Secular Trends in *Staphylococcus aureus* Bloodstream Infections over Four Decades

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UPDATED ABSTRACT

Background:
The epidemiology of bloodstream infections due to *Staphylococcus aureus* (SA-BSI) has changed dramatically over the last several decades with the widespread use of intravascular catheters, the emergence and spread of methicillin resistant *S. aureus* (MRSA) and the rise of community-onset infections. We examined secular trends in SA-BSI occurring from 1980 to 2013 with particular focus on MRSA, source of BSI and location of onset.

Methods:
Records were reviewed for all patients with SA-BSI who were hospitalized at one academic medical center. Rates of SA-BSI per 1,000 discharged patients were calculated for the first four years of four decades (1980-1983, 1990-1993, 2000-2003 and 2010-2013). Temporal trends were assessed for proportion of SA-BSI due to MRSA and attributed source.

Results:
Rates of SA-BSI increased from the 1980-3 study period through the 2000-3 study period however both hospital-onset and community-onset BSIs decreased in the last study period (Figure). In the 1980-3 study period there was only one central line-associated BSI (CLABSI) and two MRSA BSIs. The increase in SA-BSI through 2000-3 was driven by an increase in CLABSI for both hospital-onset and community-onset BSIs; in the 2000-3 period, 75/235 hospital-onset and 166/400 community-onset SA-BSIs (127 of which were dialysis catheter related) were CLABSIs. Hospital-onset SA-BSI decreased by 66% in the 2010-13 period with 40/81 SA-BSI being CLABSIs. Since 2000-3, MRSA has accounted for about half of all SA-BSI although there was a decrease in the proportion of hospital-onset SA-BSI caused by MRSA over the last two study periods, from 57.0% in 2000-3 to 51.9% in 2010-13.

Conclusion:
There was an increase in SA-BSI in the first three decades of the study period, in large part due to CLABSIs in and outside the hospital. In the last decade there has been a decrease in SAB, with a marked decrease in hospital-onset infections, including a decrease in CLABSI. While MRSA still causes almost half of all SA-BSI, there was a notable decrease in hospital-onset MRSA in recent years.

INTRODUCTION

- *Staphylococcus aureus* is one of the leading causes of bloodstream infections[1]
- We previously reported an increase in hospital and non-hospital acquired *Staphylococcus aureus* bloodstream infections (SAB) from 1980 through the 1990s[2]
- After notable increases of MRSA infections in the early 2000's, the rates of *S. aureus* infection, particularly MRSA infections have been decreasing in recent years[3,4]
- In this study we describe the changing epidemiology of SAB from 1980 through 2013 in a large urban teaching hospital in the U.S

METHODS

Setting

- Emory University Hospital Midtown, a 500-bed acute care teaching hospital in Atlanta, GA

Data Collection

- Bloodstream infections due to *S. aureus* were identified by routine laboratory-based surveillance
- Periods from 1980-1983, 1990-1993, 2000-2003, and 2010-2013 were compared
- The source of infection was determined by an infection preventionist or hospital epidemiologist using chart review
- All patients identified were admitted to the hospital; no patients were diagnosed and treated as outpatients

Definitions

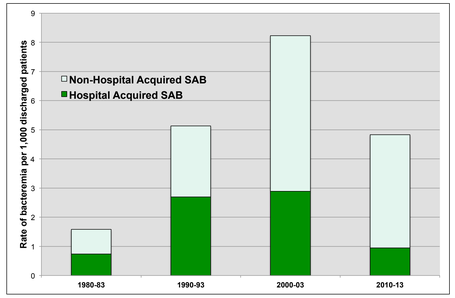
- Hospital acquired: SAB occurring >48h after admission or, for re-admissions, evidence that infection was incubating at time of recent hospital discharge
- Healthcare-associated (HCA): SAB occurring <48h after admission in a patient who had surgery, previous hospital admission, dialysis or residence in long-term care within the last 12 months; permanent indwelling catheter or percutaneous medical device present at time of culture (e.g. gastrostomy tube, urinary catheter or tracheostomy tube); or previous MRSA infection/ colonization – only available for last 2 study periods
- Community-acquired (CA): all remaining
- SAB was attributed to the intravascular catheter if there was a positive catheter tip culture, purulence at the exit site or when a central venous catheter was present without other identifiable source of SAB

Statistical Analysis

- Mantel-Haenszel X^2-test was calculated for correlations using SAS version 9.4 (SAS Institute).
- Rates were calculated using the number of patients discharged during each study period

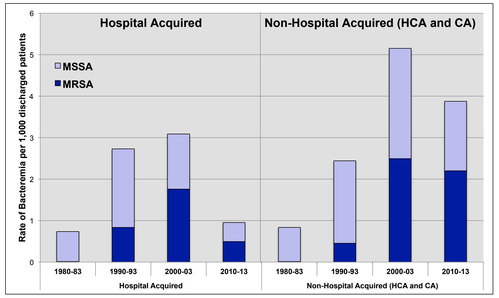
RESULTS

Figure 1 – Overall SAB Infection Rates



- After two decades of increase, the rate of SAB has decreased
- From the 2000-3 study period until 2010-13, the rate of hospital onset SAB decreased by 67%
- In 2010-13, 76% of SAB were non-hospital acquired

Figure 2 – Hospital and Non-Hospital SAB Rates Since 1980



- Both MSSA and MRSA rates have decreased over the last decade
- Among hospital acquired infections between 2000-3 and 2010-13, MRSA rates decreased 72% and MSSA 65%. Among non-hospital acquired infections, these decreases were 12% and 37%, respectively

Table 1 – Sources for Hospital Acquired SAB

Source	1980-83 MRSA/Total	1990-93 MRSA/Total	2000-03 MRSA/Total	2010-13 MRSA/Total
IV catheters	1/16	30/128	53/93	16/40
Unknown	0/23	12/54	38/56	8/16
Surgical site	0/10	15/19	13/31	2/2
Skin/decubitus	0/3	6/9	7/13	5/7
Respiratory tract	0/5	6/11	8/14	4/6
Dialysis shunt/fistula	--	1/3	6/10	3/4
Other	0/8	3/6	9/18	4/6
Total	1/65	73/230	134/235	42/82

- Significant decrease in the number of IV catheter related SAB in the 2010-13 period compared with the previous two study periods ($p < 0.01$), however IV catheters remain the leading cause of nosocomial SAB
- Proportion of hospital acquired SAB caused by MRSA decreased from 57.0% in 2000-3 to 51.9% in 2010-13

Table 2- Sources for Non-Hospital Acquired SAB

Source	1980-83 MRSA/Total	1990-93 MRSA/Total	2000-03 MRSA/Total HCA	2000-03 MRSA/Total CA	2010-13 MRSA/Total HCA	2010-13 MRSA/Total CA
IV catheters	0/0	8/43	73/167	--	56/99	--
Unknown	0/27	8/43	42/74	2/7	22/45	5/9
Dialysis shunt/fistula	1/18	5/28	10/31	--	12/32	--
Skin/decubitus	0/7	13/44	19/34	3/10	31/47	13/17
Bone/joint	0/4	0/11	10/21	1/2	15/30	0/1
Respiratory tract	0/10	0/4	11/12	2/3	8/12	4/4
Intravenous drug use	0/2	0/4	1/1	0/1	0/0	2/4
Other	0/6	4/14	15/28	2/2	18/29	1/1
Total	1/74	37/200	181/368	10/25	162/294	25/36

- True community-acquired SAB remains uncommon, despite an increase in skin related infections among CA patients. Only 11% (36/330) of non-hospital acquired SAB during the 2010-13 study period met our definition of CA infection

Table 3 – Types of IV Catheters Associated with SAB

Study period	Total	PIV	Central venous	Tunneled	Ports	PICC	Hemodial.	Other
Hospital Associated								
1980-83	16	5	7	0	0	0	**0**	4
1990-93	128	23	42	8	32	0	**3**	20
2000-03	93	18	27	0	12	17	**13**	5
2010-13	40	8	5	0	8	7	**11**	1
Healthcare Associated								
1980-83	0	0	0	0	0	0	**0**	0
1990-93	43	2	1	4	21	0	**14**	1
2000-03	167	1	2	0	20	11	**128**	5
2010-13	99	1	1	0	13	7	**74**	3

•PIV: Peripheral IV; PICC: Peripherally-Inserted Central Catheter

- After the early 1990's dialysis catheters emerged as a leading cause of catheter-associated SAB occurring outside the hospital
- There has been a marked decrease in dialysis catheter-associated SAB in the past decade, but these lines are still a major source of SAB

CONCLUSIONS

- After two decades of increase, we observed a marked decrease in SAB occurring inside the hospital
- There was a smaller decrease in SAB occurring outside the hospital in the last study period in due largely to a decrease in dialysis catheter associated infections
- Although the percent of MRSA causing SAB in the hospital has decreased, it still accounts for more than half of all SAB
- While there was an increase in community acquired SAB in the last study period, most (89%) of these non-hospital acquired episodes are healthcare-associated
- Intravascular catheters are still a leading source for infections both in and outside of the hospital
- In our urban setting, hemodialysis catheters are the most common cause of SAB occurring outside of the hospital

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