


BMJ Open US emergency care patterns among nurse practitioners and physician assistants compared with physicians: a cross-sectional analysis

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ABSTRACT

Objectives Nurse practitioners and physician assistants (NPs/PAs) increasingly practice in emergency departments (EDs), yet limited research has compared their practice patterns with those of physicians.

Design, setting and participants Using nationally representative data from the National Hospital Ambulatory Medical Care Survey (NHAMCS), we analysed ED visits among NPs/PAs and physicians between 1 January 2009 and 31 December 2017. To compare NP/PA and physician utilisation, we estimated propensity score-weighted multivariable regressions adjusted for clinical/sociodemographic variables, including triage acuity score (1=sickest/5=healthiest). Because NPs/PAs may preferentially consult physicians for more complex patients, we performed sensitivity analyses restricting to EDs with >95% of visits including the NP/PA–physician combination.

Exposures NPs/PAs.

Main outcome measures Use of hospitalisations, diagnostic tests, medications, procedures and six low-value services, for example, CT/MRI for uncomplicated headache, based on Choosing Wisely and other practice guidelines.

Results Before propensity weighting, we studied visits to 12 410 NPs/PAs-alone, 21 560 to the NP/PA–physician combination and 143 687 to physicians-alone who saw patients with increasing age (41, 45 and 47 years, $p<0.001$) and worsening triage acuity scores (3.03, 2.85 and 2.67, $p<0.001$), respectively. After weighting, NPs/PAs-alone used fewer medications (2.62 vs 2.80, $p=0.002$), diagnostic tests (3.77 vs 4.66, $p<0.001$), procedures (0.67 vs 0.77, $p<0.001$), hospitalisations (OR 0.35 (95% CI 0.26 to 0.46)) and low-value CT/MRI studies (OR 0.65 (95% CI 0.53 to 0.80)) than physicians. Contrastingly, the NP/PA–physician combination used more medications (3.08 vs 2.80, $p<0.001$), diagnostic tests (5.07 vs 4.66, $p<0.001$), procedures (0.86 vs 0.77, $p<0.001$), hospitalisations OR 1.33 (95% CI 1.17 to 1.51) and low-value CT/MRI studies (OR 1.23 (95% CI 1.07 to 1.43)) than physicians—results were similar among EDs with >95% of NP/PA visits including the NP/PA–physician combination.

Conclusions and relevance While U.S. NPs/PAs-alone used less care and low-value advanced diagnostic imaging, the NP/PA–physician combination used more care and low-value advanced diagnostic imaging than

Strengths and Limitations of this Study

- This is the first study, known to these authors, to use nationally representative data to compare both overall and low-value care patterns among nurse practitioners and physician assistants (NPs/PAs) and physicians practising in US emergency departments.
- Because patients are non-randomly assigned to providers, it is impossible to eliminate selection bias.
- The low-value care measures included in the analysis reflect a narrow aspect of quality of care; therefore, differences in utilisation do not necessarily imply differences in overall quality of care among NPs/PAs and physicians in the emergency department setting.

physicians alone. Findings were reproduced among EDs where nearly all NP/PA visits were collaborative with physicians, suggesting that NPs/PAs seeing more complex patients used more services than physicians alone, but the converse might be true for more straightforward patients.

INTRODUCTION

Each year, US emergency departments (EDs) face growing pressure to manage more and increasingly complex patients, with total annual ED visits rising from 117 million to 139 million over the past decade.^{1–5} As the US population ages, ED visits have grown in illness severity and resource utilisation.^{6 7} Approximately 9 million hospital admissions originate from EDs for individuals aged 65 years and older each year, representing over 70% of hospital admissions among older adults, and hospitalisations among older adults in the ED are increasing over time.^{7 8} Even as visit volume and complexity increase, US EDs face a growing shortage of emergency medicine physicians, raising concerns of ED overcrowding and threatening access to emergency care.⁹



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In response to these trends, commentators have increasingly advocated for expanding the role of nurse practitioners and physician assistants (NPs/PAs) to increase access to emergency care at a lower cost, in part because NPs/PAs have lower salaries than physicians.¹⁰ Whether working independently or seeing patients collaboratively with a physician, over 27 000 NPs/PAs currently work in US EDs, and NPs/PAs have seen a rapidly growing number of patients in the ED setting, from 15 million visits in 2007 to over 40 million visits in 2016.^{11–18} Nevertheless, controversy exists on how to best incorporate NPs/PAs into emergency care. For example, according to national and international surveys, many ED physicians believe that NPs should not practice autonomously and work best in collaborative teams alongside physicians, whereas NPs generally advocate for greater autonomy.^{19–24}

Despite strong opinions, limited empirical research has directly compared NPs/PAs and physicians regarding overall and low-value care patterns in the ED, which has important implications for the efficiency of US emergency care. Low-value care is particularly salient for efficiency because it reflects patient care that offers no net benefit in specific clinical scenarios—both raising costs and potentially harming patients.^{25 26} Prior work comparing ED NPs/PAs and physicians caring for ED patients has typically focused on single clinical conditions or single medical centres, or relied on older data, and largely has found conflicting results.^{27–29} One US study suggested that EDs employing NPs/PAs used more services than EDs that did not; however, this ecological work was at the ED level and could not directly compare individual NPs/PAs with physicians.³⁰ Another study using data from the National Hospital Ambulatory Medical Care Survey (NHAMCS) suggested that PAs used less services than physicians after stratifying by triage acuity, but this work did not assess low-value care or account for other potentially confounding factors such as age, comorbidities or diagnoses.¹⁸ In this context, we used nationally representative data on ED visits to compare overall and low-value care patterns among NPs/PAs and physicians.

METHODS

Data sources

We performed a cross-sectional analysis using nationally representative data from NHAMCS in order to compare emergency care patterns among NPs/PAs and physicians. The dataset includes data on visits to non-federal, hospital-based EDs. We restricted our study to ED visits for adults aged 18 years and older with any presenting complaint, between 1 January 2009 and 31 December 2017, which included 177 657 ED visits in the sample, representing an estimated 918 071 431 US ED visits.

Data collection procedures

Data were collected using a standardised survey form completed by providers or staff after each visit in each year. The survey includes items identifying the patient's

primary visit complaints; two secondary visit complaints; up to three diagnoses derived from the International Classification of Diseases, Ninth and Tenth Revisions, Clinical Modification (ICD-9-CM and ICD-10-CM); four chronic comorbidities (cerebrovascular disease (CVD), congestive heart failure (CHF), diabetes mellitus, and human immunodeficiency virus (HIV)); payer for the visit (eg, Medicare); whether the ED visit resulted in hospitalisation; clinician and patient demographic information; tests and treatments ordered; and medications given during the visit or prescribed at discharge.⁴ The data span the entire ED visit from arrival to discharge.

Main exposure: provider type

We compared visits where the clinician was an NP/PA or physician (attending physician). NP/PA visits were further subdivided by NP/PA-alone visits where the NP/PA saw the patient without a physician (NP/PA-alone) versus a collaborative visit that included an NP/PA and physician both evaluating the patient (the NP/PA–physician combination). Importantly, aside from a few exceptions, NPs and PAs were generally indistinguishable across study outcomes measures (see online appendix tables 1 and 2 for details); therefore, we combined NPs and PAs into a single exposure variable: NP/PA visits.

Outcome measures

Our primary outcome measures focused on overall utilisation of services, including use of diagnostic tests, procedures (eg, suturing), medications either given during the visit or prescribed at discharge, the length of time-per-visit (calculated from date and time of ED arrival and discharge in minutes) and whether the visit resulted in hospitalisation. As secondary outcome measures, we assessed utilisation of six health services widely considered to be low-value in specific clinical scenarios, based on prior work using NHAMCS data, Choosing Wisely recommendations, and other broadly accepted clinical practice guidelines.^{25 31–40} Because NHAMCS routinely collects data on symptoms, vital signs, visit diagnoses and comorbid conditions directly from patients' medical records, it allowed for the exclusion of important alarm features that help to define low-value care. These six low-value care measures included: (1) antibiotics (numerator) for upper respiratory infections without alarm features (denominator) such as chronic obstructive pulmonary disease (COPD), and this measure was combined with another measure of antibiotics (numerator) for skin abscesses without alarm features (denominator) such as cellulitis or signs of sepsis; (2) plain X-rays (numerator) for back pain without alarm features (denominator) such as cancer, trauma or neurological deficit; (3) advanced diagnostic imaging, including both MRI and CT (numerator) for back pain or headache without alarm features (denominator) such as trauma, cancer and neurological deficit; (4) opioids (numerator) for back pain or headache without alarm features (denominator) such as cancer and trauma; (5) inappropriate medications (numerator)

for adults aged 65 years and older (denominator) such as benzodiazepines according to Beers Criteria recommendations; and (6) guideline-discordant antibiotic choice (numerator) for uncomplicated urinary tract infections (denominator).

Analyses

Patient selection bias

A fundamental threat to validity of any comparison of physician and NP/PA utilisation is that ED patients are non-randomly assigned to NPs/PAs. NPs/PAs seeing patients in the same ED with physicians typically are assigned lower acuity/complexity patients than physicians, which has been illustrated in multiple prior analyses.^{13 14} Additionally, in cases where the decision to involve a physician is at the discretion of the NP/PA, they would more likely involve a physician for more complex cases, even for patients with relatively low triage acuity. This phenomenon also has been demonstrated in previous work.¹³ Each scenario introduces a potential bias where NPs/PAs-alone would tend to see relatively lower complexity patients (even among those visits that were judged to be lower acuity), typically leading to relatively less utilisation, even after controlling for diagnosis and other clinical/sociodemographic variables. In contrast, the NP/PA-physician combination visits where the physician is consulted at the discretion of the NP/PA would tend to be for higher complexity or less straightforward patients, even after controlling for acuity level and diagnosis, typically entailing relatively more utilisation.

We took several steps to account for these potential selection biases. First, in our primary approach, we estimated inverse probability propensity score weighting based on our prior work.⁴¹ Our propensity score weights accounted for the NHAMCS' complex survey design and nationally representative population weights and were based on patient age, sex, race, nurse-rated standard triage acuity scores (1=immediate, 2=emergent, 3=urgent, 4=semi-urgent, 5=non-urgent), primary diagnosis categories (eg, cardiovascular), chronic comorbidities (eg, HIV), residence (eg, nursing home residence, an important marker of frailty), insurance type, rural vs urban, four US regions and year (years combined into two year groupings per National Center for Health Statistics (NCHS) guidelines) to create comparison groups that were balanced on clinically relevant and observable information included in the dataset. This approach balances visits based on observable characteristics but cannot do so on unmeasured characteristics (eg, severity within a diagnosis or cases with non-straightforward presentations). Second, we performed sensitivity analyses among EDs where nearly all NP/PA visits included the NP/PA-physician combination. This approach addresses the concern that NP/PAs may choose to involve physicians in more complex or serious cases wherein the observed increase in utilisation might be explained by unmeasured severity. Evaluating practice patterns in this subgroup of EDs effectively minimises the selection effect of collaborative

visits as essentially all visits involving an NP or PA are the NP/PA-physician combination visits. Thus, the decision to invite a physician to see a patient alongside the NP/PA was no longer a function of the patient's illness severity as it was the default for virtually all patients. We also assessed the degree to which this was occurring by measuring the unadjusted, population-weighted rate of physician consultations stratified by triage severity (0–3 vs 4–5) among EDs where $\leq 95\%$ of NP/PA visits were collaborative (eg, in EDs where there was some discretion in whether NPs/PAs collaborated with a physician). Conversely, we were unable to perform analyses limiting to EDs where nearly all of NP/PA visits were NP/PA-alone visits, because we could not identify a sufficient number of EDs where NPs/PAs mostly practised alone.

Statistical analysis

We estimated weighted multivariable logistic and linear regression models to compare NPs/PAs and physicians, adjusting for the same variables outlined in the propensity score in a double-robust fashion. Our analyses used data from the entire NAMCS and NHAMCS samples in order to account for the complex survey design and sampling weights to produce national estimates.⁴² Moreover, because the 2014–2017 NHAMCS surveys inadvertently underestimated population variance, we used a statistical significance threshold of $p < 0.01$ in accordance with the NCHS guidelines, and conservatively used this threshold across all data years.

We also assessed whether our propensity weighting model violated the positivity assumption, which assumes that our propensity score is bounded between 0 and 1.⁴³ When comparing the distribution of scores between any NPs/PAs and physicians, we found excellent overlap and no violation of the positivity assumption. However, we did find subtle positivity assumption violations regarding the propensity scores of NPs/PAs-alone versus physicians and the NP/PA-physician combination versus physicians alone, with a relatively small number of outlier probabilities ($n=53$ and $n=343$ respectively) potentially biasing our results. While these outliers were small in number, we performed sensitivity analyses using propensity overlapping weights, and results remained consistent with our primary findings.⁴³ Finally, some of the utilisation measures (eg, number of medications) had missing data leading to differing sample sizes; however, for measures other than length of visit, these missing data comprised $\sim 3\%$ of the sample and were included in our analyses.

We performed all analyses using SAS (V.9.4). Because the NHAMCS is a deidentified, publicly available national database, the UCLA Institutional Review Board deemed this analysis to be exempt from review as human subject research. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology guidelines for reporting cross-sectional studies (see online supplemental appendix).



Table 1 Patient characteristics during ED visits to NPs/PAs, NPs/PAs-alone, the NP/PA-physician combination and physician alone* with and without propensity score weighting†

	Unweighted						Propensity score weighted					
	Physician (reference)	Any NP/PA	P value	NP/PA alone	NP/PA+MD	P value	Physician (reference)	Any NP/PA	P value	NP/PA alone	NP/PA+MD	P value
	143 687	33 970		12 410	21 560		143 687	33 970		12 410	21 560	
Sample size												
Mean age	47.0	43.5	<0.001	41.0	45.0	<0.001	46.4	46.1	0.44	45.7	46.0	0.45
Sex (%)			0.039			0.033			0.88			0.34
Female	56.7%	57.5%		56.8	57.9		57.4	57.3		58.1	57.0	
Race (%)			0.001			0.001			0.81			1.00
White	73.7	71.2		61.7	60.1		64.8	64.5		64.71	64.39	
Black	22.0	25.4		24.4	24.3		22.2	22.7		22.61	22.75	
Other	4.25	3.48		2.76	3.13		2.9	3.05		3.00	3.11	
Comorbidities (%)			<0.001			<0.001						
CVD	3.71	2.84	<0.001	1.53	3.6		3.64	3.76	0.62	3.59	3.74	0.95
CHF	4.13	2.8	<0.001	1.5	3.5		3.91	4.13	0.39	4.01	4.08	0.93
Diabetes mellitus	12.31	10.92	0.12	8.8	12.2		12.6	12.9	0.44	12.57	12.83	0.92
HIV	0.68	0.81	<0.001	0.78	0.82		0.57	0.49	0.28	0.55	0.49	0.75
Mean triage severity 1-5 (%)	2.67	2.92		3.03	2.85	<0.001	2.62	2.64	0.97	2.68	2.63	0.98
Primary diagnosis category (%)			0.002			<0.001			1.0			0.95
Psychiatric	5.02	3.20	<0.001	2.11	3.83		3.40	3.57		4.27	3.42	
Cardiovascular	4.06	2.21	0.65	1.27	2.75		3.38	3.37		3.14	3.41	
Respiratory	6.93	6.81	0.090	7.40	6.47		6.37	6.44		6.32	6.56	
Gastrointestinal	5.61	5.33	0.018	5.82	5.04		5.08	5.17		4.97	5.25	
Urological	3.19	2.71	0.30	2.61	2.76		2.90	2.86		3.11	2.80	
Gynaecological	3.04	3.23	<0.001	2.47	3.66		2.68	2.71		2.85	2.69	
Dermatological	2.80	3.97	<0.001	4.63	3.58		2.76	2.79		2.88	2.78	
Rheumatological	4.83	6.33	<0.001	7.52	5.65		4.79	4.77		5.02	4.75	
Orthopaedic	1.76	2.21	0.59	11.35	8.94		7.61	7.37		7.90	7.26	
Trauma	8.86	10.71	<0.001	12.3	9.79		8.28	8.08		8.28	8.74	
Miscellaneous	20.54	14.66	<0.001	18.34	24.1		25.98	26.21		25.4	26.4	
Residence (%)			<0.001			<0.001			0.32			0.047
Private residence	91.22	92.88		93.0	92.8		91.99	92.53		92.09	93.05	
Nursing home	2.53	1.53		0.89	1.90		2.35	2.06		1.63	2.13	
Homeless	1.19	1.05		1.02	1.08		0.79	0.85		0.86	0.90	
Other	1.62	1.18		1.14	1.2		1.57	1.08		0.95	1.12	
Insurance (%)			<0.001			<0.001			0.97			0.97
Private	29.0	28.8		27.0	28.0		28.3	28.1		27.7	28.1	

Continued

Table 1 Continued

	Unweighted				Propensity score weighted							
	Physician (reference)	Any NP/PA	P value	NP/PA alone	NP/PA+MD	P value	Physician (reference)	Any NP/PA	P value	NP/PA alone	NP/PA+MD	P value
Medicare	24.27	18.62		15.4	20.5		23.4	23.7		24.4	23.3	
Medicaid	21.56	25.33		26.2	24.8		22.0	21.7		21.7	21.9	
Other	25.32	28.4		31.5	26.6		26.4	26.5		26.2	26.8	
US region (%)			0.001			0.006			0.91			0.98
Northeast	20.3	26.23		25.6	26.6		17.4	17.6		18.5	16.9	
Midwest	23.35	25.64		26.7	25.1		24.0	23.9		22.2	24.4	
South	34.74	31.57		31.1	31.9		38.0	39.2		40.1	38.8	
West	21.61	16.55		16.7	16.5		20.6	19.3		19.2	19.9	
Setting (%)			0.14			0.27			0.67			0.95
Urban	73.77	76.93		75.3	77.9		73.7	74.7		73.9	74.8	
Year (%)			<0.001			<0.001			0.73			0.58
2009	15.36	11.49		12.0	11.2		11.0	10.1		11.0	10.0	
2010–2011	28.64	24.77		27.7	23.1		21.7	21.9		23.7	21.0	
2012–2013	23.11	23.94		21.9	25.1		21.3	23.2		20.3	25.2	
2014–2015	18.47	20.7		19.9	21.2		23.0	21.6		23.7	20.3	
2016–2017	14.42	19.11		18.5	19.5		23.0	23.3		21.4	23.6	

*Note: utilisation during physician visits reflect the reference group for all comparisons: (1) any NP/PA visit versus physician visit, (2) NP/PA alone visit versus physician visit and (3) NP/PA and physician visit versus physician visit.

†Propensity weighted models account for age, sex, race, comorbidities, primary diagnoses, triage acuity, insurance status, patient residence (whether the patient lives in a nursing home), whether the ED was located in an urban or rural setting, US region and year.

CHF, congestive heart failure; CVD, cerebrovascular disease; ED, emergency department; NP/PA, nurse practitioner and physician assistant; NP/PA+MD, visits including the NP/PA–physician combination; Ref, reference group.

Table 2 Adjusted* comparisons of overall utilisation during ED visits to any NPs/PAs, NPs/PAs alone the NP/PA–physician combination and physicians alone

Average value per visit	Physician (reference)	Any NP/PA	P value	Physician (reference)	NP/PA Alone	P value	NP/PA-physician combination	P value
Time per visit (min)	288.74 (n=117 294)	295.4 (n=26 092)	0.17	267.6 (n=1 172 94)	245.9 (n=9798)	0.02	289.8 (n=16 294)	<0.001
Number of medications	2.76 (n=143 687)	2.91 (n=33 870)	0.001	2.80 (n=1 436 87)	2.62 (n=12 410)	0.002	3.08 (n=21 460)	<0.001
Number of diagnostic tests	5.07 (n=142 095)	5.09 (n=33 479)	0.78	4.66 (n=1 42 095)	3.77 (n=12 237)	<0.001	5.07 (n=21 242)	<0.001
Number of procedures	0.84 (n=139 788)	0.87 (n=33 150)	0.06	0.77 (n=1 39 788)	0.67 (n=12 154)	<0.001	0.86 (n=20 996)	<0.001
Whether visit resulted in hospitalisation (ORs)	Ref (n=143 687)	0.99 (95% CI 0.88 to 1.11) (n=33 870)	0.84	Ref (n=1 43 687)	0.35 (95% CI 0.26 to 0.46) (n=12 410)	<0.001	1.33 (95% CI 1.17 to 1.51) (n=21 460)	<0.001

Note: some of the utilisation measures had missing data leading to differing sample sizes; however, for measures other than length of visit, these missing data comprised ~3% of the sample and were included in our analyses. Also note, utilisation during physician visits reflect the reference group for all comparisons: (1) any NP/PA visit versus physician alone, (2) NP/PA alone visit vs physician alone visit, (3) visits including the NP/PA–physician combination versus visits including physicians alone.

*These results include propensity score weighted and multivariable linear and logistic regression models, which account for age, sex, race, comorbidities, primary diagnosis categories, triage acuity, insurance status, patient residence (eg, whether the patient lives in a nursing home), whether the ED was located in an urban or rural setting, US region and year.

ED, emergency department; NPs/PAs, nurse practitioners and physician assistants; ref, reference group

RESULTS

We identified visits to 12 410 NPs/PAs-alone, 21 560 including the NP/PA–physician combination and 143 687 physicians alone, reflecting an estimated 918 071 431 US adult ED visits between 2009 and 2017. NPs/PAs-alone, the NP/PA–physician combination and physicians alone saw patients with increasing mean age (41, 45 and 47 years, $p<0.001$), increasing prevalence of comorbidities such as congestive heart failure (1.5%, 3.5% and 4.1%, $p<0.001$) and worsening mean triage acuity scores (3.03, 2.85, and 2.67, $p<0.001$), respectively (table 1) (note, triage acuity scores are categorised as follows: (1=immediate, 2=emergent, 3=urgent, 4=semi-urgent and 5=non-urgent). Patient seeing any NP/PA were more likely than patients seeing a physician to be black (25.4% vs 22.0%, $p=0.001$) and more likely to be insured by Medicaid (25.3% vs 21.6%, $p<0.001$), respectively. After propensity score weighting, there were no clinically or statistically significant differences in these demographic and clinical characteristics.

Overall and low-value health service utilisation comparisons

Because bivariable results were similar to multivariable results, we present multivariable results in the manuscript and bivariable results in the online appendix tables 3 and 4. Overall, visits to any NP/PAs (including both NPs/PAs-alone and the NP/PA–physician combination) resulted in similar rates of diagnostic tests, procedures, time per visit and hospitalisations; however, these visits resulted in more medications used (2.91 vs 2.76 per visit, $p=0.001$) than visits with physicians (table 2). Low-value care utilisation was similar across all six measured services among NPs/PAs and physicians (table 3).

Stratified and sensitivity analyses

NPs/PAs-alone used fewer medications (2.62 vs 2.80, $p=0.002$), diagnostic tests (3.77 vs 4.66, $p<0.001$), procedures (0.67 vs 0.77, $p<0.001$), hospitalisations (adjusted

OR (aOR) 0.35 (95% CI 0.26 to 0.46)) and low-value CT/MRI studies (0.65 (95% CI 0.53 to 0.80)) than physicians (tables 2 and 3). Time per visit was 245.9 min for NPs/PAs-alone and 267.6 min for physicians, although this difference was non-significant ($p=0.02$) using our prespecified significance threshold of $p<0.01$. In contrast, the NP/PA–physician combination used more medications (3.08 vs 2.80, $p<0.001$), diagnostic tests (5.07 vs 4.66, $p<0.001$), procedures (0.86 vs 0.77, $p<0.001$), hospitalisations aOR 1.33 (95% CI 1.17 to 1.51), low-value CT/MRI studies (aOR 1.23 (95% CI 1.07 to 1.43)) and spent more time (289.8 vs 267.6 min, $p<0.001$) than physicians during ED visits. After restricting the sample to EDs where all or almost all NP/PA visits (>95%) included the NP/PA–physician combination, we found similar results to our main findings (tables 4 and 5).

Prior to propensity weighting, when restricting to EDs where $\leq 95\%$ of NP/PA visits included the NP/PA–physician combination, 64.3% of 22 486 NP/PA visits versus 48.1% of 19 162 NP/PA visits resulted in consulting a physician for lower (ie, sicker) versus higher (ie, healthier) triage acuity scoring patients, respectively. After propensity weighting, consultation rates equalised to 49.7% of NP/PA visits among lower triage acuity scoring patients and 49.7% of NP/PA visits among higher triage acuity scoring patients.

DISCUSSION

In this large, nationally representative analysis of US emergency care, visits involving NPs/PAs used similar amounts of services and resulted in similar rates of hospitalisations when compared with visits with physicians. These overall findings, however, obscure important differences revealed in our stratified analyses. NP/PAs-alone used less care and low-value advanced diagnostic imaging whereas the NP/PA–physician combination used

Table 3 Adjusted* ORs comparing use of low-value health services during ED visits to any NPs/PAs, NPs/PAs alone, the NP/PA-physician combination and physicians alone

Low-value health service	Physician sample size (reference)*	Any NP/PA	Any NP/PA sample size	NP/PA alone	NP/PA alone sample size	NP/PA-physician combination	NP/PA-physician combination sample size
CT/MRI studies for uncomplicated back pain or headache	17 724	0.99 (95% CI 0.87 to 1.12)	4622	0.65 (95% CI 0.53 to 0.80)	1773	1.23 (95% CI 1.07 to 1.43)	2849
Antibiotics for uncomplicated URI	5455	1.14 (95% CI 0.98 to 1.33)	1796	1.2 (95% CI 0.99 to 1.46)	811	1.05 (95% CI 0.85 to 1.31)	985
Inappropriate medications for older adults	30 461	0.95 (95% CI 0.81 to 1.12)	5174	0.93 (95% CI 0.68 to 1.27)	1420	0.98 (95% CI 0.8 to 1.19)	3754
Opioid medications for uncomplicated back pain or headache	15 525	0.98 (95% CI 0.88 to 1.1)	4307	0.81 (95% CI 0.69 to 0.95)**	1725	1.11 (95% CI 0.98 to 1.25)	2582
Inappropriate antibiotics for simple UTIs	4536	0.96 (95% CI 0.77 to 1.2)	1000	0.89 (95% CI 0.61 to 1.29)	339	0.92 (95% CI 0.69 to 1.24)	661
Plain x-rays for uncomplicated back pain	10 049	1.03 (95% CI 0.92 to 1.16)	3081	0.9 (95% CI 0.76 to 1.06)	1282	1.11 (95% CI 0.96 to 1.28)	1799

Note: some of the utilisation measures had missing data leading to differing sample sizes; however, for measures other than length of visit, this comprised ~3% of the sample, and these missing data were included in our analyses.

*Utilisation during physician visits reflect the reference group for all comparisons: (1) any NP/PA visit versus physician alone, (2) NP/PA alone visit versus physician alone visit, (3) visits including the NP/PA-physician combination versus visits including physicians alone.

†These results include propensity score weighted and multivariable linear and logistic regression models, which account for age, sex, race, comorbidities, primary diagnosis categories, triage acuity, insurance status, patient residence (whether the patient lives in a nursing home), whether the ED was located in an urban or rural setting, US region and year.

‡Does not meet statistical significance as p is not less than the prespecified threshold of 0.01.

ED, emergency department; NPs/PAs, nurse practitioners and physician assistants; ref, reference group; URI, upper respiratory infection; UTI, urinary tract infection.

Table 4 Adjusted* overall utilisation within EDs where over 95% of NP/PA visits included the NP/PA-physician combination

Average value	Physician (reference)	NP/PA and physician	P value
Time per visit (min)	263.1 (n=7166)	297.2 (n=1285)	0.01
Number of medications	1.79 (n=8122)	2.34 (n=1625)	0.002
Number of diagnostic tests	4.25 (n=8032)	5.01 (n=1614)	0.03
Number of procedures	1.0 (n=7867)	1.09 (n=1602)	0.05
Whether visit resulted in hospitalisation (ORs)	Reference group (n=8112)	1.56 (95% CI 0.99 to 2.6) (n=1625)	0.05

*These results include propensity score weighted and multivariable linear and logistic regression models, which account for age, sex, race, comorbidities, primary diagnoses, triage acuity, insurance status, patient residence (whether the patient lives in a nursing home) whether the ED was located in an urban or rural setting, US region and year.

ED, emergency department; NPs/PAs, nurse practitioners and physician assistants; ref, reference group

more care, low-value advanced diagnostic imaging, and time per visit than physicians alone. Because NPs/PAs alone tend to see less complex patients than physicians, it is possible that they deliver fewer services than physicians for simpler, more algorithmic cases. In contrast, for more complex or less straightforward cases that might require input of a physician, NPs/PAs used more services than physicians alone, and these findings were reproduced in EDs where nearly all NP/PA visits were collaborative with physicians. With NPs/PAs playing an increasingly growing role in emergency care, these findings have important implications for policymakers, health system leaders and clinicians who all share a stake in improving the value and efficiency of emergency care.

The major challenge to studying the care of NP/PAs outside of experimental settings is overcoming patient selection bias. In this case, selection bias might manifest in two different ways. First, as our unadjusted data suggest, in EDs that use both NPs/PAs and physicians, cases allocated to NP/PAs generally are of lower complexity and, potentially, more straightforward.^{13 14} Though we attempt to control for this imbalance using propensity weighting methods, it is possible that there are additional unmeasured variables (eg, severity/complexity conditional on diagnosis or triage score) that our approach fails to incorporate. Nevertheless, while we cannot fully exclude unmeasured patient selection factors, our findings are consistent with NPs/PAs-alone delivering fewer services than physicians for simpler and more algorithmic cases. Our sensitivity analyses of low triage acuity visits, where fewer resulted in visits including the NP/PA-physician

Table 5 Adjusted* low-value health service utilisation within EDs where over 95% of NP/PA visits included the NP/PA–physician combination

Low-value health service	Physician (reference)	NP/PA and physician
CT/MRI studies for uncomplicated back pain or headache	n=987	2.32 (95% CI 1.46 to 3.7) (n=205)
Antibiotics for uncomplicated URI	n=319	1.38 (95% CI 0.67 to 2.84) (n=90)
Inappropriate medications for older adults	n=14 089	0.97 (95% CI 0.43 to 2.19) (n=2073)
Opioid medications for uncomplicated back pain or headache	n=851	1.25 (95% CI 0.78 to 1.99) (n=187)
Inappropriate antibiotics for simple UTIs	n=273	1.89 (95% CI 0.62 to 5.79) (n=39)
Plain X-rays for uncomplicated back pain	n=1716	1.09 (95% CI 0.63 to 1.87) (n=222)

*These results include propensity score weighted and multivariable linear and logistic regression models, which account for age, sex, race, comorbidities, primary diagnoses, triage acuity, insurance status, patient residence (whether the patient lives in a nursing home) whether the ED was located in an urban or rural setting, US region and year.

ED, emergency department; NPs/PAs, nurse practitioners and physician assistants; Ref, reference group; URI, upper respiratory infection; UTI, urinary tract infection.

combination, is consistent with this hypothesis. Such findings are also consistent with the broader primary care literature (including our own work), where primary care NPs/PAs appear to practice at similar or better efficiency of care than physicians for less emergent/complex conditions.^{25 44–50}

The second source of selection bias of concern relates to collaborative care, wherein NP/PAs choose to involve physicians in the care of a specific patients. When such consultations are initiated at the discretion of NPs/PAs, we would expect that cases where collaborative care was sought would have higher acuity/complexity, even after controlling for diagnosis and other clinical/sociodemographic variables. Thus, one would expect to see higher use of services for visits including the NP/PA–physician combination when compared with visits including physicians alone. In this case, by restricting the analyses to EDs where virtually all visits were staffed collaboratively, we effectively mitigated this potential source of bias. This exercise revealed that visits including the NP/PA–physician combination were associated with a higher use of services, including medications, testing and low-value imaging when compared with physician only cases. To be sure, it is possible the physician may be the driving force behind the NP/PA combination ordering more services than physicians alone. However, our sensitivity analyses among EDs where there effectively was no discretion occurring to create visits including the NP/PA–physician combination suggests this was not the case. Moreover, prior research suggests that NPs/PAs most frequently see the patient prior to involving an attending physicians in ED settings, often for lower acuity cases, and not the converse.^{51–53} Consistent with these data, prior physician and NP survey data suggest that physicians may manage undifferentiated and more complex ED patients more efficiently than NPs^{21 56} and our sensitivity analyses are consistent with this perspective.

Taken together, our results provide new insight into currently unresolved questions related to NP/PA scope-of-practice policies within ED settings. According to

international survey data, many emergency physicians believe that NPs should not practice autonomously and work best in collaborative teams alongside physicians, whereas NPs generally advocate for more autonomy, and NPs/PAs are increasingly practicing independently within US EDs.^{19–21} As the debate continues over whether NPs/PAs scope of ED practice should continue to expand, our analysis adds important data to the field, suggesting that NPs/PAs-alone may provide less services and low-value diagnostic imaging for lower acuity, less complex patients than physicians. Our data also suggest, contrastingly, that NPs/PAs may use more services and low-value diagnostic imaging than physicians in managing more complex cases. Such findings can inform current ongoing debates among US policymakers, health system leaders and clinicians on how to best incorporate NPs/PAs into ED care. We encourage further rigorous study of these questions, specifically randomised controlled trials evaluating the impact of various collaborative arrangements among NPs/PAs and physicians on the quality of emergency care.

Our study has several limitations. First is the inability to fully minimise selection bias as patients are non-randomly assigned to providers, which we attempted to address in detail above. In particular, we could not perform analyses limiting to EDs where virtually all of NP/PA visits were NP/PA-alone visits, because we could not find a sufficient number of EDs where NPs/PAs mostly practiced alone. Moreover, although our analyses adjusted for social determinants of health, such as race, insurance status, and rural and urban location, we could not fully separate the difference between patient selection to NPs/PAs and physicians *within* EDs versus patient selection *between* EDs as a function of the geographic location of the ED.^{57–59} Nonetheless, there is a rich literature that NPs/PAs are more likely to serve socioeconomically disadvantaged communities.^{60 61} Second, differences in utilisation do not necessarily imply differences in quality of care as the six low-value health service measures only comprise a narrow aspect of quality, and we did not assess other factors such as patient-oriented outcomes or diagnostic accuracy.

Third, we could not exclude the possibility of physicians being first to examine the patient prior to involving the NP/PA or more generally influencing medical decision making during NP/PA-alone visits; however, prior literature suggests that this is not the usual model of collaborative care.^{51–55} Fourth, we could not identify with complete certainty whether a service was low-value with the data we had. However, NHAMCS routinely collects data on symptoms, vital signs, visit diagnoses and comorbid conditions directly from patients' medical records, which can help exclude important alarm features. Moreover, we have no reason to suspect that misclassification of low-value care would differ by NPs/PAs versus physicians. Fifth, we could not account for variations in organisational practices and state-level scope-of-practice laws across the USA, which may limit NPs/PAs' ability to directly order diagnostic tests or medications.^{62–63} However, adjusting for larger US census regions did not alter our findings, and a previous rigorous analysis of the impact of state scope-of-practice laws on NP/PA practice patterns only found a modest association.⁶²

CONCLUSIONS

Compared with US ED physicians, NPs/PAs-alone used less care and low-value advanced diagnostic imaging, while the NP/PA-physician combination used more care and low-value advanced diagnostic imaging. Because NPs/PAs-alone tend to see fewer complex patients than physicians, it is possible that they used fewer services than physicians for simpler, more algorithmic cases. In contrast, NPs/PAs used more services than physicians for more complex cases—and these findings were reproduced in EDs where nearly all NPs/PAs saw patients collaboratively with physicians. With NPs/PAs playing an increasingly growing role in US EDs, these findings have important implications for policymakers and clinicians who all have a stake in improving the efficiency of emergency care.

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