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National bloodstream infection surveillance in Switzerland 2008-2014: Patterns and trends differ between university and community hospitals

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REVISED ABSTRACT

Background: In light of the recently described shift in bloodstream infections towards Gram-negative bacteria, we wanted to elucidate the epidemiology of bloodstream infections in Switzerland, comparing selected pathogens in both community (CH) and university hospitals (UH).
Methods: Data on bloodstream infections from 2008 to 2014 were obtained from the representative Swiss infection surveillance system ANRESIS. Using descriptive statistics we compared pathogen prevalence over time in all 26 participating acute care hospitals. We performed a subanalysis of community-acquired (CA) and hospital-acquired (HA) bloodstream infections in CH and UH.
Results: We analyzed a total of 42'802 bloodstream infection episodes. The most common etiologies were *E. coli* (28.3%), *S. aureus* (12.4%) and polymicrobial bloodstream infections (11.4%). The proportion of *E.coli* increased from 27.5% in 2008 to 29.6% in 2014 (p=0.04).
E. coli and *S. aureus* were more commonly reported in CH (34.3% vs 22.7%, p<0.001 and 13.9% vs 11.1%, p<0.001, respectively). Fifty percent (21'308) of episodes were CA, with *E. coli* again being more common in CHs (41.0% vs 32.4%, p<0.001). The proportion of *E. coli* in CA bloodstream infections even increased over time in CH. In contrast, CA-polymicrobial infections (9.9% vs 5.6%, p<0.001) and CA-CoNS (6.7% vs 3.4%, p<0.001) were more prevalent in UH, and their frequency in UH was more pronounced in the HA subset of bloodstream infections.
Conclusion: *E. coli*'s role as predominant pathogen in bloodstream infections in Switzerland has recently become more pronounced. There are distinct patterns in CHs and UHs, potentially influencing empiric antibiotic treatment.

INTRODUCTION

- Demographic changes and advances in medical technology have changed the epidemiology of bloodstream infections over the last decades, resulting in a shift in the pathogen spectrum toward Gram-negative bacteria (1). As epidemiology guides empiric antimicrobial therapy, it needs to be reassessed periodically.
- While a new category of healthcare-associated bloodstream infections to distinguish "true" community acquisition from those with previous healthcare exposure has been validated (2), the distinction between university centers (UH) and community hospitals (CH) has received less attention (3).
- The present study elucidates the epidemiology, etiology and temporal changes of bloodstream infection episodes (BSI) in community and university hospitals in Switzerland from 2008 to 2014, using data accrued by the national bloodstream infection surveillance database.

Figure 1: Distribution of microorganisms
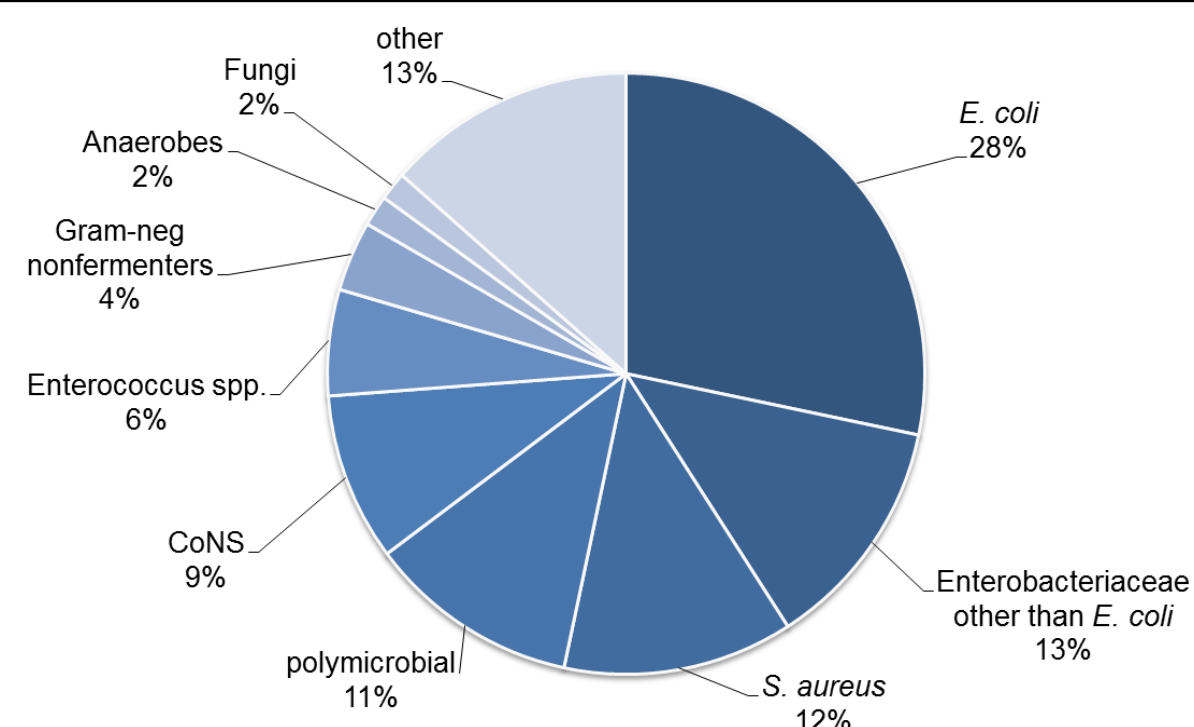
METHODS

Design and setting
We conducted a longitudinal, observational, retrospective, multicenter study on BSI in Switzerland from 2008 to 2014. Data on BSI were obtained from the national bloodstream infection surveillance database (ANRESIS), which collects microbiological data from laboratories of different hospitals.
We restricted the dataset to 26 acute-care hospitals (33.7% of all Swiss acute-care hospital beds) that continuously reported BSI information throughout the study period.

Definitions
Positive cultures were grouped as a bloodstream infection episode (BSI) if they occurred within a 7 day-window in an individual patient. If another set of cultures was obtained >7 days after the most recent positive blood culture result, it was considered a separate episode.
Contaminant episodes were defined as episodes including only one positive culture of a typical contaminant microorganism (coagulase-negative staphylococci [CoNS], Corynebacterium spp., etc.) and were excluded from the analysis. A BSI was defined as polymicrobial if different microbial species were isolated from ≥1 cultures within the same episode.

Analysis and statistics
Descriptive statistics were used to compare selected categories of pathogen over time. The analysis was stratified by variables listed in Table 1. Patterns and temporal trends were calculated for the four major microorganism groups.
BSI for which the hospitalization date was available were grouped into hospital-acquired (HA) (positive blood culture > 2 days after admission) and community-acquired (CA). Both HA and CA BSI were further differentiated into infections occurring in community (CH) and university hospitals (UH).
All analyses were conducted with the free statistical package R. P-values <0.05 were deemed significant, corrected for multiple testing as appropriate.

Table 1: Characteristics of the four major microorganism groups

	E. coli		*S. aureus*		CoNS		Polymicrobial	
Sex	p < 0.001		p < 0.001		p < 0.001		p < 0.001	
Female	6475	36.4%	1914	10.8%	1380	7.8%	1730	9.7%
Male	5626	22.5%	3402	13.6%	2494	10.0%	3160	12.6%
Age	p < 0.001		p < 0.001		p < 0.001		p < 0.001	
< 65	4129	**22.4%**	2470	13.4%	2097	11.4%	2349	12.7%
≥ 65	7973	**32.8%**	2846	11.7%	1773	7.3%	2540	10.4%
Region	p < 0.001		p = 0.2		p < 0.001		p < 0.001	
Northeast	6350	**24.5%**	3298	12.7%	3088	11.9%	3324	12.8%
Southwest	5753	**34.1%**	2019	12.0%	786	4.7%	1569	9.3%
Department	p < 0.001		p = 0.2		p < 0.001		p < 0.001	
ICU	679	**13.5%**	632	12.6%	792	**15.8%**	936	**18.6%**
Gen. wards	5193	**23.7%**	3041	13.9%	2427	**11.1%**	2793	12.7%
Acquisition	p < 0.001		p < 0.001		p < 0.001		p < 0.001	
CA	7954	**37.3%**	2530	11.9%	1015	**4.8%**	1580	**7.4%**
HA	1508	**16.9%**	1211	13.6%	1315	**14.8%**	1359	**15.3%**
Hospital type	p < 0.001		p < 0.001		p < 0.001		p < 0.001	
CH	7026	**34.3%**	2839	13.9%	1164	**5.7%**	1560	**7.6%**
UH	5077	**22.7%**	2478	11.1%	2710	**12.1%**	3333	**14.9%**

Figure 2: Microorganisms in CA and HA BSIs, grouped by hospital type
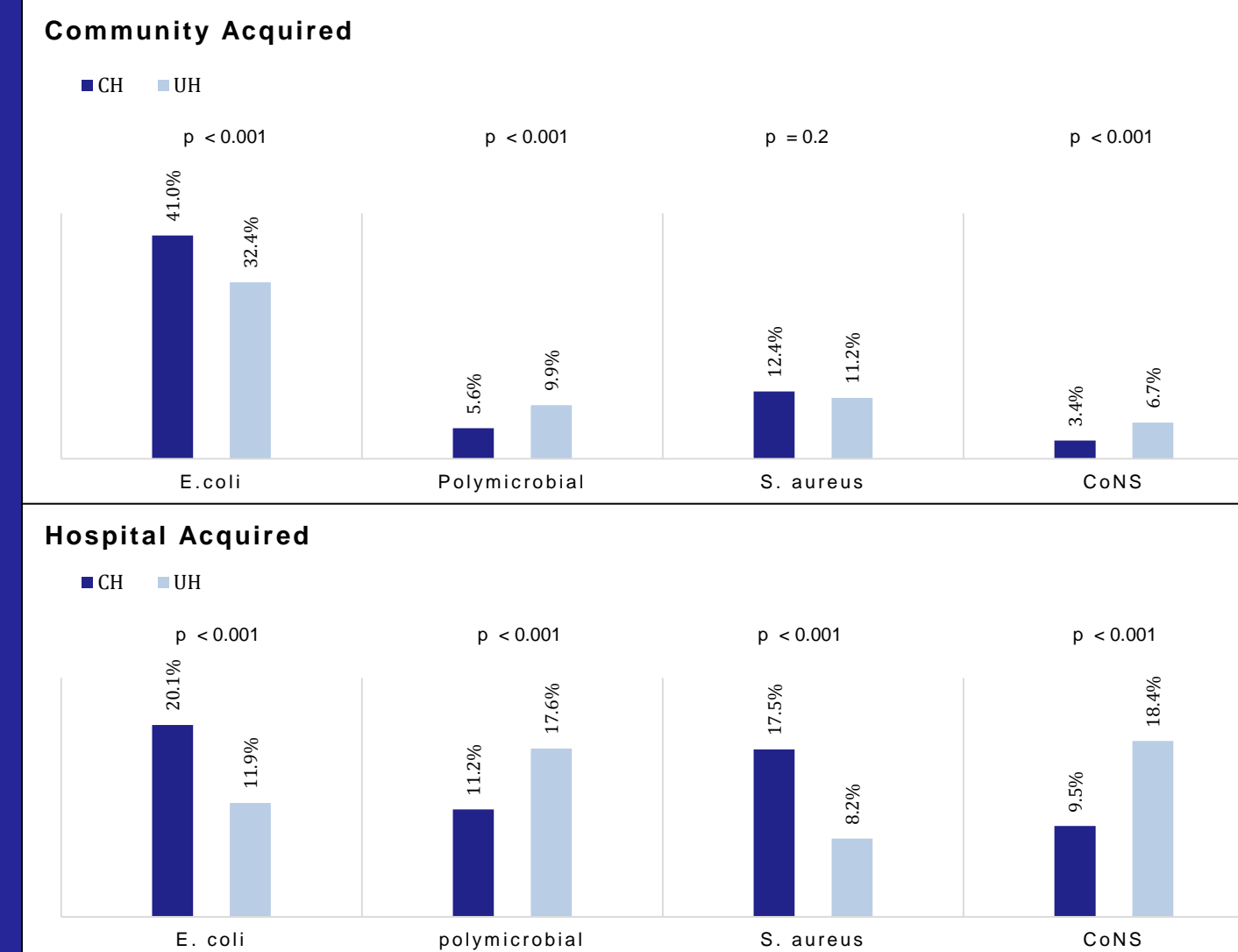
Figure 3: Trends from 2008 to 2014
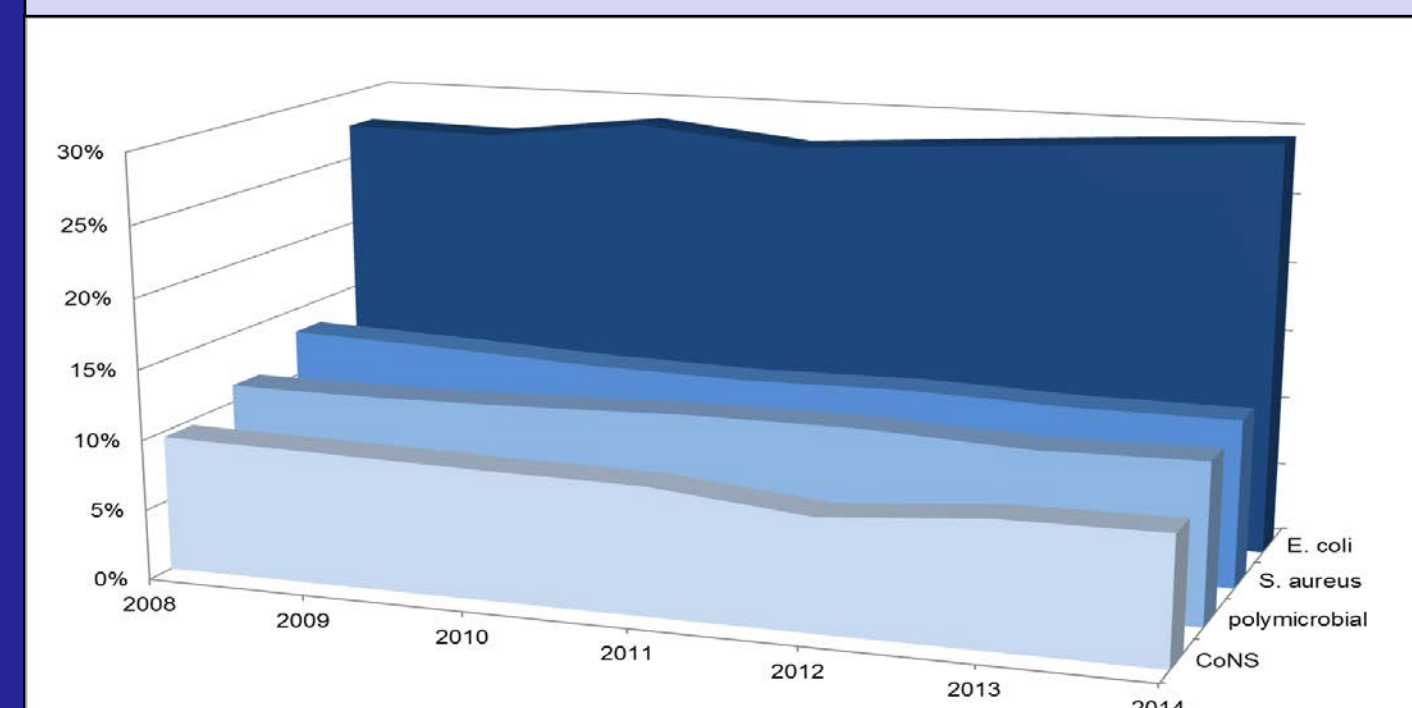
Figure 4: Trends in UH and CH, by site of acquisition

Community hospitals (CH): solid line. University hospitals (UH): dotted line.
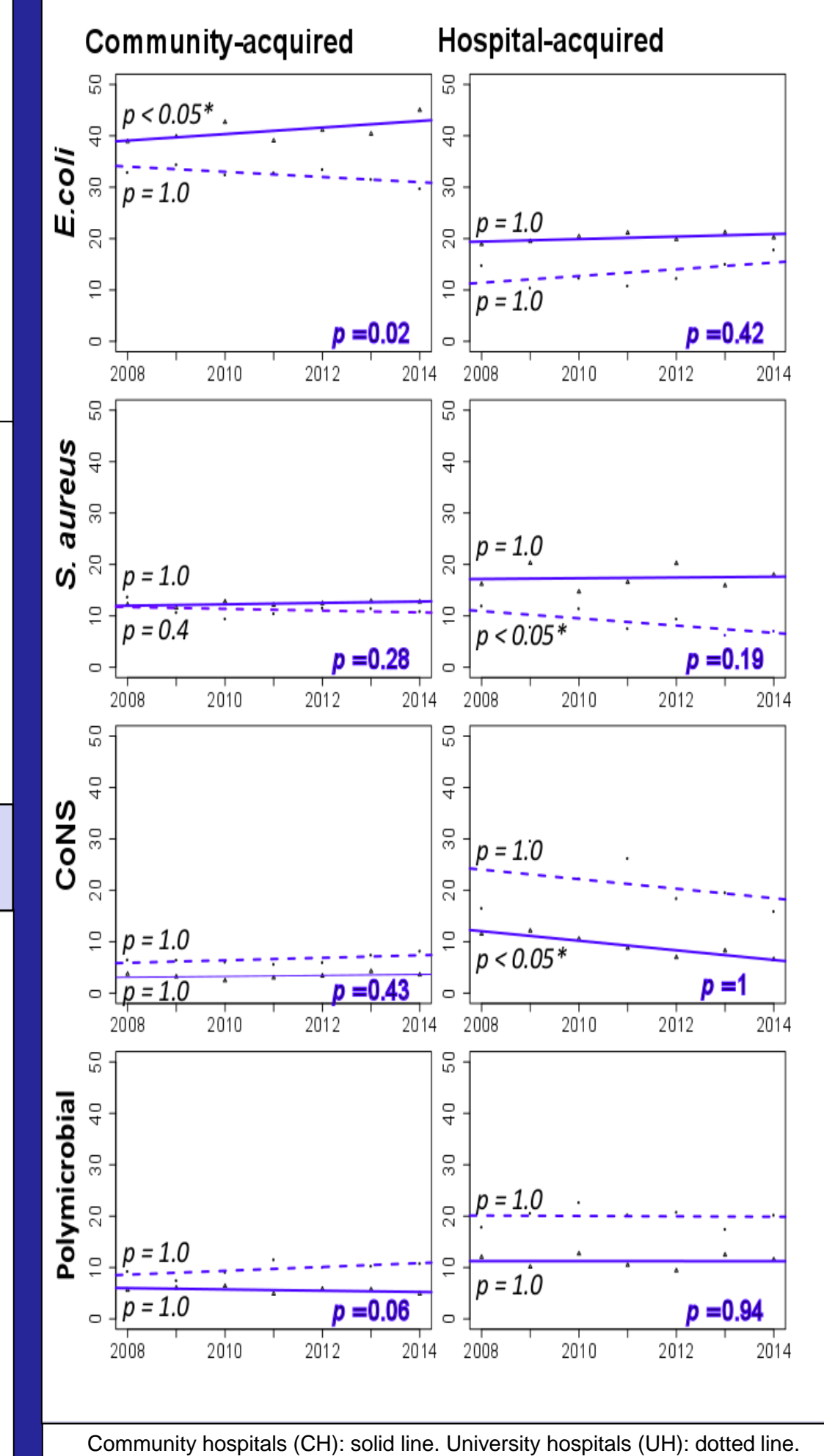
CONCLUSIONS

- **E. coli** maintained a **predominant role** in BSIs, its importance becoming even more pronounced.
- **S. aureus** was the second most frequent pathogen identified, predominated in **hospital-acquired infections** in community hospitals, and saw its prevalence decrease between 2008 and 2014.
- Difficult to treat infections, **CoNS** and **polymicrobial BSIs** remained important, especially in the **hospital-acquired** subset and in **university hospitals**.
- To our knowledge, this is the first nationwide study describing a **divergent epidemiology of BSI between community hospitals and university hospitals**, with *E. coli* representing almost 50% of episodes in community-acquired BSI in community hospitals in 2014.
- The choice of **empiric antibiotic treatment should be based on local epidemiology considering the type of hospital**. A reduced use of broad-spectrum antimicrobial agents (e.g., antibiotics against Oxacillin-resistant strains) could be envisioned for the treatment of CA and HA infections in community centers.

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3) Rodriguez-Bano, J., et al., *Epidemiology and clinical features of community-acquired, healthcare-associated and nosocomial bloodstream infections in tertiary-care and community hospitals.* Clin Microbiol Infect. 2010. **16**(9): p. 1408-13.
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