Making Healthcare Safer for All Californians

Healthcare-Associated Infections in California Hospitals

Annual Report | January to December 2021

Report to the Legislature and the People of California
by the Healthcare-Associated Infections Program,
Center for Health Care Quality,
California Department of Public Health | October 2022

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MESSAGE FROM THE CHIEF OF THE HEALTHCARE-ASSOCIATED INFECTIONS (HAI) PROGRAM

As the COVID-19 pandemic continued in 2021 with the emergence of more transmissible SARS-CoV-2 variants, some healthcare infection prevention and control (IPC) challenges lessened, while others persisted or worsened. Highly effective vaccines substantially mitigated COVID-19 morbidity and mortality, testing capacity increased, and personal protective equipment supplies improved; however, chronic staffing shortages were exacerbated by surges and burnout, and many routine HAI prevention care practices were not restored. In 2021, California hospitals' statewide incidence for central line-associated bloodstream infections (CLABSI) and methicillin-resistant Staphylococcus aureus bloodstream infections (MRSA BSI) remained persistently elevated following the substantial increases observed at the onset of the COVID-19 pandemic.

As described in this report, CDPH HAI Program epidemiologists conducted in-depth analyses of CLABSI data to further characterize hospital types and locations with the greatest increases and identify hospitals to engage in a CLABSI reduction initiative. With the support of additional Centers for Disease Control and Prevention (CDC) Epidemiology and Laboratory Capacity (ELC) funding for Strengthening HAI/AR Programs (SHARP) awarded in October 2021, the HAI Program has resumed and expanded our statewide and regional HAI and antimicrobial resistance (AR) prevention initiatives while continuing to provide IPC consultation and support across the continuum of health care as part of the ongoing COVID-19 pandemic response.

CDPH also continues to engage the California HAI Advisory Committee and other hospital partners to identify and support implementation of strategies for maintaining the highest possible quality hospital IPC practices while managing ongoing pandemic- and surge-related challenges. CDPH is also seeking advice from the HAI Advisory Committee about re-establishing short and long-term goals for HAI and AR prevention in California hospitals. Ultimately our goal is to leverage lessons learned during the pandemic to advocate for resources and improve IPC program resiliency to future stressors, and eventually achieve even greater and more sustained HAI/AR prevention outcomes.

Erin Epson, MD
Medical Director & Chief
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Center for Health Care Quality

ACKNOWLEDGEMENTS

The HAI Program would like to recognize the contributions of California hospitals that diligently track and report HAI data using the National Healthcare Safety Network protocols and definitions and for their continued dedication to ensuring the accuracy of the data used to produce this public report.

HAI Advisory Committee

The HAI Program Advisory Committee makes recommendations to CDPH on issues related to HAI surveillance, reporting, and prevention in California hospitals. The HAI Advisory Committee is comprised of voting members with HAI expertise or interest and non-voting liaison members who represent California HAI stakeholder organizations. The HAI Program thanks each member for their support and contributions.

Members

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EXECUTIVE SUMMARY

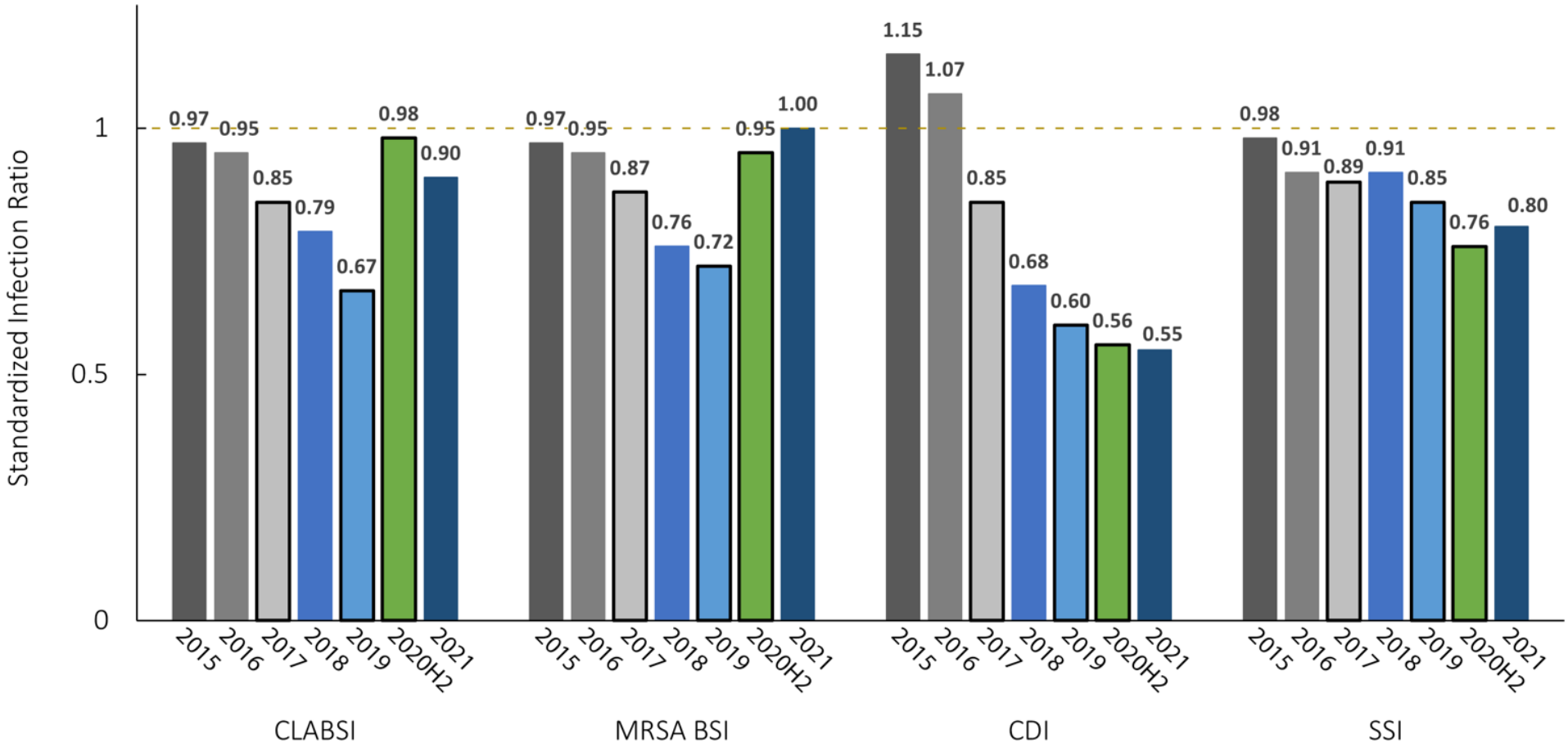
The California Department of Public Health (CDPH) publishes healthcare-associated infections (HAI) data annually to provide information about the quality of hospital care and to monitor prevention progress (Health and Safety Code (HSC) section 1288.55). This report presents California hospital HAI data for calendar year 2021. CDPH published all reported HAI numerator, denominator, and incidence data for 2021 on the California Health and Human Services (CHHS) Open Data Portal.

In 2021, 397 California general acute care hospitals reported 906 more central line-associated bloodstream infections (CLABSI), 284 more methicillin-resistant *Staphylococcus aureus* (MRSA) bloodstream infections (BSI), 150 more vancomycin-resistant enterococci (VRE) BSI, 668 fewer *Clostridioides difficile* infections (CDI), and 248 fewer surgical site infections (SSI) than were reported in 2019, prior to the COVID-19 pandemic.

CLABSI incidence was lower than 2015 national baseline, but it remained persistently elevated following the substantial increase observed at the onset of the COVID-19 pandemic in acute care hospitals. MRSA BSI incidence approached the 2015 national baseline level and remained elevated as compared with the pre-COVID-19 pandemic era. Statewide incidence for CDI and SSI continued to be lower (better) than 2015 national baselines. (Figure 1).

CLABSI incidence remained persistently elevated particularly among community hospitals. Although California hospitals reduced overall CDI incidence beyond the 2020 CDI reduction goal, pediatric hospitals did not meet the reduction goal and their CDI incidence was the same as the 2015 national baseline.

Figure 1. Healthcare-Associated Infection Incidence in California Hospitals, 2015-2021



Note: Dashed horizontal line reflects the national baseline for the standardized infection ratio (SIR). An SIR below the dashed line represents HAI prevention progress if the reduction was statistically significant. 2020H2 bar presents SIR for the latter six months of 2020.

ANNUAL REPORT

Patients in hospitals are exposed to invasive devices, procedures, and medications that put them at risk for **healthcare-associated infections (HAI).** Most HAI can be prevented if health care providers and staff consistently adhere to infection prevention care practices [1].

This report provides an annual summary of HAI data reported by California hospitals to CDPH, in accordance with Health and Safety Code sections 1288.5 and 1288.55.

METHODS

California acute care hospitals track and report to CDPH five types of hospital-onset infections (Health and Safety Code section 1288.55):

Central line-associated bloodstream infections (CLABSI), methicillin-resistant *Staphylococcus aureus* (MRSA) bloodstream infections (BSI), vancomycin-resistant enterococci (VRE) BSI, *Clostridioides difficile* infections (CDI), and surgical site infections (SSI).

This report summarizes HAI data reported to CDPH via the Centers for Disease Control and Prevention (CDC) National Healthcare Safety Network (NHSN).

In 2021, CDPH received HAI data from 328 acute care hospitals (including 205 community, 113 major teaching, and 10 pediatric acute care hospitals), 22 long-term acute care (LTAC) hospitals, 35 critical access hospitals, and 74 acute care rehabilitation hospitals (n=12) and units. CDPH reports the 2021 HAI data from LTAC, critical access, and rehabilitation hospitals in separate sections of this report because risk-adjustment methods are different for each hospital type.

Twelve (3%) California general acute care hospitals did not report complete HAI data for 2021 (Appendix A).

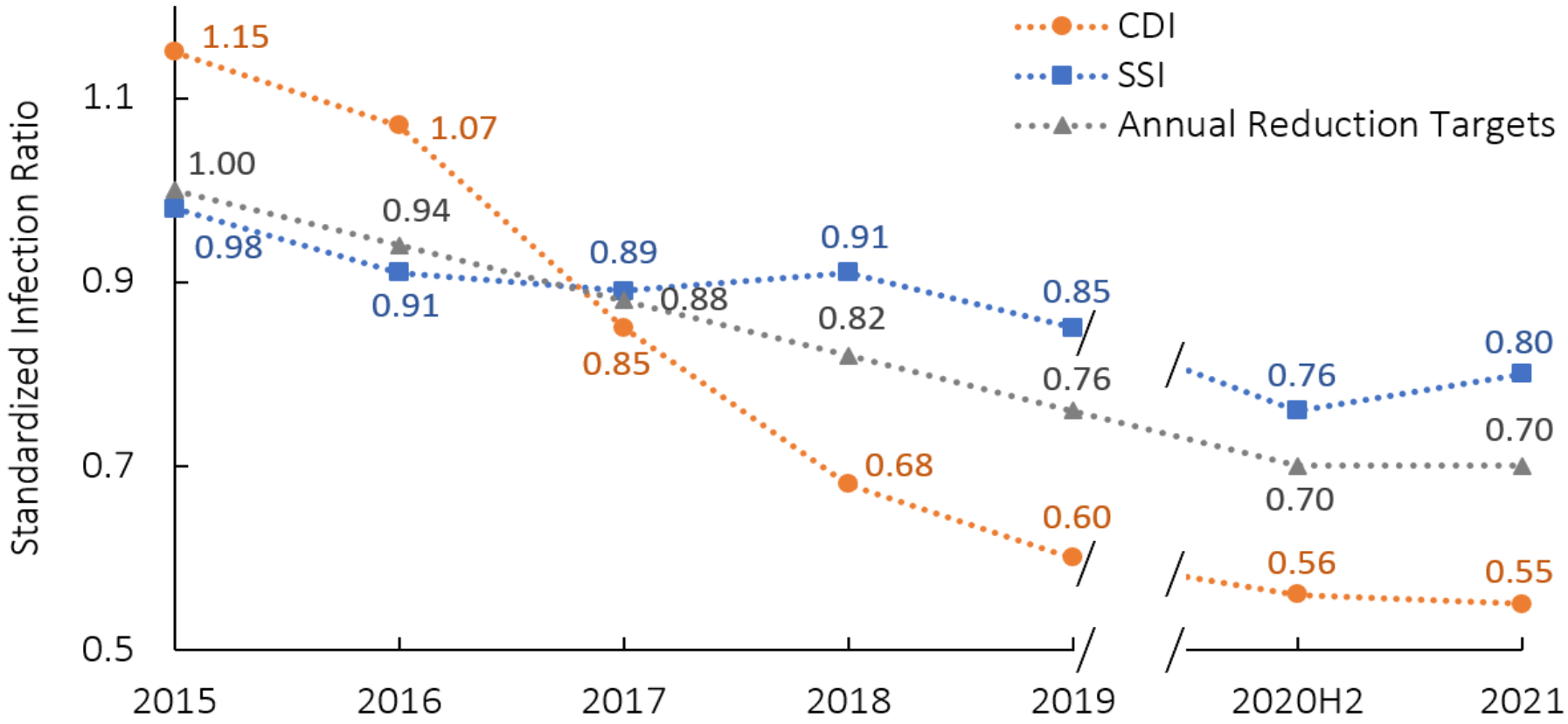
CDPH calculates and presents HAI risk based on national referent data (baselines) to track California hospital HAI prevention progress from year to year [2]. When available, CDPH reports HAI incidence using a measure called the **standardized infection ratio (SIR)**. The SIR is calculated by comparing the number of HAI that were reported by the hospital with the number of HAI that were predicted using 2015 national baseline data [3]. The predicted number of infections is determined by a risk adjustment process that accounts for differences in hospital and patient characteristics.

CDPH presents VRE BSI incidence as rates (per 10,000 patient days) because a risk adjustment model and SIR are not available.

In 2015, the California HAI Advisory Committee recommended that CDPH track each hospital's progress in meeting national HAI reduction goals [4]. From 2015 to 2020, all California hospitals were expected to achieve 50% reductions in CLABSI and MRSA BSI incidence and 30% reduction in CDI and SSI. To have met the 2020 HAI reduction goals, hospitals had to achieve SIRs at or below incremental targets each year (Figures 2 and 3). Due to the COVID-19 pandemic, CDPH continued using the 2020 HAI reduction goals to determine whether individual hospitals met those goals in 2021. CDPH will be working with the California HAI Advisory Committee and hospital partners to reestablish the target goals for 2022 and beyond.

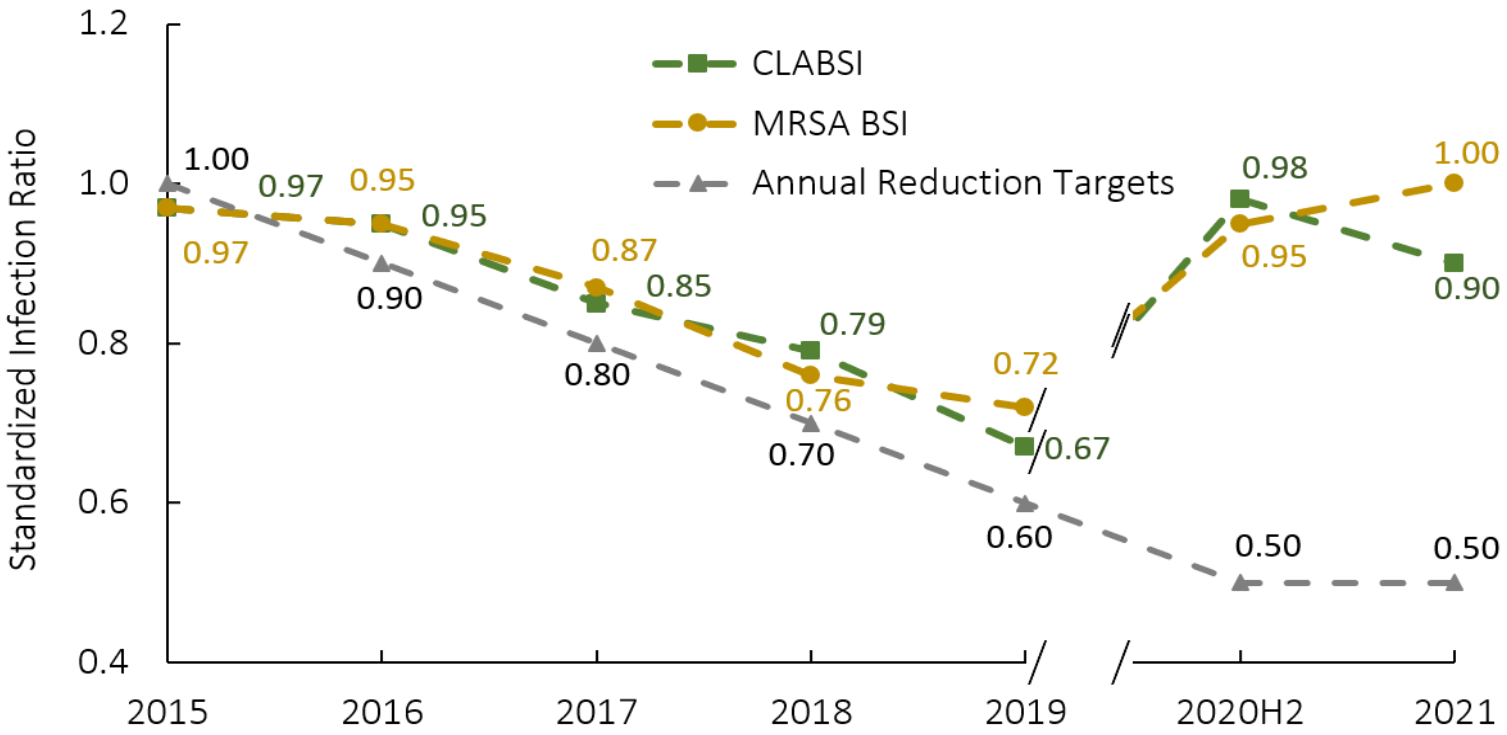
Figures 2 and 3. Standardized Infection Ratio (SIR) Targeted Reduction Goals by Year, HAI Infection Type, and Progress to Date among California Hospitals

Figure 2



Note: 2020H2 denotes the latter six months of 2020

Figure 3



Note: 2020H2 denotes the latter six months of 2020

CDPH publishes annual HAI findings on its website (www.cdph.ca.gov/HAI). The webpage includes this report and two-page HAI profiles for each California hospital. The profiles show detailed HAI data reported in 2021 and graphs of annual infection trends since 2015. The profiles are also available via the CDPH interactive map, "My Hospital's Infections" (www.cdph.ca.gov/Programs/CHCQ/HAI/Pages/HAImap.aspx).

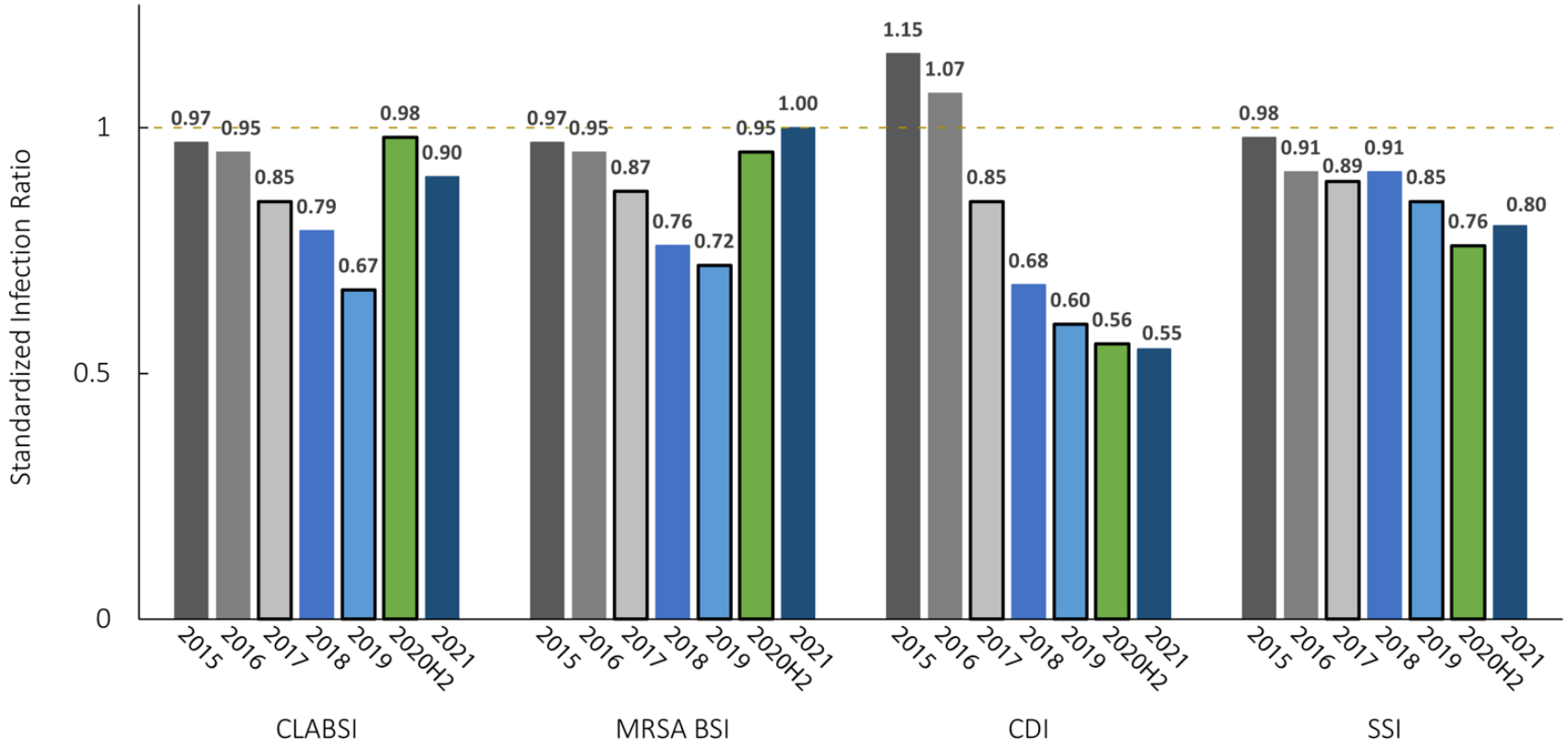
All HAI hospital-specific data tables are available for viewing or downloading at the California Health and Human Services Open Data Portal (data.chhs.ca.gov).

The Key Findings section of this report presents HAI data for the majority (328) of California acute care hospitals.

KEY FINDINGS

The statewide risk for CDI, CLABSI, and SSI is significantly lower or better than national baselines and for MRSA BSI the risk is the same as the 2015 national baseline in acute care hospitals (Figure 1). Hospitals reported 833 more CLABSI, 286 more MRSA BSI, 121 more VRE BSI, 531 fewer CDI, and 248 fewer SSI in 2021 than in 2019. The incidence across all HAI types is different in 2021 than 2019 (Table 1). In 2021, 215 (66%) hospitals in 37 counties have HAI incidence significantly better (★, green star) than the national baseline (or statewide VRE BSI rate) and 63 (19%) hospitals in 23 counties have HAI incidence significantly worse (✖, red X) for at least one infection type (Appendix B).

Figure 1. Healthcare-Associated Infection Incidence in California Hospitals, 2015-2021



Note: Dashed horizontal line reflects the national baseline for the standardized infection ratio (SIR). An SIR below the dashed line represents HAI prevention progress if the reduction was statistically significant. 2020H2 bar presents SIR for the latter six months of 2020.

Table 1. HAI Incidence in Acute Care Hospitals for the Year, 2019 Versus 2021

HAI Type	2019 SIR* or Rate**	2021 SIR* or Rate**	P-value
CLABSI	0.67	0.90	<0.0001
CDI	0.60	0.55	<0.0001
MRSA BSI	0.72	1.00	<0.0001
VRE BSI	0.26**	0.34**	<0.001
SSI†	0.85	0.80	0.009

*Standardized infection ratio; **Incidence density rate per 10,000 patient days; †All adult surgical procedures; Notes: The data from LTAC, CAH, and rehabilitation hospitals and units are not included; P-values calculated by SAS ("*mid-p*").

CLABSI

In 2021, California hospitals reported 2,583 CLABSI, 833 more infections than 2019. The statewide CLABSI SIR is 0.90, which increased by 34% since 2019, and is approaching the 2015 SIR. California hospitals need to prevent 1,148 infections to achieve the 2020 reduction goal.

MRSA BSI

Hospitals reported 892 MRSA BSI, 286 infections more than 2019. The statewide SIR among hospitals is 1.00, which increased by 39% since 2019 and is the same as the 2015 SIR and national baseline. To meet the 2020 prevention goal, hospitals must prevent 447 infections.

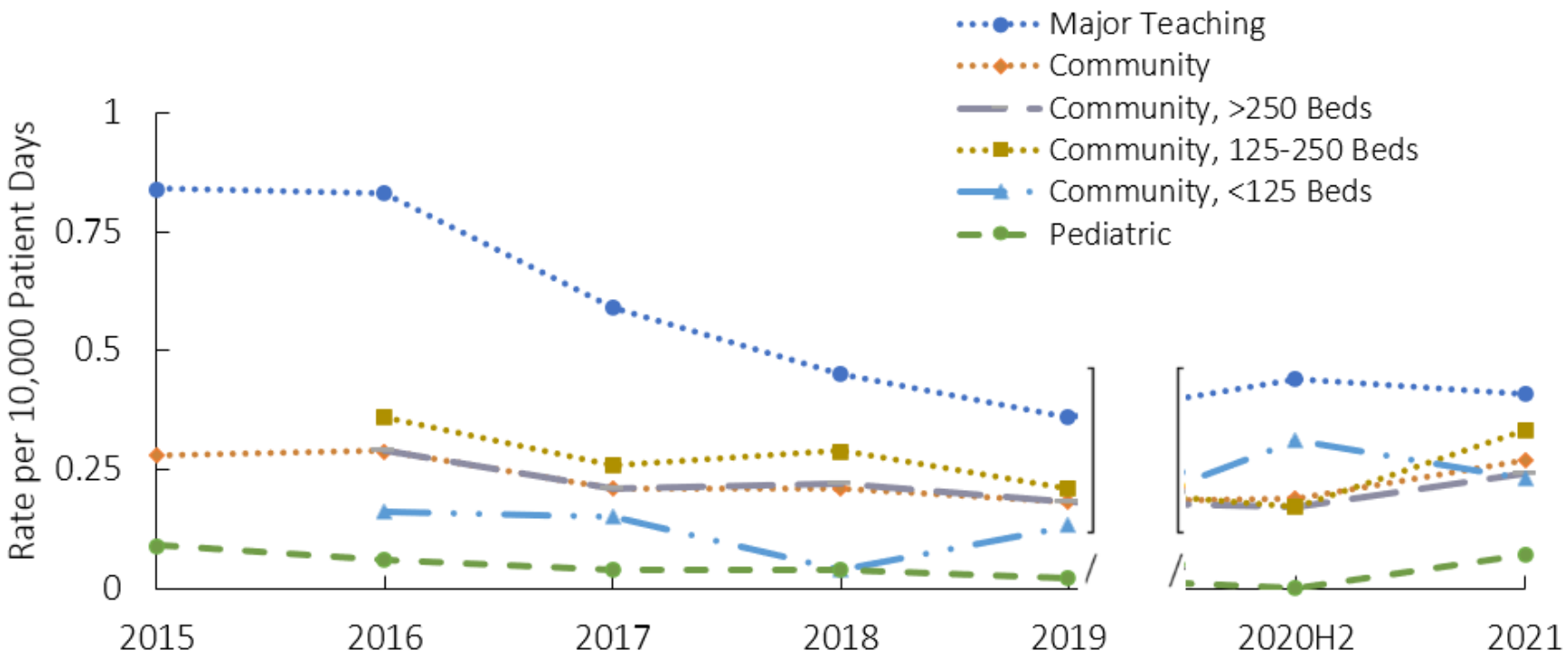
VRE BSI

In 2021, hospitals reported 511 VRE BSI, 121 infections more than 2019, and the incidence rate was 30% higher. Among all hospital types, the incidence rate in community hospitals with 125-250 beds is significantly higher (1.6 times) in 2021 compared with 2019 (Figure 4). Major teaching hospitals continued to have the highest VRE BSI rate (0.41 per 10,000 patient days) and accounted for 64% of all VRE BSI reported.

CDI

California hospitals reported 4,355 CDI in 2021, 531 fewer infections than 2019. The statewide SIR is 0.55, a reduction of 52% since 2015, which is also significantly lower than the 2019 and national baseline SIR. However, the SIR among 10 pediatric hospitals is 0.92 in 2021, which is not significantly different from the national baseline and does not meet the 2020 reduction goal. Pediatric hospitals reported a total of 138 CDI and need to prevent 33 infections to meet the 2020 reduction goal.

Figure 4. Unadjusted VRE Bloodstream Infection Rates by California Hospital Type, 2015-2021



Note: 2020H2 denotes the latter six months of 2020

SSI

CDPH reports SSI data separately for adult (18 years and older) and pediatric (younger than 18 years) surgical patients because different risk adjustment models are applied to account for differences in the two patient groups.

Among adult patients, California hospitals reported 3,417 SSI in 2021. The majority of SSI (90%) were reported among 18 surgical procedure types, which accounted for 95% of surgeries among the 28 surgical procedure types that hospitals are required to report (Table 2).

The statewide all-procedure adult SSI SIR is 0.80 in 2021, which is significantly 6% lower than 2019. SSI risk was better than national baseline for 14 procedures and no procedures were worse than the national baseline. Sixty-four facilities had low SSI incidence for all procedure categories, and 8 facilities had significantly high SSI incidence for all procedure categories. (Appendices B and C). Five facilities had significantly worse performance for the same procedure in both 2019 and 2021 (Table 3).

Among pediatric patients, hospitals reported 89 SSI in 18,796 surgical procedures in 2021. The pediatric SSI SIR is 0.70 a 16% decrease from 2019.

Table 2. Hospital Surgical Site Infection Incidence in Adult Surgical Patients for 18 Most Common Surgical Procedure Categories, 2019 vs. 2021

Surgical procedure category	*SIR 2019	*SIR 2021	2021 Compared with National Baseline	Met 2020 Target Goal?
Appendix surgery	0.62	0.51	Better	Yes
Cardiac surgery	0.68	0.80	Same	No
Cesarean section	0.88	0.80	Better	No
Colon surgery	0.84	0.87	Better	No
Coronary bypass, chest, and donor incisions	0.73	0.82	Same	No
Exploratory abdominal surgery (laparotomy)	0.92	0.87	Better	No
Gallbladder surgery	0.83	0.89	Same	No
Gastric surgery	0.77	0.58	Better	Yes
Hip prosthesis	0.89	0.85	Better	No
Hysterectomy, abdominal	0.78	0.77	Better	No
Knee prosthesis	0.98	0.88	Same	No
Laminectomy	1.02	0.77	Better	No
Open reduction of fracture	0.94	0.79	Better	No
Ovarian surgery	0.83	0.61	Same	Yes
Pacemaker surgery	1.17	0.85	Same	No
Small bowel surgery	0.82	0.77	Better	No
Spinal fusion	0.87	0.87	Better	No
Thoracic surgery	0.64	0.65	Better	Yes

Table 3. Hospitals with Procedure-Specific Surgical Site Infection Risk in Adult Surgical Patients Worse than National Baseline for Consecutive Years*

Facility Name	County	Procedures	Years Worse
Fountain Valley Regional Hospital & Medical Center	Orange	Coronary bypass, chest incision only	2019, 2021
Kaiser Foundation Hospital, Sacramento	Sacramento	Cesarean section	2019, 2021
Sutter Medical Center, Sacramento	Sacramento	Small bowel surgery	2019, 2021
Pomerado Hospital	San Diego	Gastric surgery	2019, 2021
UC San Diego Health Hillcrest, Hillcrest Medical Center	San Diego	Hip prosthesis	2019, 2021

*Due to the COVID-19 Pandemic and suspension of reporting requirements in the 1st half of 2020, data from 2020 is not included and thus 2021 and 2019 are classified as consecutive years.

HAI PREVENTION PROGRESS IN INDIVIDUAL HOSPITALS

The CDPH HAI Program uses annually reported HAI data to follow up with hospitals and communities for outreach and interventions.

Hospitals with Low HAI Incidence

Some individual hospitals are successfully sustaining low HAI incidence. Thirty-four hospitals reported low CDI, 9 hospitals low CLABSI, and 12 low all-procedure adult SSI incidence for four or five consecutive years from 2015 to 2021 (Table 4). The data from 2020 is not included in the consecutive years count because of the suspension of reporting requirements for half of 2020.

For CLABSI, of 308 hospitals with a calculated SIR in 2021, 44 (14%) are significantly better than national baseline (Appendix B), compared with 61 (20%) hospitals significantly better in 2019.

For MRSA BSI, of 298 hospitals with a calculated SIR in 2021, 5 (1.7%) are significantly better than national baseline, compared with 15 (5.1%) hospitals significantly better in 2019.

A total of 172 (54%) hospitals have a CDI SIR significantly better than national baseline in 2021, up from 155 hospitals (48%) in 2019.

Hospitals with High HAI Incidence

Ten hospitals have HAI incidence that is significantly higher (worse) than national baselines for multiple HAI types in 2021 (Table 5).

For CLABSI, of 308 hospitals with a calculated SIR, 29 (9%) hospitals have significantly higher CLABSI incidence than national baseline (Appendix B), which is 22 more hospitals than reported in 2019.

For MRSA BSI, none of the 20 hospitals that are significantly worse than national baseline in 2021 had significantly high incidence in 2019.

For CDI, 2 (1%) hospitals are worse than national baseline in 2021 versus 9 (3%) hospitals in 2019.

Table 4. Hospitals with HAI Incidence Better than National Baselines for Four or More Consecutive Years, 2015-2021*

Hospital Name	County	HAI Type	# Years
Eden Medical Center	Alameda	CDI	4
Kaiser Foundation Hospital, San Leandro	Alameda	CDI	5
Enloe Medical Center, Esplanade	Butte	CLABSI	5
Adventist Health Bakersfield	Kern	CDI	4
Adventist Health Glendale	Los Angeles	CDI	4
Adventist Health White Memorial	Los Angeles	CDI	4
California Hospital Medical Center, Los Angeles	Los Angeles	CDI	6
Centinela Hospital Medical Center	Los Angeles	SSI	6
City of Hope Helford Clinical Research Hospital	Los Angeles	SSI	4
Emanate Health Inter-Community Hospital	Los Angeles	CLABSI	4
Emanate Health Queen of the Valley Hospital	Los Angeles	CLABSI	5
Kaiser Foundation Hospital, South Bay	Los Angeles	CDI	4
LAC+USC Medical Center	Los Angeles	CDI	4
LAC+USC Medical Center	Los Angeles	SSI	6
Martin Luther King Jr. Community Hospital	Los Angeles	CDI	4
Northridge Hospital Medical Center	Los Angeles	CDI	4
PIH Health Hospital, Whittier	Los Angeles	CDI	4
Providence Saint John's Health Center	Los Angeles	SSI	6
Providence Saint Joseph Medical Center	Los Angeles	SSI	6
Whittier Hospital Medical Center	Los Angeles	SSI	6
Valley Children's Hospital	Madera	CLABSI	4
Mercy Medical Center	Merced	CDI	4
Natividad Medical Center	Monterey	CDI	6
College Hospital Costa Mesa	Orange	CDI	6
MemorialCare Orange Coast Medical Center	Orange	CLABSI	6
Providence St. Jude Medical Center	Orange	CDI	6
Kaiser Foundation Hospital, Roseville	Placer	CDI	4
Sutter Roseville Medical Center	Placer	CDI	4
Riverside University Health System - Medical Center	Riverside	CLABSI	4
Riverside University Health System - Medical Center	Riverside	CDI	5
Southwest Healthcare System, Wildomar	Riverside	SSI	6
Kaiser Foundation Hospital, Sacramento	Sacramento	CDI	4
Kaiser Foundation Hospital, South Sacramento	Sacramento	CDI	4
Mercy General Hospital	Sacramento	SSI	6
Mercy San Juan Medical Center	Sacramento	CLABSI	6
Mercy San Juan Medical Center	Sacramento	SSI	4
Sutter Medical Center, Sacramento	Sacramento	CDI	4
University of California Davis Medical Center	Sacramento	CLABSI	6
Arrowhead Regional Medical Center	San Bernardino	CDI	5
Community Hospital of San Bernardino	San Bernardino	SSI	4
Desert Valley Hospital	San Bernardino	CDI	4
Kaiser Foundation Hospital, Fontana	San Bernardino	SSI	6
St. Bernardine Medical Center	San Bernardino	SSI	6
Palomar Medical Center	San Diego	CDI	4
Scripps Memorial Hospital, La Jolla	San Diego	CDI	4
Scripps Mercy Hospital	San Diego	CDI	5
Scripps Mercy Hospital Chula Vista	San Diego	CDI	4
Sharp Mary Birch Hospital For Women And Newborns	San Diego	CDI	6
Sharp Memorial Hospital	San Diego	CDI	5
San Joaquin General Hospital	San Joaquin	CDI	4
Kaiser Foundation Hospital, Redwood City	San Mateo	CDI	5
Kaiser Foundation Hospital, South San Francisco	San Mateo	CDI	4
El Camino Health	Santa Clara	CDI	4
Regional Medical Center of San Jose	Santa Clara	CDI	6
Doctors Medical Center	Stanislaus	CLABSI	4

*Due to the COVID-19 Pandemic and suspension of reporting requirements in the 1st half of 2020, data from 2020 is not included and thus 2021 and 2019 are classified as consecutive years.

Table 5. Hospitals with HAI Incidence Worse than National Baselines or Pooled Statewide Average Rate in 2021 for Multiple Infection Types or in Consecutive Years*

Hospital Name	County	HAI Type	Worse than 2015 National Baseline
Ridgecrest Regional Hospital	Kern	SSI	2018, 2019, 2021
Cedars-Sinai Marina Del Rey Hospital	Los Angeles	MRSA BSI	2021
Cedars-Sinai Marina Del Rey Hospital	Los Angeles	VRE BSI	2021
Cedars-Sinai Medical Center	Los Angeles	VRE BSI	2019, 2021
City of Hope Helford Clinical Research Hospital	Los Angeles	VRE BSI	2015, 2016, 2017, 2018, 2019, 2021
Henry Mayo Newhall Hospital	Los Angeles	CLABSI	2021
Henry Mayo Newhall Hospital	Los Angeles	MRSA BSI	2021
Kaiser Foundation Hospital, Woodland Hills	Los Angeles	CLABSI	2021
Keck Hospital of USC	Los Angeles	MRSA BSI	2021
Keck Hospital of USC	Los Angeles	VRE BSI	2019, 2021
Los Angeles Community Hospital	Los Angeles	MRSA BSI	2021
Los Angeles Community Hospital	Los Angeles	VRE BSI	2021
Norwalk Community Hospital	Los Angeles	MRSA BSI	2021
Pacifica Hospital of the Valley	Los Angeles	VRE BSI	2021
Pacifica Hospital of the Valley	Los Angeles	CLABSI	2018, 2019, 2021
West Hills Hospital & Medical Center	Los Angeles	CLABSI	2021
West Hills Hospital & Medical Center	Los Angeles	MRSA BSI	2021
Fountain Valley Regional Hospital & Medical Center	Orange	SSI	2019, 2021
Fountain Valley Regional Hospital & Medical Center	Orange	CLABSI	2021
Los Alamitos Medical Center	Orange	CLABSI	2021
Loma Linda University Medical Center	San Bernardino	MRSA BSI	2021
Loma Linda University Medical Center	San Bernardino	VRE BSI	2016, 2017, 2018, 2019, 2021
Alvarado Hospital Medical Center	San Diego	CDI	2019, 2021
Alvarado Hospital Medical Center	San Diego	MRSA BSI	2021
Twin Cities Community Hospital	San Luis Obispo	SSI	2018, 2019, 2021
Stanford Health Care	Santa Clara	VRE BSI	2015, 2016, 2017, 2018, 2019, 2021
Emanuel Medical Center	Stanislaus	CLABSI	2021

*Due to the COVID-19 Pandemic and suspension of reporting requirements in the 1st half of 2020, data from 2020 is not included and thus 2021 and 2019 are classified as consecutive years.

LONG-TERM ACUTE CARE (LTAC) HOSPITALS

LTAC hospitals provide complex care to patients that typically require prolonged acute care (greater than 25 days) for respiratory ventilation, multiple intravenous (IV) medications, or complex wound care.

In 2021, 2 (17%) LTAC hospitals were incomplete reporters for CLABSI, MRSA BSI, VRE BSI, and CDI (Appendix A).

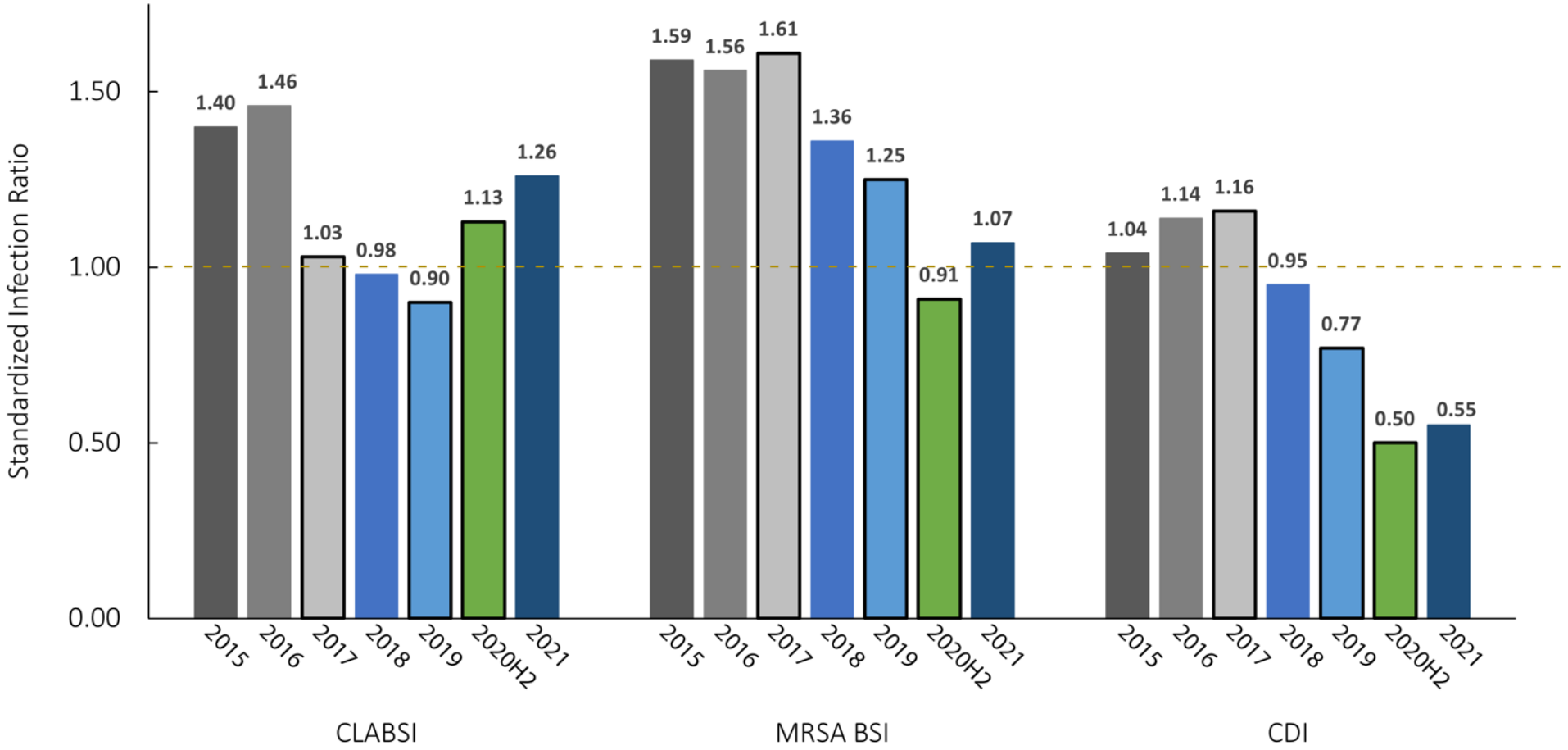
Three LTAC hospitals had significantly high incidence for both CLABSI and VRE BSI or MRSA BSI in 2021.

CLABSI in LTAC Hospitals

In 2021, 22 LTAC hospitals reported 326 CLABSI, 74 more than in 2019. The statewide CLABSI SIR is 1.26, which is significantly higher than the national baseline. The incidence significantly increased by 40% since 2019 (Figure 5). LTAC hospitals need to prevent 197 infections to meet the 2020 CLABSI reduction goal.

Of 5 LTAC hospitals with CLABSI incidence better than national baseline, Vibra Hospital of Northern California has been significantly better since 2015. One of 5 LTAC hospitals with significantly higher incidence than national baseline, Kindred Hospital, Westminster, has been worse since 2015.

Figure 5. Healthcare-Associated Infection Incidence in California Long-Term Acute Care Hospitals, 2015-2021



Note: Dashed horizontal line reflects the national baseline for the standardized infection ratio (SIR). An SIR below the dashed line represents HAI prevention progress if the reduction was statistically significant. 2020H2 bar presents SIR for the latter six months of 2020.

MRSA BSI in LTAC Hospitals

In 2021, 22 LTAC hospitals reported 79 MRSA BSI, 2 fewer than the number reported in 2019. The statewide MRSA BSI incidence is 1.07 (Figure 5) and is the same compared with the national baseline. LTAC hospitals need to prevent 42 infections to meet the 2020 prevention goal.

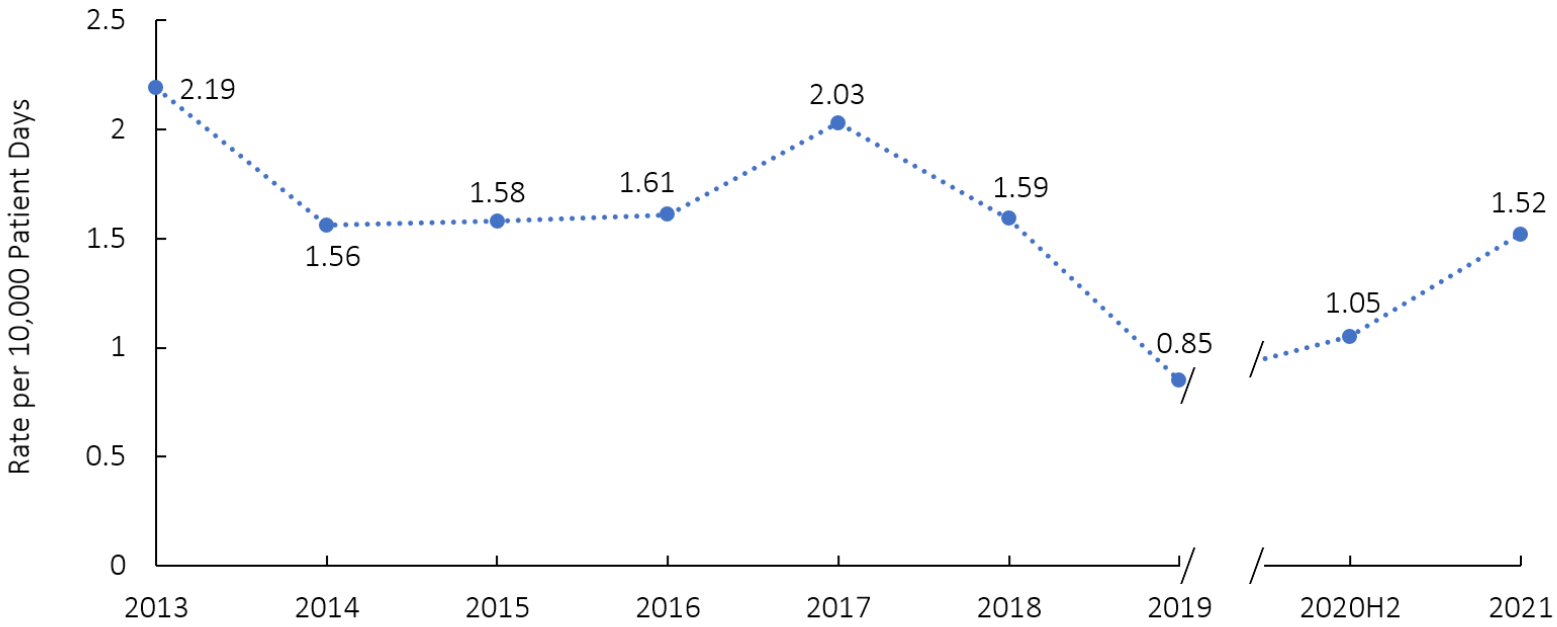
VRE BSI in LTAC Hospitals

In 2021, LTAC hospitals reported 65 VRE BSI, 27 more than reported in 2019. The incidence of 1.52 per 10,000 patient days in 2021 is 79% higher compared with 2019 (Figure 6). LTAC hospitals continued to have the highest VRE BSI incidence among all other hospital types.

CDI in LTAC Hospitals

LTAC hospitals reported 264 CDI in 2021, 126 infections fewer than the number reported in 2019. The statewide SIR among LTAC hospitals is 0.55, which is significantly better than national baseline and less than the 2020 prevention goal for CDI. Compared with the 2015 SIR, the CDI incidence has decreased by 47% (Figure 5).

Figure 6. Unadjusted VRE Bloodstream Infection Rates among Long-Term Acute Care Hospitals, 2013-2021



Note: 2020H2 denotes the latter six months of 2020.

CRITICAL ACCESS HOSPITALS

Critical access hospitals have 25 or fewer beds and are located more than 35 miles from another hospital (with some exceptions). Patients in critical access hospitals stay on average four days or less.

Five (42%) critical access hospitals were incomplete reporters in 2021 (Appendix A).

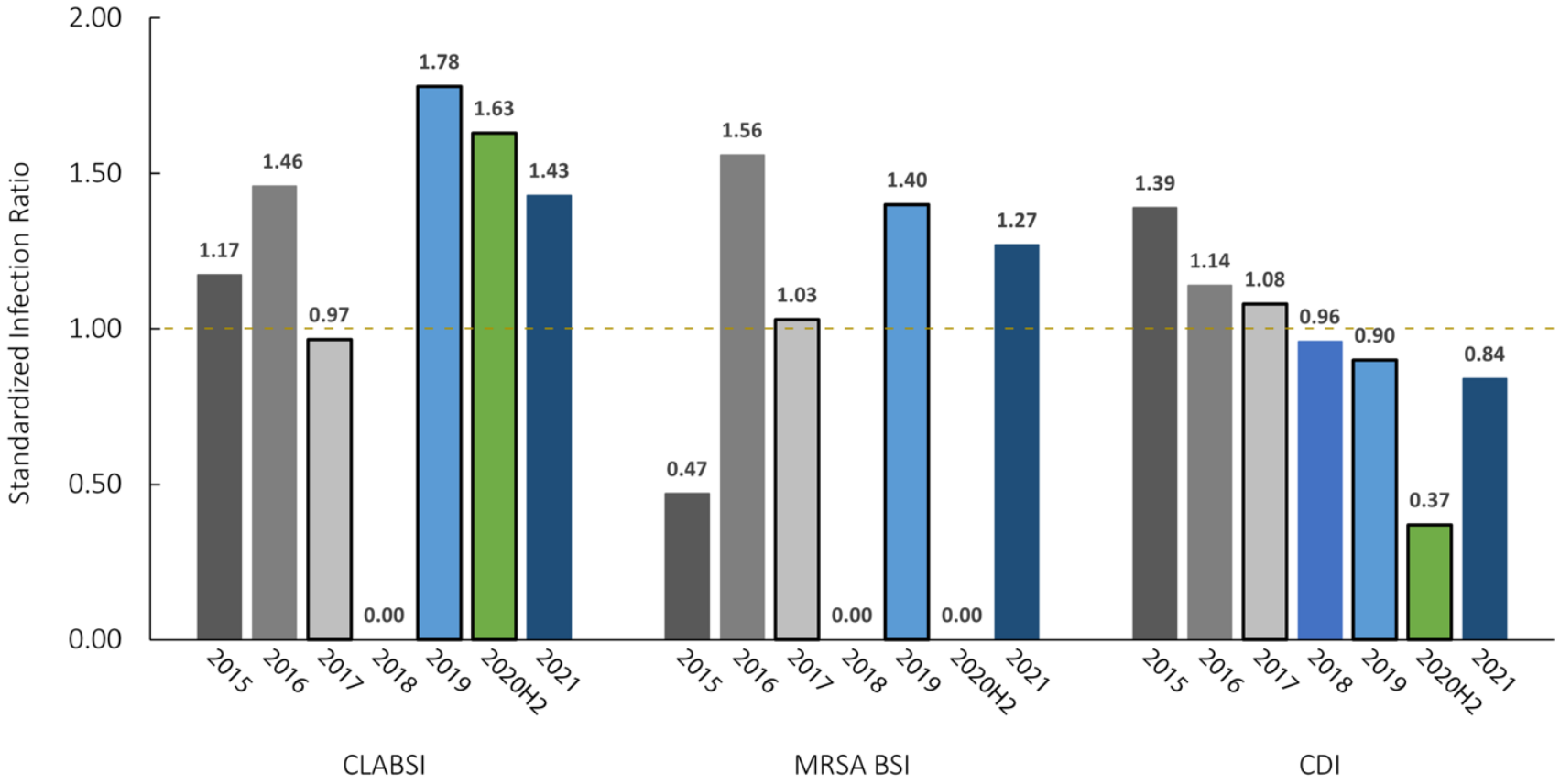
In 2021, 35 California critical access hospitals reported 4 CLABSI, 3 MRSA BSI, one VRE BSI, and 29 CDI (3 more CDI than 2019).

The statewide CLABSI incidence (SIR) is 1.43 (Figure 7), which is not significantly different than the national baseline. The infections reported occurred within three critical access hospitals. The MRSA BSI statewide incidence continues to be the same as national baseline.

The statewide CDI SIR is 0.84 and not significantly different from national baseline.

Critical access hospitals need to prevent 3 CLABSI, 2 MRSA BSI, and 5 CDI to meet the 2020 reduction goals.

Figure 7. Healthcare-Associated Infection Incidence in California Critical Access Hospitals, 2015-2021



Note: Dashed horizontal line reflects the national baseline for the standardized infection ratio (SIR). An SIR below the dashed line represents HAI prevention progress if the reduction was statistically significant. 2020H2 bar presents SIR for the latter six months of 2020.

REHABILITATION HOSPITALS AND UNITS

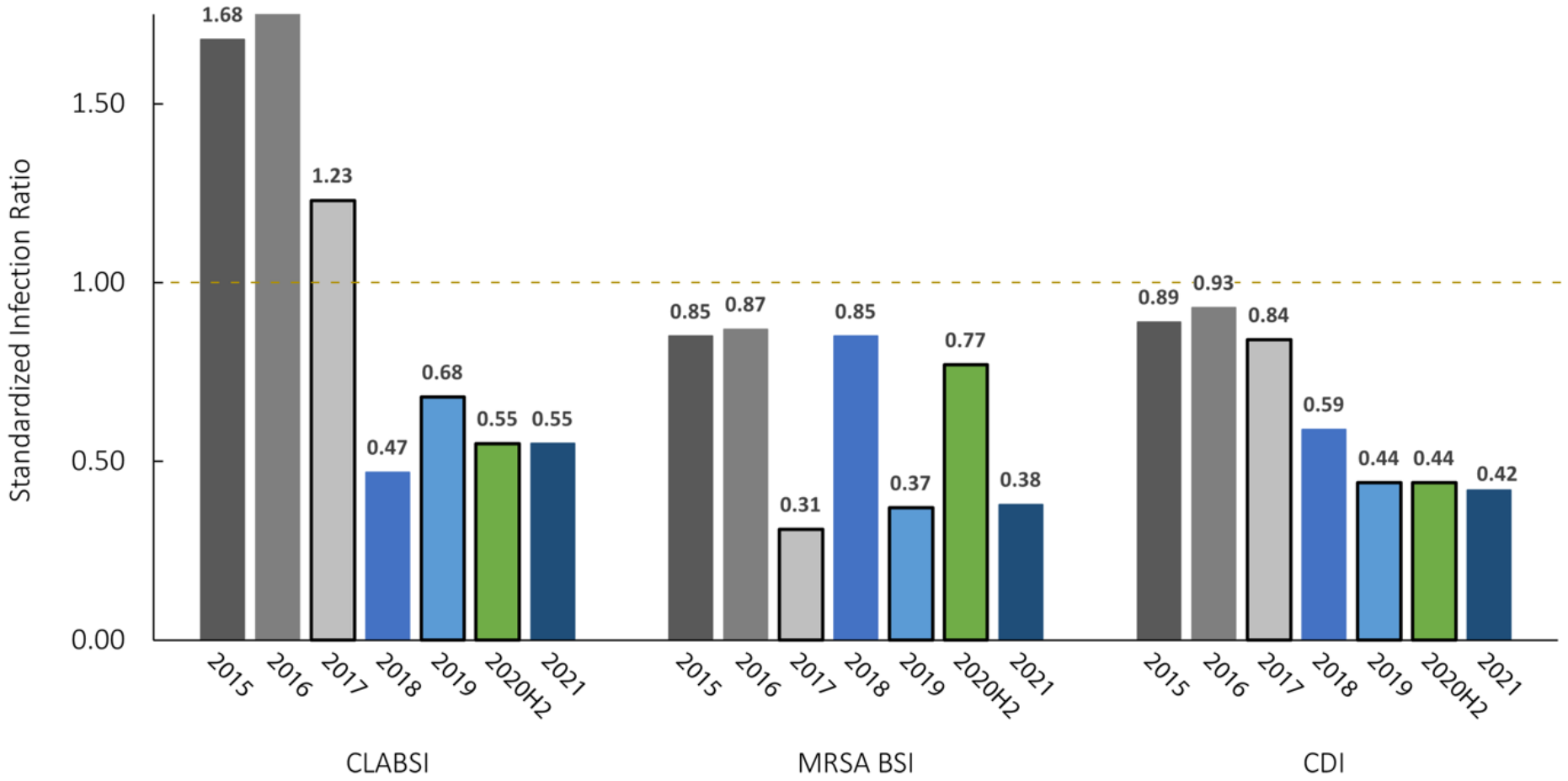
Acute care rehabilitation hospitals and units evaluate and restore function to patients who suffer from acute or chronic pain, musculoskeletal problems, stroke, and catastrophic events resulting in complete or partial paralysis.

In 2021, 12 freestanding rehabilitation hospitals and 62 hospital-based acute care rehabilitation units reported 10 CLABSI, 4 MRSA BSI, one VRE BSI, and 99 CDI (14 CDI fewer than 2019).

The statewide CLABSI incidence in rehabilitation hospitals and units (Figure 8) is significantly better than national baseline, but it is not statistically different than 2019 SIR. The MRSA BSI and CDI incidence is significantly better than national baseline.

The rehabilitation hospitals and units need to prevent one CLABSI to meet the 2020 reduction goal, whereas for the MRSA BSI and CDI these hospitals and units met the 2020 reduction goals in 2021 and 2019.

Figure 8. Healthcare-Associated Infection Incidence in California Rehabilitation Hospitals and Units, 2015-2021



Note: Dashed horizontal line reflects the national baseline for the standardized infection ratio (SIR). An SIR below the dashed line represents HAI prevention progress if the reduction was statistically significant. 2020H2 bar presents SIR for the latter six months of 2020.

PUBLIC HEALTH ACTION

To inform public health action in response to the data presented in this report, CDPH HAI Program epidemiologist staff conducted in-depth analyses of CLABSI data from before (i.e., July 2018–December 2019) and during the COVID-19 pandemic (i.e., July 2020–December 2021). The detailed findings of these analyses are included in Appendix D. We evaluated changes in hospital CLABSI incidence statewide, by hospital type, hospital location (e.g., critical care, wards), and hospital units (e.g., medical critical care unit). **We observed an overall statewide increase in hospital CLABSI incidence, especially in community hospitals and critical care locations, during the pandemic. Although the SIR increases in 2020H2 and 2021H1 relative to pre-pandemic were decreasing by 2021H2, overall, most locations had persistently higher incidence for 2021 compared with 2019.** We also compared the distribution of pathogens associated with CLABSI and antimicrobial resistance (AR) profiles using antibiogram data submitted to NHSN by California general acute care hospitals before and during pandemic periods. **We found substantial increases in the proportion of some CLABSI-associated pathogens (e.g., *Candida auris*) and AR during the pandemic, including those identified as urgent AR threats, especially *Acinetobacter* spp. and *Pseudomonas aeruginosa.*** California hospitals also continue to experience significant increases in MRSA BSI incidence in 2021 compared with pre-pandemic levels (i.e., 2019).

Altogether, these findings underscore the need for continued efforts to reinforce routine HAI and AR prevention practices during the ongoing recovery from the acute pandemic period. The HAI Program initiated a hospital CLABSI reduction project in 2022 with 34 hospitals identified with significantly high SIR, or high, within the top decile or twentieth percentile, cumulative attributable difference (CAD), which represents the overall number of infections a facility must prevent to achieve the HAI reduction goal. Among participating hospitals, 18 (53%) are community hospitals and 16 (47%) are major teaching. Nine hospitals (26%) were also identified with high MRSA BSI.

Project activities include onsite assessments with adherence monitoring of central line insertion and maintenance practices, consultations on developing facility-specific CLABSI reduction plans, follow-up with scheduled check-in and coaching sessions, educational webinars and trainings, and periodic surveys to monitor progress.

Additionally, with support of additional CDC Epidemiology and Laboratory Capacity (ELC) funding for Strengthening HAI/AR Programs (SHARP), the HAI Program resumed and expanded our statewide and regional HAI and AR prevention initiatives while continuing to provide infection prevention consultation and support across the continuum of health care as part of the ongoing COVID-19 pandemic response. Specifically, CDPH continues to:

- Build the infection preventionist (IP) workforce by continuously offering HAI Program "Basics of Infection Prevention" online training courses tailored for acute care, skilled nursing facility (SNF) and local health department (LHD) IP staff and hosting weekly office hours to review infection prevention topics.
- Provide updates on infection prevention

guidance, consultation, onsite assessment and support to hospitals, long-term healthcare and other congregate residential facilities on COVID-19 prevention and control.

- Support LHD epidemiologic investigation and response to outbreaks of COVID-19, *Legionella* and other waterborne organisms, MRSA and other AR pathogens including *Candida auris* and highly-resistant *Ancinetobactor baumannii* in healthcare settings, including outreach, enhanced surveillance, onsite infection prevention and control assessments, and education.
- Conduct outreach to clinical laboratories, infectious disease physicians, and hospital-based infection preventionists to increase laboratory capacity to test for highly-drug resistant AR pathogens by 1. developing internal capacity (e.g., new tests) and 2. submitting select pathogens to public health laboratories (e.g., carbapenem-resistant *A. baumannii* for carbapenemase testing).
- Produce a comprehensive AR report summarizing data from NHSN and other CDPH surveillance systems, focusing on *Candida* auris and carbapenemase-producing organisms.
- Engage ventilator-equipped skilled nursing facilities (vSNF) at highest risk for AR emergence and transmission to strengthen core infection prevention practices by convening them in a statewide HAI/AR prevention quality improvement collaborative.
- Engage certified nursing assistants in SNF by providing infection prevention and control training and activities as part of CDC's Project Firstline and contributing to broader AR prevention efforts.
- Expand AR prevention efforts through a range of activities, including strengthening antimicrobial stewardship programs (ASP) in hospitals and SNF, conducting focused hands-on trainings with environmental services (EVS) staff in SNF, improving interfacility communication, and conducting proactive screening testing and onsite infection control assessments at LTAC hospitals and vSNF in jurisdictions adjacent to or with patient sharing networks with jurisdictions with *C. auris* and *A. baumannii* outbreaks.
- Maintain the California ASP Honor Roll Program (Appendix E, member list) to promote optimal use of antimicrobials, prevent emergence of resistance and *Clostridioides* difficile infections, and publicly recognize California ASP that meet and exceed the CDC's Core Elements by demonstrating meaningful outcomes and engaging their local healthcare community.
- Engage all LTAC hospitals in a statewide collaborative to improve ASP and promote participation in the ASP Honor Roll.
- Collaborate with hospitals to assess appropriateness of antimicrobial use and social determinants of health in the context of COVID-19, and identify strategies to reduce health disparities among acute care facilities in California.
- Promote and foster collaboration through the California ASP Collaboration Network (ASCN) listserv platform where ASP staff from diverse healthcare settings can connect, discuss topics, and form partnerships.
- Complete, disseminate and use results of special analytic studies to inform HAI program priorities and activities. Appendix F includes a list of conference abstracts and journal articles describing studies conducted by the HAI Program staff.

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Appendix A. California General Acute Care Hospitals with Incomplete Reporting of Healthcare-Associated Infections Data, 2021*

County Hospital	Infection Type(s) with Missing or Incomplete Data in 2021*	Incomplete or Missing Data in Previous Years for At Least One HAI Type
Butte		
Oroville Hospital	CLABSI, MRSA BSI, VRE BSI, CDI	2017
Fresno		
Adventist Health Selma	CDI	
Inyo		
Southern Inyo Hospital	CLABSI, MRSA BSI, VRE BSI, CDI	2015, 2017, 2018, 2019
Los Angeles		
Greater El Monte Community Hospital	MRSA BSI, VRE BSI, CDI	2015, 2019
Marin		
Kentfield Hospital	CLABSI, MRSA BSI, VRE BSI, CDI	
Modoc		
Modoc Medical Center	CLABSI, MRSA BSI, VRE BSI, CDI	2018
Orange		
Anaheim Global Medical Center	CDI	2019
Plumas		
Plumas District Hospital	VRE BSI	
Seneca District Hospital	MRSA BSI, VRE BSI, CDI	2015, 2017, 2018, 2019
San Bernardino		
Colorado River Medical Center	CLABSI	
San Francisco		
Kentfield Hospital San Francisco	CLABSI, MRSA BSI, VRE BSI, CDI	2019
Santa Clara		
Mission Oaks Hospital	MRSA BSI, VRE BSI, CDI	2015, 2016, 2017

* Due to the COVID-19 Pandemic and suspension of year-wide reporting requirements in 2020, data from 2020 is not included in this table.

Appendix B. California Hospitals with HAI Incidence Better or Worse than National Baseline or Statewide Pooled Average Rate, 2021

Hospitals by County	CDI	CLABSI	MRSA BSI	VRE BSI	SSI
Alameda					
Alta Bates Summit Medical Center	★				
Alta Bates Summit Medical Center, Alta Bates Campus	★				
Eden Medical Center	★				
Highland Hospital					✖
Kaiser Foundation Hospital, Fremont	★				
Kaiser Foundation Hospital, Oakland/Richmond	★				
Kaiser Foundation Hospital, San Leandro	★				
Stanford Health Care - ValleyCare					★
UCSF Benioff Children's Hospital Oakland		★			
Washington Hospital	★				
Amador					
Sutter Amador Hospital	★				
Butte					
Enloe Medical Center, Esplanade		★	★	★	★
Oroville Hospital	★				
Contra Costa					
John Muir Medical Center, Walnut Creek Campus	★				
Kaiser Foundation Hospital, Antioch	★				★
Kaiser Foundation Hospital, Richmond Campus	★				
Kaiser Foundation Hospital, Walnut Creek	★	✖			
Sutter Delta Medical Center	★				
El Dorado					
Marshall Medical Center	★				
Fresno					
Clovis Community Medical Center	★				
Community Regional Medical Center	★	✖			
Fresno Heart and Surgical Hospital					★
Fresno Surgical Hospital					★
Kaiser Foundation Hospital, Fresno	★				
Saint Agnes Medical Center	★			✖	★
Humboldt					
Providence St. Joseph Hospital, Eureka	★				
Imperial					
El Centro Regional Medical Center	★	✖			
Pioneers Memorial Healthcare District		✖			
Kern					
Adventist Health Bakersfield	★				
Adventist Health Delano	★				
Bakersfield Heart Hospital		✖			

Appendix B. California Hospitals with HAI Incidence Better or Worse than National Baseline or Statewide Pooled Average Rate, 2021

Hospitals by County	CDI	CLABSI	MRSA BSI	VRE BSI	SSI
Bakersfield Memorial Hospital	★				
Kern Medical Center	★	✖			★
Mercy Hospital	★		✖		
Mercy Southwest Hospital	★				
Ridgecrest Regional Hospital					✖
Kings					
Adventist Health Hanford	★				
Los Angeles					
Adventist Health Glendale	★			✖	★
Adventist Health White Memorial	★		★		
Alhambra Hospital Medical Center	★				
Antelope Valley Hospital	★	✖			
Beverly Hospital		★			
California Hospital Medical Center, Los Angeles	★				
Casa Colina Hospital	★				
Cedars-Sinai Marina Del Rey Hospital		★	✖	✖	★
Cedars-Sinai Medical Center			★	✖	
Centinela Hospital Medical Center	★	★		✖	★
Children's Hospital Los Angeles		★			
City of Hope Helford Clinical Research Hospital				✖	★
College Medical Center	★				
Emanate Health Foothill Presbyterian Hospital		★			★
Emanate Health Inter-Community Hospital		★			★
Emanate Health Queen of the Valley Hospital		★			★
Glendale Memorial Hospital and Health Center	★				
Good Samaritan Hospital, Los Angeles			✖		★
Greater El Monte Community Hospital		★			
Henry Mayo Newhall Hospital	★	✖	✖		
Hollywood Presbyterian Medical Center	★				
Huntington Hospital	★	★			
Kaiser Foundation Hospital, Baldwin Park	★				
Kaiser Foundation Hospital, Downey	★	✖			
Kaiser Foundation Hospital, Los Angeles	★				
Kaiser Foundation Hospital, Panorama City	★				
Kaiser Foundation Hospital, South Bay	★				
Kaiser Foundation Hospital, West LA	★				
Kaiser Foundation Hospital, Woodland Hills		✖	✖		
Keck Hospital of USC		★		✖	★
L.A. Downtown Medical Center	★				
LAC+USC Medical Center	★	★	✖		★

Appendix B. California Hospitals with HAI Incidence Better or Worse than National Baseline or Statewide Pooled Average Rate, 2021

Hospitals by County	CDI	CLABSI	MRSA BSI	VRE BSI	SSI
LAC/Harbor UCLA Medical Center		✖			
LAC/Olive View-UCLA Medical Center			✖		★
LAC/Rancho Los Amigos National Rehabilitation Center		★			
Los Angeles Community Hospital	★		✖	✖	
Martin Luther King Jr. Community Hospital	★				
Memorial Hospital of Gardena	★				
MemorialCare Long Beach Medical Center	★				
MemorialCare Miller Children's & Women's Hospital Long Beach	★				
Mission Community Hospital				✖	
Monterey Park Hospital			✖		
Northridge Hospital Medical Center	★	★			
Norwalk Community Hospital			✖	✖	
Olympia Medical Center		✖			
PIH Health Hospital, Downey	★				
PIH Health Hospital, Whittier	★	★			★
Pacifica Hospital of the Valley		✖			
Palmdale Regional Medical Center					★
Pomona Valley Hospital Medical Center	★	✖			
Providence Cedars-Sinai Tarzana Medical Center	★				
Providence Holy Cross Medical Center	★				★
Providence Little Company of Mary Medical Center Torrance	★				
Providence Saint John's Health Center	★				★
Providence Saint Joseph Medical Center	★				★
Ronald Reagan UCLA Medical Center		★			★
San Dimas Community Hospital	★				
San Gabriel Valley Medical Center	★				
Sherman Oaks Hospital	★				
Southern California Hospital at Culver City	★				
Southern California Hospital at Hollywood	★				
St. Francis Medical Center	★				✖
St. Mary Medical Center, Long Beach	★	★			
Torrance Memorial Medical Center	★	★			
USC Verdugo Hills Hospital	★				
Valley Presbyterian Hospital	★	✖			★
West Hills Hospital & Medical Center	★	✖	✖		
Whittier Hospital Medical Center	★				★
Madera					
Madera Community Hospital		✖			

Appendix B. California Hospitals with HAI Incidence Better or Worse than National Baseline or Statewide Pooled Average Rate, 2021

Hospitals by County	CDI	CLABSI	MRSA BSI	VRE BSI	SSI
Valley Children's Hospital		★			
Marin					
MarinHealth Medical Center	★				
Merced					
Mercy Medical Center	★				★
Monterey					
Natividad Medical Center	★				
Salinas Valley Memorial Hospital	★	★			★
Napa					
Adventist Health St. Helena		★			
Providence Queen of the Valley Medical Center	★				
Orange					
AHMC Anaheim Regional Medical Center	★				
Chapman Global Medical Center					★
College Hospital Costa Mesa	★				
Foothill Regional Medical Center					★
Fountain Valley Regional Hospital and Medical Center	★	✖			✖
Garden Grove Hospital and Medical Center	★				
Hoag Hospital Irvine	★				
Hoag Memorial Hospital Presbyterian	★		★	★	★
Hoag Orthopedic Institute					★
Huntington Beach Hospital		✖			
Kaiser Foundation Hospital, Orange County, Anaheim	★				
Kaiser Foundation Hospital, Orange County, Irvine	★				
Los Alamitos Medical Center		✖	✖		
MemorialCare Orange Coast Medical Center		★			
MemorialCare Saddleback Medical Center	★				
Providence St. Joseph Hospital, Orange				★	
Providence St. Jude Medical Center	★			★	
University of California Irvine Medical Center	★				★
West Anaheim Medical Center			✖		
Placer					
Kaiser Foundation Hospital, Roseville	★				
Sutter Roseville Medical Center	★				★
Riverside					
Corona Regional Medical Center	★				★
Desert Regional Medical Center	★				★
Doctors Hospital of Riverside	★				
Eisenhower Medical Center	★				
Hemet Global Medical Center	★	★			★

Appendix B. California Hospitals with HAI Incidence Better or Worse than National Baseline or Statewide Pooled Average Rate, 2021

Hospitals by County	CDI	CLABSI	MRSA BSI	VRE BSI	SSI
John F. Kennedy Memorial Hospital	★				
Kaiser Foundation Hospital, Moreno Valley			✖		
Kaiser Foundation Hospital, Riverside	★				★
Loma Linda University Medical Center, Murrieta	★				
Menifee Global Medical Center	★				
Riverside Community Hospital	★	✖			
Riverside University Health System - Medical Center	★	★			★
Southwest Healthcare System, Wildomar					★
Sacramento					
Kaiser Foundation Hospital, Sacramento	★				
Kaiser Foundation Hospital, South Sacramento	★				
Mercy General Hospital	★				★
Mercy Hospital of Folsom	★				
Mercy San Juan Medical Center	★	★			★
Methodist Hospital of Sacramento	★	✖			
Sutter Medical Center, Sacramento	★	★			
University of California Davis Medical Center	★	★		✖	
San Bernardino					
Arrowhead Regional Medical Center	★				★
Barstow Community Hospital	★				
Community Hospital of San Bernardino	★	✖			★
Desert Valley Hospital	★	★			
Kaiser Foundation Hospital, Fontana					★
Kaiser Foundation Hospital, Ontario	★				
Loma Linda University Children's Hospital	★	★			
Loma Linda University Medical Center	★	★		✖	
Providence St. Mary Medical Center, Apple Valley	★				
Redlands Community Hospital	★			✖	
San Antonio Regional Hospital	★				
St. Bernardine Medical Center	★				★
Victor Valley Global Medical Center	★				
San Diego					
Alvarado Hospital Medical Center	✖		✖		★
Grossmont Hospital	★	★			★
Kaiser Foundation Hospital, San Diego	★	★			
Palomar Medical Center	★			★	
Palomar Medical Center Poway	★				
Paradise Valley Hospital	★				
Scripps Memorial Hospital, Encinitas	★				
Scripps Memorial Hospital, La Jolla	★				

Appendix B. California Hospitals with HAI Incidence Better or Worse than National Baseline or Statewide Pooled Average Rate, 2021

Hospitals by County	CDI	CLABSI	MRSA BSI	VRE BSI	SSI
Scripps Mercy Hospital	★				
Scripps Mercy Hospital Chula Vista	★				
Sharp Chula Vista Medical Center	★				
Sharp Coronado Hospital and Healthcare Center		✖			
Sharp Mary Birch Hospital For Women And Newborns	★				
Sharp Memorial Hospital	★			★	
UC San Diego Health Hillcrest		★			
UC San Diego Health La Jolla		★			
San Francisco					
California Pacific Medical Center, Mission Bernal Campus					★
California Pacific Medical Center, Van Ness Campus		★	★		★
Saint Francis Memorial Hospital		★			
St. Mary's Medical Center	★				
UCSF Medical Center				✖	★
UCSF Medical Center at Mission Bay					★
Zuckerberg San Francisco General Hospital and Trauma Center					★
San Joaquin					
Adventist Health Lodi Memorial	★				
Doctors Hospital of Manteca	★	✖			
San Joaquin General Hospital	★	✖			
St. Joseph's Medical Center Of Stockton	★	✖			
Sutter Tracy Community Hospital	★				
San Luis Obispo					
Marian Regional Medical Center, Arroyo Grande	★				
Tenet Health Central Coast Sierra Vista Regional Medical Center	★				
Tenet Health Central Coast Twin Cities Community Hospital					✖
San Mateo					
Kaiser Foundation Hospital, Redwood City	★	★			
Kaiser Foundation Hospital, South San Francisco	★				
Mills-Peninsula Medical Center	★	★			★
Sequoia Hospital	★				
Santa Barbara					
Marian Regional Medical Center	★				
Santa Barbara Cottage Hospital	★				★
Santa Clara					
El Camino Health	★	★			★
Good Samaritan Hospital, San Jose	★				

Appendix B. California Hospitals with HAI Incidence Better or Worse than National Baseline or Statewide Pooled Average Rate, 2021

Hospitals by County	CDI	CLABSI	MRSA BSI	VRE BSI	SSI
Kaiser Foundation Hospital, San Jose	★				
Kaiser Foundation Hospital, Santa Clara	★			★	
Lucile Packard Children's Hospital Stanford		★			
O'Connor Hospital	★				
Regional Medical Center of San Jose	★				
Santa Clara Valley Medical Center					✖
Stanford Health Care				✖	★
Santa Cruz					
Dominican Hospital	★	★			
Sutter Maternity & Surgery Center of Santa Cruz					★
Shasta					
Mercy Medical Center Redding	★				
Shasta Regional Medical Center	★		✖		
Solano					
Kaiser Foundation Hospital and Rehab Center, Vallejo	★				
Northbay Medical Center	★	★			
Sutter Solano Medical Center	★				
Sonoma					
Kaiser Foundation Hospital, Santa Rosa	★				
Providence Santa Rosa Memorial Hospital	★		✖		
Sonoma Specialty Hospital	✖				
Sutter Santa Rosa Regional Hospital					★
Stanislaus					
Doctors Medical Center	★	★	✖		★
Emanuel Medical Center	★	✖			✖
Kaiser Foundation Hospital, Modesto	★				★
Memorial Medical Center	★				
Tulare					
Kaweah Health Medical Center	★		✖		★
Tuolumne					
Adventist Health Sonora	★	✖			
Ventura					
Adventist Health Simi Valley	★				★
St Johns Pleasant Valley Hospital					★
St Johns Regional Medical Center	★				
Yolo					
Sutter Davis Hospital					✖
Yuba					
Adventist Health and Rideout	★		✖		

Appendix C. California Hospitals with Surgical Site Infection Incidence Better or Worse than National Baseline, 2021

Hospitals by County	Better	Worse
Alameda		
Alta Bates Summit Medical Center, Alta Bates Campus		Hip prosthesis
Highland Hospital		Colon surgery; Small bowel surgery
Kaiser Foundation Hospital, Oakland/Richmond		Spinal fusion- Pediatric
Washington Hospital		Pacemaker surgery
Contra Costa		
Kaiser Foundation Hospital, Walnut Creek		Small bowel surgery
San Ramon Regional Medical Center		Knee prosthesis
El Dorado		
Marshall Medical Center		Hysterectomy, abdominal
Fresno		
Community Regional Medical Center		Bile duct, liver or pancreatic surgery; Hip prosthesis; Knee prosthesis
Fresno Heart and Surgical Hospital	Small bowel surgery	Cardiac surgery
Kern		
Ridgecrest Regional Hospital		Colon surgery
San Joaquin Community Hospital		Kidney surgery; Rectal surgery; Spinal fusion
Los Angeles		
Cedars-Sinai Medical Center	Cardiac surgery; Liver transplant	Heart transplant
City of Hope Helford Clinical Research Hospital	Colon surgery; Gallbladder surgery	
Huntington Memorial Hospital		Hysterectomy, abdominal
Kaiser Foundation Hospital, Downey	Laminectomy	
Kaiser Foundation Hospital, Panorama City		Colon surgery
Kaiser Foundation Hospital, West LA		Thoracic surgery
LAC/Harbor UCLA Medical Center		Bile duct, liver or pancreatic surgery; Cardiac surgery
LAC+USC Medical Center	Hysterectomy, abdominal; Kidney surgery; Rectal surgery	

Appendix C. California Hospitals with Surgical Site Infection Incidence Better or Worse than National Baseline, 2021

Hospitals by County	Better	Worse
Methodist Hospital of Southern California		Hip prosthesis
Providence Saint John's Health Center	Spleen surgery	
Providence Saint Joseph Medical Center	Spinal fusion; Spleen surgery	
Ronald Reagan UCLA Medical Center	Coronary bypass, chest incision only; Spinal fusion	
Saint Francis Medical Center		Hip prosthesis; Kidney surgery; Pacemaker surgery
Santa Monica - UCLA Medical Center and Orthopaedic Hospital	Kidney surgery	
White Memorial Medical Center	Appendix surgery	
Madera		
Valley Children's Hospital		Appendix surgery- Pediatric
Merced		
Mercy Medical Center	Pacemaker surgery	
Orange		
Fountain Valley Regional Hospital & Medical Center		Coronary bypass, chest incision only; Pacemaker surgery
Kaiser Foundation Hospital, Orange County, Anaheim		Thoracic surgery
Mission Hospital Regional Medical Center		Hysterectomy, vaginal
St. Joseph Hospital, Orange	Cardiac surgery	
University of California Irvine Medical Center	Abdominal aortic aneurysm repair; Exploratory abdominal surgery (laparotomy); Small bowel surgery; Spleen surgery	
Placer		
Kaiser Foundation Hospital, Roseville		Pacemaker surgery
Sutter Roseville Hospital	Cardiac surgery	
Riverside		
Eisenhower Medical Center		Open reduction of fracture; Small bowel surgery

Appendix C. California Hospitals with Surgical Site Infection Incidence Better or Worse than National Baseline, 2021

Hospitals by County	Better	Worse
John F. Kennedy Memorial Hospital		Hysterectomy, abdominal
Kaiser Foundation Hospital, Moreno Valley		Open reduction of fracture
Riverside Community Hospital	Coronary bypass, chest and donor incisions	Hysterectomy, vaginal; Kidney surgery
Southwest Healthcare System, Wildomar	Open reduction of fracture	
Sacramento		
Kaiser Foundation Hospital, Sacramento		Cesarean section
Mercy General Hospital	Cardiac surgery; Pacemaker surgery	
Sutter Medical Center, Sacramento		Knee prosthesis; Small bowel surgery
University of California Davis Medical Center		Knee prosthesis
San Bernardino		
Arrowhead Regional Medical Center	Rectal surgery	
Kaiser Foundation Hospital, Fontana		Spinal fusion
Loma Linda University East Campus Hospital		Open reduction of fracture; Spinal fusion
St. Bernardine Medical Center	Cardiac surgery	
San Diego		
Grossmont Hospital	Laminectomy	
Kaiser Foundation Hospital, San Diego		Rectal surgery
Palomar Medical Center		Cesarean section
Pomerado Hospital		Gastric surgery
Scripps Green Hospital		Hip prosthesis
Scripps Mercy Hospital	Cardiac surgery	Hip prosthesis
Sharp Chula Vista Medical Center		Open reduction of fracture
UC San Diego Health Hillcrest, Hillcrest Medical Center	Gastric surgery; Spleen surgery	Hip prosthesis; Laminectomy
San Francisco		
California Pacific Medical Center, Van Ness Campus	Bile duct, liver or pancreatic surgery; Colon surgery; Small bowel surgery	
UCSF Medical Center at Mission Bay	Colon surgery	Spinal fusion- Pediatric

Appendix C. California Hospitals with Surgical Site Infection Incidence Better or Worse than National Baseline, 2021

Hospitals by County	Better	Worse
Zuckerberg San Francisco General Hospital and Trauma Center	Cesarean section	
San Joaquin		
San Joaquin General Hospital		Colon surgery
San Luis Obispo		
Twin Cities Community Hospital		Hysterectomy, abdominal
San Mateo		
Mills-Peninsula Medical Center	Rectal surgery	
Santa Clara		
Kaiser Foundation Hospital, San Jose		Gallbladder surgery
O'Connor Hospital		Laminectomy
Santa Clara Valley Medical Center	Gastric surgery	
Stanford Health Care	Hysterectomy, abdominal	Spleen surgery
Solano		
Kaiser Foundation Hospital and Rehab Center, Vallejo		Cesarean section
Kaiser Foundation Hospital, Vacaville		Ovarian surgery
Sonoma		
Petaluma Valley Hospital		Knee prosthesis
Stanislaus		
Emanuel Medical Center		Pacemaker surgery
Tehama		
St. Elizabeth Community Hospital		Gastric surgery
Ventura		
Los Robles Hospital & Medical Center		Hysterectomy, abdominal; Thoracic surgery
Yolo		
Sutter Davis Hospital		Spleen surgery
Woodland Memorial Hospital		Appendix surgery; Bile duct, liver, or pancreatic surgery
Rideout Memorial Hospital		Gastric surgery

Appendix D. Summary: Comparison of CLABSI Data from California Hospitals Before and During Pandemic Periods

Background

The COVID-19 pandemic has caused substantial nationwide increases in acute care hospital (ACH) CLABSI incidence [1-4], particularly in some patient care locations such as critical care (CC) units and wards. In addition, there have been significant increases in device utilization [3] and in the proportion of some CLABSI-associated pathogens such as coagulase-negative *Staphylococci [1, 5], Candida* spp. [1], and *Enterococcus faecalis* [5]. In 2022, CDPH HAI Program epidemiologist staff conducted analyses using NHSN data to compare the CLABSI incidence in California hospitals before and during the COVID-19 pandemic to further understand the impacts of the pandemic on CLABSI and inform targeted prevention efforts. Specifically, we evaluated incidence by hospital location and units, distribution of pathogens reported and their antimicrobial resistance (AR) profiles, and risk factors potentially associated with central line insertion versus maintenance.

CLABSI Incidence Analysis by Hospital Location

Methods

Using California ACH (n=327) CLABSI standardized infection ratio (SIR) data from NHSN, we compared incidence during the second halves of 2019 (2019H2) and 2020 (2020H2) to evaluate early pandemic changes, and during 2019 (pre-pandemic) and 2021 (pandemic) periods by hospital type, location type (e.g., Critical Care (CC)), and patient care location (e.g., medical CC), excluding rehabilitation units. We applied the mid-p value method statistical test by CDC [6] to compare SIRs between study periods.

Results

ACH CLABSI SIR significantly increased statewide from 2019H2 to 2020H2 by 51% (0.65 to 0.98) and from 2019 to 2021 by 34% (0.67 to 0.90). Community hospitals < 125 beds had the highest SIR and percentage increase in 2021 as well as 2020H2. Of nine location types and 58 patient care locations, CC units and medical and medical-surgical CC had significantly higher SIR in both comparisons (2020H2 versus 2019H2 and 2021 versus 2019), wards and medical wards in 2020H2 only, and step-down units and adult step-down in 2021 only. Trauma CC SIR was significantly higher only in 2020H2 compared with 2019H2, while surgical CC SIR was significantly higher in 2021 compared with 2019 (Table 1). Respiratory CC had the highest SIR (2.99, 95%CI 2.14-4.08) in 2021, but was not significantly higher when compared with 2019 (1.06, 95%CI 0.21-3.41).

Table 1. Statewide comparison of acute care hospital (ACH) CLABSI incidence before and during the COVID-19 pandemic, by hospital type and patient care location[a]

ACH	SIR[c] (95% CI[d]) 2019H2[b]	SIR[c] (95% CI[d]) 2020H2	P-Value[e]	SIR % Difference	2019 SIR (95% CI)	2021 SIR (95% CI)	P-Value	SIR % Difference
Statewide	0.65 (0.61,0.69)	0.98 (0.93,1.03)	<0.0001*	50.8	0.67 (0.64,0.70)	0.90 (0.87,0.94)	<0.0001*	34.3
Type								
Community (<125 Beds)	0.75 (0.54,1.02)	1.51 (1.22,1.85)	0.0002*	101.3	0.75 (0.60,0.93)	1.31 (1.11,1.53)	<0.0001*	74.7
Community (125 – 250 Beds)	0.78 (0.65,0.94)	1.10 (0.94,1.28)	0.0049*	41.0	0.81 (0.71,0.91)	1.06 (0.95,1.18)	0.0014*	30.9
Community (>250 Beds)	0.52 (0.44,0.61)	1.04 (0.93,1.17)	<0.0001*	100.0	0.60 (0.54,0.67)	1.02 (0.93,1.11)	<0.0001*	70.0
Major Teaching	0.67 (0.61,0.73)	0.96 (0.89,1.03)	<0.0001*	43.3	0.67 (0.63,0.72)	0.86 (0.82,0.91)	<0.0001*	28.4
Pediatric	0.64 (0.50,0.79)	0.52 (0.40,0.66)	0.2383	-18.8	0.59 (0.50,0.70)	0.55 (0.46,0.65)	0.4972	-6.8
Location								
Critical Care (CC) Units	0.73 (0.66,0.82)	1.38 (1.28,1.48)	<0.0001*	89.0	0.73 (0.68,0.79)	1.23 (1.17,1.30)	<0.0001*	68.5
Medical CC	0.90 (0.68,1.16)	2.17 (1.88,2.50)	<0.0001*	141.1	0.90 (0.75,1.08)	1.60 (1.42,1.80)	<0.0001*	77.8
Medical-Surgical CC	0.81 (0.69,0.95)	1.58 (1.43,1.75)	<0.0001*	95.1	0.82 (0.73,0.91)	1.46 (1.35,1.56)	<0.0001*	78.1
Surgical CC	0.63 (0.40,0.95)	1.06 (0.76,1.44)	0.0567	68.3	0.65 (0.48,0.87)	1.13 (0.90,1.39)	0.0031*	73.9
Trauma CC	0.51 (0.23,1.00)	1.25 (0.80,1.87)	0.0336*	145.1	0.54 (0.32,0.87)	0.73 (0.48,1.06)	0.3737	35.2
Step-Down Units	0.68 (0.52,0.87)	0.91 (0.72,1.14)	0.0865	33.8	0.62 (0.51,0.74)	1.04 (0.90,1.21)	<0.0001*	67.7
Adult Step-Down	0.66 (0.50,0.85)	0.92 (0.72,1.15)	0.0666	39.4	0.60 (0.49,0.73)	1.03 (0.89,1.20)	<0.0001*	71.7
Wards	0.58 (0.52,0.66)	0.69 (0.62,0.77)	0.0368*	19.0	0.64 (0.59,0.69)	0.65 (0.60,0.70)	0.7382	1.6
Medical Ward	0.59 (0.44,0.77)	0.88 (0.68,1.10)	0.0359*	49.2	0.68 (0.56,0.81)	0.61 (0.50,0.75)	0.4727	-10.3

[a]Only hospital locations that were statistically significant in at least one study period are presented; [b]H2: second half of year; [c]Standardized infection ratio; [d]CI: Confidence intervals; [e]P-values based on mid-P-exact test <0.05 were considered statistically significant; *Statistically significant.

Conclusions

We observed an overall statewide increase in hospital CLABSI incidence, especially in CC locations, during the pandemic. Although the SIR increase relative to the pre-pandemic period was smaller in 2021 than in 2020H2, with some exceptions, most locations had persistently higher incidence.

Pathogen and Antimicrobial Resistance Analysis

Methods

We performed analysis of California hospital (n=322) antibiogram data from NHSN to compare the distribution of pathogens associated with CLABSI and antimicrobial resistance (AR) profiles pre-pandemic (July 2018–2019) and during the pandemic (July 2020–December 2021). We determined percentage nonsusceptible (NS: isolate tested intermediate or resistant) or resistant (isolate tested resistant) to selected antimicrobials following methodology and AR phenotype definitions previously described by CDC [7]. We applied the mid-p value method statistical test by CDC [6] to compare percentage R or NS between study periods.

Results

The number of CLABSI-associated pathogens increased by 40% during the pandemic period compared with pre-pandemic (Table 2). While the five most commonly reported pathogens were the same in both periods, their proportions and rankings changed (Table 2). Three of the pathogens had an increase in proportion during the pandemic period: *Enterococcus faecalis* (+71%), Coagulase-negative staphylococci (+42%), and *Candida albicans* (+29%). *Candida auris* had the largest percent increase (+1,833%) of the pathogens reported.

Nonsusceptibility to fluoroquinolones increased during the pandemic period for most gram-negative pathogens we evaluated. In particular, there was a significant increase in NS-*Acinetobacter spp.* (44% versus 71%, +61%, p-value=0.018) and NS-*Pseudomonas aeruginosa* (PA) (17% versus 26%, +53%, p-value= 0.0398). Nonsusceptibility to piperacillin/tazobactam among PA increased significantly by 75% (16% versus 28%, p-value=0.0117). Nonsusceptibility to extended-spectrum cephalosporins (ESC) increased for all gram-negative pathogens we evaluated during the pandemic period. Though not statistically significant, NS to ESC increased by 42% among *Enterobacter spp.* (12% versus 17%) and by 26% (54% versus 68%) among *Acinetobacter spp.*

Though not statistically significant, carbapenem resistance increased by 48% (44% versus 65%) among *Acinetobacter spp.* and by 33% (15% versus 20%) among PA. While not statistically significant, carbapenem resistance among the Enterobacterales order decreased by 18% during the pandemic period (11% versus 9%); however, it doubled in *Enterobacter spp.* (4% versus 8%) and tripled in *Escherichia coli* (1% versus 3%). Although not statistically significant, percent methicillin-resistant *Staphylococcus aureus* (i.e., MRSA) central line-associated BSIs increased by 10% (40% versus 44%) during the pandemic period.

Table 2. Top five most common CLABSI-associated pathogens reported before and during the COVID-19 pandemic period

Pathogen	Pre-Pandemic Rank	Pre-Pandemic N	Pre-Pandemic %	Pandemic Rank	Pandemic N	Pandemic %
Staphylococcus aureus	1	458	13	3	533	11
Coagulase-negative staphylococci	2	445	12	1	854	17
Klebsiella spp.	3	326	9	5	319	6
Candida albicans	4	265	7	4	439	9
Enterococcus faecalis	5	263	7	2	604	12
Other pathogens		1,839	51		2,294	45
Total		3,596	100		5,043	100

Conclusions

Similar to national studies and reports [1, 5, 8], our findings showed substantial increases in the proportion of some CLABSI-associated pathogens, including those identified as urgent AR threats [8] (particularly for *Acinetobacter* spp.) during the pandemic. Results from this study mirror increases in the volume of novel and targeted multidrug-resistant organism (i.e., *C. auris,* carbapenem-resistant *Acinetobacter baumannii*) cases and outbreaks reported to us during the pandemic. Finally, findings will improve our understanding of the impact of the pandemic on AR pathogens in California hospitals and assist in statewide prevention efforts targeting antimicrobial use and resistance.

Central-Line Insertion Analysis

Methods

We conducted a retrospective cross-sectional study of CLABSI events reported by California hospitals to NHSN to identify risk factors associated with the introduction of an insertion line (i.e., extraluminal) compared to maintenance (i.e., intraluminal) in a hospital setting, including pandemic-related periods (pre-pandemic [July 2018–December 2019] versus during the pandemic [July 2020–December 2021]). Out of 7,618 CLABSI events reported during the study period, 2,295 (30%) with an insertion date available were included in the analysis. Events with insertion date available were classified based on insertion to event dates: 1) line insertion (i.e., ≤7 days) and 2) line maintenance (i.e., >7 days). We calculated relative percentage differences, differences in proportions using chi-squared tests, unadjusted odds ratios (ORs), and 95% confidence intervals (95% CI).

Results

Out of 2,295 CLABSI events, 882 (38%) were related to line insertion and 1,413 (62%) were related to line maintenance. Overall, 31% (n=708) of these events had a dialysis catheter in place. When comparing line insertion with line maintenance, there were no significant differences in distributions of gender, age group, or dialysis catheter. However, dying was more strongly associated with line insertion than line maintenance (unadjusted OR 1.58, 95%CI 1.32-1.90). While there were no significant differences in distributions between line insertion and line maintenance during the pandemic, line insertion-related events increased significantly by 94% and maintenance-related events by 77%, compared with pre-pandemic.

Conclusions

These preliminary findings will support model selection for potential future multivariable regression analysis to better inform statewide CLABSI infection prevention practices. Due to increased reporting of insertion dates during the pandemic, any preliminary comparisons between pre-pandemic and pandemic periods should be interpreted with caution.

References

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Appendix E. Antimicrobial Stewardship Program Honor Roll Members

Gold

- AHMC Seton Medical Center
- Alta Bates Summit Medical Center - Alta Bates and Summit Campuses
- California Pacific Medical Center – Davies, Mission Bernal, and Van Ness Campuses
- Children Hospital Los Angeles
- Children's Hospital of Orange County
- Community Hospital of San Bernardino
- Dominican Hospital
- Eisenhower Health
- French Hospital Medical Center
- Hoag Memorial Hospital
- Kaiser Foundation Hospital - Woodland Hills
- Kaiser Permanente West Los Angeles Medical Center
- Loma Linda University Children's Hospital
- Lompoc Valley Medical Center
- Los Alamitos Medical Center
- Lucile Packard Children's Hospital Stanford
- Marian Regional Medical Center
- Mercy Medical Center Mt. Shasta
- Mercy Medical Center Redding
- Palomar Medical Center Escondido
- Palomar Medical Center Poway
- Providence Saint John's Hospital
- Riverside University Health System
- San Mateo Medical Center
- Santa Barbara Cottage Hospital
- Sharp Chula Vista Medical Center
- Sharp Coronado Hospital
- Sharp Mary Birch Hospital for Women and Newborns / Sharp Memorial Hospital
- Sierra View District Hospital
- St. Elizabeth Community Hospital
- St. John's Regional Medical Center / St. John's Hospital Camarillo
- St. Joseph Hospital of Orange
- St. Mary's Medical Center
- Stanford Health Care
- Sutter Maternity & Surgery Center of Santa Cruz
- University of California Davis Health
- University of California Irvine
- University of California, San Francisco
- University of California San Francisco - Benioff Children's Hospital Oakland
- Veterans Affairs Greater Los Angeles Healthcare System
- Veterans Affairs Palo Alto Health Care System

Appendix E. Antimicrobial Stewardship Program Honor Roll Members

Silver

- Adventist Health & Rideout
- Adventist Health Lodi Memorial
- Antelope Valley Hospital
- Arrowhead Regional Medical Center
- California Hospital Medical Center
- City of Hope National Medical Center
- Community Memorial Hospital
- Desert Regional Medical Center
- Dignity Health - Mercy San Juan Medical Center
- Dignity Health Northridge Hospital Medical Center
- Eden Medical Center
- Foothill Regional Medical Center
- Garfield Medical Center
- Glendale Memorial Hospital and Health Center
- Goleta Valley Cottage Hospital
- Huntington Hospital
- Kaiser Foundation Hospital - Fremont
- Kaiser Foundation Hospital - San Leandro
- Kaiser Foundation Hospital - South Sacramento
- Kaiser Foundation Hospital San Francisco
- Kaiser Oakland Medical Center
- Kaiser Permanente Fresno Medical Center
- Kaiser Permanente Richmond
- Kaiser Permanente Roseville Medical Center
- Kaiser Permanente Sacramento Medical Center
- Kaiser Permanente Santa Clara Medical Center
- Kaiser Permanente Medical Center, Vacaville
- Kaiser Permanente Vallejo Medical Center
- Keck Hospital of USC
- Kindred Hospital La Mirada, San Gabriel Valley, and Santa Ana Triad
- Kindred Hospital South Bay
- La Palma Intercommunity Hospital
- Loma Linda University Medical Center
- Los Angeles County- University of Southern California Medical Center
- Los Robles Regional Medical Center
- Martin Luther King Jr. Community Hospital
- Memorial Hospital of Gardena
- MemorialCare Long Beach Medical Center
- MemorialCare Orange Coast Medical Center
- MemorialCare Saddleback Medical Center
- Mercy General Hospital
- Mercy Hospital Folsom
- Miller Children's and Women's Hospital, Long Beach
- Mills-Peninsula Medical Center
- Novato Community Hospital
- Orange County Global Medical Center
- PIH Health Good Samaritan Hospital
- Queen of the Valley Medical Center
- Redwood Memorial Hospital
- Riverside Community Hospital
- San Antonio Regional Hospital
- Santa Ynez Valley Cottage Hospital
- Sequoia Hospital
- Sierra Vista Regional Medical Center
- Southern California Hospital at Culver City
- Southern California Hospitals in Hollywood
- St Elizabeth's Community Hospital
- St Mary Medical Center Long Beach
- St. Bernardine Medical Center - Dignity Health
- St. Jude Medical Center
- Sutter Davis Hospital
- Sutter Medical Center Sacramento
- Sutter Roseville Medical Center
- Sutter Roseville Medical Center
- Twin Cities Community Hospital
- UCLA-Santa Monica Hospital / Ronald Reagan UCLA Medical Center
- UCSF Benioff Children's Hospital San Francisco
- USC Norris Cancer Hospital
- USC Verdugo Hills Hospital
- West Anaheim Medical Center
- Whittier Hospital Medical Center

Appendix E. Antimicrobial Stewardship Program Honor Roll Members

Bronze

- Adventist Health Simi Valley Medical Center
- Alhambra Hospital Medical Center
- Anaheim Global Medical Center
- Aurora San Diego
- Bear Valley Community Healthcare District
- Centinela Hospital Medical Center
- Chinese Hospital
- Coast Plaza Hospital
- College Medical Center, Long Beach
- Corona Regional Medical center
- Hoag Orthopedic Institute
- Huntington Beach Hospital
- John Muir Health - Concord Campus
- John Muir Health - Walnut Creek Campus
- Kaiser Foundation Hospital: Modesto Medical Center
- Kaiser Permanente Hospital - Manteca
- Kaiser Permanente Panorama City
- Kaiser Permanente San Jose Medical Center
- Kaiser Permanente Hospital - Walnut Creek
- Kaiser Permanente Zion and San Diego Medical Center
- Kaweah Health Medical Center
- Kern Medical
- Kindred Hospital- Baldwin Park
- Kindred Hospital Brea
- Kindred Hospital Los Angeles
- Kindred Hospital Ontario
- Kindred Hospital Rancho
- Kindred Hospital Riverside
- Kindred Hospital San Diego
- Kindred Hospital-San Francisco Bay Area
- Kindred Hospital-Westminster
- Kindred Paramount Hospital
- Madera Community Hospital
- Mammoth Hospital
- MarinHealth Medical Center
- Marshall Medical Center
- Memorial Medical Center
- Mercy Hospitals - Bakersfield
- Methodist Hospital
- Oak Valley Hospital
- Pioneers Memorial Healthcare District
- Providence Little Company Of Mary Hosp.
- Rady Children's Hospital San Diego
- Regional Medical Center of San Jose
- Salinas Valley Memorial Healthcare System
- San Antonio Regional Hospital
- San Diego County Psychiatric Hospital
- San Gabriel Valley Medical Center
- Sharp Grossmont Hospital
- St. Joseph's Medical Center
- St. Louise Regional Hospital
- Sutter Santa Rosa Hospital
- Sutter Tracy Community Hospital
- Torrance Memorial Medical Center
- Tri-City Medical Center
- University of California San Diego Health System
- West Hills Hospital and Medical Center

Appendix F. List of CDPH HAI Program Conference Presentations and Journal Publications

Conference Presentations

1. Holden, D., Mitsunaga, T., Sanford, D., Fryer, T., Nash, J., Schneider, E., Mukhopadhyay, R., Epson, E., & Sylvester, M. (2021). Multifacility outbreak of NDM/OXA-23–producing *Acinetobacter baumannii* in California, 2020–2021. [Poster Presentation]. *Antimicrobial Stewardship & Healthcare Epidemiology, 1*(S1), s79. https://doi.org/10.1017/ash.2021.155
2. Kriengkauykiat, J., Epson, E., Garcia, E., & Komaiko, K. (2021). Antimicrobial stewardship in acute-care hospitals: a report of the California healthcare-associated infections honor roll [Poster Presentation]. *Antimicrobial Stewardship & Healthcare Epidemiology*, *1*(S1), s32. https://doi.org/10.1017/ash.2021.59
3. Parriott, A., Kazerouni, N. N., & Epson, E. (2021). Comparing hospital healthcare-associated infection incidence during pre-COVID-19 pandemic and pandemic eras. [Poster Presentation]. *Antimicrobial Stewardship & Healthcare Epidemiology, 1*(S1), s45-s46. https://doi.org/10.1017/ash.2021.84
4. Stendel, P., Karmarkar, E., Kennedy, I., Bagheri, H., Nelson, T., Nelson, T., & Epson, E. (2021). Characteristics of on-site infection prevention and control visits for COVID-19—California, February 2020–December 2020. [Poster Presentation]. *Antimicrobial Stewardship & Healthcare Epidemiology, 1*(S1), s50. https://doi.org/10.1017/ash.2021.95
5. Engeda, J., Karmarkar, E., Raymond, K., Oh, P., & Epson, E. (2021, June 13-17). *Associations between resident racial/ethnic composition, neighborhood-level socioeconomic status and novel coronavirus cases in California's skilled nursing facilities — May 25–August 16, 2020.* [Poster Presentation]. Council of State and Territorial Epidemiologists 2021 Annual Conference "Building Bridges to Health" Virtual. https://www.csteconference.org/
6. Haridass, V., Mitsunaga, T., & Epson, E. (2021, June 13-17). *Evaluation of California's coronavirus disease 2019 (COVID-19) surveillance system for long-term care facilities*. [Oral Presentation]. Council of State and Territorial Epidemiologists 2021 Annual Conference "Building Bridges to Health" Virtual. https://www.csteconference.org/
7. Magro, M., Siegel, J., & Kim, J. J. (2021, June 13-17). *Pathogen distribution and antimicrobial resistance patterns for healthcare-associated infections in pediatric patients in California, National Healthcare Safety Network surveillance data, 2014–2019.* [Poster Presentation]. Council of State and Territorial Epidemiologists 2021 Annual Conference "Building Bridges to Health" Virtual. https://www.csteconference.org/
8. Parriott, A., Engeda, J., Magro, M., Daugherty, D., Doh, K., Kazerouni, N. N., Karmarkar, E., & Epson, E. (2021, June 13-17). *Use of classification tree methodology to predict large COVID-19 outbreaks in skilled nursing facilities in California*. [Oral Presentation]. Council of State and Territorial Epidemiologists 2021 Annual Conference "Building Bridges to Health" Virtual. https://www.csteconference.org/
9. Parriott, A., Kazerouni, N. N., & Epson, E. (2021, June 13-17). *Quantifying the impact of the COVID-19 pandemic on healthcare-associated infection (HAI) reporting from California hospitals*. [Poster Presentation]. Council of State and Territorial Epidemiologists 2021 Annual Conference "Building Bridges to Health" Virtual. https://www.csteconference.org/
10. Haridass, V., Horwich-Scholefield, S., Holden, D., Mitsunaga, T., Epson, E., Sylvester, M., & Mukhopadhyay, R. (2022, June 19-23). *Molecular epidemiology and healthcare exposures of patients with New Delhi metallo-β-lactamase (NDM)-producing Enterobacterales in California, 2013–2021*. [Poster Presentation]. Council of State and Territorial Epidemiologists 2022 Annual Conference "Unbridled Spirit of Public Health" Louisville, KY. https://www.csteconference.org/

11. Mitsunaga, T., Holden, D., Karmarkar, E., Kennedy, I., Nelson, T., Haridass, V., Dratch, A., O'Donnell, K., Bhaurla, S., OYong, K., Clarke, A., Takiguchi, E., Baldwin, L., Nguyen, J., Bhurtyal, K., Gomez, A., Clark, K. A., Batres, J. R., Romo, S., … Epson, E. (2021). The resurgence of *Candida auris* in California during the novel coronavirus (COVID-19) pandemic, May 2020–May 2021. [Oral Abstract Presentation]. *Open Forum Infectious Diseases, 8*(S1), S101-S102. https://doi.org/10.1093/ofid/ofab466.169
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15. Barahmani, N., Parriott, A., Epson, E., Tang, G., & Kazerouni, N. (2022). Findings from healthcare-associated infections data validation attestation in California general acute-care hospitals [Poster Presentation]. *Antimicrobial Stewardship & Healthcare Epidemiology, 2*(S1), S65-S66. https://doi.org/10.1017/ash.2022.183
16. Garcia, E., Mitsunaga, T., Haridass, V., Martin, B., Sardana, N., Franqui, L., Komaiko, K., Lanier, T., & Epson, E. (2022). Using a learning needs assessment to develop infection prevention training for certified nursing assistants [Poster Presentation]. *Antimicrobial Stewardship & Healthcare Epidemiology, 2*(S1), s50. https://doi.org/10.1017/ash.2022.152
17. Brenes, L., Magro, M., Mitsunaga, T., & Epson, E. (2022, October 19-23). Comparison of California acute care hospital central line-associated bloodstream infection incidence by hospital location before and during the COVID-19 pandemic. [Poster Presentation]. IDWeek 2022 Washington, DC. https://idweek.org/
18. Holden, D., Mitsunaga, T., Ahanya, S., Trausch, K., Haridass, V., Levit, R., Velasquez, K., Garcia, E., Sardana, N., Cabral, A., Garcia, E. G., Schneider, E., & Epson, E. (2022). *Moving from public health outbreak response to mitigation for a regional outbreak of highly-resistant New Delhi metallo-β-lactamase-producing Acinetobacter baumannii in California, May 2020 – April 2022.* [Poster Presentation]. IDWeek 2022 Washington, DC. https://idweek.org/

Journal articles

19. Magro, M., Rosenberg, J., & Epson, E. (2021). Characterizing *Clostridioides difficile* infections and hospital exposures in California using surveillance and administrative data, 2014–2015. *Infection Control and Hospital Epidemiology, 42*(3), 292–297. https://doi.org/10.1017/ice.2020.447
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for skilled nursing facility healthcare personnel, California, USA. *Emerging Infectious Diseases, 28*(8), 1734-1736. https://doi.org/10.3201/eid2808.220650

21. Parriott A, Kazerouni N, Haridass V, Barahmani N, Palmer L, Winston D, Epson E. Healthcare-associated infection reporting completeness and quality during the COVID-19 pandemic in California hospitals. *Infection Control and Hospital Epidemiology (in press)*. Conference presentation #9.
22. Parriott A, Kazerouni N, Epson E. Association of the COVID-19 pandemic with the incidence of healthcare-associated infections in California hospitals. *Manuscript submitted for publication*. Conference presentation #3.