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MAJOR ARTICLE

Association of Race or Ethnicity With Extended-Spectrum Beta-Lactamase Production in *Escherichia Coli*: A Case Control Study

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Background. There are limited and conflicting data regarding the impact of race or ethnicity on the rate of gram-negative antimicrobial resistance. This study was performed to determine whether there is a difference in extended-spectrum beta-lactamase (ESBL) *Escherichia coli* infection or colonization in minoritized patients when compared to White patients from a diverse US Midwestern city.

Methods. A case control study was performed, with controls with non-ESBL *E. coli* matched 1:1 to patients with ESBL-producing *E coli* based on age, sex, and ZIP code. A variety of other evidence-based factors for ESBL Enterobacterales infection and colonization were collected via chart review. Multivariate conditional logistic regression assessed the odds of minoritized patients as compared to White patients, while controlling for other common risk factors for ESBL Enterobacterales.

Results. A total of 364 matched pairs were included in the analysis. Females were the majority of the sample (91%), with median age of 65 years. The majority of the sample identified as White (73%), followed by Hispanic (14%) and Black (10%). Urine cultures made up the majority of the cultures in the sample (97%), and this was similar between ESBL and non-ESBL groups. While controlling for these risk factors for ESBL *E coli*, minoritized patients had a statistically significant greater odds of ESBL-producing *E coli* (odds ratio, 2.53; 95% confidence interval, 1.68–3.82).

Conclusions. In our sample, which is demographically similar to the United States, minoritized patients had higher odds of ESBL-producing *E coli*. Further research on the drivers for this disparity is needed.

Keywords. extended-spectrum beta-lactamase; gram-negative resistance; health disparity; health equity; case-control study.

Health disparities by race and ethnicity have been described in several areas of healthcare and lead to reduced rates of preventative care, reduced quality of care for chronic diseases, and increased rehospitalization rates [1]. Rates of sepsis and mortality for infectious diseases are higher in Black patients [2, 3]. Information on the impact of race on antimicrobial resistance is extremely limited and has mainly focused on gram-positive organisms. Black patients have higher rates of methicillin-resistant *Staphylococcus aureus* infection, driven by socioeconomic factors [4]. In addition, Hispanic patients with community-acquired pneumonia have shown higher rates of penicillin-resistant *Streptococcus pneumoniae* [5].

Data from gram-positive resistance may not be predictive of gram-negative resistance because the spread of each are different. Gram-positive resistance is most often spread by person-to-person contact, whereas the spread of gram-negative resistance is more often assumed to be primarily associated with antimicrobial overuse [6, 7]. However, there is some data from outside the United States that associates extended spectrum beta-lactamase (ESBL) producing Enterobacterales with person-to-person contact [8, 9]. A study from the United Kingdom found an increase in ESBL colonization in patients who live in areas with a higher-than-average prevalence of overcrowded households [8].

ESBL-producing Enterobacterales affects more than 190 000 patients each year [10]. Patients with infections caused by ESBL-producing organisms have longer hospital length of stays as well as higher mortality [11, 12]. It is a major public health concern, and the Centers for Disease Control and Prevention (CDC)

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considers it a serious antimicrobial resistance threat [13]. There are many known risk factors for ESBL Enterobacterales colonization and infection [14–18]. Well-established risk factors include a history of ESBL colonization or infection, recent hospitalization, urinary conditions such as history of catheter-associated urinary tract infection or neurogenic bladder, and recent use of antibiotics, specifically cephalosporin or fluoroquinolone. Other risk factors include comorbid conditions such as diabetes and chronic kidney disease, recent surgery, and proton pump inhibitor use [14–18].

Within the United States, there is conflicting literature assessing a possible association between race and ethnicity and gram-negative resistance. A recent epidemiology study found that White patients had a statistically higher rate of ESBL-producing bacteremia [19]. However, a study that assessed ESBL-producing bacteriuria found that LatinX patients were at higher risk [20]. In addition, the CDC found higher rates of community-associated ESBL Enterobacterales in areas with "lower median incomes, lower high school education rates, higher percentages of persons without health insurance, and limited English proficiency," which are often associated with minoritized populations within the United States [21]. The city chosen for this study, Rockford, IL, resides in a county with a 2022 CDC social vulnerability index of 0.98 (0 = low, 1 = high) [22]. ESBL resistance is the most frequently identified acquired gram-negative resistance mechanism in Rockford, with a city-wide average *E coli* ESBL rate of 5.8% in 2022. This study aims to assess whether there is an association between ESBL-producing *E coli* and the race or ethnicity of the patient, when accounting for other common risk factors associated with ESBL acquisition.

METHODS

Study Design and Patients

A case control study was conducted using data from 1 January 2021 to 31 December 2022 from 3 health systems that together provide healthcare coverage for a midsized Midwestern city and the surrounding area of Rockford, IL. Cases were defined as inpatients or outpatients ≥18 years of age with a positive culture, from any source, for an ESBL-producing *E coli*. Controls were defined as inpatients or outpatients ≥18 years of age with a positive culture, from any source, for a non–ESBL-producing *E coli*. ESBL-producing *E coli* was determined by Vitek-2 ESBL testing as determined by the Clinical and Laboratory Standards Institute [23]. Only the first positive culture for each patient was included to reduce the influence of patients with multiple positive cultures.

Patient Consent Statement

Each site either approved the study protocol or provided a letter to cede review to the University of Illinois College of Medicine at Peoria institutional review board. It received final approval as an expedited review with an approved waiver of informed consent by the University of Illinois College of Medicine at Peoria institutional review board on 5 May 2023 and was acknowledged by the University of Illinois College of Medicine at Rockford institutional review board on 26 May 2023.

Clinical Data Collection

A microbiology report listing all cultures from inpatients and outpatients growing *E coli* from January 2021 to December 2022 was generated at each health system. Patient information on these reports included date of culture, source of culture, and location of culture (inpatient or outpatient), age, sex, and ZIP code. Based on published data on ESBL risk factors, as well as differences in poverty levels across the city, patients were matched cases and controls 1:1 based on age, sex, and ZIP code [14–18]. In cases of multiple possible control matches, 1 control match was randomly selected.

A data collection template that includes additional risk factors for ESBL colonization and infection was developed and built into the REDCap (Research Electronic Data Capture) software platform. This list of data was compiled from a thorough review of the literature [14–18]. Study data were collected using the REDCap secure electronic data capture tool and obtained through review of the electronic health record. The demographic data collected included age, gender, gender identity, race or ethnicity, and residency type (personal home, facility, or unhoused). Culture data included whether the culture was drawn inpatient or outpatient, the source of the culture, and other co-resistance. Antibiotic and medication risk factors included any documented systemic antibiotic exposure within 90 days before the culture date, cephalosporin use within 90 days before the culture date, fluoroquinolone use within 90 days before the culture date, and use of immune compromising medications or proton pump inhibitors on the culture date. An immune-compromising medication was defined in the codebook, and included high-dose corticosteroids, immune-compromising chemotherapeutic agents, transplant-related immunosuppressive drugs, and immunosuppressive or immunomodulatory biologic agents (Supplementary material 1). Urinary risk factors included a healthcare provider's diagnosis of recurrent urinary tract infections, neurogenic bladder, catheter-associated urinary tract infections, or a genitourinary intervention within 12 months before the culture date. Resistance risk factors included any history of ESBL infection or colonization, and methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant *Enterococcus*, or multidrug-resistant organism infection or colonization within 12 months before the culture date. Comorbid condition history included a diagnosis of diabetes mellitus, lung disease, cerebrovascular disease,

chronic kidney disease, a current malignancy, any immune compromising condition, hospitalization for any reason within 90 days before culture date, or a major surgery within 60 days before culture date.

Data were collected by student researchers, after being trained by the principle investigator. The student researchers were supervised by site coordinators. A data codebook with specific definitions for each of the data collection points was developed by the investigators and was provided to the student researchers (Supplementary material 1). Data collection for the first 10 patients at each site was performed by both the site coordinator and student researcher to verify coding consistency. In addition, every 15th patient at each site (excluding the first 10 patients) was checked by the site coordinator for continued consistency. A data entry point was created on the REDCap data collection site that allowed for student notes or questions to the site coordinator during data collection.

Key Data Elements

The data collection process included whether the patient was racially or ethnically minoritized, and the specific racial and ethnic identity. The definition of racial or ethnic minoritized patient was anyone who identified as American Indian or Alaska Native, Asian American, Black, Hispanic, Native Hawaiian and other Pacific Islander, or more than 1 race, as based on and using terminology from the 1997 US Census Bureau Office of Management and Budget standards [24]. The primary outcome was the difference in odds of ESBL-producing *E coli* between White and minoritized patients. A secondary analysis of the odds of ESBL-producing *E. coli* between Black and White and Hispanic and White patients was performed.

Statistical Analysis

A sample size of 750 was needed to reach 80% power to detect a 10% difference in the odds of ESBL-producing *E coli* between groups. We assessed the differences in baseline demographics between groups using univariate conditional logistic regression models to account for the case control study design. *P* values were included for the demographic information because a case control study design was used. We adopted conditional logistic regression models to study the effects of potential risk factors on the primary outcome. We started with an original model that included all potential risk factors without model selection. The second model then employed a forward selection approach for model selection, which yielded the reduced final model. In our primary analysis, we included the race/ethnicity as a binary variable (ie, White vs. minoritized patients). In our secondary analysis, we included the specific race/ethnicity in the model (ie, White, Black, Hispanic). We used complete case analysis to deal with missing data. All analyses were performed using statistical software R.

RESULTS

Patient Characteristics

A total of 728 patients (364 matched pairs) were included in the final analysis. Eleven matched pairs were excluded from the analysis because they were younger than 18 years of age or their medical records (or the medical records of their matched pair) were not available to the researcher. The patients whose medical records were not available were all associated with 1 site that serves as a reference laboratory for smaller outlying hospitals. A total of 32 ZIP codes, which includes all of the ZIP codes within the greater Rockford, IL, area, were included in the sample. The demographic information for the included patients is described in Table 1. The sample included mostly females (91%), with a median age of 65 years. Patients identified as either White (73%), Hispanic (14%), Black (10%), Asian American (2.3%), more than 1 race or ethnicity (0.8%), or American Indian or Alaska Native (0.1%). Urine cultures made up the majority of the cultures in the sample (97%); this percentage was similar between ESBL and non-ESBL groups. For the overall sample, 23% of cultures were from hospitalized patients, and this percentage was similar between the ESBL and non-ESBL groups. The majority of the patients resided in personal homes (93%), which included both houses and apartments.

Table 1. Demographic Information

	ESBL[a] (n = 364)	Non-ESBL[a] (n = 364)	*P* Value[b]
Female (%)	91%	91%	…
Median age	65 (46, 76)	65 (46, 76)	…
Source, n (%)	…	…	.5
Urine	352 (97%)	354 (97%)	
Blood	3 (0.8%)	3 (0.8%)	
Wound- surgical	4 (1.1%)	1 (0.3%)	
Wound- swabs	5 (1.4%)	5 (1.4%)	
Sputum	0 (0%)	1 (0.3%)	
Race/ethnicity (%)	…	…	<.001
White	242 (66%)	299 (79%)	
Hispanic	67 (18%)	32 (8.8%)	
Black	37 (10%)	38 (10%)	
Asian American	13 (3.6%)	4 (1.1%)	
More than 1 race or ethnicity	4 (1.1%)	2 (0.5%)	
American Indian or Alaska Native	1 (0.3%)	0 (0%)	
Location of culture (%)	…	…	.023
Inpatient	94 (26%)	72 (20%)	
Outpatient	268 (74%)	292 (80%)	
Unknown	2 (0.5%)	0 (0%)	
Type of residence (%)	…	…	.001
Personal home	329 (90.4%)	350 (96.2%)	
Facility	35 (9.6%)	14 (3.8%)	

Abbreviation: ESBL, extended-spectrum beta-lactamase.

[a]Median (interquartile range); n (%).

[b]Conditional logistic regression models.

Risk Factors for Resistance

The full model included a comprehensive list of risk factors that were known to be associated with ESBL resistance in prior studies. The comprehensive list of risk factors is available in Appendix 1. The results for the reduced final model of our primary analysis are listed in Table 2, and the results for the full model are available in Appendix 2. In the reduced model, prior ESBL infection or colonization, systemic antibiotic use within 90 days, neurogenic bladder, and immune suppressing conditions or medications have statistically significant associations with the risk of ESBL-producing *E coli*. While controlling for these risk factors for ESBL-producing *E coli*, minoritized patients had a statistically significant greater risk of ESBL-producing *E coli* (odds ratio, 2.53; 95% confidence interval, 1.68–3.82).

While reviewing the demographic breakdown of the population, a difference in the odds of ESBL resistance was noted for Hispanic patients compared to White patients. A secondary analysis was performed to assess the difference between Hispanic and White patients and Black and White patients. The results for the reduced model in the secondary analysis are presented in Table 3. This analysis found that Hispanic patients had a statistically significant greater risk of ESBL-producing *E coli* compared to White patients (odds ratio, 3.70; 95% confidence interval, 2.12–6.46). Because of low sample sizes, a comparison between all other (non-Black or non-Hispanic) races or ethnicities and White patients was not performed.

Table 2. Reduced Logistic Regression Model of Differences in ESBL *Escherichia coli* for Minoritized Compared to White Patients

Variable Name	Odds Ratio (95% CI)	*P* Value
Racial or ethnic minoritized patient = Yes	2.53 (1.68–3.82)	<.001
Antibiotic use within 90 d = Yes	1.97 (1.37–2.83)	<.001
Neurogenic bladder = Yes	5.66 (1.00–29.45)	.039
Current immune suppressing condition = Yes	2.08 (0.97–4.46)	.058
Prior ESBL infection or colonization = Yes	16.14 (3.79–68.69)	<.001
Current immune suppressing medications = Yes	0.36 (0.14–0.92)	.032

Abbreviations: CI, confidence interval; ESBL, extended-spectrum beta-lactamase.

Table 3. Reduced Logistic Regression Model of Differences in ESBL *Escherichia coli* for a Specific Race or Ethnicity Compared to White Patients

Variable Name	Odds Ratio (95% CI)	*P* Value
Hispanic = Yes	3.70 (2.12–6.46)	<.001
Black = Yes	1.28 (0.70–2.34)	.425
Antibiotic use within 90 d = Yes	2.11 (1.45–3.07)	<.001
Neurogenic bladder = Yes	3.86 (0.75–19.91)	.107
Current immune suppressing condition = Yes	1.91 (0.90–4.08)	.093
Prior ESBL infection or colonization = Yes	18.94 (4.38–81.96)	<.001
Current immune suppressing medications = Yes	0.45 (0.18–1.13)	.09

Abbreviations: CI, confidence interval; ESBL, extended-spectrum beta-lactamase.

DISCUSSION

This study appears to be the first study specifically designed to assess the racial and ethnic differences in ESBL-producing *E coli* in the United States, while taking into account other well-known risk factors for ESBL resistance in the model. One limitation of this study it that is was performed in a single city, Rockford, IL. However, Rockford is a multiracial and multiethnic city with a high social vulnerability index [22]. Rockford has a higher percentage of Black residents than the United States (22% vs. 14%), but a lower percentage of Asian American residents (3.6% vs. 6.3%) [25, 26]. Another limitation of the study is that we were only able to review medical records for 728 patients instead of the planned 750. However, given the difference seen for our primary outcome the risk of type II error is negated. In addition, the low sample size for some of the individual ethnicities limits specific assessment for individual minoritized identities, and limits application to Asian Americans, Native Americans, Pacific Islanders, or those that identify as more than 1 race or ethnicity. A larger study is needed to further assess these populations. Finally, our definition of minoritized patients used the 1997 Office of Management and Budget standards; however, these were adjusted in 2024. Future studies should use the updated list and terminology to define minoritized patients within the United States [24, 27].

Our study results were similar to results of an epidemiologic study conducted in patients with ESBL bacteriuria [20]. This study found that patients who identified as LatinX race/ethnicity had a higher rate of community-onset ESBL-producing *E coli* bacteriuria [20]. Our similar finding is likely reflective of the large percent of urine cultures in our sample and the greater percentage of outpatient cultures. It is also important to note that both of these studies differ from the published epidemiologic data for ESBL Enterobacterales bacteremia [19]. This retrospective cohort study found that, in patients with bacteremia, White patients were more likely to have ESBL-producing organisms compared to minoritized patients [19]. Given these discrepancies, further studies that use a large sample from multiple culture sources is needed to comprehensively assess this difference.

An unanswered question is the driver for this disparity and a potential causal pathway. As an initial assessment, this study was narrowly focused on race and ethnicity as markers for this health disparity. Based on the other published literature, it is likely that individual or structural social determinants of health underlie the risk difference found in this study [21]. Possible drivers of health inequity include differences in quality of care, differences in health insurance coverage, non-English language preference, residential segregation, or other social and economic vulnerabilities [28]. In addition, recent travel to area with high-endemic ESBL areas has been identified as a risk factor for ESBL carriage [29]. These possible drivers of resistance and health inequity should be priorities in future research.

This study used a matching process that included age, gender, and ZIP code. Age and gender were used to compare populations with similar risk for ESBL-producing organisms. Income has been identified in other health disparity research as a possible confounder [30]. ZIP code was added to adjust for noted income inequality within the Rockford, IL, metro area, where the 2021 median income by ZIP code ranged from $24 648 to $158 177 [31]. Addition of ZIP codes as matching points may have obscured social vulnerabilities that underlie racial or ethnic health disparities, although these are more pronounced at a neighborhood or census tract level and are often lost at the ZIP code level [32]. Further research, including mixed methods study using a health disparity analysis of this data combined with a pilot qualitative study is planned. Qualitative data derived from patient interviews will help determine causes, such as travel or use of nonprescribed antibiotics, which are not available from the electronic heath record. This information will determine potential causal pathways, which will assist in the creation of interventions targeted to high-risk populations.

CONCLUSION

In our sample, from a diverse Midwestern city, minoritized patients had higher odds of ESBL-producing *E coli*. Further research on the drivers for this disparity is needed. This study was performed to provide additional information to an area of antimicrobial resistance that is understudied. Additional research and support from the infectious diseases community is needed.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

Notes

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Author contributions. A.H. (conceptualization, methodology, project administration, funding acquisition, data curation, writing—original draft), M.B. (methodology, supervision, data curation, writing—review and editing), T.M. (methodology, supervision, data curation, writing—review and editing), J.S. (methodology, validation, formal analysis, writing—review and editing), E.O-B. (investigation, writing—review and editing), A. S-M. (investigation, writing—review and editing), R.S. (investigation, writing—review and editing), M.A.Z. (methodology, resources, writing—review and editing).

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Appendix 1. Full Demographic Information of ESBL Risk Factors

Characteristic	N	Overall, N = 728[a]	ESBL, N = 364[a]	Non-ESBL, N = 364[a]	*P* Value[b]
Patient age	728	65 (46, 76)	65 (46, 76)	65 (46, 76)	>.9
Gender identity	728	…	…	…	>.9
Female	…	661 (91%)	331 (91%)	330 (91%)	…
Male	…	66 (9.1%)	33 (9.1%)	33 (9.1%)	…
Transgender male	…	1 (0.1%)	0 (0%)	1 (0.3%)	…
Race	728	…	…	…	<.001
White	…	530 (73%)	242 (66%)	288 (79%)	…
Hispanic	…	99 (14%)	67 (18%)	32 (8.8%)	…
Black	…	75 (10%)	37 (10%)	38 (10%)	…
Asian American	…	17 (2.3%)	13 (3.6%)	4 (1.1%)	…
More than 1 race or ethnicity	…	6 (0.8%)	4 (1.1%)	2 (0.5%)	…
American Indian or Alaska Native	…	1 (0.1%)	1 (0.3%)	0 (0%)	…
Residence type	728	…	…	…	.001
Facility	…	49 (6.7%)	35 (9.6%)	14 (3.8%)	…
Personal home (includes houses and apartments)	…	679 (93%)	329 (90%)	350 (96%)	…
Culture site	728	…	…	…	.5
Blood	…	6 (0.8%)	3 (0.8%)	3 (0.8%)	…
Sputum	…	1 (0.1%)	0 (0%)	1 (0.3%)	…
Urine	…	706 (97%)	352 (97%)	354 (97%)	…
Wound-surgical and other surgical cultures	…	5 (0.7%)	4 (1.1%)	1 (0.3%)	…
Wound-swab	…	10 (1.4%)	5 (1.4%)	5 (1.4%)	…
Inpatient or outpatient culture	728	…	…	…	.023
Inpatient	…	166 (23%)	94 (26%)	72 (20%)	…
Outpatient	…	560 (77%)	268 (74%)	292 (80%)	…
Unknown	…	2 (0.3%)	2 (0.5%)	0 (0%)	…
Racial or ethnic minoritized patient	728	…	…	…	<.001
No	…	529 (73%)	241 (66%)	288 (79%)	…
Yes	…	199 (27%)	123 (34%)	76 (21%)	…
Antibiotic use within 90 d	728	…	…	…	<.001
No	…	515 (71%)	228 (63%)	287 (79%)	…
Yes	…	213 (29%)	136 (37%)	77 (21%)	…
Cephalosporin use within 90 d	728	…	…	…	<.001
No	…	618 (85%)	292 (80%)	326 (90%)	…
Yes	…	110 (15%)	72 (20%)	38 (10%)	…
Fluoroquinolone use within 90 d	728	…	…	…	.016
No	…	700 (96%)	344 (95%)	356 (98%)	…
Yes	…	28 (3.8%)	20 (5.5%)	8 (2.2%)	…
Recurrent urinary tract infection	728	…	…	…	.037
No	…	678 (93%)	332 (91%)	346 (95%)	…
Yes	…	50 (6.9%)	32 (8.8%)	18 (4.9%)	…
Neurogenic bladder	728	…	…	…	.009
No	…	715 (98%)	353 (97%)	362 (99%)	…
Yes	…	13 (1.8%)	11 (3.0%)	2 (0.5%)	…
Catheter-associated urinary tract infection	728	…	…	…	.244
No	…	716 (98%)	356 (98%)	360 (99%)	…
Yes	…	12 (1.6%)	8 (2.2%)	4 (1.1%)	…

Appendix 1. Continued

Characteristic	N	Overall, N = 728[a]	ESBL, N = 364[a]	Non-ESBL, N = 364[a]	*P* Value[b]
Genitourinary intervention within 12 mo	728	…	…	…	.050
No	…	718 (99%)	356 (98%)	362 (99%)	…
Yes	…	10 (1.4%)	8 (2.2%)	2 (0.5%)	…
Diabetes mellitus	728	…	…	…	.16
No	…	546 (75%)	265 (73%)	281 (77%)	…
Yes	…	182 (25%)	99 (27%)	83 (23%)	…
Lung disease	728	…	…	…	.165
No	…	572 (79%)	279 (77%)	293 (80%)	…
Yes	…	156 (21%)	85 (23%)	71 (20%)	…
Cerebrovascular disease	728	…	…	…	.215
No	…	667 (92%)	329 (90%)	338 (93%)	…
Yes	…	61 (8.4%)	35 (9.6%)	26 (7.1%)	…
Chronic kidney disease	728	…	…	…	.121
No	…	618 (85%)	302 (83%)	316 (87%)	…
Yes	…	110 (15%)	62 (17%)	48 (13%)	…
Current immune suppressing condition	728	…	…	…	.018
No	…	673 (92%)	328 (90%)	345 (95%)	…
Yes	…	55 (7.6%)	36 (9.9%)	19 (5.2%)	…
Current malignancy	728	…	…	…	.309
No	…	660 (91%)	326 (90%)	334 (92%)	…
Yes	…	68 (9.3%)	38 (10%)	30 (8.2%)	…
Prior ESBL infection or colonization	728	…	…	…	<.001
No	…	686 (94%)	326 (90%)	360 (99%)	…
Yes	…	42 (5.8%)	38 (10%)	4 (1.1%)	…
Methicillin-resistant *Staphylococcus aureus* infection or colonization	728	…	…	…	.035
No	…	709 (97%)	350 (96%)	359 (99%)	…
Yes	…	19 (2.6%)	14 (3.8%)	5 (1.4%)	…
Vancomycin-resistant *Enterococcus* infection or colonization	728	…	…	…	.047
No	…	721 (99%)	358 (98%)	363 (100%)	…
Yes	…	7 (1.0%)	6 (1.6%)	1 (0.3%)	…
multidrug-resistant organism infection or colonization	728	…	…	…	>.9
No	…	718 (99%)	359 (99%)	359 (99%)	…
Yes	…	10 (1.4%)	5 (1.4%)	5 (1.4%)	…
Hospitalization within 90 d	728	…	…	…	.001
No	…	603 (83%)	285 (78%)	318 (87%)	…
Yes	…	125 (17%)	79 (22%)	46 (13%)	…
Major surgery within 60 d	728	…	…	…	.282
No	…	712 (98%)	354 (97%)	358 (98%)	…
Yes	…	16 (2.2%)	10 (2.7%)	6 (1.6%)	…
Current immune suppressing medications	728	…	…	…	.397
No	…	691 (95%)	348 (96%)	343 (94%)	…
Yes	…	37 (5.1%)	16 (4.4%)	21 (5.8%)	…
Current proton pump inhibitor	728	…	…	…	.154
No	…	559 (77%)	272 (75%)	287 (79%)	…
Yes	…	169 (23%)	92 (25%)	77 (21%)	…

Abbreviation: ESBL, extended-spectrum beta-lactamase.

[a]Median (interquartile range); n (%)

[b]Conditional logistic regression models.

Appendix 2. Full Logistic Regression Model of Differences in ESBL *Escherichia coli* for Minoritized Compared to White Patients

Variable Name	Odds Ratio (95% CI)	*P* Value
Racial or ethnic minoritized patient = Yes	2.58 (1.69–3.92)	<.001
Outpatient culture = Yes	0.89 (0.56–1.39)	.575
Antibiotic use within 90 d = Yes	1.64 (0.98–2.74)	.058
Cephalosporin use within 90 d = Yes	1.18 (0.61–2.27)	.63
Fluoroquinolone use within 90 d = Yes	1.24 (0.45–3.47)	.679
Recurrent UTI = Yes	1.94 (0.80–4.69)	.142
Neurogenic bladder = Yes	6.04 (0.97–37.63)	.054
Catheter-associated urinary tract infection = Yes	0.28 (0.05–1.68)	.164
Genitourinary intervention within 12 m = Yes	1.93 (0.24–15.59)	.536
Diabetes mellitus = Yes	1.05 (0.69–1.61)	.812
Lung disease = Yes	1.14 (0.71–1.81)	.59
Cerebrovascular disease = Yes	1.47 (0.72–2.99)	.293
Chronic kidney disease = Yes	1.26 (0.72–2.21)	.42
Current immune suppressing condition = Yes	2.09 (0.86–5.07)	.103
Current malignancy = Yes	0.84 (0.42–1.68)	.63
Prior ESBL infection or colonization = Yes	14.39 (3.19–65.04)	.001
Methicillin-resistant *Staphylococcus aureus* infection or colonization = Yes	1.83 (0.54–6.13)	.33
Vancomycin-resistant *Enterococcus* infection or colonization = Yes	1.41 (0.08–25.77)	.817
Multidrug-resistant organism infection or colonization = Yes	0.62 (0.13–3.02)	.555
Hospitalization within 90 d = Yes	1.11 (0.63–1.93)	.725
Major surgery within 60 d = Yes	0.98 (0.23–4.20)	.972
Current immune suppressing medications = Yes	0.31 (0.18–0.83)	.019
Current proton pump inhibitor = Yes	1.09 (0.69–1.71)	.719

Abbreviations: CI, confidence interval; ESBL, extended-spectrum beta-lactamase; UTI, urinary tract infection.

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