.9)	7067 (14.0)	8900 (13.9)	4598 (13.9)	4302 (13.9)

(Continues)

TABLE 1 (Continued)

	Unrestricted sample–all visits			Restricted sample–first visit only		
	All adults (N = 106,011)[a]	Females (N = 55,435)[a]	Males (N = 50,576)[a]	All adults (N = 64,117)[a]	Females (N = 33,124)[a]	Males (N = 30,993)[a]
Friday	15,098 (14.2)	7965 (14.4)	7133 (14.1)	9124 (14.2)	4760 (14.4)	4364 (14.1)
Saturday	14,580 (13.8)	7622 (13.7)	6958 (13.8)	8714 (13.6)	4506 (13.6)	4208 (13.6)
Sunday	15,094 (14.2)	8010 (14.4)	7084 (14.0)	9130 (14.2)	4786 (14.4)	4344 (14.0)
ED workload, No. (%)						
Green	88,149 (83.2)	46,083 (83.1)	42,066 (83.2)	52,664 (82.1)	27,222 (82.2)	25,442 (82.1)
Yellow	16,685 (15.7)	8745 (15.8)	7940 (15.7)	10612 (16.6)	5478 (16.5)	5134 (16.6)
Red	1177 (1.1)	607 (1.1)	570 (1.1)	841 (1.3)	424 (1.3)	417 (1.3)
Disposition, No. (%)						
Home	66,523 (62.8)	36,253 (65.4)	30,270 (59.9)	41,459 (64.7)	22,294 (67.3)	19,165 (61.8)
Observation	12,685 (12.0)	6334 (11.4)	6351 (12.6)	7199 (11.2)	3496 (10.6)	3703 (11.9)
Inpatient	22,781 (21.5)	10,678 (19.3)	12,103 (23.9)	13,077 (20.4)	6020 (18.2)	7057 (22.8)
ICU, No. (%)						
Expired	24 (0.0)	17 (0.0)	7 (0.0)	12 (0.0)	9 (0.0)	3 (0.0)
Transfer	44 (0.0)	17 (0.0)	27 (0.1)	30 (0.0)	13 (0.0)	17 (0.1)
Other	3954 (3.7)	2136 (3.9)	1818 (3.6)	2340 (3.6)	1292 (3.9)	1048 (3.4)
Chief concern, No. (%)						
General and unspecified	25,407 (24.0)	12,502 (22.6)	12,905 (25.5)	16,089 (25.1)	7743 (23.4)	8346 (26.9)
Digestive	17,607 (16.6)	10,448 (18.8)	7159 (14.2)	10,440 (16.3)	6085 (18.4)	4355 (14.1)
Musculoskeletal	15,935 (15.0)	8474 (15.3)	7461 (14.8)	10,100 (15.8)	5300 (16.0)	4800 (15.5)
Cardiovascular	13,034 (12.3)	6349 (11.5)	6685 (13.2)	7902 (12.3)	3797 (11.5)	4105 (13.2)
Neurological	11,001 (10.4)	6063 (10.9)	4938 (9.8)	6643 (10.4)	3669 (11.1)	2974 (9.6)
Respiratory	8908 (8.4)	4609 (8.3)	4299 (8.5)	4646 (7.2)	2375 (7.2)	2271 (7.3)
Urologic	4102 (3.9)	1989 (3.6)	2113 (4.2)	2477 (3.9)	1215 (3.7)	1262 (4.1)
Eye	2143 (2.0)	1054 (1.9)	1089 (2.2)	1552 (2.4)	738 (2.2)	814 (2.6)
ENT	1423 (1.3)	691 (1.2)	732 (1.4)	812 (1.3)	391 (1.2)	421 (1.4)
Skin	1403 (1.3)	720 (1.3)	683 (1.4)	825 (1.3)	418 (1.3)	407 (1.3)
Genital	1249 (1.2)	777 (1.4)	472 (0.9)	751 (1.2)	473 (1.4)	278 (0.9)
Procedure-related	1086 (1.0)	449 (0.8)	637 (1.3)	430 (0.7)	192 (0.6)	238 (0.8)
Dental	968 (0.9)	432 (0.8)	536 (1.1)	553 (0.9)	241 (0.7)	312 (1.0)
Endocrine	700 (0.7)	330 (0.6)	370 (0.7)	318 (0.5)	176 (0.5)	142 (0.5)
Hematologic	652 (0.6)	289 (0.5)	363 (0.7)	344 (0.5)	153 (0.5)	191 (0.6)
Social	351 (0.3)	217 (0.4)	134 (0.3)	208 (0.3)	131 (0.4)	77 (0.2)
Pregnancy	42 (0.0)	42 (0.1)	0 (0.0)	27 (0.0)	27 (0.1)	0 (0.0)

Abbreviations: BMI, body mass index; ED, emergency department; ENT, ear, nose, and throat; ESI, emergency severity index; MEW, modified early warning.
[a]Unless otherwise specified.

3.3 | LOS analysis

The median LOS was 237 min (interquartile range [IQR], 159–335) for all patients (Table 2). The difference in median LOS between males and females (All Visit sample) was 8 min. After adjusting for patient age, BMI, race, ethnicity, and modified early warning score (MEWS).[14,15]

ESI, chief complaint, disposition, as well as arrival method, time of day, and day of the week, comparison between sexes found a statistically significant effect (relative risk, RR = 1.016; 95% CI, 1.007–1.026; $P < 0.01$).[14,15] The expected difference in median LOS showed female patients experiencing 3.7 min longer LOS in the ED (95% CI, 1.6–6.1 min). These differences did not meet the pre-defined threshold for clinical significance. When examining median LOS by different ESI levels, the same trend of females having longer times is seen (Table 3). Further breakdown of the First Visit sample in this way found a 10-min longer median LOS for females with ESI level 3

TABLE 2 Throughput and process time measures presented by patient sex for all visits (unrestricted sample), and only first ED visit (restricted sample)

Time measures (min)	Median [Q1–Q3] Adult ED visits (N = 106,011)	Adult female ED visits (N = 55,435)	Adult male ED visits (N = 50,576)	Median difference (95% CI)[a]	RR (95% CI)[b]	P value[b]
Length of stay	237 [159–335]	241 [163–338]	233 [155–331]	8 (7–11)	1.016 (1.007–1.026)	<0.001
Door-to-room time	9 [2-56]	10 [2–63]	8 [2–49]	2 (2–2)	1.058 (1.039–1.077)	<0.001
Door-to-healthcare practitioner	47 [22–105]	50 [23–110]	45 [21-98]	5 (4–6)	1.055 (1.036–1.074)	<0.001
Door-to-disposition	187 [119–275]	194 [125–284]	178 [113–266]	16 (14–18)	1.049 (1.041–1.058)	<0.001
Door-to-OTC analgesia[c]	82 [33–170]	84 [33–174]	80 [33–164]	4 (0–8)	1.010 (0.975–1.046)	0.582
Door-to-advanced analgesia[d]	90 [50–167]	95 [52–173]	84 [46–159]	11 (8–14)	1.060 (1.037–1.083)	<0.001
Door-to-PO ondansetron order	67 [34–138]	70 [35–142]	62 [33–132]	8 (4–11)	1.050 (1.007–1.095)	0.022
Door-to-IM or IV antiemetic order[e]	74 [39–146]	76 [40–150]	69 [37–139]	7 (4–10)	1.044 (1.007–1.082)	0.019
Door-to- ECG	12 [2–34]	13 [3–36]	11 [2–32]	2 (1–3)	1.031 (0.996–1.066)	0.082
Time measures (min)	**First-time adult ED visits (N = 64,117)**	**First-time adult male ED visits (N = 33,124)**	**First-time adult female ED visits (N = 30,993)**	**Median difference (95% CI)[a]**	**RR (95% CI)[b]**	**P value[b]**
Length of stay	234 [156–333]	239 [159–337]	230 [152–329]	9 (6–11)	1.017 (1.016–1.018)	<0.001
Door-to-room time	10 [2–61]	11 [2–69]	9 [2–54]	2 (2–3)	1.060 (1.058–1.063)	<0.001
Door-to-healthcare practitioner	48 [22–108]	51 [23–114]	45 [21–100]	6 (4–7)	1.059 (1.057–1.061)	<0.001
Door-to-disposition	186 [118–276]	194 [124–285]	177 [112–266]	17 (14–19)	1.049 (1.048–1.050)	<0.001
Door-to-OTC analgesia[c]	79 [33–170]	82 [33–174]	76 [32–162]	6 (0–12)	1.016 (1.012–1.020)	<0.001
Door-to-advanced analgesia[d]	89 [48–166]	94 [51–173]	82 [45–159]	12 (9–16)	1.057 (1.054–1.061)	<0.001
Door-to-PO ondansetron order	67 [34–139]	70 [35–145]	61 [32–131]	9 (5–13)	1.063 (1.058–1.068)	<0.001
Door-to-IM or IV antiemetic order[e]	73 [38–148]	76 [40–152]	68 [36–139]	8 (5–12)	1.048 (1.043–1.052)	<0.001
Door-to-ECG	12 [2–35]	12 [3–37]	10 [2–32]	2 (1–3)	1.031 (1.027–1.036)	<0.001

Abbreviations: BMI, body mass index; CI, confidence interval; ED, emergency department; IM, intramuscular; IV, intravenous; OR, odds ratio; OTC, over the counter; PO, per os; RR, relative risk.
[a]CIs calculated using a bootstrap interval.
[b]Adjusted for age, BMI, race, ethnicity, MEWS, ESI, arrival time of day, arrival day of the week, disposition, arrival method, chief complaint, and ED location. ORs represent a proportion change in median throughput time for females relative to males.
[c]Acetaminophen, ibuprofen.
[d]Ketorolac, fentanyl, morphine, hydromorphone, and ketamine.
[e]Ondansetron, metoclopramide, promethazine, droperidol, and prochlorperazine.

compared to males, ($P < 0.01$) which did meet our threshold for clinical significance.

3.4 | DTR time analysis

Among the 102,234 ED visits included for DTR analysis, median DTR time was 9 (IQR, 2–56) min (Tables 2 and 3). Comparison between sexes after adjusting for confounding variables again found a significant effect (RR = 1.058; 95% CI, 1.039–1.077; $P < 0.01$). The expected difference in median DTR time showed females had 0.5 min longer wait (95% CI, 0.3–0.6 min). These differences did not meet our threshold for clinical significance. When examining median DTR by ESI levels, there is no difference seen at ESI 2 for males versus females, and small differences at the other ESI breakdowns (Table 3).

TABLE 3 Key throughput time measures presented by ESI level and sex for both all visits (unrestricted sample) and first visit (restricted sample) to the ED

Patient sex	All visits–ESI level 2 (N = 21,866) Median[b] [Q1–Q3]	RR[a] (95% CI)	P value	All visits–ESI level 3 (N = 66,925) Median[b] [IQR]	RR[a] (95% CI)	P value[b]	All visits–ESI level 4–5 (N = 17,127) Median[a] [IQR]	RR[b] (95% CI)	P value[a]
Length of stay (min)									
All	245 [169–354]			251 [174–344]			169 [102–262]		
Males	242 [164–354]	0.958 (0.933–0.984)	0.001	246 [169–339]	1.033 (1.023–1.043)	<0.001	165 [98–261]	1.013 (0.993–1.033)	0.214
Females	248 [172–354]			255 [178–349]			172 [106–263]		
Door-to-room (min)									
All	3 [1–15]			11 [2–67]			24 [3–99]		
Males	3 [1–14]	1.096 (1.039–1.156)	<0.001	10 [2–60]	1.071 (1.048–1.094)	<0.001	23 [3–97]	0.999 (0.962–1.037)	0.960
Females	3 [1–16]			12 [2–72]			26 [4–101]		
Door-to-healthcare pratitioner (min)									
All	34 [17–63]			51 [24–114]			63 [26–134]		
Males	33 [17–60]	1.054 (1.007–1.103)	0.025	49 [23–107]	1.066 (1.043–1.089)	<0.001	61 [25–132]	1.014 (0.972–1.059)	0.515
Females	35 [18–66]			54 [24–119]			64 [26–136]		
	First visits–ESI level 2 (N = 13,119)			First visits–ESI level 3 (N = 40,445)			First visits–ESI level 4–5 (N = 10,490)		
Length of stay (min)									
All	240 [162–353]			248 [171–343]			168 [104–263]		
Males	236 [158–353]	0.954 (0.952–0.956)	<0.001	243 [167–337]	1.034 (1.033–1.035)	<0.001	165 [99–261]	1.014 (1.012–1.017)	<0.001
Females	243 [167–354]			253 [175–348]			171 [107–264]		
Door-to-room (min)									
All	3 [1–16]			13 [2–72]			27 [4–102]		
Males	3 [1–14]	1.128 (1.119–1.137)	<0.001	11 [2–66]	1.071 (1.067–1.074)	<0.001	25 [4–102]	0.996 (0.991–1.001)	0.083
Females	3 [1–17]			14 [2–78]			29 [4–103]		
Door-to-healthcare practitioner (min)									
All	33 [17–63]			53 [24–117]			65 [26–138]		
Males	32 [16–59]	1.107 (1.101–1.112)	<0.001	50 [23–111]	1.064 (1.061–1.066)	<0.001	63 [25–137]	1.001 (0.997–1.005)	0.599
Females	35 [18–67]			55 [25–123]			67 [27–140]		

Abbreviations: CI, confidence interval; ED, emergency department; ESI, emergency severity index; IQR, interquartile range; OR, odds ratio; RR, relative risk.

[a]Proportion change in median time, adjusted for BMI, age, sex, race, ethnicity, modified early warnings, arrival time of day, arrival day of the week, disposition, arrival method, chief complaint, and ED location. ORs represent a proportion change in median throughput time for females relative to males.

[b]Mean and median values are given in minutes.

3.5 | DTP time analysis

A total of 101,831 ED visits were included in DTP analysis—median DTP time for this cohort was 47 min (IQR, 22–105) (Tables 2 and 3). After covariate adjustment, there was a significant difference in DTP time between the sexes (RR = 1.055; 95% CI, 1.036–1.074, $P < 0.01$). Compared to the median DTP time for males, female patients were associated with a longer DTP time by 2.2 min (95% CI, 1.6–2.6 min). This difference did not cross our threshold for clinical significance. When median DTP is examined stratified across ESI levels, the small differences between males and females persist with females consistently having longer times (Table 3).

3.6 | Modified early warning score and emergency severity index

In both, All Visit and First Visit samples, the number of female and male patients were similarly distributed within different MEW score categories (Table 1). However, for patients with the lowest (0) MEW scores, meaning they do not have significant abnormalities in objective vital signs or the alert, voice, pain, unresponsive (AVPU) scale, the throughput measure differences were most pronounced. Unfortunately, there are only 90 occurrences of this MEW level—limiting statistical analysis. When analyzing low (0 or 1) MEW scores, females had longer DTD (RR = 1.09; 95% CI, 1.01–1.18; $P = 0.022$; adjusted median difference 16.7 min) compared to males. There was no difference in LOS (RR = 1.07; 95% CI, 0.99–1.16; $P = 0.074$; adjusted median difference, 15.5 min), DTR (RR = 1.13; 95% CI, 0.93–1.37; $P = 0.21$; adjusted median difference, 2.0 min), or DTP (RR = 1.12; 95% CI, 0.96–1.30; $P = 0.16$; adjusted median difference, 6.2 min). When examining ESI, where lower numbers are assigned to more time-sensitive presentations, female patients had larger percentage of ESI level 3 designations and smaller percentage of ESI level 2 designations in both the All Visit and First Visit samples.(Table 1). When examining throughput measures by ESI level, female patients had longer median LOS times at all ESI levels, however, the magnitude of the time differences is less than for the MEWS stratifications and is also not uniformly clinically significant (Figure 2).

3.7 | Other care measures

When looking at all ED visits, females had longer times to receive OTC analgesia (median difference, 4 min), advanced analgesia (median difference, 11 min), oral ondansetron (median difference, 8 min), or other antiemetic medications (median difference, 7 min) compared with males (Table 2). There is also a 2-min longer median door-to-ECG time for females. Only 1 of these individually crossed our threshold for clinical significance. Evaluating door-to-disposition (DTD) time showed that women had a median DTD time that is 16 min longer than males, $P < 0.01$. This measure did also meet our criteria for clinical significance.

3.8 | Red light status analysis

A total of 1177 ED registrations occurred when the ED was already in red light status (RLS), and we were able to collect the necessary data for analysis. During these times of ED crowding, the median DTR, DTP, and LOS for males and females was mostly the same. Median DTD time was 25 min longer for females than males during RLS—this did exceed our threshold for clinical significance but did not achieve statistical significance ($P = 0.31$; RR, 1.032). (Table 4)

4 | LIMITATIONS

This study has numerous limitations and potential limitations to be aware of. This study was conducted at an ED at a Level I Trauma center serving a large area in southeast Minnesota, western Wisconsin, and northern Iowa, including many rural areas. In addition, Mayo Clinic's quaternary care practice brings patients who may be critically ill from all over the country and world. Therefore, our results may not be generalizable to other EDs, particularly those in large urban settings or whose patients reside in the immediate vicinity of the ED. The use of administrative data may affect the accuracy of some variables (e.g., length of stay), although we believe the likelihood of systematic sex-based bias in data ascertainment is low. In addition, this study does not address the geographical location, sexual orientation, body morphological, racial, or ethnic profiles of patients. Our study cannot identify care delivery factors such as screening every medication for safety in pregnancy or breastfeeding, which may account for time differences. Further, if there is a difference in healthcare literacy, there may be differences in the depth and completeness of discussions or questions between healthcare teams and patients. Females and males may move through their ED care with differences in accompanying family and friends that may account for differences in care delivery times—for example, the presence of children or infants may take more time for logistics of care delivery. Nor does the study address how availability of ED resources play a role in disparities for chief concerns, method of arrival, arrival time of day, and LOS between sexes. This study does not account for the differences in testing, consultations, or use of other services (such as interpreters) that could be factored in. This study design cannot account for the effect that assessments such as an abnormal ECG would have on the care delivery either. Furthermore, we wish to emphasize that speed is not equal to optimal care.

The use of DTR and DTP allows for some double representation of differences in the rooming practice because they would also affect the DTP time; there are also situations where healthcare practitioners engaged patients before they were roomed and so a room-to-healthcare practitioner time would have negative time values as well. For these reasons, we chose to use DTP; however, the limitation of this strategy is important.

There may be concern regarding clustering of the data by the healthcare practitioner if the same practitioner saw multiple patients and were highly biased in their care delivery—however, given the size of our dataset and the extended study period, we believe this is unlikely

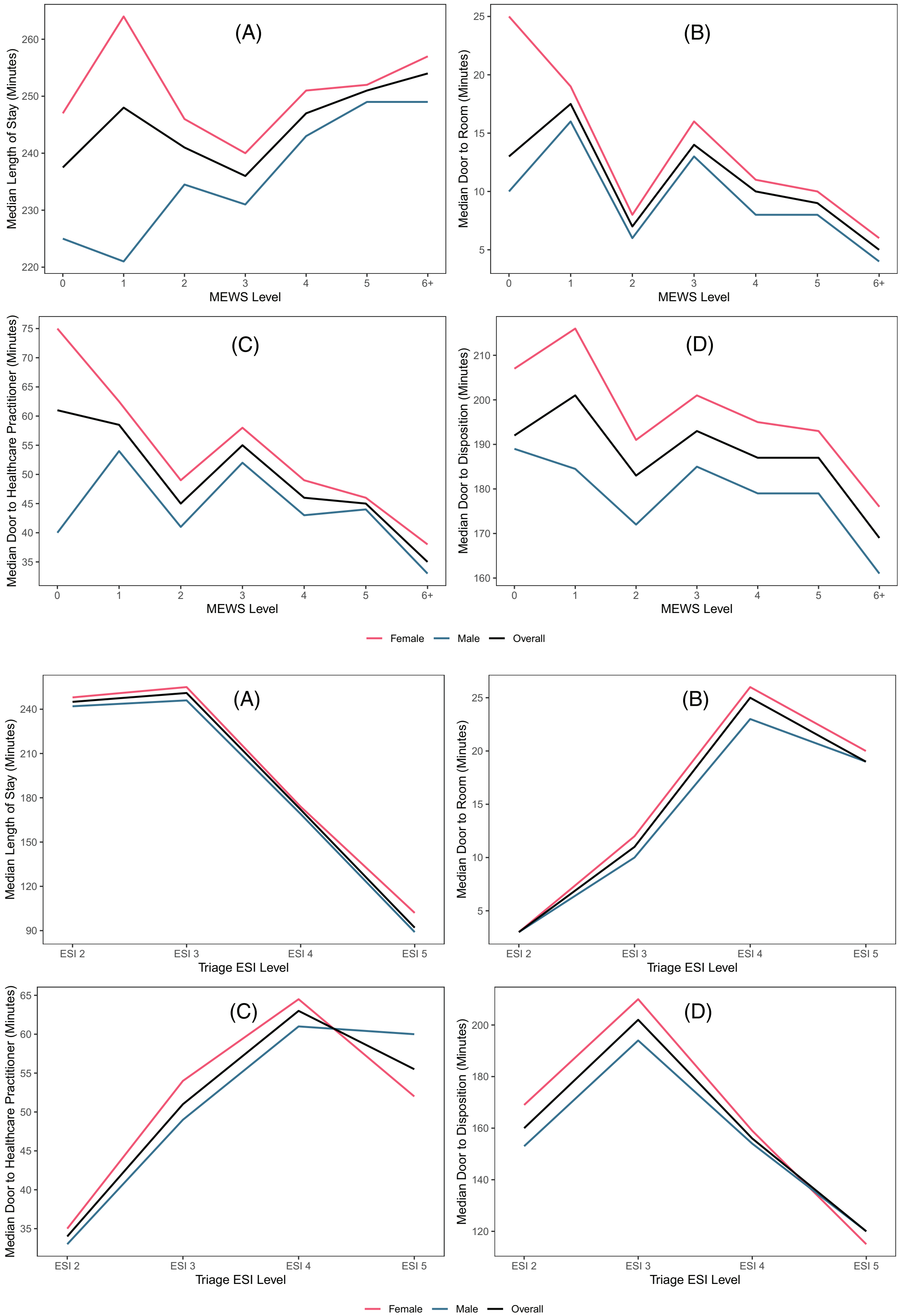

FIGURE 2 Female and male emergency department (ED) length of stay. (A) Door-to-room. (B) Door-to-healthcare practitioner. (C) Door-to-disposition. (D) Stratified by emergency severity index and modified early warning score. MEWS, modified early warning score

TABLE 4 Throughput measures during ED red light periods

	Median [Q1–Q3]				
Time measures (min)	Adult ED visits (N = 1177)	Adult female ED visits (N = 607)	Adult male ED visits (N = 570)	RR (95% CI)[a]	*P* value[a]
Length of stay	273 [174–393]	273 [176–389]	272 [173–402]	0.988 (0.921–1.060)	0.742
Door-to-room time	79 [11–206]	81 [10–202]	77 [12–212]	0.982 (0.889–1.084)	0.716
Door-to-healthcare practitioner	129 [47–237]	129 [48–234]	128 [46–240]	1.017 (0.974–1.061)	0.940
Door-to-disposition	139 [151–359]	253 [156–361]	228 [146–357]	1.032 (0.972–1.096)	0.305

Abbreviations: CI, confidence interval; ED, emergency department; RR, relative risk.
[a]Odds ratio and *P* value adjusted for body mass index, age, race, modified early warnings, emergency severity index, arrival time of day, arrival day of the week, disposition, arrival method, chief complaint, and ED location.

to affect our identification of systemic differences. All of these factors could impact the outcome of patient experiences in the ED. We recognize that intersectionality plays an important role in health care access and interaction with and use of healthcare systems.[16] Therefore, further studies addressing these parameters should be conducted to determine the role of intersectionality in the timeliness of ED interventions.

5 | DISCUSSION

In this study of more than 100,000 ED visits, we investigated disparities in ED throughput and care measures based on patient sex. Overall, clinically meaningful differences were identified, particularly in the throughput times of patients with MEWS of 0 or 1. The DTD overall shows a clinically significant difference as well. In addition, statistically significant differences were found in favor of men in nearly all measures. Furthermore, there were differences in the assignment of ESI level between males and females and the frequency of discharge from the ED as well. These differences were consistent when examining both the First Visit sample and the All Visit samples.

Our findings are parallel to other studies, such as by Vigil et al,[17] who compared the sex of the triage nurse against the sex of the patient to identify disparate ESI assignment practices. They found that there were differences in ESI designation that could not be accounted for by pain intensity or vital signs alone, which suggests that although ESI is widely deemed as an objective method to determine urgency in the ED, it could nevertheless be susceptible to sex-related factors that can influence ESI assignment. Similarly, we found that the distribution of ESI assignments were different between males and females, where females had a higher percentage of ESI level 3 designations and smaller percentage of ESI level 2 designations. Overestimation and underestimation of ESI level designations can lead to unnecessary and insufficient treatments, respectively, leading to poor clinical outcomes. Lau et al[18] found women with flank or abdominal pain, trauma, or headache were less likely to receive opioid pain medications during an ED visit than men with similar complaints and also less likely to be given naloxone after having opioid overdose-related ED care.[19] Similar to pain scores, time is also an important metric that can inform us of the over-/underestimation of illness severity by healthcare practitioner, both physician and non-physician. When compared between sexes, our study found that all of the time-to-symptom treatment measures were longer for females than males. If we consider our previous finding that females had higher percentage of ESI level 3 and less ESI level 2 designations than males, we may understand why males received more timely treatments—this is speculative explanation at this point, however.

We find the evaluation of the ESI level and MEWS particularly thought-provoking. Given that patients are roomed based on their ESI levels, the fact that males and females of similar ESI level are roomed similarly is not surprising. The disparity seen in throughput times for persons with lowest MEWS (Figure 2), even though a small subset, tickles the question of whether there may be bias affecting the ESI assignments. Cumulatively, the different ESI designations, longer DTR and DTP times, longer time to receive OTC analgesics, advanced analgesia, and antiemetic medications in our investigation may imply the severity of illness of female patients and what female patients are experiencing is underappreciated by the ED system.

Under-appreciation of illness severity does not always have to yield worse outcomes. The investigation by Preciado et al[20] into ED management of persons with suspected acute coronary syndrome showed that the care of women was more adherent to the history, ECG, age, risk factors, and troponin (HEART) score pathway than was the care of men. In their investigation, men underwent more procedures and had more unindicated hospitalizations. Women had better long-term outcomes than men in this study as well; yet, once again, the concern for the presentations of male patients caused care to be escalated beyond what was recommended by the objective HEART score more often than for women.[20]

Of course, bias within the system is one possible explanation for our findings, but this is not the only possible explanation. For example, sex-based differences in communication patterns across the patient and care team members could be contributing to differing throughput times. The differences in DTP and LOS could potentially be related to pregnancy testing or pelvic examinations—the time impact of these studies could not be ascertained from our retrospective chart review. There is also the possibility that female patients presented with conditions that necessitated different care and disposition.

Moving forward, a multicenter, prospective investigation would help clarify the question of whether these patterns are related to patient care factors or systemic bias. Furthermore, specific assessment of the impact that patient sex has on the ESI assignment in a large cohort would be intriguing. There may be useful information to be learned in comparing the effect of patient reported gender against healthcare team assumed gender on throughput measures. Investigations into specific critical diagnoses such as sepsis, shock, myocardial infarction, neutropenic fever, and others would be potentially revealing as well. Additionally, examining similar questions for other types of potential biases such as obesity, language, and so on would be important to moving toward healthcare justice and equity. Last, future studies that address how availability of ED resources play a role in disparities for chief concerns, method of arrival, arrival time of day, and length of stay between sexes can inform us further to avoid sex-related bias in the ED.

Of course, this study is not designed to identify downstream outcome differences from the differences identified. Yet, if these differences are not necessitated by patient care factors, then they represent unnecessary or potentially harmful delays or mis-designations for females receiving emergency care. If truly based on explicit or implicit bias, mis-assignment of ESI level creates a potential for mismatch between patient health need and accuracy and efficiency of healthcare delivery—at a system level. Furthermore, delays in receiving symptom treatments even by a few minutes represent a substandard care delivery if they are caused by bias—even if there is no mortality or serious morbidity that follows. Finally, most concerning, if these findings are related to bias, this should prompt us all to wonder in what other ways sex biases could be creating a suboptimal healthcare system for the community.

In conclusion, our study identified several statistically significant sex-related differences in ED throughput and care measures, nearly uniformly in favor of males, although most did not achieve our predetermined threshold for clinical significance.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

VRB, KK, RLC, MMJ were responsible for conceptualization. VRB, KK, AWH, AFM were responsible for data collection. AFM performed data analysis; MMJ assisted with data analysis strategy. EGO, KK, AWH, JMK, DMN, RLC, KMT, KLS, LEW, BEM, ATS, AJM, AFM, MMJ, VRB all participated in critical review and evaluation of the results. EGO, KK, VRB were responsible for primary authorship of the paper. All authors participated in review and editing of the paper.

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REFERENCES

1. FitzGerald C, Hurst S. Implicit bias in healthcare professionals: a systematic review. *BMC Med Ethics*. 2017;18(1):19. 10.1186/s12910-017-0179-8
2. Hall WJ, Chapman MV, Lee KM, et al. Implicit racial/ethnic bias among health care professionals and its influence on health care outcomes: a systematic review. *Am J Public Health*. 2015;105(12):e60-e76. 10.2105/ajph.2015.302903
3. Chapman EN, Kaatz A, Carnes M. Physicians and implicit bias: how doctors may unwittingly perpetuate health care disparities. *J Gen Intern Med*. 2013;28(11):1504-1510. https://doi.org/10.1007/s11606-013-2441-1
4. McGann Donlan S, Mycyk MB. Is female sex associated with ED delays to diagnosis of appendicitis in the computed tomography era? *Am J Emerg Med*. 2009;27(7):856-858. 10.1016/j.ajem.2008.06.004
5. Chen EH, Shofer FS, Dean AJ, et al. Gender disparity in analgesic treatment of emergency department patients with acute abdominal pain. *Acad Emerg Med*. 2008;15(5):414-418. 10.1111/j.1553-2712.2008.00100.x
6. Siddiqui A, Belland L, Rivera-Reyes L, et al. A Multicenter evaluation of the impact of sex on abdominal and fracture pain care. *Med Care*. 2015;53(11):948-953. 10.1097/mlr.0000000000000430
7. CMS Office of Minority Health and RAND Corporation. *Gender Disparities in Health Care in Medicare Advantage*. CMS Office of Minority Health and RAND Corporation; https://www.cms.gov/About-CMS/Agency-Information/OMH/Downloads/Health-Disparities-Gender-Disparities-National-Report.pdf
8. Heidari S, Babor TF, De Castro P, Tort S, Curno M. Sex and Gender Equity in Research: rationale for the SAGER guidelines and recommended use. *Res Integr Peer Rev*. 2016;1:2. 10.1186/s41073-016-0007-6
9. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *PLoS Med*. 2007;4(10):e296. 10.1371/journal.pmed.0040296
10. Malmström T, Huuskonen O, Torkki P, Malmström R. Structured classification for ED presenting complaints - from free text field-based approach to ICPC-2 ED application. *Scand J Trauma Resusc Emerg Med*. 2012;20:76. 10.1186/1757-7241-20-76
11. Lichen IM, Bellamkonda VR, Campbell RL, et al. Association between patients' body mass index and emergency department wait times: a multicenter observational cohort investigation by the reducing disparities increasing equity in emergency medicine (REDEEM) study group. *Am J Emerg Med*. 2021;49:178-184. 10.1016/j.ajem.2021.06.007

12. Antman EM, Anbe DT, Armstrong PW, et al. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction–executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 1999 Guidelines for the Management of Patients With Acute Myocardial Infarction): a report of the American college of cardiology/American heart association task force on practice guidelines (writing committee to revise the 1999 guidelines for the management of patients with acute myocardial infarction). *Circulation*. 2004;110(5):588-636. 10.1161/01.CIR.0000134791.68010.FA
13. Diercks DB, Peacock WF, Hiestand BC, et al. Frequency and consequences of recording an electrocardiogram >10 minutes after arrival in an emergency room in non-ST-segment elevation acute coronary syndromes (from the CRUSADE Initiative). *Am J Cardiol*. 2006;97(4):437-442. 10.1016/j.amjcard.2005.09.073
14. Gardner-Thorpe J, Love N, Wrightson J, Walsh S, Keeling N. The value of Modified Early Warning Score (MEWS) in surgical in-patients: a prospective observational study. *Ann R Coll Surg Engl*. 2006;88(6):571-575. 10.1308/003588406x130615
15. Subbe CP, Kruger M, Rutherford P, Gemmel L. Validation of a modified Early Warning Score in medical admissions. *QJM*. 2001;94(10):521-526. 10.1093/qjmed/94.10.521
16. Hankivsky O, Christoffersen A. Intersectionality and the determinants of health: a Canadian perspective. *Crit Public Health*. 2008;18(3):271-283. 10.1080/09581590802294296
17. Vigil JM, Coulombe P, Alcock J, Stith SS, Kruger E, Cichowski S. How nurse gender influences patient priority assignments in US emergency departments. *Pain*. 2017;158(3):377-382. 10.1097/j.pain.0000000000000725
18. Lau T, Hayward J, Vatanpour S, Innes G. Sex-related differences in opioid administration in the emergency department: a population-based study. *Emerg Med J*. 2021;38(6):467-473. 10.1136/emermed-2020-210215
19. Forbes LA, Canner JK, Milio L, Halscott T, Vaught AJ. Association of patient sex and pregnancy status with naloxone administration during emergency department visits. *Obstet Gynecol*. 2021;137(5):855-863. 10.1097/AOG.0000000000004357
20. Preciado SM, Sharp AL, Sun BC, et al. Evaluating sex disparities in the emergency department management of patients with suspected acute coronary syndrome. *Ann Emerg Med*. 2021;77(4):416-424. 10.1016/j.annemergmed.2020.10.022

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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