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### Authors

Tehrani, David M  
Cao, Chenghua  
Kwark, Homin  
[et al.](#)

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

David M. Tehrani, MS;<sup>1</sup> Chenghua Cao, MPH;<sup>1</sup> Homin Kwark;<sup>1</sup> Susan S. Huang, MD, MPH<sup>1</sup>

We assess the impact of revised *International Classification of Diseases, Ninth Revision*, codes on methicillin-resistant *Staphylococcus aureus* burden in California hospitals. Codes were rapidly adopted, demonstrating new capture of colonization and continued relatively stable capture of infections. Nevertheless, despite new colonization codes, coded data demonstrated poor retention between serial hospitalizations.

Methicillin-resistant *Staphylococcus aureus* (MRSA) administrative codes have previously relied on simultaneous codes for *Staphylococcus aureus* infections and antibiotic resistance (V09.0). These codes did not differentiate between colonization and infection.<sup>1,2</sup> To add to the confusion, the V09.0 code could be used to indicate antibiotic-resistant pathogens other than MRSA. In the absence of specific codes for MRSA, accurate estimates of MRSA burden have been difficult to obtain. Beginning in 2008, separate MRSA-specific *International Classification of Diseases, Ninth Revision* (ICD-9), codes were instituted to improve the distinction between colonization and current infection.<sup>3</sup>

## METHODS

We conducted a retrospective cohort study of adults discharged from California acute care hospitals during 2005-2010 to assess the adoption of revised MRSA ICD-9 codes and their impact on MRSA burden estimates. Data were obtained from California mandatory hospitalization data, which include up to 25 ICD-9 codes,<sup>4</sup> each of which is associated with a present-on-admission (POA) code to indicate whether a condition existed at admission or was acquired during hospital stay. Unique record-linking numbers allowed tracking patients across hospitalizations. Low-volume hospitals (<1,000 admissions/year) were excluded.

We defined MRSA infection using available codes before and after October 2008 (pre-2008 vs post-2008). Pre-2008, MRSA ICD-9 code combinations for infections included pneumonia (482.41 plus V09.0), septicemia (038.11 plus V09.0), and unspecified infection (041.11 plus V09.0). Post-2008, replacement single codes included MRSA pneumonia (482.42), MRSA septicemia (038.12), and unspecified MRSA infections (041.12). We further stratified infections by community onset (CO-MRSA, POA = Yes) and hospital onset (HO-MRSA, POA = No).

We defined MRSA colonization using V02.54 (MRSA colonization) or V12.04 (personal history of MRSA), which were newly instituted in 2008. All rates were based on quarterly cases per 1,000 admissions.

To assess uptake of codes and trends in code usage, we first used linear regression models to identify whether trends existed pre-2008. Then, we used an interrupted time series design using segmental regression models, adjusted for serial autocorrelation, to evaluate (a) an immediate drop or rise after institution of revised codes and (b) a significant change in slope from the pre-2008 period.<sup>5</sup>

Because the new MRSA codes were meant to identify patients with a history of MRSA, we assessed whether these new codes were stably present across serial hospitalizations in the post-2008 period. We expressed this as the proportion of patients with any MRSA code who retained a code on their next admission. All statistical analyses were performed using SAS 9.3 (SAS Institute).

## RESULTS

During the 6-year period, there were 17,354,517 admissions in 340 California hospitals: 1.9% admissions had any MRSA code, and 1.5% admissions had any MRSA infection code. Among admissions with MRSA infection codes, MRSA pneumonia and sepsis were present in 19.3% and 14.7%, respectively. Unspecified infections constituted the majority (70.0%) of MRSA infection admissions. HO-MRSA infection constituted 8.5% of all MRSA infections, with pneumonia and sepsis constituting 40.9% and 20.0% of HO-MRSA infections, respectively.

Figure 1 shows rates of MRSA per 1,000 admissions during 2005-2010. In the pre-2008 period, we saw no significant trend in quarterly rates for any MRSA or any infection code categories. Following the change, there was rapid and near- complete uptake of the revised MRSA infection codes within 3 months such that we did not detect any abrupt changes in overall infection rates (Table 1). Post-2008, there were small but significant reductions in the slope for both HO and CO- MRSA infections of pneumonia and sepsis. Unspecified HO- MRSA infections also had a significant reduction in slope in the post-2008 period.

In contrast to infection codes, we found an abrupt adoption in the use of new colonization and personal history codes, which abruptly increased the combination of any MRSA codes (Table 1). Usage of the MRSA colonization code in- creased from 2.8 to 6.2 cases per 1,000 admissions after its first quarter of institution to the end of 2010. A similar increase was present for the MRSA personal history code, with minimal overlap (1.3%) with the colonization code. However, despite the increase of MRSA colonization codes, only 22.0% of these codes were retained across serial hospitalization.

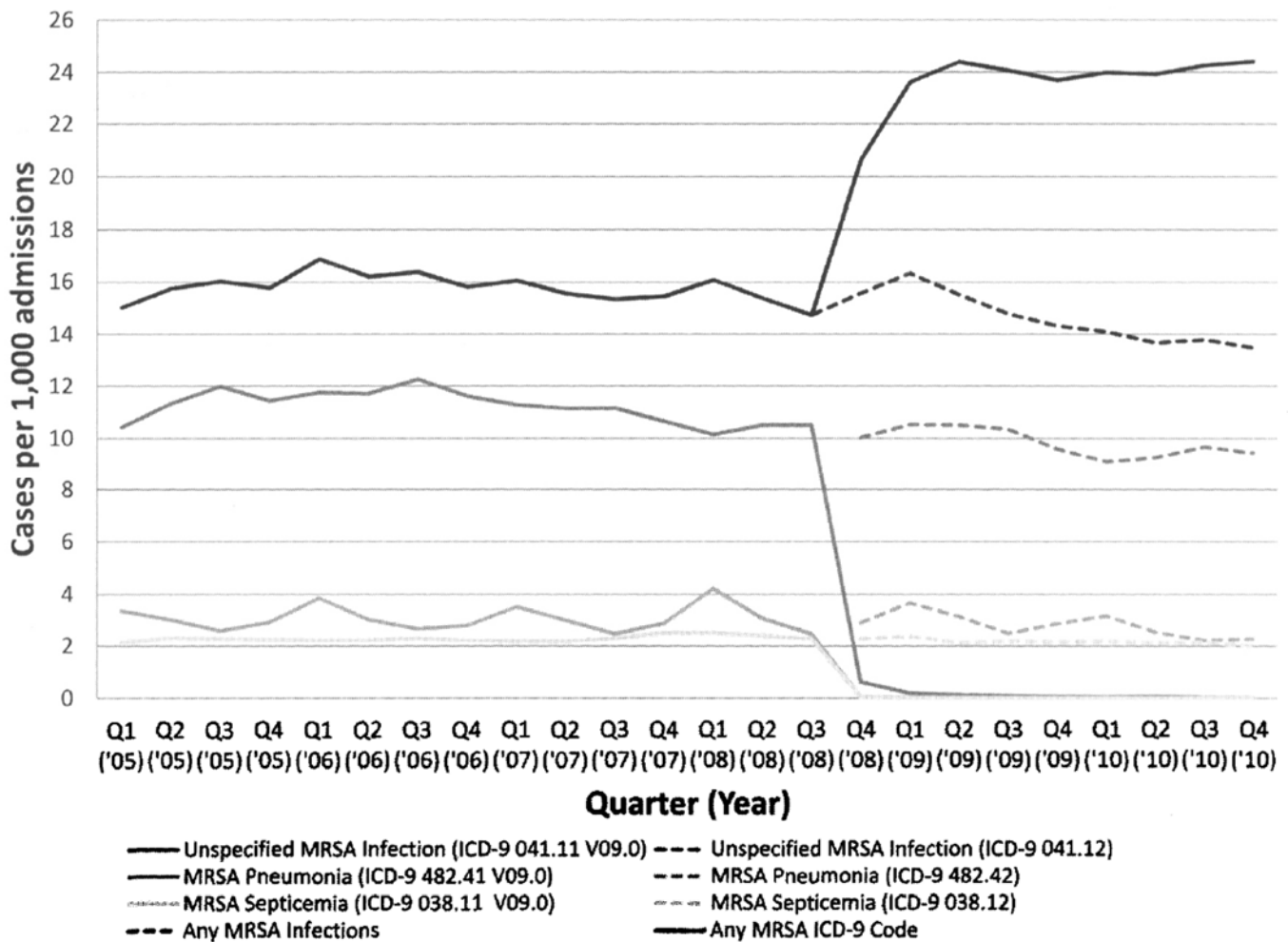


FIGURE 1. Rates of methicillin-resistant *Staphylococcus aureus* (MRSA) in California hospitals, 2005-2010. ICD-9, *International Classification of Diseases, Ninth Revision*.

For those patients coded with any MRSA code in the post2008 period, only 16.2% had a MRSA code on the subsequent hospitalization. This amounted to 2.4% of admissions having a MRSA code after the new coding change. However, if multiple years were used to attribute MRSA status, this value would increase. For example, if all patients admitted in 2010 were evaluated in that year and the preceding 2 years for a MRSA ICD-9 code, we found that 4.9% of patients were known to have MRSA.

## DISCUSSION

The newly instituted 2008 MRSA ICD-9 infection codes were rapidly adopted in a 1-to-1 transition. There was some concern that prior infection codes were also used to indicate past infections. Surprisingly, we did not see immediate shift in infection rates after the institution of separate infection and colonization codes in 2008. The gain of instituting MRSA ICD-9 codes was mainly in the increasing capture of MRSA- colonized patients.

Despite this gain in colonization, these codes were not consistently applied from hospitalization to hospitalization, indicating that MRSA coding from a single hospitalization may not be ideal in estimating overall MRSA burden. Nonetheless, we show that it may be possible to combine patient hospitalizations over multiple years to attain estimates similar to recent national estimates of MRSA burden among hospitalized patients.<sup>6</sup>

With the nearly seamless 1-to-1 transition in infection codes, we found that codes indicating MRSA infections decreased in the post-2008 period. While reduction in HO- MRSA infections might be influenced by national efforts or pressure to reduce healthcare-associated infection, we found that nearly all HO and all CO-MRSA infections showed a decline.<sup>7</sup> It was not possible in this study to account for the substantial numbers of CO-MRSA infection that may still be healthcare associated due to proximity from a prior hospitalization or recent admission to a nursing home.<sup>8</sup>

There are several additional limitations to this study. We did not validate either the pre-2008 or post-2008 ICD-9 codes. Nonetheless, because of the large and ample data available, MRSA ICD-9 codes have been used previously for national estimates.<sup>9</sup> In addition, although we reported a marked increase in use of MRSA colonization and personal history codes, we are unable to determine the contribution attributable to the newly available MRSA codes versus a new 2009 California law to screen high-risk patients.<sup>10</sup> Finally, although California represents more than 10% of the US population, these data may not be generalizable to other geographical regions.

In conclusion, the new 2008 administrative codes have allowed increased capture of MRSA colonization and prior history through new codes, without evidence of redistributing previously coded infections into infections that were present during the current admission versus previous admissions. The seamless transition to the post-2008 MRSA infection codes suggests a likely easy transition to ICD-10 codes that also represent a 1-to-1 exchange of MRSA codes. Understanding the value of readily available administrative codes for estimating MRSA burden may require gleaning information over serial admissions and will require chart validation to accurately define the epidemiology of this important pathogen.

TABLE 1. Impact of Methicillin-Resistant *Staphylococcus aureus* (MRSA) International Classification of Diseases, Ninth Revision (ICD-9), Codes on MRSA Quarterly Rates after Code Revision, 2005-2010

MRSA designation	Abrupt change after revised code institution <sup>a</sup>		Trend after revised code institution <sup>b</sup> (post-2008) <sup>c</sup>	
	Estimated	<i>p</i>	Estimated	<i>p</i>
Any MRSA code	6.9	<.0001	0.3	<.01
Any infection	0.8	.06	-0.3	<.001
MRSA infections				
Pneumonia	0.1	.50	-0.07	<.01
Septicemia	-0.02	.75	-0.05	<.01
Unspecified	0.3	.55	-0.1	.11
Community-onset MRSA infections				
Pneumonia	0.1	.50	-0.07	<.01
Septicemia	-0.05	.49	-0.04	<.01
Unspecified	0.4	.41	0.1	.17
Hospital-onset MRSA infections				
Pneumonia	0.09	<.01	-0.03	<.0001
Septicemia	0.03	.15	-0.01	<.01
Unspecified	-0.06	.14	-0.02	.02

• Immediate increase or decrease in MRSA rates after October 1, 2008, institution of revised MRSA ICD-9 codes.

<sup>b</sup> Change in slope after institution of revised MRSA ICD-9 codes.

<sup>c</sup> Indicates a time period after October 1, 2008, to December 31, 2010.

<sup>d</sup> Parameter estimates can be interpreted as a continuing increase or decrease in prevalence of MRSA cases per 1,000 patient admissions for each sequential yearly quarter.

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Affiliation: 1. Division of Infectious Disease and Health Policy Research Institute, University of California Irvine School of Medicine, Irvine, California.

Address correspondence to David M. Tehrani, MS, University of California Irvine School of Medicine, Division of Infectious Diseases and Health Policy Research Institute, 100 Theory Drive, Suite 110, Irvine, CA 92617 (tehranid@uci.edu).

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## REFERENCES

1. Schweizer ML, Eber MR, Laxminarayan R, et al. Validity of ICD9-CM coding for identifying incident methicillin-resistant *Staphylococcus aureus* (MRSA) infections: is MRSA infection coded as a chronic disease? *Infect Control Hosp Epidemiol* 2011; 32(2): 148-154.
2. Schaefer MK, Ellingson K, Conover C, et al. Evaluation of International Classification of Diseases, Ninth Revision, Clinical Modification codes for reporting methicillin-resistant *Staphylococcus aureus* infections at a hospital in Illinois. *Infect Control Hosp Epidemiol* 2010;31(5):463-468.
3. Index to diseases and injuries. In *ICD-9-CM Index to Diseases Addenda (FY09), Effective October 1, 2008*. Atlanta, GA: Centers for Disease Control and Prevention; 2008.
4. Inpatient hospital discharges, 2009 and 2010. Sacramento: State of California Office of Statewide Health Planning and Development. <http://www.oshpd.ca.gov>.
5. Wagner AK, Soumerai SB, Zhang R, Ross-Degnan D. Segmented regression analysis of interrupted time series studies in medication use research. *J Clin Pharm Ther* 2002;27(4):299-309.
6. Jarvis WR, Jarvis AA, Chinn RY. National prevalence of methicillin-resistant *Staphylococcus aureus* in inpatients at United States health care facilities, 2010. *Am J Infect Control* 2012;40(3): 194-200.
7. Kallen AJ, Mu Y, Bulens S, et al. Healthcare-associated invasive MRSA infections, 2005-2008. *JAMA* 2010;304(6):641-648.
8. Avery TR, Kleinman KP, Klompas M, Aschengrau A, Huang SS. Inclusion of 30-day postdischarge detection triples the incidence of hospital-onset methicillin-resistant *Staphylococcus aureus*. *Infect Control Hosp Epidemiol* 2012;33(2):114-121.
9. Klein E, Smith DL, Laxminarayan R. Hospitalizations and deaths caused by methicillin-resistant *Staphylococcus aureus*, United States, 1999-2005. *Emerg Infect Dis* 2007;13(12):1840-1846.
10. Medical Facility Infection Control and Prevention Act. In *Health and Safety Code*. Sacramento: State of California Health and Human Services Agency, California Department of Public Health; 2008.