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Emergency department utilization and predictors of mortality for inpatient inguinal hernia repairs

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Abstract

Background: Although inguinal hernias are common surgical diagnoses, minimally symptomatic patients are often not scheduled for repairs and are asked to seek medical attention if they develop symptoms. We investigated factors associated with emergency department (ED) utilization for inguinal hernia repairs and determined whether ED utilization affected mortality for this otherwise electively treated condition.

Methods: We performed a retrospective analysis of the 2009–2013 Nationwide Inpatient Sample to identify patients who presented through the ED and were then admitted for unilateral inguinal hernia repairs. Multivariable logistic regressions that adjusted for several patient and hospital characteristics determined predictors of both ED admission and postoperative mortality.

Results: There were 116,357 inpatient hospitalizations. The majority (57%) resulted from ED admissions, of which most (85%) had a diagnosis of obstruction or gangrene. Notable predictors of ED admission from the multivariable analysis included obstruction (odds ratio, 9.77 [95% confidence interval: 9.05–10.55]), gangrene (18.24 [13.00–25.59]), Black race (1.47 [1.29–1.69]), Hispanic ethnicity (1.35 [1.18–1.54]), self-pay (2.29 [1.97–2.66]) and Medicaid insurance (1.76 [1.50–2.06]). While overall mortality decreased from 2.03% in 2009 to 1.36% in 2013, admission through the ED was independently associated with higher mortality compared with elective repair (1.67 [1.21–2.29]), even after adjusting for the diagnosis of obstruction and gangrene. Other predictors of mortality included patient age and comorbidities.

Conclusions: In our study, Black, Hispanic, and self-pay patients were more likely to present through the ED. After adjusting for obstruction or gangrene, simply presenting through the ED was independently associated with a 67% higher postoperative mortality rate compared with that

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of an elective operation. Our findings suggest both a difference in ED utilization and subsequent difference in mortality by patient race and ethnicity and insurance for this common surgical condition.

Keywords

Inguinal hernia; Nationwide inpatient sample; Emergency department; Mortality; Inpatient

Introduction

Inguinal hernia repairs are one of the most common surgical procedures in the United States. More than 750,000 are performed annually, with the lifetime risk of an inguinal hernia being 27% for men and 3% for women.¹ Even though surgery is the only successful treatment of an inguinal hernia, the decision to operate is determined mostly by the patient's clinical history and examination. Asymptomatic and minimally symptomatic patients are often delegated to a "watchful waiting" treatment plan and are instructed to seek medical attention if they develop worsening symptoms, especially those associated with obstruction or gangrene.² If this happens, patients commonly undergo a scheduled operation or alternatively receive surgery after being admitted through an emergency department (ED). Previous studies have suggested that up to one-quarter of patients who follow the "watchful waiting" paradigm end up getting surgical repair within 2 years.³

While most inguinal hernia repairs are elective outpatient procedures and carry a postoperative mortality rate of <0.5%,⁴ many patients require emergent repairs because of exacerbating symptoms or strangulated tissue. Emergent repairs are associated with increased postoperative length of stay, greater medical costs, significant morbidity, and a 7-fold increase in mortality.⁵ However, while patients who undergo emergent hernia repairs often present through the ED, not every patient who presents to the ED with a symptomatic inguinal hernia will require an emergent surgical repair. Little is known about the current composition of patients using the ED for their inguinal hernia repair. Patients may be presenting because of worsening hernia symptomatology or due to a growing trend of increased ED utilization for nonurgent care.⁶ Also, little is known regarding differences in outcomes between patients with similar clinical presentations and comorbidities who are admitted through the ED for their hernia repair compared with those who undergo elective surgery.

This study had two aims in evaluating patients who require ED admission for their inguinal hernia repair. The first sought to better characterize the patient population that used the ED by identifying patient and hospital characteristics associated with ED admission. The second determined whether simply presenting through the ED, irrespective of obstruction or gangrene, for an inguinal hernia repair affected a patient's postoperative mortality rate for what should be an otherwise elective procedure. To assess the uncommon outcome of mortality from inguinal hernia repairs, we examined repairs that required postoperative inpatient care using the Nationwide Inpatient Sample (NIS) data from 2009 to 2013.

Methods

Study population

To understand the significance of outcomes in patients requiring ED admissions, we compared this patient population with a similar group which may have comparable clinical histories. We therefore chose to compare ED patients with those who underwent elective repair but required inpatient hospitalization afterward. We performed a retrospective analysis using the US NIS database, which is created and maintained by the Agency for Healthcare and Research Quality and is the largest all-payer inpatient healthcare database in the United States. We included all hospitalizations for unilateral inguinal hernia repairs from January 1, 2009 to December 31, 2013, the 5-y period before full implementation of the Affordable Care Act (ACA).

We identified inpatient hospitalizations for unilateral inguinal hernia repairs using the International Classification of Diseases-9-Schedule Modification (ICD-9-CM). We included patients with ICD-9-CM codes 17.1 and 53.0 for unilateral repair of an inguinal hernia. Exclusion criteria included age <18 y, codes for bilateral repairs of inguinal hernias (53.1), unilateral repair of femoral hernias (53.2), bilateral repair of femoral hernias (53.3), a negative procedure day (i.e., due to readmission), and patients with cancer (140–239). We excluded hospitalizations with concurrent operations such as cholecystectomies (51.2) and appendectomies (47) to remove unilateral inguinal hernia repairs performed secondarily with procedures for other diagnoses. We also excluded hospitalizations indicating that patients had previously received the hernia repair at a separate facility, including transfers and readmissions.

Variable definitions

To determine whether an inpatient stay originated from an admission through the ED, we used the HCUP_ED variable in NIS. Hereafter, we label all sources of admission not through the ED as scheduled admissions. Mortality was based on the disposition at discharge indicating expired. Factors that may affect the relationship between admission source and mortality were determined *a priori*. These included patient age at admission, sex (male and female), race (White, Black, Hispanic ethnicity, Asian, Native American, and other), payer (Medicare, Medicaid, private, self-pay/no charge/other), preoperative obstruction (ICD-9-CM codes 550.10 and 550.11), preoperative gangrene (550.00 and 550.01), indicator that the patient had a history of hernia (550.01 and 550.11), and quarter and calendar year of the hernia repair. We also used the Elixhauser score, a method for measuring patient comorbidity from ICD-9-CM diagnosis codes.⁷ The list of 30 comorbidities that make up the Elixhauser score captures acute and chronic conditions and has been shown to be significantly associated with in-hospital mortality.⁷ Hospital characteristics included region, hospital type, bed size, and teaching institution.

Analysis

In all analyses, we used the recommended sampling weights accounting for the NIS stratum and clustering at the level of the hospital, including the Agency for Healthcare and Research Quality-provided trend weights that account for the redesign of the dataset in 2012. We first

calculated the yearly number of patients who presented through the ED for their hernia repair from 2009 to 2013 and determined the proportion of patients with hernia complications (obstruction only, gangrene only, both obstruction and gangrene, neither) by admission sources (ED versus scheduled). Next, we performed a multivariable logistic regression to determine which patient and hospital characteristics were associated with presenting through the ED and analyzed the interaction term between selected statistically significant patient characteristics from the fully adjusted model. Calculating the interaction term between two independent risk factors determined whether a patient having two risk factors faced an even greater risk for presenting through the ED than only having either risk factor.

To evaluate mortality after inpatient inguinal hernia repairs, we calculated the unadjusted postoperative mortality rates by admission source and for the entire study population. Then, we performed a second multivariable logistic regression to determine which patient and hospital characteristics were associated with mortality after inpatient inguinal hernia repairs to determine whether simply presenting through the ED was associated with mortality.

Both our multivariable models adjusted for the differences in case mix within the study population, allowing us to determine the independent influence of each patient and hospital characteristic on the respective outcomes. All analyses were performed in SAS version 9.2 (Cary, NC).

Results

From 2009 to 2013, there were 116,357 inpatient hospitalizations for inguinal hernia repairs in the United States (Table 1). One-fifth of patients (18.9%; scheduled: 17.3%, ED: 20.1%) were female and most were aged 65 y (56.7%; scheduled: 58.0%, ED: 55.8%) and had Medicare insurance (54.6%; scheduled: 56.5%, ED: 53.2%). Three-quarters (75.5%) of the patients who underwent a scheduled procedure were White, relative to two-thirds (66.6%) who were admitted through the ED for their hernia repair. Half of all patients had an Elixhauser score of 0–1 (49.2%; scheduled: 50.6%, ED: 48.2%). Most patients were admitted on the weekday (83.5%; scheduled: 95.8%, ED: 74.3%) and were performed at large (61.7%; scheduled: 63.7%, ED: 60.3%), private nonprofit (73.0%; scheduled: 74.1%, ED: 72.1%), and urban (90.0%; scheduled: 88.7%, ED: 91.1%) hospitals.

The yearly number of inpatient inguinal hernia repairs remained relatively stable with just more than 20,000 procedures, and for each year, more than half of these patients (55.6%–59.4%) presented through the ED (Fig. 1). Hernia-related complications were common among those who presented through the ED (83.2% obstruction and 1.8% gangrene).

After adjustment (Table 2), the following factors were associated with ED presentation: female gender (odds ratio 1.34 [95% confidence interval: 1.24–1.45]), younger patient age (18–44 y: 1.38 [1.20–1.60]), race and ethnicity (Black: 1.47 [1.29–1.69], Hispanic: 1.35 [1.18–1.54]), Medicaid (1.76 [1.50–2.06]), and self-pay (2.29 [1.97–2.66]) insurance relative to Medicare, preoperative obstruction (9.77 [9.05–10.55]), gangrene (18.24 [13.00–25.59]), and four or more comorbidities (1.25 [1.11–1.40]). While Black and Hispanic patients were

more likely to be self-pay ($P < 0.001$), and as both race and insurance status were risk factors for ED admission, there was no statistical interaction (i.e., no increased risk by having both risk factors) on ED admission ($P = 0.44$) in the fully adjusted model. Finally, urban nonteaching hospitals (1.47 [1.32–1.63]) and rural teaching institutions (0.81 [0.70–0.93]) were associated with ED admission. There was no statistical relationship between hospital bed size, type, discharge quarter, or calendar years with ED admission.

Even though the overall mortality rate from hernia repairs fell from 2.03% to 1.36% during the 5-y study period, the un-adjusted postoperative mortality rate for those who presented through the ED was still twice that of those who underwent a scheduled repair (scheduled: 0.6%; ED: 1.3%). Subsequently, multivariable regression analysis (Table 3) determined that ED admission before surgery relative to scheduled elective surgery was a significant predictor of mortality (1.67 [1.21–2.29]), even after adjusting for obstruction and gangrene and other patient and hospital characteristics. Other predictors of mortality (Table 3) included calendar years 2012 and 2013 (2012: 0.63 [0.45–0.90]; 2013: 0.69 [0.48–0.97]; reference: 2009), age (18–44 y: 0.043 [0.006–0.34]; 45–64 y: 0.27 [0.17–0.44]; reference: 65+ y), higher Elixhauser score (1: 2.79 [1.27–6.10]; 2–3: 3.94 [1.87–8.32]; 4+: 16.92 [8.16–25.12]; reference: 0), preoperative gangrene (4.52 [2.63–7.75]), and a small hospital bed size (0.60 [0.40–0.89]; reference: large). Patient sex, race, payer status, preoperative obstruction, recurrent hernias, admitting day, discharge quarter, and teaching institution were not associated with mortality.

Discussion

Our findings document trends in ED utilization for symptomatic inguinal hernias but also suggest a potential difference in care with regards to postoperative mortality by race and ethnicity and insurance status. Most ED admissions were for patients experiencing hernia complications, and both obstruction and gangrene were statistically associated with ED admission. However, patient race and ethnicity and insurance status were two nonclinical factors independently associated with ED presentation in patients who were ultimately admitted for a hernia repair. Our second multivariable model found that, regardless of clinical severity, being admitted through the ED for an inguinal hernia repair was associated with a 67% higher postoperative mortality rate compared with that from a scheduled operation. Gangrene was associated with an increased risk in mortality, consistent with other studies that have examined emergent general surgeries,⁷ but obstruction was not associated with increased mortality within this inpatient population. Previous studies have shown that higher mortality from ED admissions is related to more clinically emergent presentations.⁷ Our analysis adjusted for the presence of such hernia complications as obstruction and gangrene as potential confounders to allow comparison of patients with similar clinical severity between ED admission and elective repairs requiring postoperative inpatient care.

Multivariable analysis found that, regardless of clinical severity, being admitted through the ED for an inguinal hernia repair was associated with a 67% higher postoperative mortality rate when compared to elective inpatient care. There are multiple factors that may contribute to this finding. Surgical factors include patient acuity and severity of presentation. In addition, patients who present acutely to the ED may have other comorbidities which may

negatively impact outcomes after a surgical procedure. Furthermore, presentation to the ED eliminates planning and optimization associated with a scheduled hernia repair, including refining outpatient prescription meds, encouraging behavioral modifications such as smoking cessation or weight loss, or perioperative education to optimize outcomes.

Current evidence-based findings recommend that certain patients with asymptomatic hernias do not require surgery and that physicians should practice “watchful waiting.”¹⁰ When these patients develop hernia symptoms, they are encouraged to seek care and often present to the ED for further evaluation. Although the NIS database could not determine which patients in our study had used prior medical care for their hernia, we found that the vast majority (85%) of the patients who were admitted for inguinal herniorrhaphy through the ED had hernia obstruction or gangrene formation, which may explain why more than half of the study population used the ED. These findings may suggest that for the inpatient population, patients were appropriately using the ED when they had hernia complications and were likely not doing so for nonurgent care.

Our findings document trends in ED utilization for symptomatic inguinal hernias but also suggest a potential difference in outcome with regards to postoperative mortality by race and ethnicity and insurance status. While hernia complications were associated with ED admission, nonclinical factors such as Black, Hispanic, and self-pay patients were also more likely to present through the ED. Prior studies have documented similar differences in utilization of health care services by race and insurance status in emergent and elective surgical conditions, including appendectomies, cholecystectomies, colorectal procedures, laparotomies, and vascular surgeries.¹¹ However, our analysis determined that there was no synergistic or multiplicative effect for patients who had both race and insurance status commonly associated with ED utilization.

We also observed several previously described associations in this study relating to older patient age and hospital size. In a nationwide sample of inpatient and outpatient hernia repairs from 2001 to 2010,¹² Beadles *et al.* found that patients aged ≥ 65 y had the highest rate of emergent inguinal hernia repairs and were subsequently associated with greater mortality.¹³ While we confirmed that older age was also associated with higher mortality in this inpatient population, we also found that this association was irrespective of obstruction and gangrene, suggesting that older patients still face a higher mortality when undergoing surgical repairs. In addition, older patients were more likely to present through the ED as well and thereby increase their postoperative mortality risk. Accordingly, for patients who consult outpatient care for their hernia, physicians may benefit by further considering elective repairs of their patients’ inguinal hernias in older patients with multiple comorbidities, both of which were independent risk factors for presenting through the ED and for a higher postoperative mortality rate. Previous studies have documented that safe elective inguinal hernia repairs can be performed in older patients with multiple comorbidities,¹⁴ which may circumvent a future ED admission for a hernia repair.

The findings of our study should be taken within the context of several limitations. We studied a specific subset of all unilateral inguinal hernia repairs in the United States that we considered to require the most urgent care and our findings may not apply to all patients,

particularly most patients undergoing outpatient procedures. The lack of information on outpatient visits before the admission prevents us from examining the need for urgent care among those whose hernia had previously been evaluated and were under “watchful waiting” management. Another limitation is the lack of information on some of the patient factors incorporated in our analysis, such as the extent of obstruction and gangrene which may not be accurately captured from ICD-9-CM codes exclusively, hernia chronicity, medication history, or other unrecorded medical data pertaining to the patients may serve as confounding variables. Further studies are needed to examine the costs and benefits for delaying or foregoing an elective repair of an inguinal hernia before making definite claims for whether elective repairs are superior to watchful waiting in certain subsets of patients. Recurrent hernias were not associated with an increased risk of mortality and may suggest that they carry the same risk of mortality as primary hernias. However, further research should investigate postoperative complications, length of hospital stay, and costs between primary and recurrent hernias.

Looking forward, the ACA has decreased the proportion of uninsured citizens in the United States from 15.7% before 2014 to 9.2% in early 2015. As insurance coverage has been associated with increased healthcare utilization other than the ED, future studies can evaluate how future changes in insurance coverage may impact ED admission for this common surgical condition. Furthermore, given that admission through the ED impacts mortality, potential institutional level or qualitative studies are needed to further understand this cohort of patients who acquire ED admission.

Conclusion

Most patients presenting through the ED for their inpatient inguinal hernia repair have complications that likely warrant emergent care, and both obstruction and gangrene were independent risk factors for ED admission. However, independent of having a diagnosis of obstruction or gangrene, surgical mortality is significantly higher after an ED admission for inguinal hernia repair compared to elective inpatient surgery. Black, Hispanic, and self-pay patients were also more likely to present through the ED, suggesting a potential difference in outcome for this common surgical condition by patient race, ethnicity and insurance status. Finally, because of the increased mortality in older patients presenting through the ED and evidence from other studies that elderly patients can undergo safe repairs, “watchful waiting” should be carefully considered in the elderly population.

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Fig. 1 – .

Yearly inpatient inguinal hernia repairs by admission source. The yearly number of inpatient inguinal hernia repairs remained relatively stable with just more than 20,000 procedures, and for each year, more than half of these patients (55.6%–59.4%) presented through the ED.

Table 1 –

Patient and hospital characteristics of inpatient inguinal hernia repairs from 2009 to 2013.

Characteristics	Scheduled	ED	Total
<i>N</i>	49,717	66,641	116,357
Sex, %			
Female	17.3	20.1	18.9
Age (y), %			
18–44	9.4	3.0	12.4
45–64	32.6	29.6	30.9
65+	58.0	55.8	56.7
Race and ethnicity, %			
White	75.5	66.6	70.3
Black	9.9	14.9	12.8
Hispanic	9.1	13.1	11.4
Asian, Native American, other	5.5	5.5	5.5
Payer, %			
Medicare	56.5	53.2	54.6
Medicaid	5.8	8.6	7.4
Private	29.6	19.2	23.7
Self-pay/no charge/other	8.2	19.0	14.4
Elixhauser score, %			
0 (no comorbidities)	23.7	25.1	24.5
1 (one comorbidity)	26.9	23.1	24.7
2–3	35.5	33.8	34.6
4+	13.9	17.9	16.2
Admitting day, %			
Monday through Friday	95.8	74.3	83.5
Saturday and Sunday	4.2	25.7	16.5
Day of procedure, %			
Day 0 (presentation)	82.1	54.0	66.0

Characteristics	Scheduled	ED	Total
Day 1	10.6	27.6	20.3
Day 2	3.7	8.9	6.7
Day 3	1.8	4.6	3.4
Day 4	1.1	3.0	2.2
Day 5	0.6	1.9	1.4
Recurrent hernia, %			
Yes	6.1	15.3	11.3
No	93.9	84.7	88.7
Discharge quarter, %			
January to March	26.1	25.1	25.5
April to June	25.0	24.6	24.8
July to September	24.7	25.2	25.0
October to December	24.2	25.1	24.7
Hospital type, %			
Government, nonfederal	12.5	12.3	12.4
Private, not profit	74.1	72.1	73.0
Private, invest-own	13.4	15.6	14.6
Hospital bed size, %			
Small	12.3	12.3	12.3
Medium	24.0	27.5	26.0
Large	63.7	60.3	61.7
Teaching institution, %			
Rural	11.4	9.0	10.0
Urban nonteaching	37.3	48.6	43.7
Urban teaching	51.4	42.5	46.3
Region, %			
Northeast	21.5	26.4	24.2
Midwest	22.5	14.0	17.6
South	35.6	38.7	37.4
West	20.4	20.9	20.7

Table 2 –

Adjusted multivariable analysis predicting ED admission.

Characteristics	OR	P value
Year		0.14
CY 2009	Ref	
CY 2010	0.84 (0.76–1.00)	
CY 2011	0.85 (0.73–0.99)	
CY 2012	0.88 (0.77–0.99)	
CY 2013	0.92 (0.81–1.04)	
Sex		< 0.0001
Male	Ref	
Female	1.34 (1.24–1.45)	
Age (y)		< 0.0001
18–44	1.38 (1.20–1.60)	
45–64	0.95 (0.86–1.06)	
65+	Ref	
Race and ethnicity		< 0.0001
White	Ref	
Black	1.47 (1.29–1.69)	
Hispanic	1.35 (1.18–1.54)	
Asian, Native American, other	0.84 (0.73–0.95)	
Payer		< 0.0001
Medicare	Ref	
Medicaid	1.76 (1.50–2.06)	
Private	0.84 (0.75–0.93)	
Self-pay/no charge/other	2.29 (1.97–2.66)	
Elixhauser score		< 0.0001
0 (no comorbidities)	Ref	
1 (one comorbidity)	0.92 (0.84–1.01)	
2–3	1.00 (0.91–1.09)	
4+	1.25 (1.11–1.40)	

Characteristics	OR	P value
Admitting day		< 0.0001
Monday through Friday	Ref	
Saturday and Sunday	5.91 (5.17–6.76)	
Obstruction		< 0.0001
Yes	9.77 (9.05–10.55)	
No	Ref	
Gangrene		< 0.0001
Yes	18.24 (13.00–25.59)	
No	Ref	
Recurrent hernia		0.14
Yes	1.09 (0.97–1.22)	
No	Ref	
Discharge quarter		0.53
January to March	Ref	
April to June	1.03 (0.93–1.13)	
July to September	0.98 (0.89–1.08)	
October to December	1.03 (0.94–1.13)	
Hospital type		0.22
Government, nonfederal	Ref	
Private, not-profit	1.15 (0.98–1.34)	
Private, invest-own	1.15 (0.96–1.39)	
Hospital bed size		0.08
Small	0.97 (0.86–1.09)	
Medium	1.11 (1.00–1.24)	
Large	Ref	
Teaching institution		< 0.0001
Rural	0.81 (0.70–0.93)	
Urban nonteaching	1.47 (1.32–1.63)	
Urban teaching	Ref	

OR = odds ratio.

Bold values indicate statistical significance at $P < 0.05$.

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Table 3 –
Adjusted multivariable analysis of patient and hospital factors associated with mortality.

Characteristics	OR (95% CI)	P value
Source of admission		0.0017
ED	1.67 (1.21–2.29)	
Non-ED	Ref	
Year		0.061
CY 2009	Ref	
CY 2010	0.81 (0.58–1.13)	
CY 2011	0.89 (0.65–1.22)	
CY 2012	0.63 (0.45–0.90)	
CY 2013	0.69 (0.48–0.97)	
Sex		0.77
Male	Ref	
Female	0.96 (0.74–1.25)	
Age (y)		< 0.0001
18–44	0.043 (0.006–0.34)	
45–64	0.27 (0.17–0.44)	
65+	Ref	
Race and ethnicity		0.23
White	Ref	
Black	0.68 (0.44–1.05)	
Hispanic	0.77 (0.49–1.19)	
Asian, Native Am, other	1.12 (0.64–1.94)	
Payer		0.46
Medicare	Ref	
Medicaid	1.46 (0.78–2.74)	
Private	0.87 (0.57–1.31)	
Self-pay/no charge/other	0.90 (0.42–1.90)	
Elixhauser score		< 0.0001
0 (no comorbidities)	Ref	

Characteristics	OR (95% CI)	P value
1 (one comorbidity)	2.79 (1.27–6.10)	
2–3	3.94 (1.87–8.32)	
4+	16.92 (8.16–35.12)	
Admitting day		0.066
Monday through Friday	Ref	
Saturday and Sunday	1.29 (0.98–1.70)	
Obstruction		0.38
Yes	1.16 (0.83–1.60)	
No	Ref	
Gangrene		< 0.0001
Yes	4.52 (2.63–7.75)	
No	Ref	
Recurrent hernia		0.50
Yes	0.89 (0.63–1.25)	
No	Ref	
Discharge quarter, %		0.59
January to March	Ref	
April to June	1.23 (0.90–1.70)	
July to September	1.13 (0.82–1.57)	
October to December	1.19 (0.87–1.63)	
Hospital type		0.33
Government, nonfederal	Ref	
Private, not-profit	0.87 (0.60–1.26)	
Private, invest-own	0.71 (0.45–1.23)	
Hospital bed size		0.034
Small	0.60 (0.40–0.89)	
Medium	1.02 (0.80–1.30)	
Large	Ref	
Teaching institution		0.46
Rural	1.26 (0.87–1.82)	
Urban nonteaching	1.04 (0.81–1.34)	

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Characteristics	OR (95% CI)	P value
Urban teaching		Ref

CI = confidence interval; OR = odds ratio.
Bold values indicate statistical significance at $P < 0.05$.