

Predicting Hospitalizations and Returns to the Emergency Department 30-Days
Post Emergency Department Discharge Among Patients with Acute Bacterial Skin
and Skin Structure Infections

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Abstract

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BACKGROUND: Despite Acute Bacterial Skin and Skin Structure Infections (ABSSSI) being among the most common infections, and the requirement to track hospital quality measures associated with readmissions, there is no risk stratification tool to guide clinical decision-making processes in the Emergency Department (ED) for deciding when to hospitalize a patient with ABSSSI. The primary objective of this study was to develop a regression model to identify patient, treatment, and facility-level factors that would predict a composite outcome of either hospitalization or return to the ED for any reason within 30-days post initial ED visit discharge for a patient with ABSSSI. The secondary objective was to evaluate the role of an admission at the initial ED visit (Initial Episode of Care, IEC) discharge on the probability of experiencing the composite outcome.

METHODS: A retrospective cohort database analysis was conducted using data collected from a retrospective manual medical chart review across 41 ED sites in the United States. The outcome

of interest was a composite outcome of the occurrence of an unscheduled all-cause hospitalization or return to the ED within 30-days post IEC discharge for patients with ABSSSI. Predictors of interest included patient, treatment, and facility-level factors collected in the ED for patients with ABSSSI. Backward stepwise regression was used to select variables for inclusion in the multivariable prediction model and model discrimination and calibration were assessed. As a secondary aim, the role of the admission at IEC on the composite outcome was evaluated using recycled predictions.

RESULTS: Of a total of 937 patients with ABSSSI included in the model, 205 (21.9%) experienced an unscheduled all-cause hospitalization or return to the ED 30-days post IEC discharge. The stepwise multivariable generalized linear model identified admission decision at IEC, Charlson Comorbidity Index (CCI) score, being immunocompromised, having a hospitalization within 90 days prior to IEC visit, and facility bed capacity as being best predictive of the composite outcome (Akaike Information Criteria [AIC] score = 973.39). Model discrimination was poor (AUC = 0.61) and calibration was good (χ^2 Hosmer-Lemeshow = 12.26 [p=0.14]). There was no significant difference in the composite outcome between those that were admitted versus not at IEC, with those admitted experiencing a 7% lower predicted risk of experiencing the composite outcome, when compared to those not admitted at IEC (95% confidence interval [CI]: 0.68 to 1.29) in the study population. Using the method of recycled predictions, the difference in predictive probability of a hospitalization or ED return 30-days post IEC discharge for those not admitted at IEC vs those admitted at IEC was 5.6%.

CONCLUSION: Our findings provide an estimate of the probability of admission or ED revisit within 30 days of IEC among patients with ABSSSI; and a preliminary prediction model for the

same. Future work will include identification of a model with improved model discrimination and conducting a model validation exercise. Our work is a first step in the development of a risk stratification tools to ensure clinician efforts target ABSSSI patients with a need for admission at IEC, and one that identifies characteristics that predict hospitalizations or ED revisits within 30 days of IEC.

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DEDICATION

For my Mom and Dad.

This work is the result of you making me think I can do anything.

BACKGROUND

Hospital readmissions or returns to the emergency department (ED) are common and costly. All-cause hospital readmissions within 30 days are used to capture shortfalls in transitions of care from the hospital setting and are a measure of hospital quality tied to financial penalties for poorly performing hospitals.¹ Similarly, unplanned return ED visits after ED discharge may also reflect inadequate ED discharge practices or follow-up procedures.

Acute bacterial skin and skin structure infections (ABSSSI) include cellulitis/erysipelas, wound infections, and major cutaneous abscesses and are often caused by gram-positive pathogens, including but not limited to *Staphylococcus aureus* (both methicillin-resistant [MRSA] and methicillin-susceptible strains) and *Streptococcus pyogenes*.² ABSSSIs, also known as complicated skin and soft tissue infections (cSSTI), are among the most common clinically encountered infections³ and are a common reason for ED visits.^{4,5} Most patients with ABSSSIs present to the ED, and clinicians in the ED serve as “gatekeepers” to hospital admission.⁶ ED clinicians weigh anticipated benefit, clinical uncertainty, risk within the inpatient environment^{7,8}, and the associated cost of a hospital stay when deciding if hospitalization is appropriate for a patient. Although these factors are understood, there is no standardized decision pathway for patients presenting with ABSSSI to the ED.^{9,10}

Despite ABSSSI being among the most common infections, and the requirement to track hospital quality measures associated with readmissions, there is no risk stratification tool to guide clinical decision-making processes in the ED.^{11,12} Developing a predictive model for unplanned hospitalizations or return to the ED would allow ED clinicians to prospectively assess and

potentially reduce rates of hospitalizations or returns to the ED 30-days post discharge for patients with ABSSSI.

OBJECTIVE

The primary objective of this study was to develop a regression model to identify patient, treatment, and facility-level factors that would predict a composite outcome of either hospitalization or return to the ED for any reason within 30-days post initial ED visit discharge for a patient with ABSSSI. The secondary objective was to evaluate the role of one specific predictor of interest – whether a patient was admitted at the initial ED visit discharge – on the probability of experiencing the composite outcome.

METHODS

Study Design and Study Population

We used data collected from a retrospective manual medical chart review across 41 ED sites in the United States, and conducted a retrospective cohort database analysis. The medical chart abstraction contained information on patient, treatment, and facility-level factors for patients with ABSSSI presenting to an ED from July 1, 2012 through June 30, 2013.

Male or female subjects aged 18 or older who presented with an ABSSSI at the ED with a documented ED disposition, and met all the inclusion and none of the exclusion criteria were eligible for inclusion in this analysis. The following ICD-9 Codes defined ABSSSI: 681.XX (cellulitis and abscess of finger and toe), 682.XX (other cellulitis and abscess), 686.XX (other local infections of skin and subcutaneous tissue), 958.3 (posttraumatic wound infection, not

elsewhere classified), and 998.5X (postoperative wound infection) (**Appendix 1**). Patients with any of the following diagnoses identified during the ED visit were excluded: necrotizing fasciitis (728.86), gas gangrene (040.0), gangrene (785.4), osteomyelitis, infections involving a diabetic foot ulceration, perirectal abscess or a decubitus ulcer, septic arthritis, subjects with an infected device, infections caused by fungi, known or suspected human immunodeficiency virus (HIV) infected patients with a CD4 cell count < 200 cells/mm³ or with a past or current acquired immunodeficiency syndrome (AIDS)-defining condition and unknown CD4 count (**Appendix 2**). These patients were excluded because these diagnoses require more complex treatment regimens than typical patients with ABSSSI.^{2,13}

The initial episode of care (IEC) was defined as the initial ED visit up to the point of ED discharge. Patients who were transferred to another hospital or expired at ED disposition were excluded from the analysis since their ultimate admission status was unknown or they were unable to have a return visit (**Appendix 3**). As the data were de-identified, the University of Washington Human Subjects Division determined that the study did not constitute human subjects research.

Outcome of Interest

The outcome of interest was a composite outcome of the occurrence of an unscheduled all-cause hospitalization or return to the ED within 30-days post IEC discharge for patients with ABSSSI.

Predictors of Interest

Data collected during IEC were assessed as possible predictors of interest. Each variable was evaluated to characterize the amount of data not available or missing. The variables used in the model included patient demographic and clinical characteristics (age, gender, Charlson Comorbidity Index [CCI]¹⁴, comorbidities, and social history), patient-specific infection episode data (lesion description, culture taken, antimicrobial treatment, significant surgical interventions), patient disposition at end of IEC (admit, not admit) and facility characteristics (location, bed capacity, facility descriptors, hospital/organization type).

One predictor of interest, whether each patient was admitted or not at the end of the initial ED visit, was thought to be important *a priori* and was evaluated specifically as an indicator of selection bias. Patients were defined as admitted at IEC if they were admitted to an ICU service, a non-ICU service, or transferred to an observational bed/service. Patients were defined as not admitted at IEC if they were discharged home, left against medical advice, or transferred to a skilled nursing facility or long term care from the initial ED visit. We labeled this as the ‘admitted at IEC’ variable.

Statistical Analysis

To characterize predictors of interest means and standard deviations were used for continuous variables, chi-2 tests for binary and categorical variables. Univariable generalized linear models specifying a binomial family and a logit link were used to explore the association between each predictor of interest and the composite outcome. Backward stepwise regression was used to select variables for inclusion in the multivariable prediction model by optimizing the Akaike

Information Criteria (AIC), a widely used statistical metric used to select the most parsimonious model that minimizes information loss.¹⁵ Using these selected variables, the multivariable prediction model was then estimated using a generalized linear model, again specifying a binomial family and a logit link. We evaluated model discrimination using a receiver operating characteristic (ROC) curve; the area under the curve (AUC) was calculated. We assessed model calibration by comparing the observed and predicted risks across deciles of predicted risk in a calibration curve plot.

As a secondary aim, we evaluated the role of the ‘admitted at IEC’ variable on the composite outcome. We first estimated whether all patient and facility characteristics differed between those who were and were not admitted at the end of the IEC. Next, after identifying the multivariable prediction model having the lowest AIC, we used the method of recycled predictions to predict the probability of the composite outcome when setting all patients to be admitted, and subsequently when setting all patients to be not admitted, and calculating the difference in that predictive probability. Using recycled predictions provided us with adjusted means, and enabled us to understand the marginal effect of admission at IEC on our composite outcome while holding all other predictors constant.¹⁶ Finally, we use a box plot to illustrate the effect of the difference in predictive probability of experiencing the composite outcome by subgrouping patients who were observed to have been admitted at IEC and those who were not, and within each subgroup, comparing the median probability of the observed value for admitted at IEC versus the counterfactual.

Missing data were not imputed; thus, analyses were undertaken using patients with available data only. Patients with no missing data across all covariates in the model were included in the stepwise multivariable generalized linear model (**Appendix 4**). All statistical tests were two-sided; statistical significance was defined as $p < 0.05$. All statistical analyses were conducted using RStudio 1.0.143 (RStudio, Inc., Boston, MA) and STATA 14.2 (StataCorp, LP, College Station, TX).

RESULTS

Characteristics of the Population

Between July 1, 2012 and June 30, 2013, 1,451 patients with ABSSSI were initially treated in the ED and met the inclusion criteria. **Table 1** summarizes the patient and facility-level characteristics for the population, and provides these descriptions by subgroup of admitted at IEC. The patients' mean age at inclusion was 45.9 years, and the most common infection type was cellulitis (50.4%) followed by major abscess (37.5%). There appears to be an appreciable difference in several patient, treatment and facility-level characteristics between those admitted versus not admitted. Differences in mean age, health insurance type, body mass index (BMI), CCI score¹⁴, severe or moderate renal failure¹⁷, Child-Pugh classification¹⁸, infection type, smoking status, being diabetic, being immunocompromised, active or history of suspected drug use, history of ABSSSI within 30 days of IEC visit, hospitalization within 90 days prior to IEC visit, long-term care within 90 days prior to IEC visit, systemic antibiotic use within 90 days prior to IEC visit, known history of MRSA, initial systemic inflammatory response syndrome (SIRS)¹⁹, whether first antibiotic dose was given in ED, and if a MRSA coverage antibiotic

prescribed at ED discharge were noted, possibly due to severity of illness for those requiring admission versus those not.

Due to high counts of missing data (**Appendix 5**), the following covariates were dropped from the model: body mass index (BMI), moderate or severe renal failure, Child-Pugh classification, end organ damage if diabetic, current/active/past history of suspected intravenous (IV) drug use, known history of MRSA, subject lives alone, subject relies on others for transportation, initial systemic inflammatory response syndrome (SIRS), lesion surface area, and route (IV or oral) of first antibiotic dose if administered in ED. Among the 1,451 patients, 937 (64.6%) patients had no missing data across all covariates and were included in the stepwise multivariable generalized linear model (**Appendix 4**).

Characteristics Associated with an All-Cause Hospitalization or Return to the Emergency Department 30-Days Post Initial Episode of Care Discharge (Composite Outcome)

205 (21.9%) of 937 patients experienced an unscheduled all-cause hospitalization or return to the ED 30-days post IEC discharge (**Table 2**). **Table 2** also lists all variables considered for model selection in the backward stepwise regression, and uses univariable generalized linear models to compare each characteristic between patients who did or did not experience the composite outcome (all-cause hospitalization or return to ED 30-days post IEC discharge). Age, health insurance type, CCI score, hospitalization within 90 days of IEC visit, systemic antibiotic use within 90 days prior to IEC visit, and facility bed capacity were the patient, treatment, and facility related risk factors were associated with experiencing the composite outcome of interest (**Appendix 6**). There was no significant difference in the composite outcome between those that

were admitted versus not at IEC, with those admitted experiencing a 7% lower predicted risk of experiencing the composite outcome, when compared to those not admitted at IEC (95% confidence interval [CI]: 0.68 to 1.29) in the study population.

All-cause Hospitalization or Return to the ED 30-Days Post IEC Discharge Prediction

Model

The stepwise multivariable generalized linear model identified admission decision at IEC, CCI score, being immunocompromised, having a hospitalization within 90 days prior to IEC visit, and facility bed capacity as being predictive of an all-cause hospitalization or return to the ED 30-days post IEC discharge (**Table 3**) with the lowest AIC (AIC = 973.39).

The ROC curve (**Figure 1**) that estimates discrimination for the multivariable generalized regression prediction model reveals an AUC of 0.61 (95% CI: (0.56 to 0.65), indicating poor predictive power. The predicted probability of a hospitalization or return to the ED 30-days post IEC discharge were in good agreement with observed outcomes, indicating good calibration (**Figure 2**). The χ^2 for Hosmer-Lemeshow goodness-of-fit test was 12.26 ($p=0.14$). As shown in **Figure 2**, the highest-risk quintile of patients had an approximately 2-fold higher probability of hospitalization or return to the ED 30-days post IEC discharge (observed 38%, predicted 34.8%) compared to the lowest-risk quintile (observed 17%, predicted 12.9%).

Exploratory Analysis of the Role of Hospital Admission at Point of Discharge from Initial Episode of Care

Three hundred and fifty (37.4%) patients were admitted at IEC. **Figure 3** addresses our secondary aim, and illustrates that among those who were observed to not be admitted at IEC,

the median predicted probability of being readmitted when all were set as not being admitted is 0.20; and the median predicted probability of being readmitted when we set them all as being admitted is 0.24. Among those who were observed to be admitted, the median predicted probability of being readmitted when we set them all as not being admitted is 0.15; and the median predicted probability of being readmitted when we set them all as being admitted is 0.18 (**Figure 3**). The mean difference in predictive probability of a hospitalization or ED return 30-days post IEC discharge for those not admitted at IEC versus those admitted at IEC, when holding all other covariates constant (recycled predictions [**Appendix 7**]) was 5.6% (**Table 4**).

DISCUSSION

We conducted an analysis to develop a regression model to identify patient, treatment, and facility-level characteristics that would predict a hospitalization or return to the ED for any reason within 30-days post IEC discharge for patients with ABSSSI. Taken collectively, we found that these patient, treatment, and facility-level factors were important and potentially useful predictors of the composite outcome. Two characteristics readily obtainable at time of the initial ED visit were found to be associated with a higher rate of the composite outcome: CCI score and hospitalization within 90 days prior to IEC visit. Of interest, admitting at IEC was found to result in lower odds of the composite outcome when compared to not admitting at IEC.

Our subgroup analysis from our recycled predictions suggests possible selection bias. This is noted when comparing the median predicted probabilities among those who were observed to not be admitted at IEC when set to not being admitted (observed) compared to those who were admitted and set to all being not admitted (counterfactual) (0.20 compared to 0.15) and vice

versa (0.24 vs 0.18). If there was no selection bias between those admitted and not admitted at IEC we would expect no difference here.

Despite finding five variables predictive of the composite outcome, only three were significantly associated with the composite outcome (CCI score, immunocompromised status, and hospitalization within 90 days prior to IEC visit) and model discrimination was poor. It is worth noting that for most models of 30-day readmission for other underlying conditions using retrospective data, the level of discrimination ranges from 0.60 to 0.77.²⁰ However, our model indicated good calibration of composite outcome risk across deciles, with a greater than 2-fold difference from lowest to highest. Potential causes of the difficulty in predicting an all-cause hospitalization or return to the ED 30-days post IEC discharge for patients with ABSSSI may be due to the heterogeneity in severity within the population and treatment variability across EDs.

Comparison with Literature

The factors we found predictive of an all-cause hospitalization or return to the ED 30-days post IEC discharge for patients with ABSSSI were admission decision at IEC, CCI score, being immunocompromised, having a hospitalization within 90 days prior to IEC visit, and facility bed capacity. Similar to other studies prior admissions²⁰ and bed capacity²¹ were described as important in several models of readmission prediction. The CCI score has been validated for predicting mortality²² and we found that it was associated with 30-day readmission.

Although age has been described as important in a number of other readmission prediction models²⁰, the stepwise regression did not select age for inclusion in our model for patients with

ABSSSI, further illustrating the need to find both clinically and significant associations for hospitalizations or returns to ED in the ABSSSI patient population. Unlike other studies of readmissions²⁰, insurance type was also not selected as an important variable. In our study, variables other than insurance that might reflect extent of social support (i.e. living alone, relying on other for transportation) were ultimately dropped from the model due to missing data and were not evaluated for inclusion in our predictive model.

Being immunocompromised was associated with a lower rate of the composite outcome. However, other studies found immunocompromised patients have a tendency towards initial treatment failure and higher readmission rates within 30 days.^{23,24} Our finding could be due to the possible selection bias in our study population, meaning the treatment an immunocompromised patient received at IEC varied from patients not immunocompromised. For those admitted at IEC, the quality of inpatient care could also have mitigated risk²⁵ although the evidence is mixed.²⁶

Strengths & Limitations

Study strengths include we were able to capture unscheduled/unplanned readmissions, which is not always accomplished in readmission studies.²⁰ A wide range of patient, treatment, and facility-level variables encountered in everyday clinical practice were evaluated. Diagnoses and treatments were abstracted from individual patient medical records as opposed to billing or other administrative data, further increasing the accuracy of patient, treatment, and facility variables.

A limitation of this study is the restriction of the analysis to the first follow-up visit within the 30-day post IEC discharge period, meaning we made no analysis of second or subsequent hospitalizations or returns to ED. Neither did we consider follow-up visits exclusively for ABSSSI. In addition, because we took an ED provider perspective of assessing a high-risk patient we only assessed variables known in the IEC and did not assess clinical or treatment variables from after discharge from the ED. Thus, for patients who were admitted, no clinical and treatment data from their inpatient stay was included in the model. Further, there is the possibility of misclassification bias for patients who may not have returned to the original study site for a hospitalization or return to ED. As robust as the variety of data collected in this study were, there was also a good amount of missing data that prevented us from assessing some valuable patient, clinical, and treatment variables of specific interest to the ABSSSI population and may have led to decreased predictive power. Despite these concerns there remains interest in reducing rates of 30-day hospitalizations or returns to ED, and in turn, identifying patients at high risk of the composite outcome and optimizing treatment pathways for patients with ABSSSI.

Future Work

First, to account for any selection bias in our model between patients admitted at IEC and not admitted, future work should involve propensity score matching. An individual's propensity score will be estimated as the probability of being admitted at IEC, given the individuals covariates, using a logistic model and if admitted, matched to a not admitted patient and vice versa. This approach may reduce sample size and caution will be exercised. We hope that use of the propensity score matching method will improve model discrimination. Secondly, in our

model we assessed the composite outcome of hospitalizations or returns to ED; future work will include analyses and build a model for each outcome alone, and also for skin-related versus all cause readmissions. Another consideration for future work is to use a shorter follow up time frame specifically for returns to the ED (e.g. 3 or 7 days). Further research will also be necessary to validate the prediction tool for hospitalizations or returns to ED for patients with ABSSSI. Creation of this preliminary prediction model is the first step in creating a robust prediction model that may eventually enable ED providers to prospectively identify patient and facility-level characteristics that predict future hospitalizations or return visits to the ED post IEC discharge.

CONCLUSION

In summary, we developed a predictive model for unscheduled all-cause hospitalizations or ED returns 30-days post IEC discharge using five readily variables readily available at the time of IEC in the ED: admission decision at IEC, CCI score, being immunocompromised, having a hospitalization within 90 days prior to IEC visit, and facility bed capacity. While the model discriminated poorly (AUC = 0.61), it is a first step in developing a more refined prediction model for use in this context.²⁰ Our findings indicate the risk of readmission among patients with ABSSSI and the need to develop risk stratification tools to ensure clinician efforts target ABSSSI patients with a need for admission at IEC.

Table 1. Summary of Patient, Treatment, and Facility Characteristics by Initial Episode of Care Admission Status

Characteristic	Total (N = 1451)	Admitted at IEC (n = 559; 38.5%)	Not Admitted at IEC (n = 892; 61.5%)
A. Patient Level Covariates			
Mean (\pm SD) Age, years	45.9 (\pm 17.4)	51.2 (\pm 17.4)	42.6 (\pm 16.6)
Gender, n (%)			
Male	773 (53.3%)	305 (54.6%)	468 (52.5%)
Female	678 (46.7%)	254 (45.4%)	424 (47.5%)
Health Insurance Type, n (%)			
Commercial	401 (27.6%)	161 (28.8%)	240 (26.9%)
Medicaid	230 (15.9%)	72 (12.9%)	158 (17.7%)
Medicare	197 (13.6%)	115 (20.6%)	82 (9.2%)
Self-pay	393 (27.1%)	112 (20%)	281 (31.5%)
Other ^a	159 (11%)	77 (13.8%)	82 (9.2%)
Missing	71 (4.9%)	22 (3.9%)	49 (5.5%)
Mean (\pm SD) BMI, kg/m ²	31.14 (\pm 9.8)	31.9 (\pm 10.2)	30.58 (\pm 9.6)
\leq 30, n (%)	668 (46%)	273 (48.8%)	395 (44.3%)
30-40, n (%)	437 (30.1%)	171 (30.6%)	266 (29.8%)
$>$ 41, n (%)	174 (12%)	93 (16.6%)	81 (9.1%)
Missing (%)	172 (11.9%)	22 (3.9%)	150 (16.8%)
CCI score, n (%)			
0	802 (55.3%)	175 (31.3%)	627 (70.3%)
1	257 (17.7%)	120 (21.5%)	137 (15.4%)
2	122 (8.4%)	55 (9.8%)	67 (7.5%)
3	66 (4.5%)	56 (10%)	10 (1.1%)
4+	166 (11.4%)	116 (20.8%)	50 (5.6%)
Missing	38 (2.6%)	37 (6.6%)	1 (0.1%)
Severe or Moderate Renal failure ^b , n (%) [*]			
Yes	36 (2.5%)	31 (5.5%)	5 (0.6%)
No	699 (48.2%)	477 (85.3%)	222 (24.9%)
Missing	716 (49.3%)	51 (9.1%)	665 (74.6%)
Child- Pugh Classification, n (%)			
No Liver Disease	192 (13.2%)	150 (26.8%)	42 (4.7%)
Mild Liver Disease	156 (10.8%)	138 (24.7%)	18 (2%)
Moderate or Severe Liver Disease	10 (0.7%)	9 (1.6%)	1 (0.1%)
Missing	1093 (75.3%)	262 (46.9%)	831 (93.2%)
Infection Type, n (%)			
Major Abscess	544 (37.5%)	151 (27%)	393 (44.1%)
Cellulitis	731 (50.4%)	326 (58.3%)	405 (45.4%)
Traumatic Wound	69 (4.8%)	23 (4.1%)	46 (5.2%)
Surgical Site Infection	89 (6.1%)	52 (9.3%)	37 (4.1%)
Missing	18 (1.2%)	7 (1.3%)	11 (1.2%)
Current Smoker, n (%)			
Yes	501 (34.5%)	185 (33.1%)	316 (35.4%)
No	848 (58.4%)	361 (64.6%)	487 (54.6%)
Missing	102 (7%)	13 (2.3%)	89 (10%)

Table 1 (continued). Summary of Patient, Treatment, and Facility Characteristics by Initial Episode of Care Admission Status

Characteristic	Total (N = 1451)	Admitted at IEC (n = 559; 38.5%)	Not Admitted at IEC (n = 892; 61.5%)
A. Patient Level Covariates (continued)			
Diabetes, n (%)			
Yes	334 (23%)	172 (30.8%)	162 (18.2%)
No	1078 (74.3%)	378 (67.6%)	700 (78.5%)
Missing	39 (2.7%)	9 (1.6%)	30 (3.4%)
Diabetes: With Organ Damage?, n (%)			
Yes, with Organ Damage	90 (6.2%)	65 (11.6%)	25 (2.8%)
Yes, without Organ Damage	244 (16.8%)	107 (19.1%)	137 (15.4%)
Missing	1117 (77.0%)	387 (69.2%)	730 (81.8%)
Immunocompromised, n (%)			
Yes	47 (3.2%)	30 (5.4%)	17 (1.9%)
No	1238 (85.3%)	463 (82.8%)	775 (86.9%)
Missing	166 (11.4%)	66 (11.8%)	100 (11.2%)
Current/Active/Past History of Suspected IV Drug Use?, n (%)			
Yes	130 (9%)	78 (14%)	52 (5.8%)
No	1134 (78.2%)	444 (79.4%)	690 (77.4%)
Missing	187 (12.9%)	37 (6.6%)	150 (16.8%)
Past History of ABSSSI within 30 days of this Admission?, n (%)			
Yes	213 (14.7%)	121 (21.6%)	92 (10.3%)
No	1207 (83.2%)	428 (76.6%)	779 (87.3%)
Missing	31 (2.1%)	10 (1.8%)	21 (2.4%)
Hospitalization within 90 days prior to this admission?, n (%)			
Yes	234 (16.1%)	146 (26.1%)	88 (9.9%)
No	1188 (81.9%)	407 (72.8%)	781 (87.6%)
Missing	29 (2%)	6 (1.1%)	23 (2.6%)
Long Term Care within 90 days prior to this admission?, n (%)*			
Yes	44 (3%)	37 (6.6%)	7 (0.8%)
No	1372 (94.6%)	515 (92.1%)	857 (96.1%)
Missing	35 (2.4%)	7 (1.3%)	28 (3.1%)
Systemic antibiotic use within 90 days prior to this admission?, n (%)			
Yes	400 (27.6%)	225 (40.3%)	175 (19.6%)
No	1008 (69.5%)	321 (57.4%)	687 (77%)
Missing	43 (3%)	13 (2.3%)	30 (3.4%)
Does the patient have a known history of MRSA including colonization?, n (%)			
Yes	157 (10.8%)	86 (15.4%)	71 (8%)
No	1109 (76.4%)	415 (74.2%)	694 (77.8%)
Missing	185 (12.7%)	58 (10.4%)	127 (14.2%)

Table 1 (continued). Summary of Patient, Treatment, and Facility Characteristics by Initial Episode of Care Admission Status

Characteristic	Total (N = 1451)	Admitted at IEC (n = 559; 38.5%)	Not Admitted at IEC (n = 892; 61.5%)
A. Patient Level Covariates (continued)			
Did patient live alone?, n (%)			
Yes	133 (9.2%)	68 (12.2%)	65 (7.3%)
No	510 (35.1%)	271 (48.5%)	239 (26.8%)
Missing	808 (55.7%)	220 (39.4%)	588 (65.9%)
Did the patient rely on others for transportation? (Family, Friends, Public transportation), n (%)			
Yes	257 (17.7%)	114 (20.4%)	143 (16%)
No	291 (20.1%)	140 (25%)	151 (16.9%)
Missing	903 (62.2%)	305 (54.6%)	598 (67%)
Mean (\pm SD) Approximate distance from Patient home to facility of record, miles	25.12 (\pm 94.1)	22.5 (\pm 68.9)	26.8 (\pm 106.9)
>10, n (%)	467 (32.2%)	219 (39.2%)	248 (27.8%)
\leq 10, n (%)	954 (65.7%)	331 (59.2%)	623 (69.8%)
Missing	30 (2.1%)	9 (1.6%)	19 (2.1%)
Initial SIRS, n (%)			
Yes	203 (14%)	159 (28.4%)	44 (4.9%)
No	546 (37.6%)	334 (59.7%)	212 (23.8%)
Missing	702 (48.4%)	66 (11.8%)	636 (71.3%)
Presence of abscess, n (%)			
Yes	544 (37.5%)	151 (27%)	393 (44.1%)
No	889 (61.3%)	401 (71.7%)	488 (54.7%)
Missing	18 (1.2%)	7 (1.3%)	11 (1.2%)
Mean (\pm SD) Lesion Surface Area Admission, cm ²	33.9 (\pm 83.8)	60.7 (\pm 125)	20.4 (\pm 46.5)
\geq 75, n (%)	61 (4.2%)	40 (7.2%)	21 (2.4%)
<75, n (%)	505 (34.8%)	150 (26.8%)	355 (39.8%)
Missing	885 (61%)	369 (66%)	516 (57.8%)
Purulent Drainage on Presentation to ED, n (%)			
Present	330 (22.7%)	134 (24%)	196 (22%)
Absent	989 (68.2%)	377 (67.4%)	612 (68.6%)
Missing	132 (9.1%)	48 (8.6%)	84 (9.4%)
B. Treatment Characteristics			
Did the lesion require surgical intervention?, n (%)			
Yes	604 (41.6%)	237 (42.4%)	367 (41.1%)
No	846 (58.3%)	321 (57.4%)	525 (58.9%)
Missing	1 (0.1%)	1 (0.2%)	0 (0%)
Was initial lesion culture result performed in ED?, n (%)			
Yes	179 (12.3%)	80 (14.3%)	99 (11.1%)
No	1272 (87.7%)	479 (85.7%)	793 (88.9%)

Table 1 (continued). Summary of Patient, Treatment, and Facility Characteristics by Initial Episode of Care Admission Status

Characteristic	Total (N = 1451)	Admitted at IEC (n = 559; 38.5%)	Not Admitted at IEC (n = 892; 61.5%)
B. Treatment Characteristics (continued)			
Was the 1st antibiotic dose given in ED?, n (%)			
Yes	810 (55.8%)	412 (73.7%)	398 (44.6%)
No	641 (44.2%)	147 (26.3%)	494 (55.4%)
If 1st antibiotic dose given in ED was it given as PO or IV?, n (%)			
IV	598 (41.2%)	407 (72.8%)	191 (21.4%)
PO	208 (14.3%)	5 (0.9%)	203 (22.8%)
Missing	645 (44.5%)	147 (26.3%)	498 (55.8%)
Was a MRSA coverage antibiotic prescribed at ED discharge?, n (%)			
Yes	968 (66.7%)	321 (57.4%)	647 (72.5%)
No	482 (33.2%)	237 (42.4%)	245 (27.5%)
Missing	1 (0.1%)	1 (0.2%)	0 (0%)
C. Facility Variables			
Study site location (geographic region), n (%)			
Northeast	164 (11.3%)	86 (15.4%)	78 (8.7%)
Midwest	386 (26.6%)	185 (33.1%)	201 (22.5%)
South	618 (42.6%)	192 (34.3%)	426 (47.8%)
West	247 (17%)	61 (10.9%)	186 (20.9%)
Mean (\pm SD) Bed Capacity	650 (\pm 249)	673.9 (\pm 232)	635.1 (\pm 258.1)
\leq 250, n (%)	66 (4.5%)	24 (4.3%)	42 (4.7%)
251-499, n (%)	378 (26.1%)	95 (17%)	283 (31.7%)
500-749, n (%)	633 (43.6%)	283 (50.6%)	350 (39.2%)
750-999, n (%)	252 (17.4%)	113 (20.2%)	139 (15.6%)
\geq 1,000, n (%)	122 (8.4%)	44 (7.9%)	78 (8.7%)
Mean (\pm SD) Average Percent of Beds Filled (census), in %	80.8 (\pm 13.8)	79.5 (\pm 15.1)	81.6 (\pm 12.8)
\leq 50, n (%)	24 (1.7%)	24 (4.3%)	0 (0%)
51-65, n (%)	156 (10.8%)	48 (8.6%)	108 (12.1%)
66-80, n (%)	489 (33.7%)	194 (34.7%)	295 (33.1%)
81-95, n (%)	605 (41.7%)	233 (41.7%)	372 (41.7%)
\geq 96, n (%)	177 (12.2%)	60 (10.7%)	117 (13.1%)
Hospital Type Description (academic medical center, community), n (%)			
Academic Medical Center	932 (64.2%)	367 (65.7%)	565 (63.3%)
Community	519 (35.8%)	192 (34.3%)	327 (36.7%)
Hospital/Organization Type (not for profit, for profit), n (%)			
Not for Profit	1326 (91.4%)	520 (93%)	806 (90.4%)
For Profit	125 (8.6%)	39 (7%)	86 (9.6%)

Table 1 (continued). Summary of Patient, Treatment, and Facility Characteristics by Initial Episode of Care Admission Status

Characteristic	Total (N = 1451)	Admitted at IEC (n = 559; 38.5%)	Not Admitted at IEC (n = 892; 61.5%)
C. Facility Variables (continued)			
Mean (\pm SD) Number of ED visits that result in Admission a year?	18545 (\pm 11635)	22794 (\pm 11979)	16053 (\pm 10674)
\leq 10,000, n (%)	338 (23.3%)	60 (10.7%)	278 (31.2%)
10,001 - 20,000, n (%)	558 (38.5%)	213 (38.1%)	345 (38.7%)
20,001 - 30,000, n (%)	368 (25.4%)	153 (27.4%)	215 (24.1%)
30,001 - 40,000, n (%)	49 (3.4%)	33 (5.9%)	16 (1.8%)
$>$ 40,000, n (%)	83 (5.7%)	57 (10.2%)	26 (2.9%)
Are there Antimicrobial Oversight/Stewardship activities in the emergency department?, n (%)			
Yes	701 (48.3%)	248 (44.4%)	453 (50.8%)
No	724 (49.9%)	299 (53.5%)	425 (47.6%)
<p>ABSSSI=acute bacterial skin and skin structure infection; BMI=body mass index; CCI=Charlson comorbidity index; CI=confidence interval; ED=emergency department; IEC=initial episode of care; IV=intravenous; IVDU=intravenous drug use; MRSA=methicillin-resistant Staphylococcus aureus; PO=oral; SD=standard deviation; SIRS=systemic inflammatory response syndrome.</p> <p>^aIncludes those with \geq2 insurances and those with Tricare.</p> <p>^bGlomerular filtration rate (GFR) $<$ 30ml/min.</p>			

Table 2. Summary of Potential Patient, Treatment, and Facility Predictors by Composite Outcome Status

Characteristic	All-cause hospitalization or return to ED 30-d post IEC discharge (n = 205, 21.9%)	No all-cause hospitalization or return to ED 30-d post IEC discharge (n = 732, 78.1%)	Odds Ratio (95% CI)	Total (N = 937)
A. Patient Level Covariates				
Mean (\pm SD) Age*, years	48.6 (\pm 18.7)	45.5 (\pm 17.3)	1.01 (1.001, 1.019)	46.2 (\pm 17.6)
Gender, n (%)				
Male	106 (51.7%)	379 (51.8%)	1 (0.73, 1.36)	485 (51.8%)
Health Insurance Type, n (%)*				
Commercial	48 (23.4%)	224 (30.6%)	1.00	272 (29%)
Medicaid	44 (21.5%)	120 (16.4%)	1.71 (1.07, 2.73)	164 (17.5%)
Medicare	38 (18.5%)	95 (13%)	1.87 (1.14, 3.05)	133 (14.2%)
Self-pay	46 (22.4%)	204 (27.9%)	1.05 (0.67, 1.65)	250 (26.7%)
Other ^a	29 (14.1%)	89 (12.2%)	1.52 (0.9, 2.57)	118 (12.6%)
Mean (\pm SD), CCI score*	1.5 (\pm 2.05)	1.1 (\pm 1.98)	1.09 (1.02, 1.17)	1.2 (\pm 2)
Infection Type, n (%)				
Major Abscess	79 (38.5%)	280 (38.3%)	1.00	359 (38.3%)
Cellulitis	100 (48.8%)	375 (51.2%)	0.95 (0.68, 1.32)	475 (50.7%)
Traumatic Wound	9 (4.4%)	26 (3.6%)	1.23 (0.55, 2.73)	35 (3.7%)
Surgical Site Infection	17 (8.3%)	51 (7%)	1.18 (0.65, 2.16)	68 (7.3%)
Current Smoker, n (%)				
Yes	73 (35.6%)	242 (33.1%)	1.12 (0.81, 1.55)	315 (33.6%)
No	132 (64.4%)	490 (66.9%)		622 (66.4%)
Diabetes, n (%)				
Yes	57 (27.8%)	171 (23.4%)	1.26 (0.89, 1.8)	228 (24.3%)
No	148 (72.2%)	561 (76.6%)		709 (75.7%)
Immunocompromised, n (%)				
Yes	6 (2.9%)	33 (4.5%)	0.64 (0.26, 1.55)	39 (4.2%)
No	199 (97.1%)	699 (95.5%)		898 (95.8%)
Past History of ABSSSI within 30 days of this Admission?, n (%)				
Yes	33 (16.1%)	89 (12.2%)	1.39 (0.9, 2.14)	122 (13%)
No	172 (83.9%)	643 (87.8%)		815 (87%)
No	156 (76.1%)	629 (85.9%)		785 (83.8%)
Hospitalization within 90 days prior to this admission?*, n (%)				
Yes	49 (23.9%)	103 (14.1%)	1.92 (1.31 - 2.82)	152 (16.2%)
No	156 (76.1%)	629 (85.9%)		785 (83.8%)
Long Term Care within 90 days prior to this admission?, n (%)				
Yes	8 (3.9%)	19 (2.6%)	1.52 (0.66, 3.54)	27 (2.9%)
No	197 (96.1%)	713 (97.4%)		910 (97.1%)
Systemic antibiotic use within 90 days prior to this admission?*, n (%)				
Yes	67 (32.7%)	185 (25.3%)	1.44 (1.03, 2.01)	252 (26.9%)
No	138 (67.3%)	547 (74.7%)		685 (73.1%)
Mean (\pm SD) Approximate distance from Patient home to facility of record, miles	30.3 (\pm 106.2)	26.9 (\pm 100.7)	1 (0.999, 1.002)	27.6 (\pm 101.9)
Presence of abscess, n (%)				
Yes	79 (38.5%)	280 (38.3%)	1.01 (0.74, 1.39)	359 (38.3%)
No	126 (61.5%)	452 (61.7%)		578 (61.7%)
Purulent Drainage on Presentation to ED, n (%)				
Present	54 (26.3%)	174 (23.8%)	1.15 (0.8, 1.64)	228 (24.3%)
Absent	151 (73.7%)	558 (76.2%)		709 (75.7%)

Table 2 (continued). Summary of Potential Patient, Treatment, and Facility Predictors by Composite Outcome Status

Characteristic	All-cause hospitalization or return to ED 30-d post IEC discharge (n = 205, 21.9%)	No all-cause hospitalization or return to ED 30-d post IEC discharge (n =732, 78.1%)	Odds Ratio (95% CI)	Total (N = 937)
B. Treatment Characteristics				
Patient admitted at IEC?, n (%)				
Yes	74 (36.1%)	276 (37.7%)	0.93 (0.68, 1.29)	350 (37.4%)
No	131 (63.9%)	456 (62.3%)		587 (62.6%)
Did the lesion require surgical intervention?, n (%)				
Yes	89 (43.4%)	304 (41.5%)	1.08 (0.79, 1.48)	393 (41.9%)
No	116 (56.6%)	428 (58.5%)		544 (58.1%)
Was Initial Lesion Culture Result performed in ED?, n (%)				
Yes	28 (13.7%)	91 (12.4%)	1.11 (0.71, 1.76)	119 (12.7%)
No	177 (86.3%)	641 (87.6%)		818 (87.3%)
Was the 1st antibiotic dose given in ED?, n (%)				
Yes	113 (55.1%)	406 (55.5%)	0.99 (0.72, 1.35)	519 (55.4%)
No	92 (44.9%)	326 (44.5%)		418 (44.6%)
Was a MRSA coverage antibiotic prescribed at ED discharge?, n (%)				
Yes	136 (66.3%)	503 (68.7%)	0.9 (0.65, 1.25)	639 (68.2%)
No	69 (33.7%)	229 (31.3%)		298 (31.8%)
C. Facility Variables				
Study site location (geographic region), n (%)				
Northeast	21 (10.2%)	80 (10.9%)	1.00	101 (10.8%)
Midwest	57 (27.8%)	214 (29.2%)	1.02 (0.58, 1.78)	271 (28.9%)
South	103 (50.2%)	348 (47.5%)	1.13 (0.66, 1.92)	451 (48.1%)
West	24 (11.7%)	90 (12.3%)	1.02 (0.52, 1.97)	114 (12.2%)
Mean (±SD) Bed Capacity	693.6 (±275.8)	665.7 (±256.6)	1 (0.9998, 1.001)	671.8 (±261.1)
Mean (±SD) Average Percent of Beds Filled (census), in %	80 (±13.8)	80.8 (±14)	0.996 (0.985, 1.007)	80.7 (±14)
Hospital Type Description (academic medical center, community), n (%)				
Academic Medical Center	125 (61%)	457 (62.4%)	0.94 (0.68, 1.29)	582 (62.1%)
Community	80 (39%)	275 (37.6%)		355 (37.9%)
Hospital/Organization Type (not for profit, for profit), n (%)				
Not for Profit	186 (90.7%)	664 (90.7%)	1.003 (0.59, 1.71)	850 (90.7%)
For Profit	19 (9.3%)	68 (9.3%)		87 (9.3%)
Mean (±SD) Number of ED visits that result in Admission a year?	19368 (±12761)	19219 (±11778)	1.00 (1.00, 1.00)	19251 (±11993)
Are there Antimicrobial Oversight/Stewardship activities in the emergency department?, n (%)				
Yes	109 (53.2%)	364 (49.7%)	1.15 (0.84, 1.57)	473 (50.5%)
No	96 (46.8%)	368 (50.3%)		464 (49.5%)
ABSSSI=acute bacterial skin and skin structure infection; CCI=Charlson comorbidity index; CI=confidence interval; ED=emergency department; IEC=initial episode of care; MRSA=methicillin-resistant Staphylococcus aureus; SD=standard deviation. -Odds ratios estimated using a generalized linear regression model. ^a Includes those with ≥2 insurances and those with Tricare. *Statistically significant difference between those with an all-cause hospitalization or return to ED 30-days post IEC discharge and those without an all-cause hospitalization or return to ED 30-days post IEC discharge, p<0.05.				

Table 3. Multivariable Generalized Linear Regression Model: Predictors of Composite Outcome

Characteristic (Referent Variable)	Beta Coefficients	Odds Ratio (95% CI)	p-value
Admitted at IEC (not admitted)	-0.35	0.71 (0.293, 1.01)	0.06
CCI score (continuous)	0.11	1.12 (1.027, 1.21)	0.01
Immunocompromised (not immunocompromised)	-1.001	0.36 (0.139, 0.95)	0.04
Hospitalization within 90 days prior to IEC visit (no hospitalization)	0.68	1.98 (1.313, 2.99)	0.001
Bed capacity at facility (continuous)	0.0004	1 (0.9999, 1.001)	0.14
CI=Confidence Interval			

Table 4. Recycled Predictions: Predictive Probability of Composite Outcome

Fixed Independent Variable	Mean	Min	Max
All set as not admitted at IEC	24.16%	7.65%	57.09%
All set as admitted at IEC	18.52%	5.53%	48.44%
Overall Difference	5.64%	2.12%	8.65%

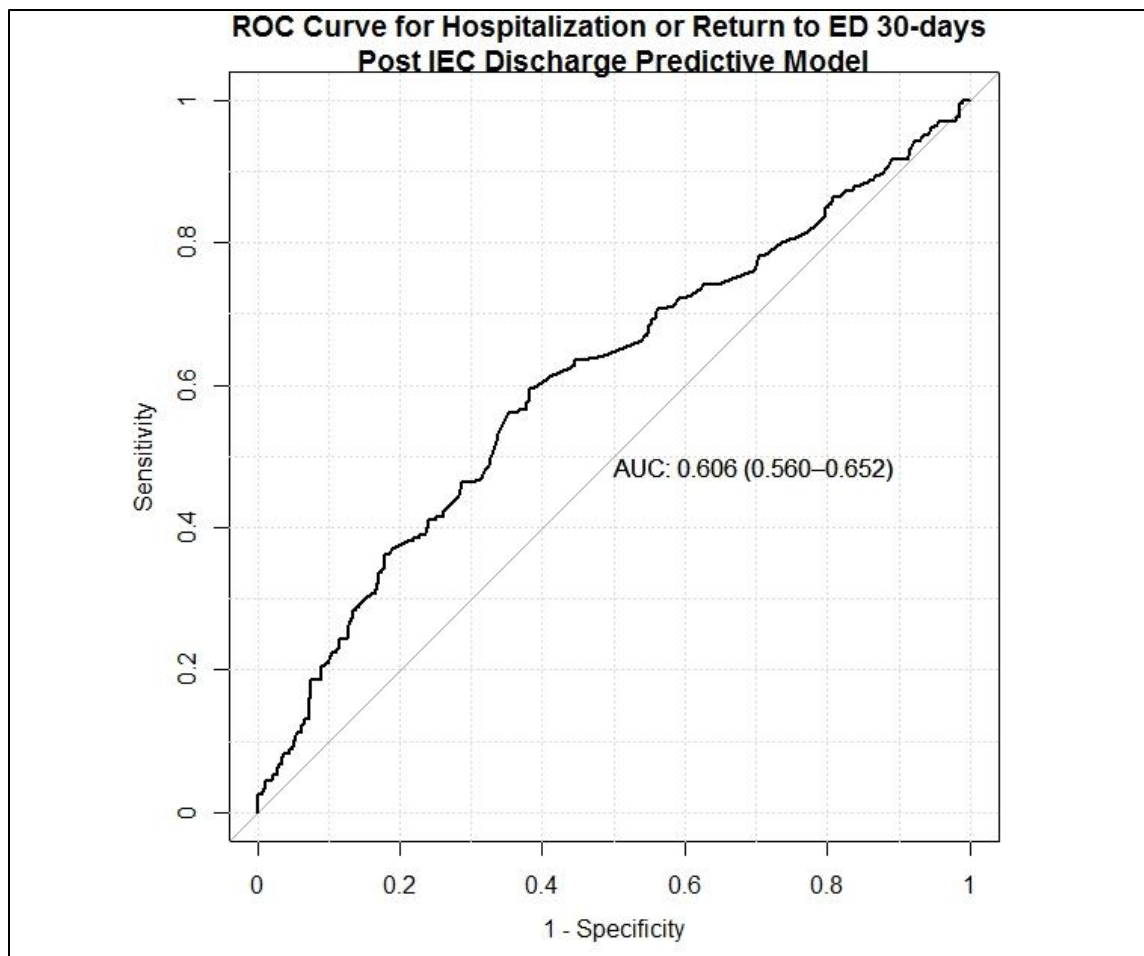


Figure 1. Receiver Operating Characteristic (ROC) Curve

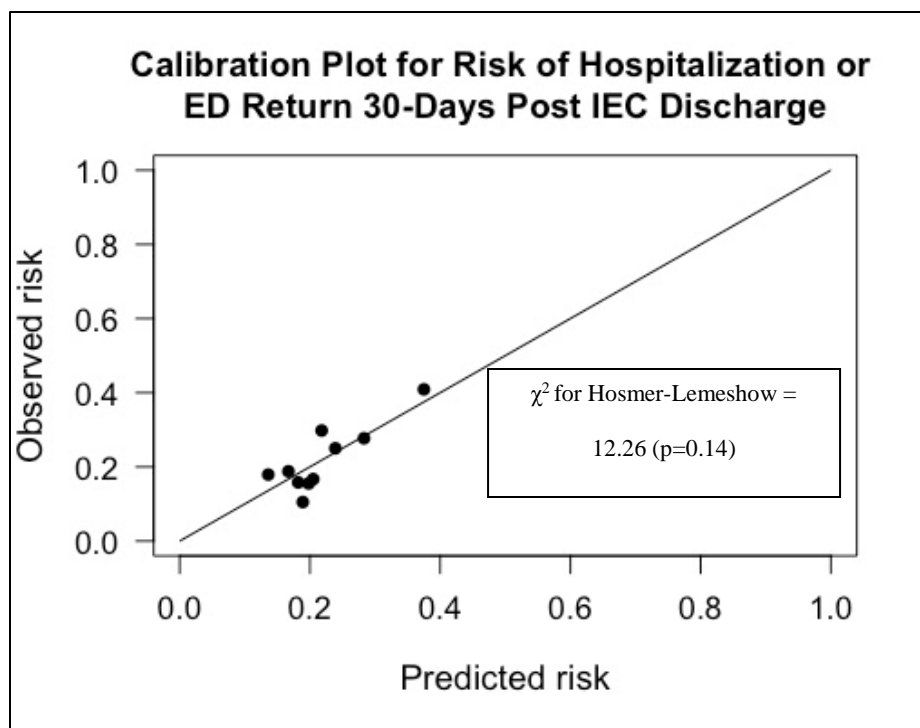


Figure 2. Calibration Plot

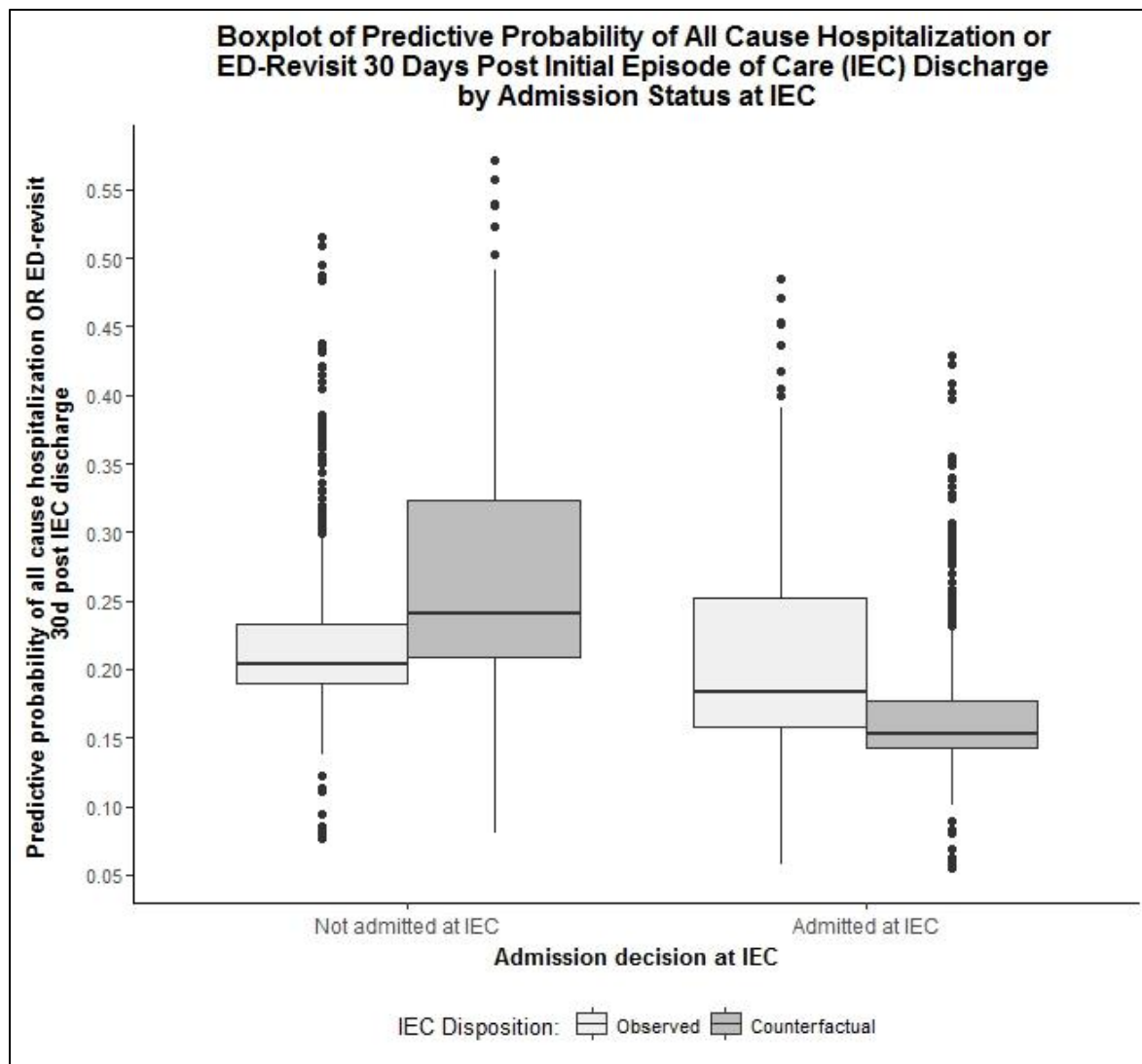


Figure 3. Boxplot of Predictive Probabilities from Recycled Predictions

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APPENDICES

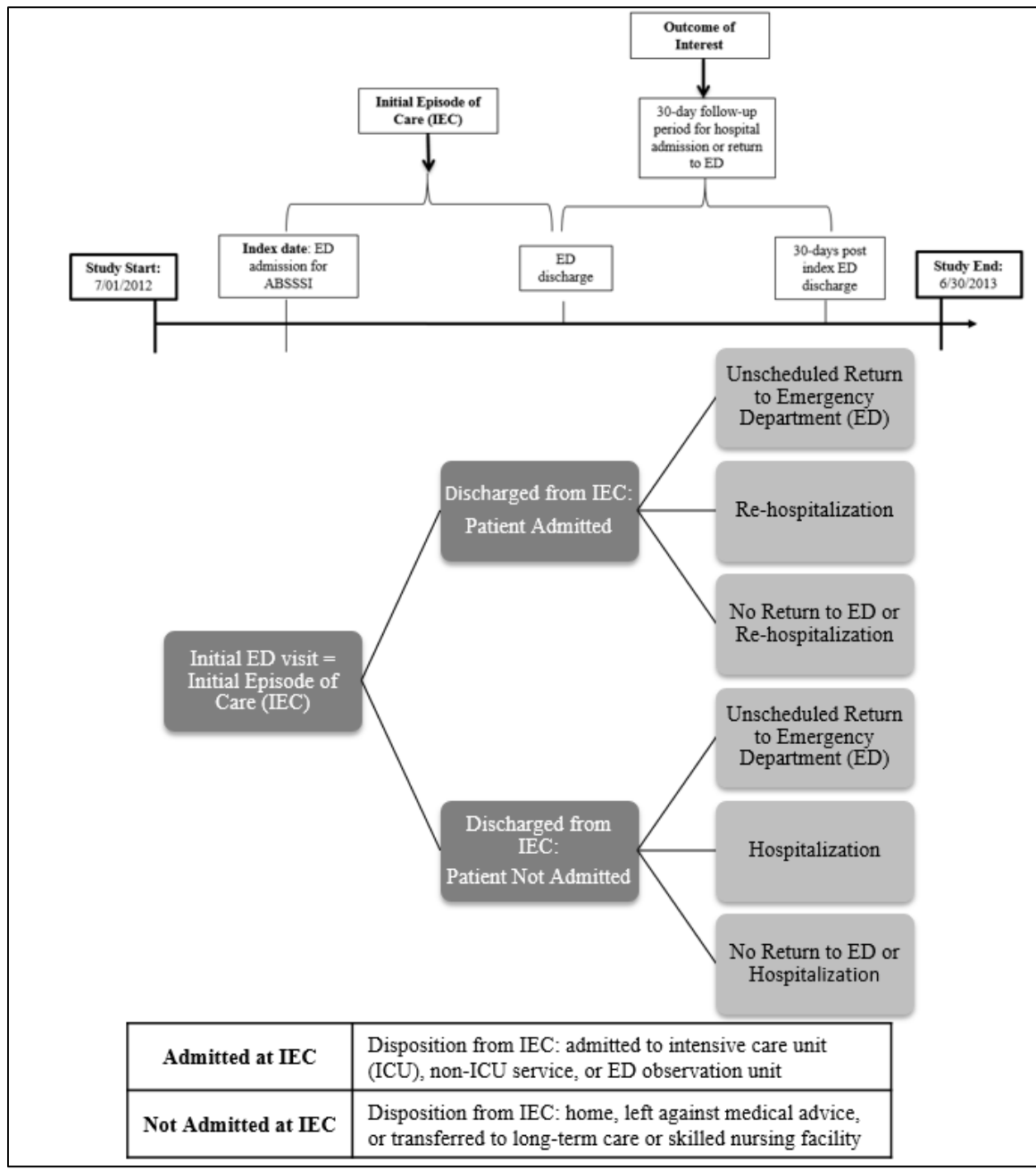
Appendix 1. Inclusion criteria: ICD-9 codes that defined ABSSSI

ICD-9 Codes	Description
• 681.XX	• Cellulitis and abscess of finger and toe
• 682.XX	• Other cellulitis and abscess
• 686.XX	• Other local infections of skin and subcutaneous tissue
• 958.3	• Posttraumatic wound infection, not elsewhere classified
• 998.5X	• Postoperative wound infection

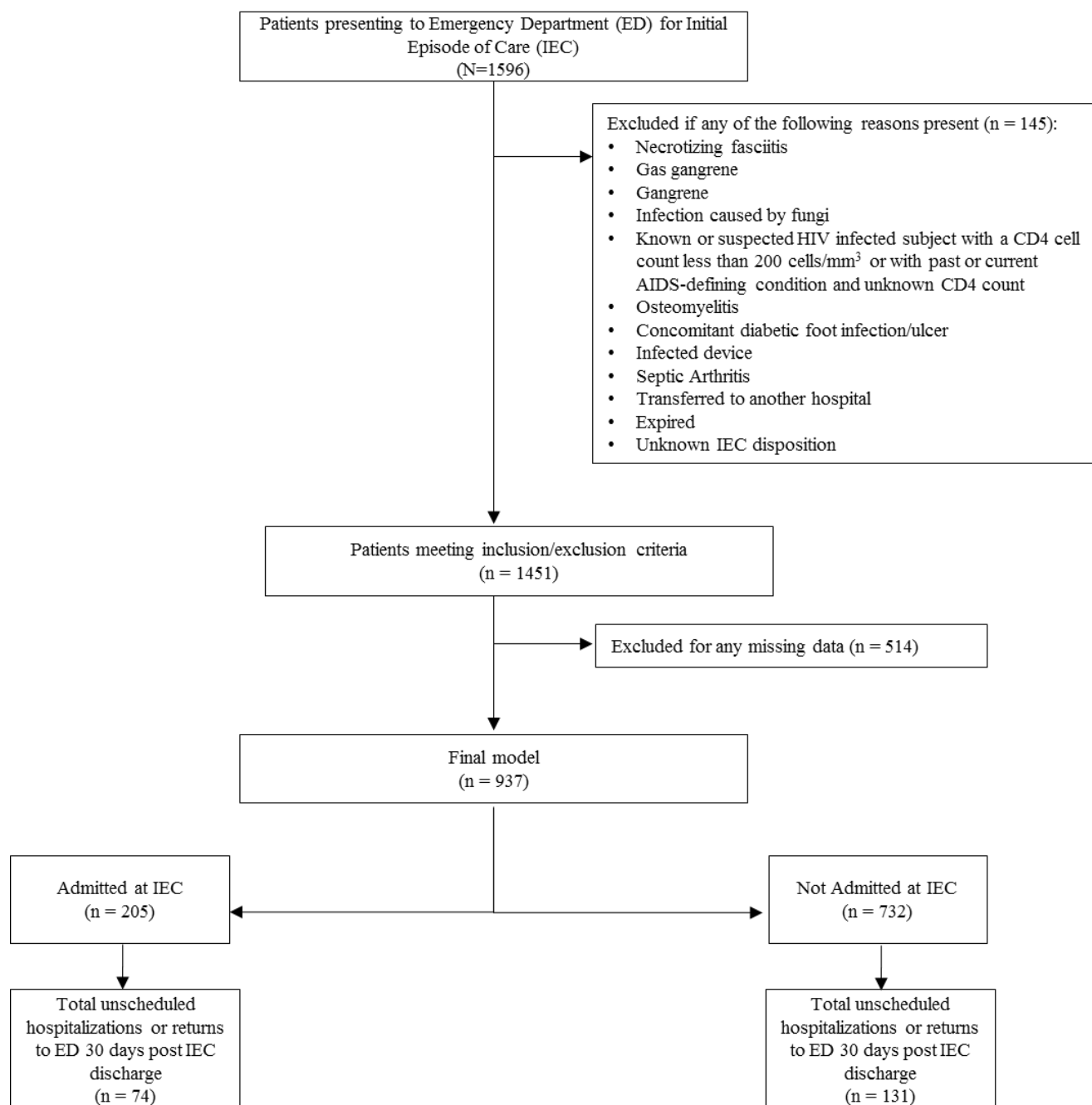
Appendix 2. Exclusion Criteria

All subjects with any of the following diagnoses during initial episode of care admission:	
• All subjects less than 18 years of age	• Perirectal abscess or a decubitus ulcer
• Necrotizing fasciitis (728.86)	• Septic arthritis
• Gas gangrene (040.0)	• Subjects with an infected device
• Gangrene (785.4)	• Infections caused by fungi, whether alone or in combination with a bacterial pathogen
• Osteomyelitis	• Known or suspected human immunodeficiency virus (HIV) infected patients with a CD4 cell count < 200 cells/mm ³ or with a past or current acquired immunodeficiency syndrome (AIDS)-defining condition and unknown CD4 count
• Infections involving a diabetic foot ulceration	
All subjects with any of the following dispositions from initial episode of care admission:	
• Transferred to another hospital	
• Expired	

Appendix 3. Study Diagram



Appendix 4. Patient Flow Diagram



Appendix 5. Characterization of Missing Data in Patients Meeting Inclusion/Exclusion Criteria

Missing Data by Characteristic, n (%)	Total (N = 1451)	Admitted at IEC (n = 559)	Not Admitted at IEC (n = 892)	All-cause hospitalization or return to the ED 30-d post IEC (n = 305)	No all-cause hospitalization or return to ED 30-d post IEC (n = 1146)
A. Subject Level Covariates					
Age	1 (0.1%)	0 (0%)	1 (0.1%)	0 (0%)	1 (0.1%)
Gender	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Health Insurance Type	71 (4.9%)	22 (3.9%)	49 (5.5%)	16 (5.2%)	55 (4.8%)
BMI*	172 (11.9%)	22 (3.9%)	150 (16.8%)	25 (8.2%)	147 (12.8%)
CCI score	38 (2.6%)	37 (6.6%)	1 (0.1%)	3 (1%)	35 (3.1%)
Moderate or Severe Renal Failure*	716 (49.3%)	51 (9.1%)	665 (74.6%)	140 (45.9%)	576 (50.3%)
Child - Pugh Classification*	1093 (75.3%)	262 (46.9%)	831 (93.2%)	226 (74.1%)	867 (75.7%)
Infection Type	18 (1.2%)	7 (1.3%)	11 (1.2%)	1 (0.3%)	17 (1.5%)
Current Smoker	102 (7%)	13 (2.3%)	89 (10%)	11 (3.6%)	91 (7.9%)
Diabetes	39 (2.7%)	9 (1.6%)	30 (3.4%)	7 (2.3%)	32 (2.8%)
Diabetes: with end organ damage*	1117 (77.0%)	387 (69.2%)	730 (81.8%)	228 (74.8%)	889 (77.6%)
Immunocompromised	166 (11.4%)	66 (11.8%)	100 (11.2%)	39 (12.8%)	127 (11.1%)
Current/Active/Past History of Suspected IV Drug Use?*	187 (12.9%)	37 (6.6%)	150 (16.8%)	35 (11.5%)	152 (13.3%)
Past History of ABSSSI within 30 days of this Admission?	31 (2.1%)	10 (1.8%)	21 (2.4%)	7 (2.3%)	24 (2.1%)
Hospitalization within 90 days prior to this admission?	29 (2%)	6 (1.1%)	23 (2.6%)	2 (0.7%)	27 (2.4%)
Long Term Care within 90 days prior to this admission?	35 (2.4%)	7 (1.3%)	28 (3.1%)	5 (1.6%)	30 (2.6%)
Systemic antibiotic use within 90 days prior to this admission?	43 (3%)	13 (2.3%)	30 (3.4%)	7 (2.3%)	36 (3.1%)
Does the subject have a known history of MRSA including colonization?*	185 (12.7%)	58 (10.4%)	127 (14.2%)	41 (13.4%)	144 (12.6%)
Did subject live alone?*	808 (55.7%)	220 (39.4%)	588 (65.9%)	155 (50.8%)	653 (57%)
Did the subject rely on others for transportation? (Family, Friends, Public transportation)*	903 (62.2%)	305 (54.6%)	598 (67%)	178 (58.4%)	725 (63.3%)
Approximate distance (miles) from subject home to facility of record	28 (1.9%)	9 (1.6%)	19 (2.1%)	5 (1.6%)	23 (2%)
Initial SIRS: y/n*	702 (48.4%)	66 (11.8%)	636 (71.3%)	140 (45.9%)	562 (49%)
Presence of abscess: y/n	18 (1.2%)	7 (1.3%)	11 (1.2%)	1 (0.3%)	17 (1.5%)
Lesion Surface Area Admission*	885 (61%)	369 (66%)	516 (57.8%)	186 (61%)	699 (61%)
Purulent Drainage on Presentation to ED	132 (9.1%)	48 (8.6%)	84 (9.4%)	33 (10.8%)	99 (8.6%)

Appendix 5 (continued). Characterization of Missing Data in Patients Meeting Inclusion/Exclusion Criteria

Missing Data by Characteristic, n (%)	Total (N = 1451)	Admitted at IEC (n = 559)	Not Admitted at IEC (n = 892)	All-cause hospitalization or return to the ED 30-d post IEC (n = 305)	No all-cause hospitalization or return to ED 30-d post IEC (n = 1146)
B. Treatment Characteristics					
Did the lesion require surgical intervention?	1 (0.1%)	1 (0.2%)	0 (0%)	0 (0%)	1 (0.1%)
Was Initial Lesion Culture Result performed in ED?	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Was the 1st antibiotic dose given in ED?	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
If the 1st antibiotic dose was given in ED was it PO or IV?*	645 (44.5%)	147 (26.3%)	498 (55.8%)	136 (44.6%)	509 (44.4%)
Was a MRSA coverage antibiotic prescribed at ED discharge?	1 (0.1%)	1 (0.2%)	0 (0%)	0 (0%)	1 (0.1%)
D. Facility Variables					
Study site location (geographic region)	36 (2.5%)	35 (6.3%)	1 (0.1%)	2 (0.7%)	34 (3%)
Bed Capacity	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Average Percent of Beds Filled (census) (%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Hospital Type Description (academic medical center, community)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Hospital/Organization Type (not for profit, for profit)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Number of ED visits that result in Admission a year?	55 (3.8%)	43 (7.7%)	12 (1.3%)	11 (3.6%)	44 (3.8%)
Are there Antimicrobial Oversight/Stewardship activities in the emergency department?	26 (1.8%)	12 (2.1%)	14 (1.6%)	5 (1.6%)	21 (1.8%)
*Variable dropped from multivariable model due to missingness					

Appendix 6. Backward Stepwise Regression Output in RStudio

```

Stepwise Model Path
Analysis of Deviance Table

Initial Model:
outcome ~ iecdispo + age + sex + instypcat2 + cci + infectp +
  smoke + diab + immunocomp + phabsssi + hosp + ltc90 + abx90 +
  distance + abscesspres + pdraina + surg + edculture2 + eddose2 +
  mrsaabx + region + numbeds + census + hdesc2 + type2h2 +
  edadmit.y + hwamed

Final Model:
outcome ~ iecdispo + cci + immunocomp + hosp + numbeds

      Step Df      Deviance Resid. Df Resid. Dev      AIC
1                0 0.000000e+00      903  945.2669 1013.2669
2 - abscesspres  0 0.000000e+00      903  945.2669 1013.2669
3 - infectp      3 7.728639e-01      906  946.0398 1008.0398
4 - region      3 1.145756e+00      909  947.1855 1003.1855
5 - instypcat2  4 4.933152e+00      913  952.1187 1000.1187
6 - diab        1 6.138188e-07      914  952.1187  998.1187
7 - type2h2     1 2.931585e-04      915  952.1190  996.1190
8 - ltc90       1 4.627114e-04      916  952.1194  994.1194
9 - eddose2     1 3.240546e-02      917  952.1518  992.1518
10 - sex        1 4.632704e-02      918  952.1982  990.1982
11 - hdesc2     1 1.437045e-01      919  952.3419  988.3419
12 - mrsaabx    1 1.629897e-01      920  952.5049  986.5049
13 - edculture2 1 1.944124e-01      921  952.6993  984.6993
14 - distance   1 2.575314e-01      922  952.9568  982.9568
15 - abx90      1 3.460843e-01      923  953.3029  981.3029
16 - hwamed     1 4.197854e-01      924  953.7227  979.7227
17 - pdraina    1 4.423142e-01      925  954.1650  978.1650
18 - edadmit.y  1 4.948798e-01      926  954.6599  976.6599
19 - smoke      1 6.714391e-01      927  955.3313  975.3313
20 - phabsssi   1 1.199889e+00      928  956.5312  974.5312
21 - surg       1 1.111892e+00      929  957.6431  973.6431
22 - census     1 1.834438e+00      930  959.4775  973.4775
23 - age        1 1.910893e+00      931  961.3884  973.3884
>
>
> AIC(step)
[1] 973.3884
> |

```

Appendix 7. STATA Code and Output for Generalized Linear Model and Recycled Prediction

```

running C:\Program Files (x86)\Stata14\sysprofile.do ...

. doedit "\\netid.washington.edu\csde\other\desktop\sheshap\Desktop\sheila.do"

. import delimited "\\netid.washington.edu\csde\Other\Desktop\sheshap\Desktop\com
> pletecases_finalmodel.csv
(29 vars, 937 obs)

. do "C:\TEMP\82\STD00000000.tmp"

. gen admit=iecdispo

.

. replace admit=iecdispo
(0 real changes made)

. glm outcome admit cci immunocomp hosp numbeds, eform link(logit) family(binomi
> al)

Iteration 0:  log likelihood = -481.28026
Iteration 1:  log likelihood = -480.69451
Iteration 2:  log likelihood = -480.69421
Iteration 3:  log likelihood = -480.69421

Generalized linear models              No. of obs   =    937
Optimization      : ML                 Residual df   =    931
                                                Scale parameter =    1
Deviance          = 961.3884145         (1/df) Deviance = 1.032641
Pearson          = 942.2280654         (1/df) Pearson  = 1.01206

Variance function: V(u) = u*(1-u)      [Bernoulli]
Link function     : g(u) = ln(u/(1-u))  [Logit]

Log likelihood    = -480.6942073        AIC           = 1.038835
                                                BIC           = -5409.15

-----+-----

```

outcome	Odds Ratio	Std. Err.	z	P> z	[95% Conf. Interval]	
admit	.706108	.1282061	-1.92	0.055	.4946759	1.007909
cci	1.11571	.0471151	2.59	0.010	1.027084	1.211983
immunocomp	.364588	.178428	-2.06	0.039	.13971	.9514308
hosp	1.980664	.4153896	3.26	0.001	1.313091	2.98763
numbeds	1.000441	.0003015	1.46	0.143	.9998507	1.001032
_cons	.1863219	.0426971	-7.33	0.000	.1189062	.29196

```

. replace admit=0
(350 real changes made)

. predict outcome0
(option mu assumed; predicted mean outcome)

. replace admit=1
(937 real changes made)

. predict outcome1
(option mu assumed; predicted mean outcome)

.

. sum outcome*


```

Variable	Obs	Mean	Std. Dev.	Min	Max
outcome	937	.2187834	.4136421	0	1
outcome0	937	.2416325	.0760188	.0765132	.5708923
outcome1	937	.1852166	.0647877	.0552694	.4843815

```

. //TO SHOW THE DIFFERENCE IN MEAN OF OUTCOME0-OUTCOME1
. compare outcome0 - outcome1


```

	count	difference		
		minimum	average	maximum
outcome0>outcome1	937	.0212438	.0564159	.0867735
jointly defined	937	.0212438	.0564159	.0867735
total	937			

```

.
end of do-file
.

```