The 2017 statewide antibiogram is the sixth annual antibiogram report released by the Hawaii State Department of Health (HDOH). Similar to prior statewide antibiograms, data were compiled based on recommendations from the Clinical and Laboratory Standards Institute (CLSI) M39 Guidelines (See Appendix A). HDOH generates this statewide antibiogram to monitor and investigate antimicrobial resistance across the state.

- Tripler Army Medical Center, Kaiser Permanente, Diagnostic Laboratory Services, Clinical Laboratories of Hawaii (CLH), and Kuakini Hospital each submitted their data in aggregate form. The data represent isolates cultured from January 2017 through December 2017.

- Percent changes in susceptibility were not evaluated for Chi-squared ($\chi^2$) tests for significance because of laboratory reporting methods changes resulting in some artificially inflated differences. Statistical analysis will be reintroduced in future antibiograms as data submission stabilizes and data quality improves.

- **Note:** Data are presented for surveillance purposes only and should not be used in clinical decision making. This antibiogram does not obviate individual clinical assessment and isolate susceptibility testing.

- Limitations:
  - A distinction was not made between inpatient and outpatient isolates in all laboratories; additionally, not all laboratories distinguished between urine and systemic isolates (See Appendix B). Data presented on the statewide antibiogram are thus presented in aggregate form considering those parameters.
  - Not all laboratories have implemented the revised carbapenem, cephalosporin, and monobactam breakpoints for *Enterobacteriaceae* recommended by CLSI in 2010 (M100-S20).1

**Stopping the Spread of Antimicrobial Resistance**

Increased antimicrobial resistance, resulting in part from overuse and misuse of antimicrobials, is one of today’s most urgent public health issues. Each year, two million people in the United States are infected with an antimicrobial resistant pathogen, resulting in at least 23,000 deaths.2 To combat this growing threat, a coordinated approach across the care continuum is necessary. Recent studies have found 30–50% of all antimicrobials prescribed in the outpatient setting in the United States are either unnecessary or inappropriate. Antimicrobial stewardship is aimed at reducing these numbers by ensuring antimicrobials are only used when needed, as well as making certain the right drug, dose, and duration are selected. In Hawaii, the Hawaii Antimicrobial Stewardship Collaborative (HASC) has been working to implement and sustain antimicrobial stewardship programs within the state’s healthcare facilities. More recently, these endeavors have started to move into long-term care facilities, as well as the outpatient setting. The statewide antibiogram is a useful tool to understand antimicrobial susceptibility in Hawaii and potentially monitor antimicrobial resistance trends over time. The annual statewide antibiogram reports and the efforts of HASC continue to raise awareness of antimicrobial resistance threats and promote the judicious use of antimicrobials among prescribers and healthcare facilities in Hawaii.

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1 As entered in the National Healthcare Safety Network (NHSN) 2017 Annual Facility Survey, 91% of facilities reported implementing revised breakpoints for *Enterobacteriaceae* for both carbapenem and cephalosporin/monobactam.

# of all isolates from all sources

<table>
<thead>
<tr>
<th>Percent Susceptible (Number of isolates tested)</th>
<th>Penicillins</th>
<th>Cephalosporins</th>
<th>Quinolones</th>
<th>Tetracyclines</th>
<th>Other Antimicrobials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterococcus sp. (unspeciated and other)</td>
<td>338</td>
<td>90 (338)</td>
<td>†</td>
<td>†</td>
<td>36 (338)</td>
</tr>
<tr>
<td>Enterococcus faecalis</td>
<td>6,791</td>
<td>100 (6,791)</td>
<td>99 (681)</td>
<td>84 (3,991)</td>
<td>16 (3,585)</td>
</tr>
<tr>
<td>Enterococcus faecium</td>
<td>788</td>
<td>28 (788)</td>
<td>†</td>
<td>18 (147)</td>
<td>41 (147)</td>
</tr>
<tr>
<td>Methicillin-susceptible Staphylococcus aureus (MSSA)*</td>
<td>18,828</td>
<td>100 (18,728)</td>
<td>40 (10,820)</td>
<td>100 (10,213)</td>
<td>†</td>
</tr>
<tr>
<td>Methicillin-resistant Staphylococcus aureus (MRSA)*</td>
<td>7,445</td>
<td>†</td>
<td>0 (7,445)</td>
<td>0 (3,436)</td>
<td>0 (98)</td>
</tr>
<tr>
<td>Streptococcus pneumoniae</td>
<td>403</td>
<td>85 (292)</td>
<td>98 (274)</td>
<td>98 (296)</td>
<td>78 (403)</td>
</tr>
</tbody>
</table>

Note: Data are presented for surveillance purposes only and are not intended for use in clinical decision making. This antibiogram should not take the place of individual clinical assessment and isolate susceptibility testing.

* The vancomycin susceptibilities presented reflect *Staphylococcus aureus* isolates with an MIC ≤ 4 μg/mL; treatment failures have been observed in isolates with an MIC to vancomycin of 2 μg/mL.
† Insufficient sample size.
# 2017 Hawaii Statewide Antiobiotic Susceptibility Testing

## Gram-Negative Organisms

<table>
<thead>
<tr>
<th>Percent Susceptible (Number of isolates tested)</th>
<th>Penicillins</th>
<th>Cephalosporins</th>
<th>Carbapenems</th>
<th>Quinolones</th>
<th>Other Antimicrobials</th>
</tr>
</thead>
<tbody>
<tr>
<td># of isolates from all sources</td>
<td>Amoxicillin/Clavulanate</td>
<td>Piperacillin/ Tazobactam</td>
<td>Ceftriaxone</td>
<td>Ceftazidime</td>
<td>Cefepime</td>
</tr>
<tr>
<td>Acinetobacter sp. ‡</td>
<td>859</td>
<td>93 (805)</td>
<td>75 (843)</td>
<td>17 (841)</td>
<td>83 (154)</td>
</tr>
<tr>
<td>Citrobacter freundii †</td>
<td>452</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>97 (412)</td>
</tr>
<tr>
<td>Citrobacter koseri †</td>
<td>1,214</td>
<td>97 (1,213)</td>
<td>78 (434)</td>
<td>98 (1,205)</td>
<td>99 (622)</td>
</tr>
<tr>
<td>Enterobacter sp.</td>
<td>2,948</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>86 (1,740)</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>49,745</td>
<td>88 (43,611)</td>
<td>64 (30,677)</td>
<td>98 (46,444)</td>
<td>73 (4,077)</td>
</tr>
<tr>
<td>Klebsiella pneumoniae</td>
<td>10,640</td>
<td>95 (4,475)</td>
<td>85 (6,391)</td>
<td>96 (10,209)</td>
<td>87 (2,798)</td>
</tr>
<tr>
<td>Proteus mirabilis</td>
<td>4,872</td>
<td>99 (2,199)</td>
<td>95 (2,765)</td>
<td>100 (4,813)</td>
<td>97 (805)</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>7,413</td>
<td>99 (6,822)</td>
<td>91 (3,409)</td>
<td>93 (6,573)</td>
<td>*</td>
</tr>
<tr>
<td>Serratia marcescens</td>
<td>864</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Comparison with 2016 Susceptibility: [Green] 10% or greater increase  [Yellow] 5–9% increase [Orange] 5–9% decrease [Red] 10% or greater decrease

Note: Data are presented for surveillance purposes only and are not intended for use in clinical decision making. This antiobiotic should not take the place of individual clinical assessment and isolate susceptibility testing.

* Because of the presence of inducible beta-lactamase, these organisms should be considered resistant to the antimicrobial indicated
† Data exclude one facility that did not differentiate between *Citrobacter freundii* and *Citrobacter koseri* isolates (n = 16 unspeciated *Citrobacter* isolates excluded)
‡ Insufficient sample size
Appendix A: Summary of the recommendations contained in CLSI M39-A4 Guidelines

The Routine Cumulative Antibiogram
- Analyze/present cumulative antibiogram report at least annually
- Include only final, verified test results
- Include only species with testing data for ≥30 isolates
- Include only diagnostic isolates
- Eliminate duplicate isolates
- Include only antimicrobial agents routinely tested
- Report percent susceptible and do not include percent intermediate
- Suggested supplemental analyses:
  - For *Streptococcus pneumoniae* and cefotaxime/ceftriaxone/penicillin: report percent susceptible for both meningitis and non-meningitis breakpoints
  - For viridans group streptococci and penicillin: list both percent intermediate and percent susceptible.
  - For antimicrobial agents that have susceptible dose-dependent (SDD)* interpretive criteria, calculate and list separately the percent susceptible and percent SDD
  - Perform separate analyses for oxacillin-resistant *S. aureus* (MRSA) and oxacillin-susceptible *S. aureus*
  - Differentiate *Enterococcus faecalis* and *E. faecium*, and present their susceptibility patterns separately

The Enhanced Antibiogram
- Stratifying cumulative antibiogram data by various parameters
  - Differentiate by nursing unit or site of care (e.g., ICU, outpatient clinic)†
  - Differentiate by an organism’s resistance characteristics, especially for multidrug resistant organisms (MDROs; e.g., VRE, ESBL)
  - Differentiate by specimen type or infection site (e.g., urine and blood isolates)†
  - Differentiate by clinical service or patient population (e.g., surgical, pediatric)
- Supplemental analyses of MDROs
  - List the percentage of a species that is multidrug resistant (MDR) next to the organism name
  - Stratify isolates of species where MDR is known to occur (e.g., *K. pneumoniae*)
- Examine the percentage of isolates susceptible to drugs in relevant combinations for individual species or for groups of organisms

Appendix B: Additional factors that can impact aggregate antibiogram data
- Interpretation and clinical utility of particular pathogen-antimicrobial combinations may differ depending on site of infection, in particular for urinary or central nervous system infections; additionally, susceptibility testing performed at different laboratories may vary depending on source of specimen, and different minimum inhibitory concentration (MIC)‡ “breakpoints” may be given for antimicrobials most frequently used to treat urinary tract infections—for instance, nitrofurantoin and trimethoprim-sulfamethoxazole
- Patient population served: for example, substantial differences may be seen in susceptibility patterns in the outpatient and inpatient setting
- Culturing practices: for example, susceptibility patterns may be biased if local practice involves culturing for uncomplicated infections only in the context of treatment failure
- Laboratory antimicrobial susceptibility testing and reporting policies
- Temporal outbreaks

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* The SDD category implies susceptibility of an isolate is dependent on the dosing regimen used in the patient.
† These recommendations moved from Suggested Supplemental Analyses (M39-A3) to the Enhanced Antibiogram.
‡ The MIC is defined as the lowest concentration of a drug that will inhibit the visible growth of an organism after overnight incubation.