

## Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

**eTable 1. Definition of Covariates**

<b>Covariate</b>	<b>Definition</b>
<b>Demographic</b>	
Sex	Male, Female
Age at index culture date in years	≥ 18 years at index culture date
Race/Ethnicity	White non-Hispanic, Black non-Hispanic, Hispanic, Asian/Hawaiian/Pacific Islander, American Indian or Alaska Native/Multiple/Other/Unknown
<b>Characteristics of Index Admission</b>	
Specimen Site of Index Infection	
Other	Specimen site of index infection including blood, respiratory, GU, GI, skin/bone and other sites
Respiratory	Respiratory specimen site of index infection only
Source of Infection	
Present at hospital admission	Index culture date ≤2 days (48 hours) of admission
Hospital-onset	Index culture date >2 days (48 hours) after admission
Co-Infecting Pathogen	Other pathogens ( <b>NOT</b> limited to only gram negative) that were present in the same sample as Pseudomonas
ICU Prior to Index Culture	Intensive Care Unit admission during hospitalization prior to index culture date
Skilled Nurse Facilities Transfer	Patient was transferred from a skilled nursing facility or long-term care facility (not including hospice care)
<b>Invasive Devices and/or Procedures (between admission and prior to culture date)</b>	Insertion of the following device and/or procedure between admission and prior to index date: Endotracheal tube, tracheostomy, hemodialysis, gastric or jejunal feeding tube, indwelling urinary catheter, CVC/Port/PICC
<b>Surgery prior to Index Culture</b>	Any surgery (in operation room) prior to index date
<b>LOS from admission to index culture</b>	Length of stay from admission to index date: 0-3, 4-10, 11+ days
<b>ICU LOS prior to index culture</b>	Length of stay in the intensive care unit prior to index date: 0-3, 4-10, 11+ days
<b>Pseudomonas 30 days prior to index admission</b>	Included both inpatient and outpatient settings
No Prior Pseudomonas (ref)	No prior Pseudomonas infection (used as a reference point)
Carbapenem-Susceptible Pseudomonas	Prior Carbapenem-Susceptible Pseudomonas culture 30 days prior to index date
Carbapenem-Resistant Pseudomonas	Prior Carbapenem-Resistant Pseudomonas culture 30 days prior to index date

<b>Covariate</b>	<b>Definition</b>
<b>Healthcare Exposure in 6 months Prior to Index Admission</b>	
Previous hospitalization	Previous hospitalization ≤6 months prior to index date
Number of days hospitalized	Number of days the patient was hospitalized in the ≤6 months prior to index date: 0-3, 4-10, 11+ days
Previous ICU Admission	Prior intensive care unit admission ≤6 months prior to index date
Dialysis	History of active dialysis ≤6 months prior to index date
<b>Comorbidity 6 months prior to index date</b>	Comorbidity ICD codes from both inpatient and/or outpatient settings
Myocardial infarction	<b>Enhanced ICD-9-CM:</b> 410.x, 412.x <b>ICD-10:</b> I21.x, I22.x, I25.2
Congestive heart failure	<b>Enhanced ICD-9-CM:</b> 398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 425.4-425.9, 428.x <b>ICD-10:</b> I09.9, I11.0, I13.0, I13.2, I25.5, I42.0, I42.5-I42.9, I43.x, I50.x, P29.0
Peripheral vascular disease	<b>Enhanced ICD-9-CM:</b> 093.0, 437.3, 440.x, 441.x, 443.1-443.9, 447.1, 557.1, 557.9, V43.4 <b>ICD-10:</b> I70.x, I71.x, I73.1, I73.8, I73.9, I77.1, I79.0, I79.2, K55.1, K55.8, K55.9, Z95.8, Z95.9
Cerebrovascular disease	<b>Enhanced ICD-9-CM:</b> 362.34, 430.x-438.x <b>ICD-10:</b> G45.x, G46.x, H34.0, I60.x-I69.x
Dementia	<b>Enhanced ICD-9-CM:</b> 290.x, 294.1, 331.2 <b>ICD-10:</b> F00.x-F03.x, F05.1, G30.x, G31.1
Chronic pulmonary disease	<b>Enhanced ICD-9-CM:</b> 416.8, 416.9, 490.x-505.x, 506.4, 508.1, 508.8 <b>ICD-10:</b> I27.8, I27.9, J40.x-J47.x, J60.x-J67.x, J68.4, J70.1, J70.3
Peptic ulcer disease	<b>Enhanced ICD-9-CM:</b> 531.x-534.x <b>ICD-10:</b> K25.x-K28.x
Mild liver disease	<b>Enhanced ICD-9-CM:</b> 070.22, 070.23, 070.32, 070.33, 070.44, 070.54, 070.6, 070.9, 570.x, 571.x, 573.3, 573.4, 573.8, 573.9, V42.7 <b>ICD-10:</b> B18.x, K70.0-K70.3, K70.9, K71.3-K71.5, K71.7, K73.x, K74.x, K76.0, K76.2-K76.4, K76.8, K76.9, Z94.4
Diabetes (with and without chronic complication)	<b>Enhanced ICD-9-CM:</b> 250.0-250.9 <b>ICD-10:</b> E10.0-E10.9, E11.0-E11.9, E12.0-E12.9, E13.0-E13.9, E14.0- E14.9
Hemiplegia or paraplegia	<b>Enhanced ICD-9-CM:</b> 334.1, 342.x, 343.x, 344.0-344.6, 344.9 <b>ICD-10:</b> G04.1, G11.4, G80.1, G80.2, G81.x, G82.x, G83.0-G83.4, G83.9

<b>Covariate</b>	<b>Definition</b>
Renal Disease	<b>Enhanced ICD-9-CM:</b> 403.01, 403.11, 403.91, 404.02, 404.03, 404.12, 404.13, 404.92, 404.93, 582.x, 583.0-583.7, 585.x, 586.x, 588.0, V42.0, V45.1, V56.x <b>ICD-10:</b> I12.0, I13.1, N03.2-N03.7, N05.2-N05.7, N18.x, N19.x, N25.0, Z49.0-Z49.2, Z94.0, Z99.2
Malignancy, including leukemia and lymphoma (≠ malignant neoplasm of skin)	<b>Enhanced ICD-9-CM:</b> 140.x-172.x, 174.x-195.8, 200.x-208.x, 238.6 <b>ICD-10:</b> C00.x-C26.x, C30.x-C34.x, C37.x-C41.x, C43.x, C45.x-C58.x, C60.x-C76.x, C81.x-C85.x, C88.x, C90.x-C97.x
Moderate or severe liver disease	<b>Enhanced ICD-9-CM:</b> 456.0-456.2, 572.2-572.8 <b>ICD-10:</b> I85.0, I85.9, I86.4, I98.2, K70.4, K71.1, K72.1, K72.9, K76.5, K76.6, K76.7
Metastatic solid tumor	<b>Enhanced ICD-9-CM:</b> 196.x-199.x <b>ICD-10:</b> C77.x-C80.x
Organ Transplant	Identified by National Transplant Services Directory
AIDS/HIV	Identified by HIV Registry
Other immune conditions	<b>Enhanced ICD-9-CM:</b> 279.x, 288.x, 289.x, 795.7x <b>ICD-10:</b> D47.4, D57.x, D68.x, D70.x, D71, D72.x- D76.x, D77, D80.x- D84.x, D89.x, I88.x, M35.9, R75, R76.x
Rheumatologic/Inflammatory	<b>Enhanced ICD-9-CM:</b> 446.5, 710.0-710.4, 710.8, 714.0-714.2, 714.8 <b>ICD-10:</b> M05.x, M06.x, M31.5, M32.x-M35.x, M36.0
<b>Antibiotic use in the 30 days prior to index date</b>	Included mediations from both inpatient and outpatient settings
Aminoglycosides	Use of Aminoglycosides in the 30 days prior to index date
Carbapenems	Use of Carbapenems in the 30 days prior to index date
1 <sup>st</sup> generation Cephalosporins	Use of 1 <sup>st</sup> generation Cephalosporins in the 30 days prior to index date
2 <sup>nd</sup> generation Cephalosporins	Use of 2 <sup>nd</sup> generation Cephalosporins in the 30 days prior to index date
3 <sup>rd</sup> generation Cephalosporins	Use of 3 <sup>rd</sup> generation Cephalosporins in the 30 days prior to index date
4 <sup>th</sup> generation Cephalosporins	Use of 4 <sup>th</sup> generation Cephalosporins in the 30 days prior to index date
Ceftazidime/Cefepime/Ceftolozane-Tazobactam (combined)	Use of Ceftazidime/Cefepime/Ceftolozane-Tazobactam (combined) in the 30 days prior to index date
Other Cephalosporins*	Use of Other Cephalosporins in the 30 days prior to index date. Other Cephalosporins include: Cefaclor Cefazolin, Cefixime, Cefotaxime, Cefotetan, Cefoxitin, Cefpodoxime, Ceftriaxone, Cefuroxime and Cephalexin and excludes Ceftazidime, Cefepime, Ceftolozane-Tazobactam
Monobactam	Use of Monobactam in the 30 days prior to index date

<b>Covariate</b>	<b>Definition</b>
Glycylcyclines + Tetracyclines	Use of Glycylcyclines + Tetracyclines in the 30 days prior to index date
Penicillin	Use of Penicillin in the 30 days prior to index date
Polymyxin + Derivatives	Use of Polymixin+Derivatives in the 30 days prior to index date
Quinolones	Use of Quinolones in the 30 days prior to index date
Piperacillin-tazobactam	Use of Piperacillin-tazobactam in the 30 days prior to index date

**eTable 2. Comparison of Training and Validation Data Sets for Patients with CR and Non-CR *Pseudomonas aeruginosa* Infections**

	Training			Validation		
	CR** (N=1185)	Non-CR (N=4649)	P Value*	CR** (N=1139)	Non-CR (N=4529)	P Value *
<b>Demographic</b>						
Male Sex	680 (57.4%)	2626 (56.5%)	.577	701 (61.6%)	2547 (56.2%)	.001
Age at index date in years			<.001			<.001
18-39	75 (6.3%)	231 (5.0%)		68 (6.0%)	293 (6.5%)	
40-64	333 (28.1%)	1165 (25.1%)		354 (31.1%)	1127 (24.9%)	
65-84	634 (53.5%)	2490 (53.6%)		602 (52.9%)	2411 (53.2%)	
85+	143 (12.1%)	763 (16.4%)		115 (10.1%)	698 (15.4%)	
Race/Ethnicity			<.001			.197
Non-Hispanic White	499 (42.11%)	2289 (49.24%)		544 (47.76%)	2211 (48.82%)	
Asian/Hawaiian/Pacific Islander	122 (10.3%)	370 (7.96%)		112 (9.83%)	365 (8.06%)	
Black non-Hispanic	258 (21.77%)	754 (16.22%)		211 (18.53%)	780 (17.22%)	
Hispanic	295 (24.89%)	1200 (25.81%)		262 (23%)	1134 (25.04%)	
American Indian/Alaska Native/Multiple/Other/Unknown	11 (0.93%)	36 (0.77%)		10 (0.88%)	39 (0.86%)	
<b>Characteristics of Index Admission</b>						
Specimen Site of Index Infection			<.001			<.001
Other	440 (37.1%)	2744 (59.0%)		457 (40.1%)	2665 (58.8%)	
Respiratory	745 (62.9%)	1905 (41.0%)		682 (59.9%)	1864 (41.2%)	
Source of Infection			<.001			<.001
Present at hospital admission	611 (51.6%)	3151 (67.8%)		663 (58.2%)	3095 (68.3%)	
Hospital-onset	574 (48.4%)	1498 (32.2%)		476 (41.8%)	1434 (31.7%)	
Co-Infecting Pathogen	353 (29.8%)	1367 (29.4%)	.795	352 (30.9%)	1273 (28.1%)	.062
ICU Prior to Index Culture	500 (42.2%)	1125 (24.2%)	<.001	424 (37.2%)	1115 (24.6%)	<.001
Skilled Nurse Facilities Transfer	229 (19.3%)	326 (7.0%)	<.001	206 (18.1%)	243 (5.4%)	<.001
<b>Invasive Devices and/or Procedures (between admission and prior to culture date)</b>						
Endotracheal tube	319 (26.9%)	756 (16.3%)	<.001	237 (20.8%)	773 (17.1%)	.003
Tracheostomy	573 (48.4%)	544 (11.7%)	<.001	495 (43.5%)	530 (11.7%)	<.001
HemoDialysis	155 (13.1%)	203 (4.4%)	<.001	131 (11.5%)	181 (4.0%)	<.001
Gastric or jejunal feeding tube	539 (45.5%)	875 (18.8%)	<.001	487 (42.8%)	791 (17.5%)	<.001
Indwelling urinary catheter	749 (63.2%)	1925 (41.4%)	<.001	661 (58.0%)	1830 (40.4%)	<.001
CVC/Port/PICC	453 (38.2%)	855 (18.4%)	<.001	363 (31.9%)	802 (17.7%)	<.001
<b>Surgery prior to Index Culture</b>	252 (21.3%)	609 (13.1%)	<.001	171 (15.0%)	583 (12.9%)	.057

	Training			Validation		
	CR** (N=1185)	Non-CR (N=4649)	P Value*	CR** (N=1139)	Non-CR (N=4529)	P Value *
<b>LOS from admission to index culture</b>			<.001			<.001
0-3	630 (53.2%)	3259 (70.1%)		686 (60.2%)	3197 (70.6%)	
4-10	172 (14.5%)	715 (15.4%)		164 (14.4%)	701 (15.5%)	
11+	383 (32.3%)	675 (14.5%)		289 (25.4%)	631 (13.9%)	
<b>Pseudomonas 30 days prior to index admission</b>			<.001			<.001
No Prior Pseudomonas Carbapenem-Susceptible	642 (54.2%)	3675 (79.1%)		652 (57.2%)	3653 (80.7%)	
Pseudomonas Carbapenem-Resistant	168 (14.2%)	882 (19.0%)		140 (12.3%)	811 (17.9%)	
Pseudomonas	375 (31.7%)	92 (2.0%)		347 (30.5%)	65 (1.4%)	
<b>Healthcare Exposure in 6 months Prior to Index Admission</b>						
Previous hospitalization	941 (79.4%)	2749 (59.1%)	<.001	942 (82.7%)	2661 (58.8%)	<.001
Previous ICU Admission	449 (37.9%)	824 (17.7%)	<.001	459 (40.3%)	776 (17.1%)	<.001
<b>Comorbidity</b>						
Myocardial infarction	258 (21.8%)	735 (15.8%)	<.001	197 (17.3%)	746 (16.5%)	.504
Congestive heart failure	404 (34.1%)	1266 (27.2%)	<.001	435 (38.2%)	1291 (28.5%)	<.001
Peripheral vascular disease	714 (60.3%)	2567 (55.2%)	.002	700 (61.5%)	2343 (51.7%)	<.001
Cerebrovascular disease	363 (30.6%)	826 (17.8%)	<.001	337 (29.6%)	868 (19.2%)	<.001
Dementia	128 (10.8%)	308 (6.6%)	<.001	83 (7.3%)	276 (6.1%)	.140
Chronic pulmonary disease	527 (44.5%)	1855 (39.9%)	.004	510 (44.8%)	1822 (40.2%)	.005
Peptic ulcer disease	50 (4.2%)	131 (2.8%)	.013	56 (4.9%)	99 (2.2%)	<.001
Mild liver disease	120 (10.1%)	366 (7.9%)	.012	139 (12.2%)	365 (8.1%)	<.001
Diabetes	546 (46.1%)	1883 (40.5%)	.001	568 (49.9%)	1885 (41.6%)	<.001
Hemiplegia or paraplegia	181 (15.3%)	393 (8.5%)	<.001	161 (14.1%)	371 (8.2%)	<.001
Malignancy, including leukemia and lymphoma (≠ malignant neoplasm of skin)	164 (13.8%)	834 (17.9%)	.001	231 (20.3%)	841 (18.6%)	.187
Moderate or severe liver disease	19 (1.6%)	57 (1.2%)	.307	36 (3.2%)	57 (1.3%)	<.001
Metastatic solid tumor	51 (4.3%)	257 (5.5%)	.093	58 (5.1%)	295 (6.5%)	.076
Organ Transplant	47 (4.0%)	119 (2.6%)	.009	31 (2.7%)	107 (2.4%)	.482
<b>Antibiotic use in 30 days prior to index date</b>						
Aminoglycosides	75 (6.3%)	126 (2.7%)	<.001	72 (6.3%)	119 (2.6%)	<.001
Carbapenems	291 (24.6%)	186 (4.0%)	<.001	251 (22.0%)	156 (3.4%)	<.001
Ceftazidime/Cefepime/Ceftolozane-Tazobactam (combined)	400 (33.8%)	867 (18.6%)	<.001	201 (36.9%)	1066 (20.2%)	<.001
Other Cephalosporins***	320 (27.0%)	2076 (44.7%)	<.001	129 (23.7%)	2267 (42.9%)	<.001
Monobactam	26 (2.2%)	44 (1.0%)	<.001	27 (2.4%)	41 (0.9%)	<.001
Glycylcyclines + Tetracyclines	55 (4.6%)	396 (8.5%)	<.001	52 (4.6%)	398 (8.8%)	<.001
Penicillin	428 (36.1%)	1505 (32.4%)	.015	436 (38.3%)	1330 (29.4%)	<.001
Quinolones	418 (35.3%)	926 (19.9%)	<.001	383 (33.6%)	881 (19.5%)	<.001
Piperacillin-tazobactam	367 (31.0%)	1181 (25.4%)	<.001	379 (33.3%)	1055 (23.3%)	<.001

	Training			Validation		P Value *
	CR** (N=1185)	Non-CR (N=4649)	P Value*	CR** (N=1139)	Non-CR (N=4529)	
<b>Medical Facility</b>			<.001			<.001
A	84 (7.09%)	311 (6.69%)		48 (4.21%)	286 (6.31%)	
B	85 (7.17%)	375 (8.07%)		86 (7.55%)	354 (7.82%)	
	119 (10.04%)	421 (9.06%)		96 (8.43%)	502 (11.08%)	
C	137 (11.56%)	600 (12.91%)		148 (12.99%)	539 (11.9%)	
D	63 (5.32%)	274 (5.89%)		64 (5.62%)	262 (5.78%)	
E	84 (7.09%)	302 (6.5%)		73 (6.41%)	221 (4.88%)	
F	66 (5.57%)	245 (5.27%)		101 (8.87%)	237 (5.23%)	
G	72 (6.08%)	197 (4.24%)		65 (5.71%)	208 (4.59%)	
H	67 (5.65%)	301 (6.47%)		73 (6.41%)	327 (7.22%)	
		573 (12.33%)		94 (8.25%)	566 (12.5%)	
I	100 (8.44%)	399 (8.58%)		68 (5.97%)	403 (8.9%)	
J	76 (6.41%)	136 (11.48%)		112 (9.83%)	306 (6.76%)	
K	96 (8.1%)	302 (6.5%)		111 (9.75%)	318 (7.02%)	
L						
M						

\*Chi-square test and t test used to calculate P-values for categorical and continuous variables, respectively.

\*\*SD = Standard Deviation; CR = Carbapenem non-Susceptible; EBR = Carbapenem&Ceftazidime&Piperacillin-Tazobactam non-susceptible.

\*\*\*Other Cephalosporins include: Cefaclor Cefazolin, Cefixime, Cefotaxime, Cefotetan, Cefoxitin, Cefpodoxime, Ceftriaxone, Cefuroxime and Cephalexin and excludes Ceftazidime, Cefepime, Ceftolozane-Tazobactam



**eTable 3. Comparison of Training and Validation Data Sets for Patients With EBR and Non-EBR *Pseudomonas aeruginosa* Infections**

	Training			Validation		P Value*
	EBR** (N=545)	Non-EBR (N=5289)	P Value*	EBR** (N=488)	Non-EBR (N=5180)	
<b>Demographic</b>						
Male Sex	315 (57.8%)	2991 (56.6%)	.576	322 (66.0%)	2926 (56.5%)	<.001
Age at index date in years			.010			.024
<65	195 (35.8%)	1609 (30.4%)		181 (37.1%)	1661 (32.1%)	
>=65	350 (64.2%)	3680 (69.6%)		307 (62.9%)	3519 (67.9%)	
Race/Ethnicity			<.001			.061
Non-Hispanic White	209 (38.4%)	2579 (48.8%)		220 (45.1%)	2535 (48.9%)	
Asian/Hawaiian/Pacific Islander	54 (9.9%)	438 (8.3%)		54 (11.1%)	423 (8.2%)	
Black non-Hispanic	120 (22.0%)	892 (16.9%)		99 (20.3%)	892 (17.2%)	
Hispanic	157 (28.8%)	1338 (25.3%)		111 (22.8%)	1285 (24.8%)	
American Indian/Alaska Native/Multiple/Other/Unknown	5 (0.9%)	42 (0.8%)		4 (0.8%)	45 (0.9%)	
<b>Characteristics of Index Admission</b>						
Specimen Site of Index Infection			<.001			<.001
Other	171 (31.4%)	3013 (57.0%)		169 (34.6%)	2953 (57.0%)	
Respiratory	374 (68.6%)	2276 (43.0%)		319 (65.4%)	2227 (43.0%)	
Source of Infection			<.001			<.001
Present at hospital admission	257 (47.2%)	3505 (66.3%)		245 (50.2%)	3513 (67.8%)	
Hospital-onset	288 (52.8%)	1784 (33.7%)		243 (49.8%)	1667 (32.2%)	
Co-infecting Pathogen	166 (30.5%)	1554 (29.4%)	.600	155 (31.8%)	1470 (28.4%)	.114
ICU Prior to Index Culture	261 (47.9%)	1364 (25.8%)	<.001	200 (41.0%)	1339 (25.9%)	<.001
Skilled Nurse Facilities Transfer	134 (24.6%)	421 (8.0%)	<.001	97 (19.9%)	352 (6.8%)	<.001
<b>Invasive Devices and/or Procedures (between admission and prior to culture date)</b>						
Endotracheal tube	151 (27.7%)	924 (17.5%)	<.001	105 (21.5%)	905 (17.5%)	.026
Tracheostomy	320 (58.7%)	797 (15.1%)	<.001	262 (53.7%)	763 (14.7%)	<.001
HemoDialysis	93 (17.1%)	265 (5.0%)	<.001	67 (13.7%)	245 (4.7%)	<.001
Gastric or jejunal feeding tube	272 (49.9%)	1142 (21.6%)	<.001	257 (52.7%)	1021 (19.7%)	<.001
Indwelling urinary catheter	371 (68.1%)	2303 (43.5%)	<.001	317 (65.0%)	2174 (42.0%)	<.001
CVC/Port/PICC	253 (46.4%)	1055 (20.0%)	<.001	178 (36.5%)	987 (19.1%)	<.001
<b>Surgery prior to Index Culture</b>	129 (23.7%)	732 (13.8%)	<.001	80 (16.4%)	674 (13.0%)	.036
<b>LOS from admission to index culture</b>			<.001			<.001
0-3	263 (48.3%)	3626 (68.6%)		256 (52.5%)	3627 (70.0%)	
4-10	73 (13.4%)	814 (15.4%)		81 (16.6%)	784 (15.1%)	
11+	209 (38.4%)	849 (16.1%)		151 (30.9%)	769 (14.9%)	
<b><i>Pseudomonas</i> 30 days prior to index admission</b>						
No Prior <i>Pseudomonas</i>	236 (43.3%)	4081 (77.2%)	<.001	228 (46.7%)	4077 (78.7%)	<.001
Carbapenem-Susceptible <i>Pseudomonas</i>	90 (16.5%)	960 (18.2%)		65 (13.3%)	886 (17.1%)	
Carbapenem-Resistant <i>Pseudomonas</i>	219 (40.2%)	248 (4.7%)		195 (40.0%)	217 (4.2%)	
<b>Healthcare Exposure in 6 months Prior to Index Admission</b>						
Previous hospitalization	459 (84.2%)	3231 (61.1%)	<.001	410 (84.0%)	3193 (61.6%)	<.001
Previous ICU Admission	235 (43.1%)	1038 (19.6%)	<.001	226 (46.3%)	1009 (19.5%)	<.001
<b>Comorbidity</b>						
Myocardial infarction	136 (25.0%)	857 (16.2%)	<.001	88 (18.0%)	855 (16.5%)	.387
Congestive heart failure	210 (38.5%)	1460 (27.6%)	<.001	203 (41.6%)	1523 (29.4%)	<.001
Peripheral vascular disease	329 (60.4%)	2952 (55.8%)	.041	297 (60.9%)	2746 (53.0%)	.001
Cerebrovascular disease	179 (32.8%)	1010 (19.1%)	<.001	148 (30.3%)	1057 (20.4%)	<.001
Dementia	63 (11.6%)	373 (7.1%)	.000	35 (7.2%)	324 (6.3%)	.426
Chronic pulmonary disease	235 (43.1%)	2147 (40.6%)	.253	239 (49.0%)	2093 (40.4%)	<.001

	Training			Validation		P Value*
	EBR** (N=545)	Non-EBR (N=5289)		EBR** (N=488)	Non-EBR (N=5180)	
Peptic ulcer disease	27 (5.0%)	154 (2.9%)	.009	28 (5.7%)	127 (2.5%)	<.001
Mild liver disease	63 (11.6%)	423 (8.0%)	.004	64 (13.1%)	440 (8.5%)	.001
Diabetes	260 (47.7%)	2169 (41.0%)	.003	256 (52.5%)	2197 (42.4%)	<.001
Hemiplegia or paraplegia	83 (15.2%)	491 (9.3%)	<.001	83 (17.0%)	449 (8.7%)	<.001
Malignancy, including leukemia and lymphoma (≠ malignant neoplasm of skin)	71 (13.0%)	927 (17.5%)	.008	98 (20.1%)	974 (18.8%)	.490
AIDS/HIV	2 (0.4%)	25 (0.5%)	.729	0 (0.0%)	39 (0.8%)	.054
<b>Antibiotic use in 30 days prior to index date</b>						
Aminoglycosides	43 (7.9%)	158 (3.0%)	<.001	36 (7.4%)	155 (3.0%)	<.001
Carbapenems	156 (28.6%)	321 (6.1%)	<.001	121 (24.8%)	286 (5.5%)	<.001
Ceftazidime/Cefepime/Ceftolozane-Tazobactam (combined)	201 (36.9%)	1066 (20.2%)	<.001	201 (36.9%)	1066 (20.2%)	<.001
Other Cephalosporins***	129 (23.7%)	2267 (42.9%)	<.001	129 (23.7%)	2267 (42.9%)	<.001
Monobactam	13 (2.4%)	57 (1.1%)	.008	18 (3.7%)	50 (1.0%)	<.001
Glycylcyclines + Tetracyclines	18 (3.3%)	433 (8.2%)	<.001	23 (4.7%)	427 (8.2%)	.006
Penicillin	206 (37.8%)	1727 (32.7%)	.015	212 (43.4%)	1554 (30.0%)	<.001
Quinolones	196 (36.0%)	1148 (21.7%)	<.001	157 (32.2%)	1107 (21.4%)	<.001
Piperacillin-tazobactam	180 (33.0%)	1368 (25.9%)	<.001	194 (39.8%)	1240 (23.9%)	<.001
<b>Medical Facility</b>			<.001			<.001
A	41 (7.52%)	354 (6.69%)		16 (3.28%)	318 (6.14%)	
B	39 (7.16%)	421 (7.96%)		30 (6.15%)	410 (7.92%)	
C	44 (8.07%)	496 (9.38%)		32 (6.56%)	566 (10.93%)	
D	59 (10.83%)	678 (12.82%)		62 (12.7%)	625 (12.07%)	
E	26 (4.77%)	311 (5.88%)		29 (5.94%)	297 (5.73%)	
F	33 (6.06%)	353 (6.67%)		30 (6.15%)	264 (5.1%)	
G	37 (6.79%)	274 (5.18%)		49 (10.04%)	289 (5.58%)	
H	39 (7.16%)	230 (4.35%)		29 (5.94%)	244 (4.71%)	
I	36 (6.61%)	332 (6.28%)		28 (5.74%)	372 (7.18%)	
J	48 (8.81%)	625 (11.82%)		37 (7.58%)	623 (12.03%)	
K	29 (5.32%)	446 (8.43%)		27 (5.53%)	444 (8.57%)	
L	75 (13.76%)	410 (7.75%)		68 (13.93%)	350 (6.76%)	
M	39 (7.16%)	359 (6.79%)		51 (10.45%)	378 (7.3%)	

\*Chi-square test and t test used to calculate P-values for categorical and continuous variables, respectively.

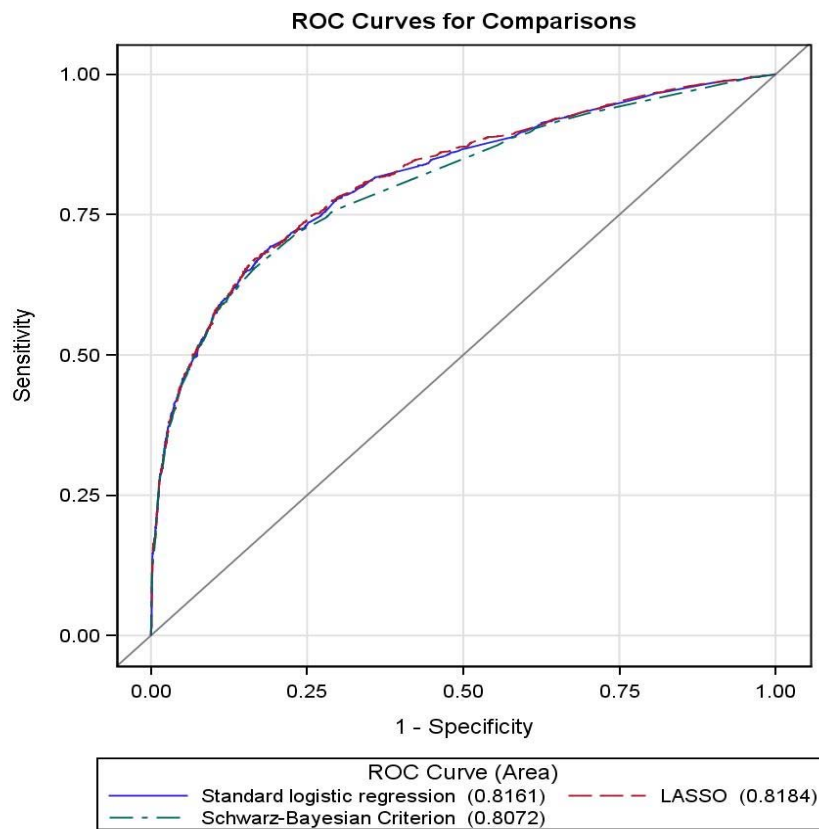
\*\*SD = Standard Deviation; CR = Carbapenem non-Susceptible; EBR = Carbapenem&Ceftazidime&Piperacillin-Tazobactam non-susceptible.

\*\*\*Other Cephalosporins include: Cefaclor Cefazolin, Cefixime, Cefotaxime, Cefotetan, Cefoxitin, Cefpodoxime, Ceftriaxone, Cefuroxime and Cephalexin and excludes Ceftazidime, Cefepime, Ceftolozane-Tazobactam

**eFigure 1. Comparison of Model Performance by Variable Selection Approach: Traditional Logistic Regression, LASSO, and Schwarz-Bayesian Criterion (SBC)**

**a.) Carbapenem non-susceptible Pseudomonas (training dataset, n=5834)**

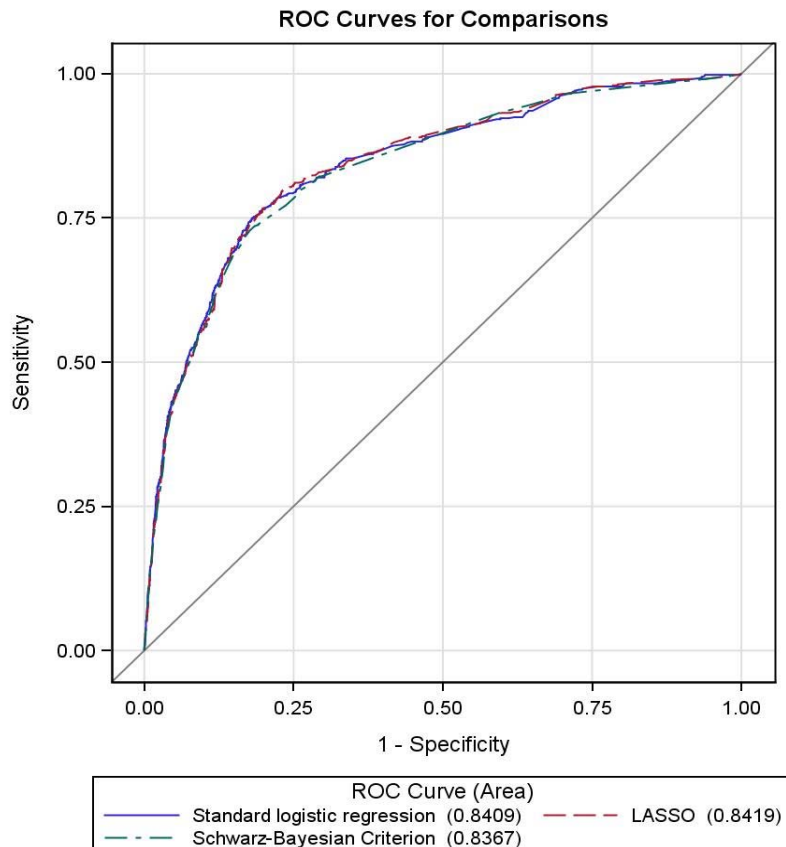
ROC Model	ROC Association Statistics					
	Mann-Whitney			Somers' D	Gamma	Tau-a
	C-statistic	Standard Error	95% Wald Confidence Limits			
Standard logistic regression	0.8161	0.0075	0.8014 0.8308	0.6322	0.638	0.2047
LASSO	0.8132	0.00757	0.7983 0.828	0.6263	0.6289	0.2028
Schwarz-Bayesian Criterion	0.8072	0.00771	0.7921 0.8223	0.6143	0.6484	0.1989



Model Covariates
<b>Standard logistic regression:</b> Skilled nurse facility transfer, invasive device (tracheostomy, CVC/Port/PICC), previous Pseudomonas, previous hospitalization, comorbidities (cerebrovascular disease, dementia, hemiplegia or paraplegia, malignancy), carbapenems, other cephalosporins, quinolones.
<b>LASSO:</b> specimen, skilled nurse facility transfer, invasive device (tracheostomy, tube, UA, CVC/Port/PICC), previous Pseudomonas, previous hospitalization, previous ICU Admission, comorbidities (cerebrovascular disease, dementia, hemiplegia or paraplegia, malignancy), carbapenems, other cephalosporins, quinolones.
<b>SBC High performance logistic regression:</b> Invasive device (tracheostomy, CVC/Port/PICC), previous Pseudomonas, previous hospitalization, comorbidities (cerebrovascular disease, or malignancy), carbapenems, quinolones.

a.) Carbapenem & ceftazidime & piperacillin-tazobactam non-susceptible *Pseudomonas* (training dataset, n=5834)

ROC Model	ROC Association Statistics					
	Mann-Whitney			Somers' D	Gamma	Tau-a
	C-statistic	Standard Error	95% Wald Confidence Limits			
Standard logistic regression	0.8409	0.00945	0.8224 0.8595	0.6819	0.6842	0.1155
LASSO	0.8419	0.00928	0.8237 0.8601	0.6839	0.687	0.1159
Schwarz-Bayesian Criterion	0.8367	0.00941	0.8183 0.8552	0.6734	0.708	0.1141



**Model Covariates**

**Standard logistic regression:** Age 65+ at index date in years, specimen, skilled nurse facility transfer, invasive device (tracheostomy, hemodialysis, tube, CVC/Port/PICC), previous *Pseudomonas*, previous hospitalization, MI, dementia, carbapenems, other cephalosporins,

**LASSO:** specimen, skilled nurse facility transfer, invasive device (tracheostomy, CVC/Port/PICC), previous *Pseudomonas*, previous hospitalization, comorbidities (myocardial infarction, cerebrovascular disease), carbapenems, other cephalosporins, quinolones.

**SBC High performance logistic regression:** Skilled nurse facility transfer, invasive device (tracheostomy, CVC/Port/PICC), previous *Pseudomonas*, previous hospitalization, carbapenems

**eTable 4. Selected Characteristics of Patients With CR, Non-CR, EBR, and Non-EBR *Pseudomonas aeruginosa* Infections**

	Total Patients (n=7775)	CR** (n=963)	Non-CR** (n=6812)	P Value*	EBR (n=325)	Non-EBR (n=7450)	P Value*
<b>Sex</b>				.977			.8128
Female	3467 (44.59%)	429 (44.55%)	3038 (44.6%)		147 (45.23%)	3320 (44.56%)	
Male	4308 (55.41%)	534 (55.45%)	3774 (55.4%)		178 (54.77%)	4130 (55.44%)	
<b>Age at index date in years</b>				.001			.2288
Mean (SD)	70.3 (15.49)	68.9 (15.37)	70.5 (15.50)		69.4 (15.13)	70.3 (15.51)	
Median	73	71	73		72	73	
Q1, Q3	62.0, 81.0	61.0, 80.0	62.0, 82.0		62.0, 80.0	62.0, 81.0	
Range	(18.0-107.0)	(18.0-97.0)	(18.0-107.0)		(18.0-96.0)	(18.0-107.0)	
<b>Age at index date in years</b>				.018			.5742
18-39	383 (4.93%)	48 (4.98%)	335 (4.92%)		14 (4.31%)	369 (4.95%)	
40-64	1936 (24.9%)	268 (27.83%)	1668 (24.49%)		84 (25.85%)	1852 (24.86%)	
65-84	4159 (53.49%)	516 (53.58%)	3643 (53.48%)		181 (55.69%)	3978 (53.4%)	
85+	1297 (16.68%)	131 (13.6%)	1166 (17.12%)		46 (14.15%)	1251 (16.79%)	
<b>Race/Ethnicity</b>				.001			.0001
Non-Hispanic White	3927 (50.51%)	441 (45.79%)	3486 (51.17%)		132 (40.62%)	3795 (50.94%)	
Asian/Hawaiian/Pacific Islander	577 (7.42%)	81 (8.41%)	496 (7.28%)		29 (8.92%)	548 (7.36%)	
Black non-Hispanic	1246 (16.03%)	197 (20.46%)	1049 (15.4%)		81 (24.92%)	1165 (15.64%)	
Hispanic	1968 (25.31%)	237 (24.61%)	1731 (25.41%)		80 (24.62%)	1888 (25.34%)	
American Indian/Alaska Native/Multiple/Other <sup>‡</sup> /Unknown	57 (0.73%)	7 (0.73%)	50 (0.73%)		3 (0.92%)	54 (0.72%)	
<b>Charlson Comorbidity Score</b>				<.001			<.0001
0	879 (11.31%)	67 (6.96%)	812 (11.92%)		19 (5.85%)	860 (11.54%)	
1	1004 (12.91%)	101 (10.49%)	903 (13.26%)		24 (7.38%)	980 (13.15%)	
2	1316 (16.93%)	152 (15.78%)	1164 (17.09%)		51 (15.69%)	1265 (16.98%)	
≥3	4576 (58.86%)	643 (66.77%)	3933 (57.74%)		231 (71.08%)	4345 (58.32%)	

\*Chi-square test and t test used to calculate P-values for categorical and continuous variables, respectively.

\*\*SD = Standard Deviation; CR = Carbapenem non-Susceptible; EBR = Carbapenem&Ceftazidime&Piperacillin-Tazobactam non-susceptible.

<sup>‡</sup>'Other' race was defined by self-report of 'other', or Bahamian, Guatemalan, Honduran, Mestizo, Nicaraguan, or Panamanian; Mild liver disease includes ICD-9/10 codes for alcoholic cirrhosis, cirrhosis without mention of alcohol, biliary cirrhosis, chronic hepatitis; moderate or severe liver disease includes ICD-9/10 codes for hepatic coma, portal hypertension, other sequelae of chronic liver disease, and esophageal varices

**eTable 5. Antibiotic Susceptibility Results, Stratified by CR and EBR Status**

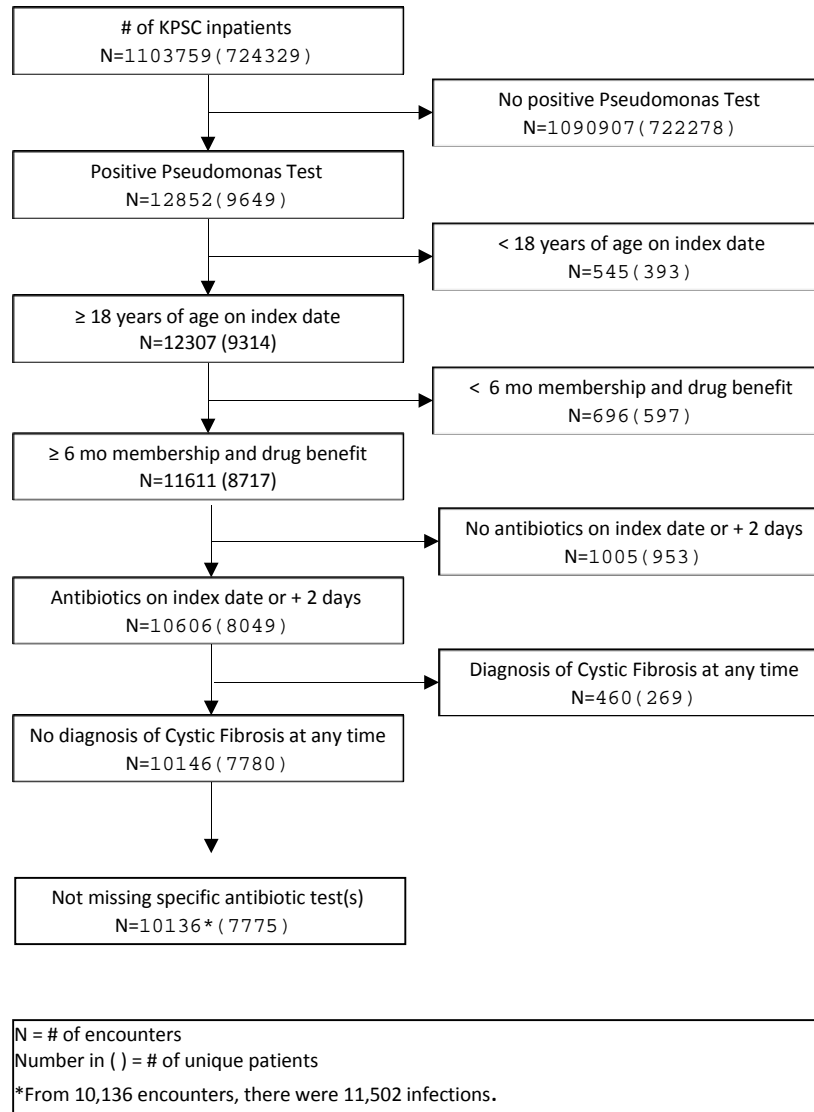
Antibiotic	Overall Tested (N=11502)	Overall Non-Susceptible	NON-CR (N=9178)	CR (N=2324)	NON-EBR (N=10469)	EBR (N=1033)
			Non-susceptible	Non-susceptible	Non-susceptible	Non-susceptible
Amikacin <sup>†</sup>	1963	572 (29.1)	296 (3.2)	276 (11.9)	395 (3.8)	177 (17.1)
Aztreonam	11492	3497 (30.4)	1987 (21.6)	1510 (65.0)	2568 (24.5)	929 (89.9)
Ceftazidime	11500	2191 (19.1)	1076 (11.7)	1115 (48.0)	1158 (11.1)	1033 (100.0)
Ciprofloxacin	11495	2910 (25.3)	1396 (15.2)	1514 (65.1)	2117 (20.2)	793 (76.8)
Gentamicin	11502	2009 (17.5)	1050 (11.4)	959 (41.3)	1460 (13.9)	549 (53.1)
Imipenem	11491	2185 (19.0)	0 (0.0)	2185 (94.0)	1185 (11.3)	1000 (96.8)
Meropenem	11498	1790 (15.6)	0 (0.0)	1790 (77.0)	855 (8.2)	935 (90.5)
Piperacillin+Tazobactam	11500	2230 (19.4)	1000 (10.9)	1230 (52.9)	1197 (11.4)	1033 (100.0)
Tobramycin <sup>†</sup>	1961	681 (34.7)	244 (2.7)	437 (18.8)	418 (4.0)	263 (25.5)

All data are presented as number (percent) unless otherwise indicated

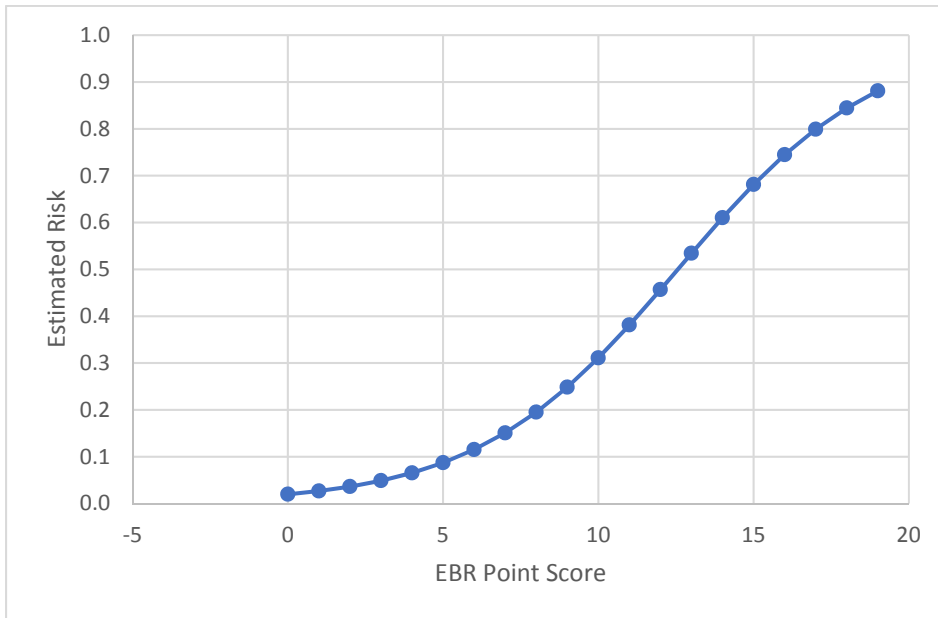
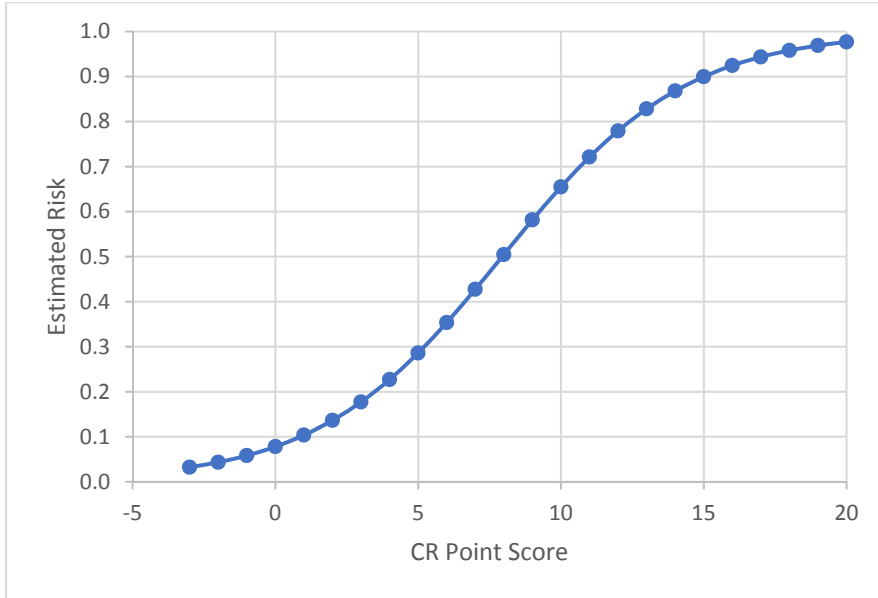
\* CR = Carbapenem non-Susceptible; EBR = Carbapenem&Ceftazidime&Piperacillin-Tazobactam non-susceptible.

<sup>†</sup> Amikacin and tobramycin only reported if gentamicin is intermediate or resistant

**eFigure 2. Flowchart of Study Population Selection**



**eFigure 3. Estimated Risk of Carbapenem-Resistant (CR) and Carbapenem, Ceftazidime, and Piperacillin-Tazobactam-Resistant (EBR) *Pseudomonas aeruginosa* Infection by Point Total**





**eTable 6. Comparison of Observed and Point-Based Predicted Risk by Quintile for CR and EBR *Pseudomonas aeruginosa* (n = 5668)**

**a.) Carbapenem Non-Susceptible (CR) *Pseudomonas aeruginosa***

Estimated Risk Quintile	N	CR Cases	Observed Risk	Mean Point-Based Estimated Risk	Lower Confidence Interval	Upper Confidence Interval
1	1127	57	0.051	0.054	0.054	0.055
2	870	65	0.075	0.074	0.074	0.075
3	1794	203	0.113	0.092	0.091	0.093
4	747	153	0.205	0.143	0.140	0.145
5	1130	661	0.585	0.491	0.477	0.505

**b.) Carbapenem & Ceftazidime & Piperacillin-Tazobactam Non-Susceptible (EBR)**

***Pseudomonas aeruginosa***

Estimated Risk Quintiles	N	EBR Cases	Observed Risk	Mean Point-Based Estimated Risk	Lower Confidence Interval	Upper Confidence Interval
1	1635	22	0.014	0.020	0.020	0.020
2	640	34	0.053	0.055	0.054	0.057
3	1671	62	0.037	0.049	0.049	0.049
4	595	53	0.089	0.112	0.108	0.117
5	1127	317	0.281	0.316	0.305	0.328

**eTable 7. Sensitivity Analyses Including only the First Infection per Patient**

**Multivariable final model for carbapenem non-susceptible (CR) *P. aeruginosa* infection derived from training dataset, restricted to first infection (n=3,888)**

	OR (95% CI)*	P Value
<b>Skilled Nurse Facilities Transfer</b>	2.20 (1.44- 3.37)	.021
<b>Tracheostomy (from admission to culture date)</b>	3.33 (2.65- 4.19)	.002
<b>Pseudomonas 30 days prior to index admission</b>		<.0001
No Prior Pseudomonas (ref)		
Carbapenem-Susceptible Pseudomonas	0.38 (0.24- 0.60)	
Carbapenem-Resistant Pseudomonas	11.87 (7.99- 17.61)	
<b>Previous Hospitalization in 6 months Prior to Index Admission</b>	1.80 (1.51- 2.15)	<.0001
<b>Carbapenems 30 days prior to index date</b>	4.18 (3.29- 5.31)	<.0001
<b>Other Cephalosporins 30 days prior to index date</b>	0.77 (0.66- 0.91)	.002
<b>Quinolones</b>	1.53 (1.29- 1.81)	<.0001

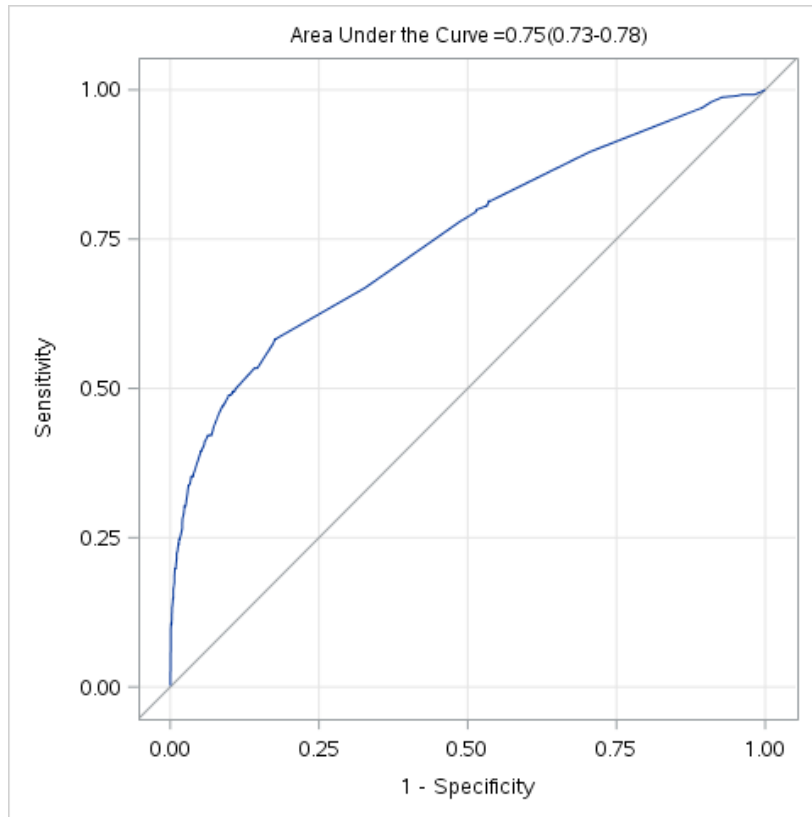
\* Generalized estimating equation methods were applied to account for within-medical facility correlation.

**Multivariable final model for carbapenem & ceftazidime & piperacillin-tazobactam non-susceptible (EBR) *P. aeruginosa* infection derived from training dataset, restricted to first infection (n=3,888)**

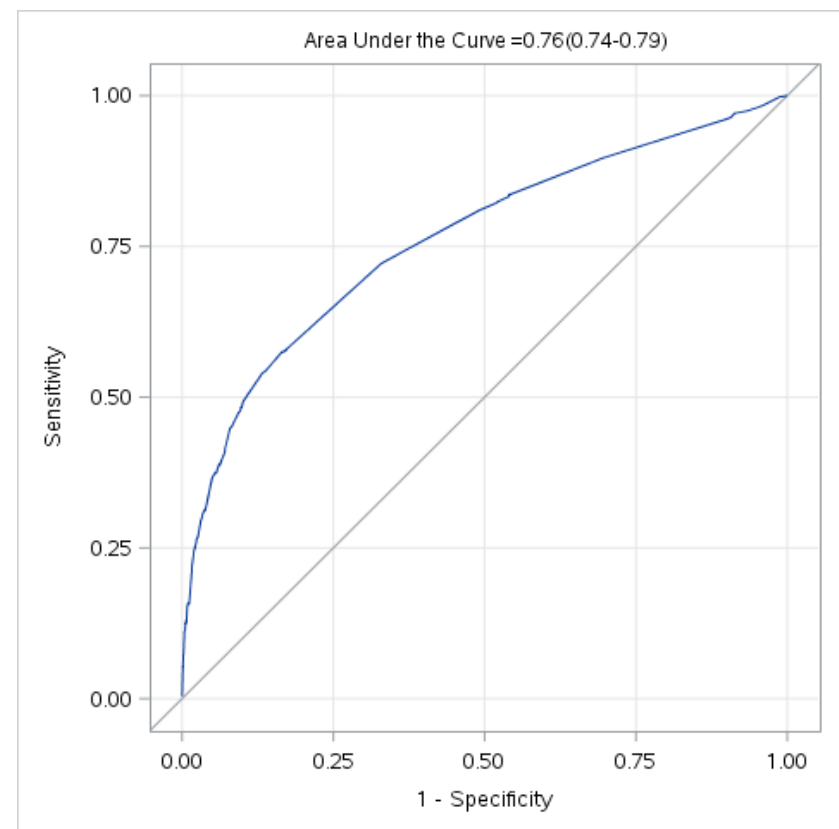
	OR (95% CI)*	P Value
<b>Skilled Nurse Facilities Transfer</b>	2.30 (1.33- 3.97)	.0359
<b>Tracheostomy (from admission to culture date)</b>	3.25 (2.27- 4.65)	.0034
<b>CVC/Port/PICC (from admission to culture date)</b>	1.69 (1.19- 2.40)	.0215
<b>Pseudomonas 30 days prior to index admission</b>		.0559
No Prior Pseudomonas (ref)		
Carbapenem-Susceptible Pseudomonas	0.76 (0.51- 1.13)	
Carbapenem-Resistant Pseudomonas	7.06 (3.91- 12.77)	
<b>Previous Hospitalization in 6 months Prior to Index Admission</b>	1.69 (1.25- 2.29)	.0082
<b>Carbapenems 30 days prior to index date</b>	1.87 (1.17- 2.97)	.0504

#### eFigure 4. Models in Training and Validation Data Sets

Carbapenem non-susceptible model in training dataset (1st infection per patient n=3888)

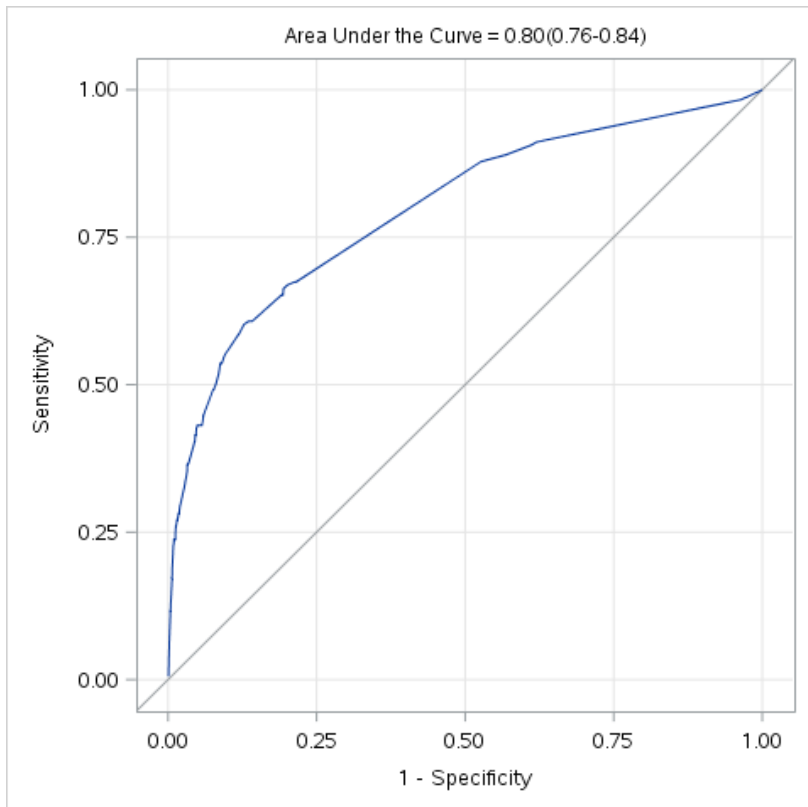


Carbapenem non-susceptible model in validation dataset (1st infection per patient n=3887)



**Extensively beta-lactam non-susceptible model in training dataset (1st infection per patient n=3888)**

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**Extensively beta-lactam non-susceptible model in validation dataset (1st infection per patient n=3887)**

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