



# Estimated Burden of Methicillin-Resistant *Staphylococcus aureus* in California Hospitals following Changes to Administrative Codes, 2005-2010

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## Background

- Methicillin-resistant *Staphylococcus aureus* (MRSA) is one of the most important healthcare-associated pathogens when accounting for diversity of disease and propensity for widespread transmission.
- However, past studies have shown poor accuracy when using ICD-9 codes for measures of healthcare-associated infections.
- In the absence of a specific codes for MRSA as well as codes distinguishing MRSA infection from colonization, accurate estimates of MRSA disease from administrative data have been difficult to obtain.
- Beginning in October 2008, separate ICD-9 codes for MRSA pneumonia, septicemia, and unspecified infection were created. In addition, separate codes for MRSA colonization and a personal history of MRSA were instituted to improve the distinction between MRSA infection and colonization.

## Objective

- Assess the adoption of revised MRSA ICD-9 codes in California hospitals from 2005 to 2010 and their impact on estimates of MRSA disease burden.

## Study Design

- Population-based retrospective cohort study of all adult (≥18 years old) patients discharged from California acute-care hospitals during January 2005–December 2010.
- Low volume hospitals (<1,000 admissions per year) excluded.
- MRSA carriage** - presence of MRSA based upon any MRSA code, regardless of a designation of infection, colonization or personal history.
- MRSA infection** - based upon available codes before and after October 1, 2008 (pre-2008 vs post-2008).
  - Pre-2008: MRSA pneumonia (482.41 plus V09.0), MRSA septicemia (038.11 plus V09.0), and unspecified MRSA infection (041.11 plus V09.0)
  - Post-2008: MRSA pneumonia (482.42), MRSA septicemia (038.12), and unspecified MRSA infection (041.12)
- MRSA colonization** - use of either of the post-2008 MRSA newly-created codes of MRSA colonization (V02.54) or personal history of MRSA (V12.04).
- Calculated quarterly rates per 1,000 total admissions
- Using an interrupted time series design, we assessed changes in level and trend after institution of revised MRSA ICD-9 codes using segmental regression models.
- To evaluate the sensitivity of the MRSA personal history code, we identified all patients in the post-2008 period with a MRSA infection code to see if on next readmission (to any hospital) patients were coded with a MRSA personal history code.

## MRSA Patient Characteristics

Patient Characteristics	2005-2010 Admissions (%)	Pre-2008 MRSA Carriage/Infections (%)	Post-2008 MRSA Carriage (%)	Post-2008 MRSA Infections (%)
Hospitalizations (N)	17,354,517	170,356	154,779	95,518
Male	37.8	56.3	53.3	55.9
Age				
18-44	34.6	21.4	17.5	18.7
45-64	26.9	33.3	33.1	34.1
65-84	29.3	33.3	34.9	33.7
≥85	9.2	12.0	14.6	13.5
Race				
White	68.8	72.5	71.6	70.9
Black	8.8	11.2	11.2	11.0
Asian	8.2	5.6	6.0	6.2
Comorbidities				
Diabetes	21.6	37.8	39.3	39.4
Renal Disease	10.0	16.4	25.9	24.8
Liver Disease	2.8	3.7	4.4	4.3
Cancer	8.1	6.7	9.3	7.1
Surgery	32.3	27.5	23.2	26.1
Length of Stay				
≤2 days	44.3	7.9	14.3	8.9
3-4 days	28.8	17.4	23.0	19.6
5-6 days	11.1	16.5	17.3	16.9
7-8 days	5.7	13.1	12.0	12.8
>8 days	10.0	45.1	33.3	41.9
Insurance Type				
Medicare	39.2	52.7	57.9	55.3
Medicaid	20.0	18.0	17.1	18.4
Commercial	32.3	17.7	16.6	16.1

Note. Categories of MRSA infection and carriage are defined the same in the pre-2008 period as only MRSA infection ICD-9 codes were present during this period.

## Trend & Impact of Revised Codes

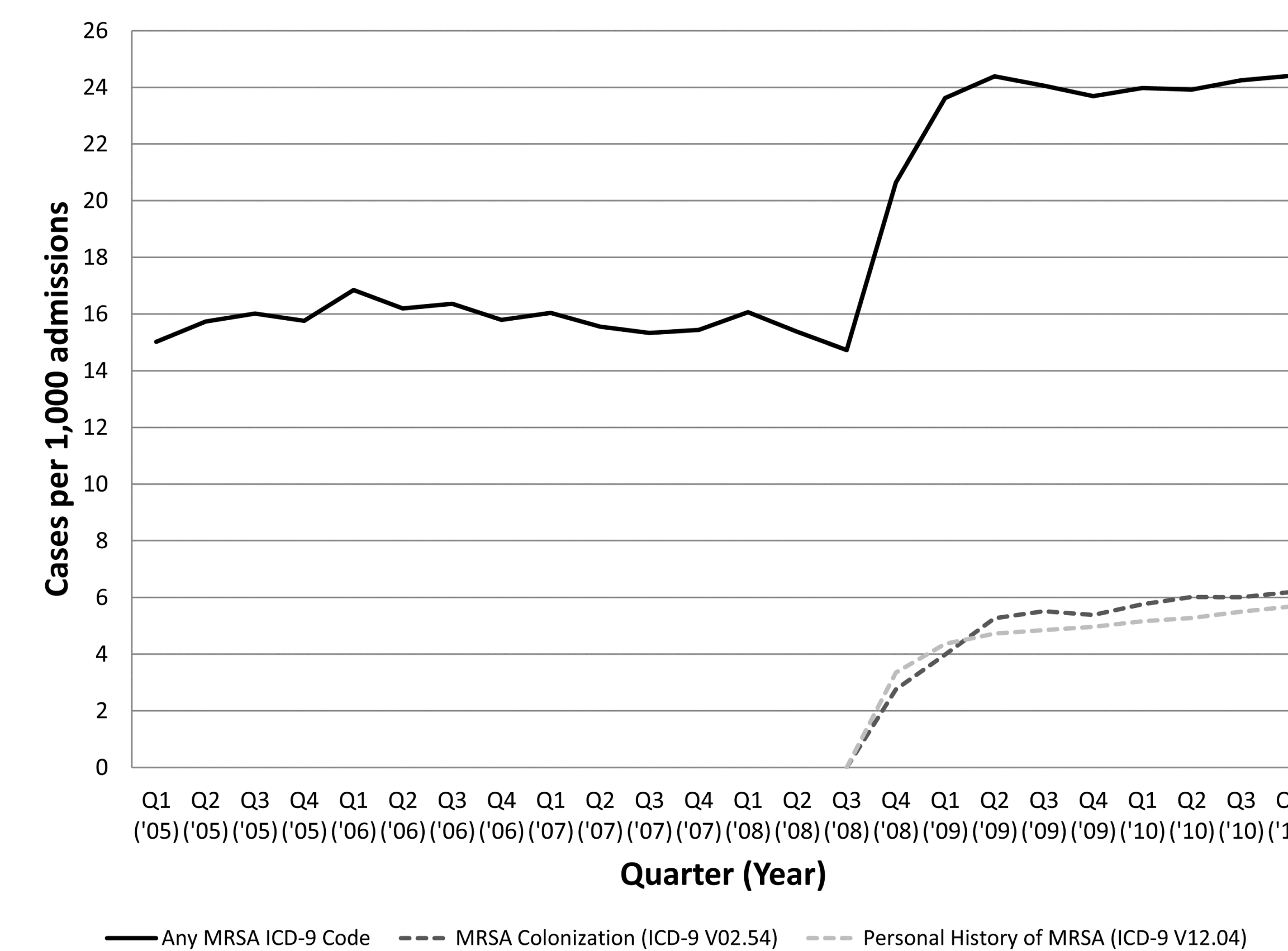
MRSA Designation	Level Change After Intervention		Trend After Intervention (Post-2008)	
	Estimate	P	Estimate	P
Carriage	6.9	<0.0001	0.3	<0.01
Any Infection	0.8	0.06	-0.3	<0.001
<b>MRSA Infections</b>				
Pneumonia	0.1	0.50	-0.07	<0.01
Septicemia	-0.02	0.75	-0.05	<0.01
Unspecified	0.3	0.55	-0.1	0.11
<b>Community-Onset MRSA Infections</b>				
Pneumonia	0.1	0.50	-0.07	<0.01
Septicemia	-0.05	0.49	-0.04	<0.01
Unspecified	0.4	0.41	-0.1	0.17
<b>Hospital-Onset MRSA Infections</b>				
Pneumonia	0.09	<0.01	-0.03	<0.0001
Septicemia	0.03	0.15	-0.01	<0.01
Unspecified	-0.06	0.14	-0.02	0.02

<sup>a</sup>Abrupt change in MRSA rates immediately after institution of revised ICD-9 MRSA codes.  
<sup>b</sup>Change in slope after institution of revised ICD-9 MRSA codes.  
<sup>c</sup>Parameter estimates can be interpreted as a continuing increase or decrease in prevalence of MRSA infection cases per 1,000 patient admissions for each sequential yearly quarter.  
 Note. Methicillin Resistant *Staphylococcus aureus*, MRSA; *International Classification of Disease, Ninth Revision*, ICD-9.

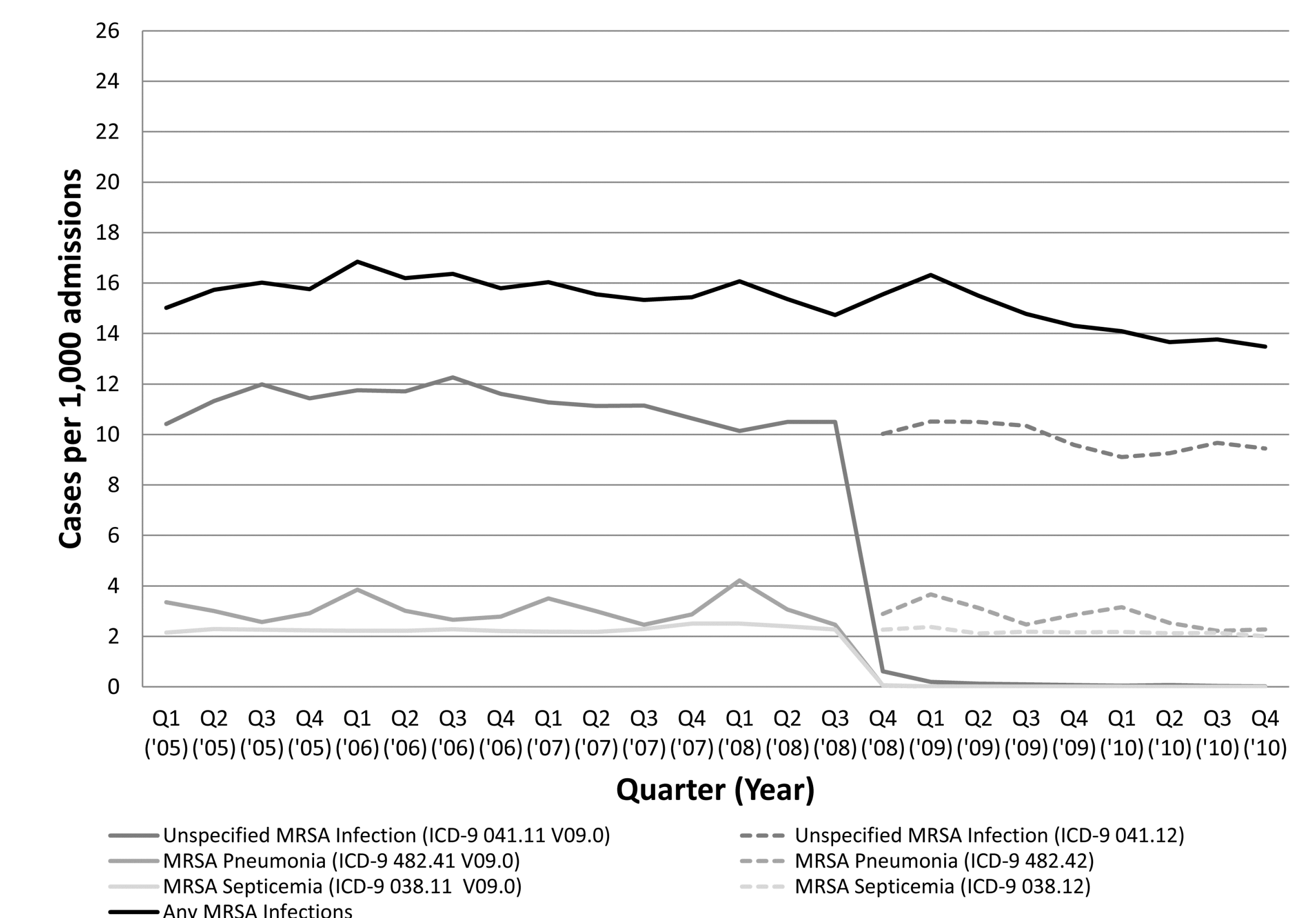
## Results

- During the 6-year study period, there were 17,354,517 adult admissions to 340 California hospitals; 1.9% of admissions with MRSA carriage and 1.5% of admissions with MRSA infection.
- MRSA carriage rates increased from 15.8 to 23.7 cases per 1,000 admissions in the pre-2008 to the post-2008 periods, while average rates of MRSA infection declined from 15.8 to 14.6 cases per 1,000 admissions.
- Although there was no immediate change in overall MRSA infection rates following the coding change, MRSA infections showed a decreasing trend of 0.3 cases per 1,000 admissions in the post-2008 period (p<0.001).
- However, immediately after the introduction of the revised MRSA codes, MRSA carriage increased by 6.9 cases per 1,000 hospital admissions (p<0.0001), followed by an increasing trend of 0.3 cases per 1,000 admissions (p<0.01).
- Of those with either a MRSA colonization or MRSA personal history code, only 22.0% (5,820/26,502) maintained one of the two codes on next admission.
- If all patients admitted in 2010 were evaluated in that year and the preceding two years for a MRSA ICD-9 code, we found that 4.9% of patients were known to have MRSA.

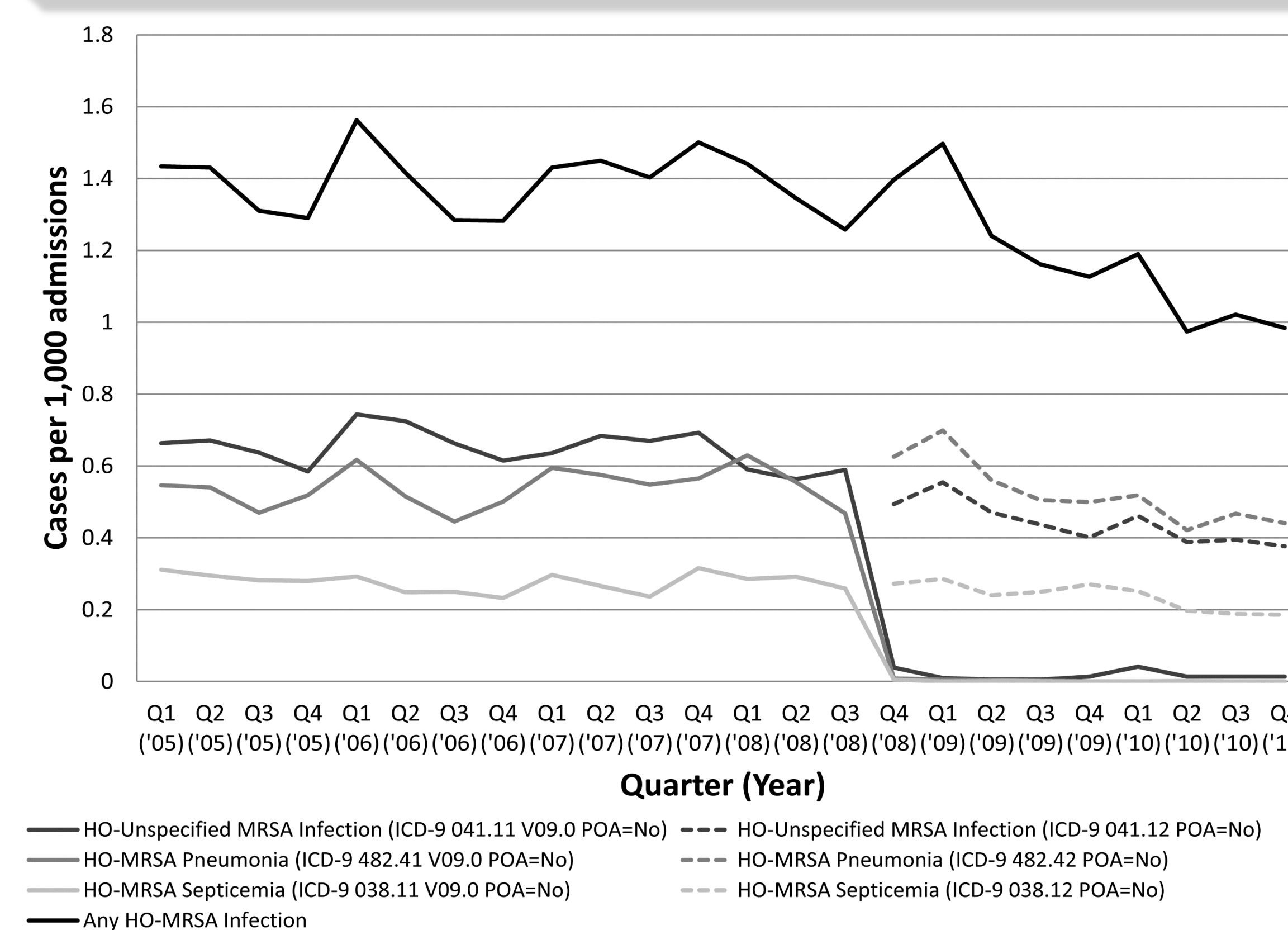
## Rates of MRSA Colonization



## Rates of MRSA Infections



## Rates of HO-MRSA Infections



## Conclusion

- After the 2008 ICD-9 revision, there was a near-instantaneous transition of prior to revised MRSA specific ICD-9 infection codes.
- We did not see immediate shift in infection rates after the institution of separate infection and colonization codes in 2008, suggesting prior codes were largely used to designate infection.
- MRSA infection codes supported a decreasing trend since 2008, which is consistent with national reports of reductions in HAIs.
- Despite this gain in colonization, these codes were not consistently applied from hospitalization to hospitalization.
- National estimates of hospital MRSA prevalence of 5-8% suggest colonization as reported by coded data is under-reported at 2.4%.
- It is unclear if use of multiple years of coded can produce accurate estimates. Nonetheless, a single year's prevalence was increased to 4.9% when accounting for patients' admission with MRSA over recent years.