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RISING UNITED STATES HOSPITAL ADMISSIONS FOR GRAM+ ACUTE BACTERIAL SKIN AND SKIN STRUCTURE INFECTIONS (ABSSSIs)

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ABSTRACT

Background: In an era of healthcare reform, an important priority to reduce costs and produce savings is to decrease and avoid hospital stay since hospital admissions account for a large proportion of healthcare spending. Our objective was to characterize the recent trends and predictors of hospital costs for ABSSSI admissions in the US.

Methods: A retrospective cross-sectional database analysis was performed using the largest publicly available all-payer inpatient database, US Healthcare Cost and Utilization Project National Inpatient Sample (HCUP NIS), representing >1,000 hospitals with more than 8 million hospital stays per year, from 2005 to 2011. The analysis included adult (≥18 years) hospital admissions with a principal diagnosis of ABSSSI: 681.XX, 682.XX, 686.XX, 958.3, 998.5X, and 035. Descriptive and bivariate analyses were conducted to assess patient and hospital characteristics. Data were weighted using a "weight" variable provided by HCUP, to produce national estimates. Costs were inflated to 2012 USD.

Results: There were 4,891,187 adult ABSSSI hospital admissions representing roughly 2% of all hospital admissions from 2005 to 2011. Hospital admissions were predominantly in urban hospitals (85.4%) of large bed size (325 to >450 beds by region, 59.1%). ABSSSI patients were often white (60.3%) with mean age 55.7 years (±18.6 yrs), with Medicare insurance coverage (40.7%), moderate severity of illness and low risk of mortality at baseline. ABSSSI hospital admissions significantly increased over time by 17.3% from 2005 to 2011 (641,863 to 752,770 respectively, p<0.0001), while LOS significantly decreased over this time period (5.40 to 4.95 days, p<0.0001). The average total cost of an ABSSSI admission was $9,895 in 2011, with earlier years being >$10,000. Adjusted costs were greater in patients with post-operative wound infections ($9,388) compared to other ABSSSI diagnoses ($7,222 to $7,898). Adjusted healthcare costs nearly doubled when LOS increased to 3–6 days as compared to <3 days ($8,365 vs $4,820, respectively). APR-DRG severity of illness/mortality risk and type of infection were the common strongest predictors of mortality, LOS and costs, in addition to year of admission (for mortality), discharge disposition (for LOS), and LOS (for costs).

Conclusions: Nationally, ABSSSI related hospital admissions have increased in the recent years, while hospital LOS has significantly decreased by almost half a day which may indicate that more patients are being shifted to outpatient settings for some of their care.

BACKGROUND

- Outpatient treatment has become a common approach to manage patients presenting with ABSSSI to reduce the costs associated with inpatient hospital stay and treatment by as much as 6–10 times.[2]
- In the US, total hospital admissions for skin and soft tissue infections during 2000–2004 increased substantially by 29%[3] with downstream impact on risk of mortality, length of stay, and hospital costs.
- The objective of this study was to characterize the recent trends and predictors of hospital costs for ABSSSI admissions in the US.

METHODS

- A retrospective cross-sectional database analysis was performed from 2005 to 2011 using the US Healthcare Cost and Utilization Project National Inpatient Sample (HCUP NIS) dataset.[4]
- The HCUP NIS database contains hospital discharge data, representing roughly a fifth of all U.S. community hospitals, totaling over 8 million hospital stays per year.
  - It is the largest publicly available all-payer inpatient care database representing over 1,000 hospitals across 45 states
- The dataset includes information on:
  - Primary and secondary procedures,
  - Admission and discharge status,
  - Patient demographics (gender, age, race, median income),
  - Hospital characteristics (ownership, size, teaching status),
  - Insurance type,
  - Total healthcare charges (converted to costs using hospital specific cost to charge ratio),
  - Length of stay, and
  - Severity adjustment measures
- Inclusion criteria for the analysis includes hospital admissions with:
  - Patients ≥18 years of age
  - Primary diagnosis of ABSSSI was defined using the following ICD-9-CM codes:

Table 1. Inclusion Criteria (ICD-9) for the Primary Diagnosis Consistent with ABSSSI

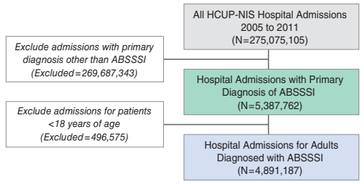
ICD-9 Codes	Description
681.XX	Cellulitis and abscess of finger and toe
682.XX	Other cellulitis and abscess
686.XX	Other local infections of skin and subcutaneous tissue
958.3	Posttraumatic wound infection, not elsewhere classified
998.5X	Postoperative wound infection
035	Erysipelas

- The ICD-9 codes selected are consistent with the ABSSSI infection types described in the FDA guidance.[5]
- All Patient Refined Diagnosis Related Groups (APR-DRGs) for Severity of Illness (SOI) and Risk of Mortality (ROM) were evaluated.
- Key comorbidities were identified by the Charlson-Deyo Comorbidity Index.
- Descriptive and bivariate analyses were conducted to assess patient and hospital characteristics as well as total healthcare costs. Multivariable analysis using generalized linear model (GLM- gamma distribution, loglink) was used to assess factors associated with total healthcare costs. Least squares (LS) means (i.e. covariate adjusted groups means) for LOS and cost were calculated, holding the covariates at its mean value.
- For all analyses, data were weighted to produce national estimates using a variable provided by HCUP. Costs were inflated to 2012 USD.

RESULTS

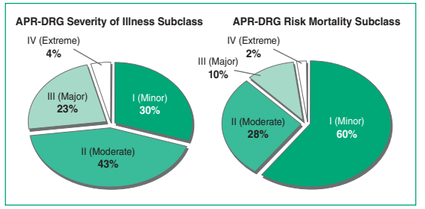
- Admissions due to ABSSSI infection types (n=4,891,187) made up 1.8% of all hospital admissions.

Figure 1. Patient Cohort Included for Analysis



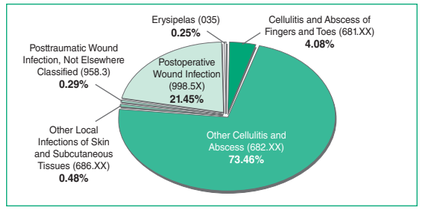
- ABSSSI patients were primarily:
  - Male (50.8%)
  - White (60.3%)
  - Mean age = 55.7 (±18.6) years
  - Medicare insurance status (40.7%)
  - Routine discharge from the hospital (53.8%)
  - APR-DRG Risk of Mortality Class I (60.38%) and Severity of Illness Class I (30%) and II (43%). See Figure 2.
- Most of the discharges were contributed by hospitals that were:
  - Large in size (>325 beds; 59.1%)
  - From the South (39.0%)
  - Urban location (85.4%)
  - Privately (Non-profit) owned (71.0%)
  - With a non-teaching status (55.3%)
- The most prevalent comorbidities (for all years) were diabetes (25.2%), COPD (17.3%), CHF (10.3%), moderate to severe renal disease (9.3%), peripheral vascular disease (6.2%), and diabetes with complications (5.5%). There was a significant change in number of comorbidities over time (p<0.0001) with a significant decrease in the percent of patients without comorbidities in the 2005–2011 timeframe from 3.5% in 2005 to 1.9% in 2011 (p<0.0001) among patients admitted with ABSSSI.

Figure 2. APR-DRG Severity of Illness and Risk of Mortality Distribution



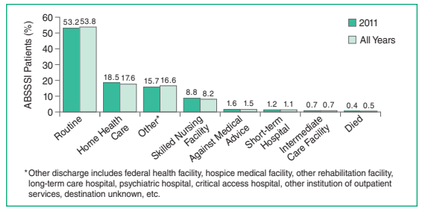
- The most common type of ABSSSI was other cellulitis and abscess followed by postoperative wound infection and cellulitis and abscess of fingers and toes.

Figure 3. ABSSSI Patients by Infection Type



- The most common type of hospital discharge for all the years was routine discharge (53.8%) followed by discharge with home health care (17.6%) (Figure 4).

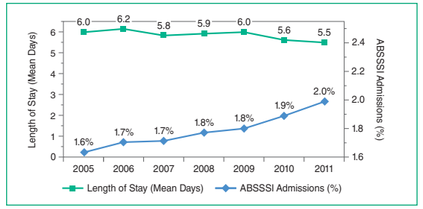
Figure 4. Discharge Disposition for Hospitalized ABSSSI Patients



*Other discharge includes federal health facility, hospice medical facility, other rehabilitation facility, long-term care hospital, psychiatric hospital, critical access hospital, other institution of outpatient services, destination unknown, etc.

- From 2005 to 2011, ABSSSI infection rate significantly increased (p<0.0001) while length of stay significantly decreased in this time period (P<0.001) (Figure 5).
- Total inpatient costs did not significantly differ ($10,376 in 2005 vs $9,895 in 2011) and mortality rate remained constant over time.

Figure 5. ABSSSI Admissions and Length of Stay per Year



- Patients with postoperative wound infection (5.8 days) had the longest length of hospital stay (Table 2).

Table 2. Length of Stay by Infection Type for ABSSSI Patients

Outcome	Type of Infection	Adjusted Means* (95% CI)
Length of Stay (days)	Other Cellulitis	4.53 (4.53–4.54)
	Cellulitis—Fingers/toes	4.76 (4.73–4.79)
	Other Infections†	5.13 (5.07–5.20)
	Postoperative Wound Infection	5.81 (5.80–5.83)

* LS Means, adjusted for patient demographics (age, sex, race, insurance, year of admission, discharge disposition), hospital characteristics (region, location, size, teaching status) and APR-DRG severity of illness
†post-traumatic wound infections, erysipelas and other SSTIs are grouped together as 'other infections' due to low sample size

- APR-DRG risk of mortality and year of admission were the strongest predictors of mortality. Discharge disposition, APR-DRG severity of illness and type of infection were the strongest predictors of length of hospital stay; and APR-DRG severity of illness measure, LOS and infection type were the strongest predictors of cost.
- Total costs were stratified by type of infection (Table 3) as well as length of inpatient stay and were adjusted for patient demographics, hospital characteristics, and APR-DRG severity of illness.
- Hospital admissions with a diagnosis of postoperative wound infection had the highest total cost ($9,388).

Table 3. Total Costs for ABSSSI Patients by Type of Infection

Outcome	Type of Infection	Adjusted Means* (95% CI)
Total Costs	Other Cellulitis	$7,222 ($7,214–$7,231)
	Cellulitis—Fingers/toes	$7,724 ($7,684–$7,764)
	Other Infections†	$7,898 ($7,818–$7,980)
	Postoperative Wound Infection	$9,388 ($9,366–$9,410)

* LS Means, adjusted for patient demographics, hospital characteristics and severity of illness
†post-traumatic wound infections, erysipelas and other SSTIs are grouped together as 'other infections' due to low sample size

- Inpatient admissions with length of stay of 3 to 6 days were approximately 75% more expensive than hospital admissions of less than 3 days (Table 4).

Table 4. Total Costs for ABSSSI Patients by Length of Stay

Outcome	Length of Stay	Adjusted Means* (95% CI)
Total Costs	Less than 3 Days	$4,820 ($4,813–$4,828)
	3–6 Days	$8,365 ($8,350–$8,380)
	More than 6 Days	$17,462 ($17,419–$17,504)

* LS Means, adjusted for patient demographics, hospital characteristics and severity of illness

CONCLUSIONS

- ABSSSI-related hospital admissions continue to significantly increase at the national level contributing to clinical and economic burden in the healthcare system.
- Inpatient admissions among ABSSSI patients lasting more than 3 days are three times more expensive than those lasting less than 3 days.
  - Patients discharged in less than 3 days accrue half the costs of those patients in the hospital 3–6 days.
- Hospital inpatient length of stay has significantly decreased by almost half a day in recent years which may indicate that more patients are being shifted to outpatient settings of care to continue their treatment and reduce hospital costs. Hospital costs have not decreased during this same time period.

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Presented at SHM 2014, March 24–27, 2014, Las Vegas, Nevada, USA.
Research funding provided by Durata Therapeutics, Inc.