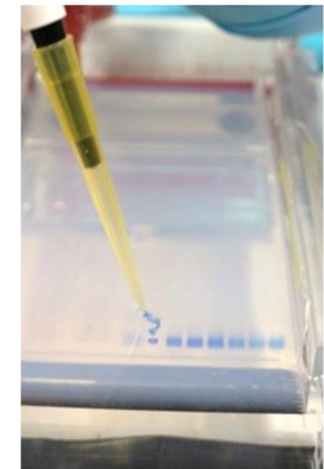

# ANTIMICROBIAL RESISTANCE SURVEILLANCE PROGRAM
# 2014 Data Summary Report


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# FOREWORD: MESSAGE FROM THE ANTIMICROBIAL RESISTANCE SURVEILLANCE PROGRAM HEAD

Antimicrobial resistance is now recognized worldwide as a public health problem that threatens both human and animal health. It causes prolonged illnesses, increased mortality, and increased costs not only to the individual patient but also to the global economy due to economic losses secondary to reduced productivity caused by illness and higher costs of treatment. According to the World Health Organization (WHO), "addressing this problem requires long-term investment, financial and technical support, development of new medicines, diagnostic tools, vaccines and strengthening health systems to ensure more appropriate use of and access to antimicrobial agents."

In 2014, the WHO released the first ever Antimicrobial Resistance Global Report on Surveillance which focused on a few microorganisms of public health importance. The Philippines contributed its national data to this report. As expected, the data showed widespread antimicrobial resistance in all parts of the world further highlighting the urgency of developing a global action plan on antimicrobial resistance which the World Health Assembly reflected in its resolution WHA 67.25 in May 2014.

The draft global action plan sets out five strategic objectives: (1) to improve awareness and understanding of antimicrobial resistance; (2) to strengthen knowledge through surveillance and research; (3) to reduce the incidence of infection; (4) to optimize the use of antimicrobial agents; and (5) to ensure sustainable investment in countering antimicrobial resistance.

Since 1988, the ARSP had been providing high quality antimicrobial resistance surveillance data to the Department of Health and to the rest of the medical community which include not only current antimicrobial resistance rates but also trends in AMR. It is committed to do so as part of the proposed overall Philippine action plan to combat AMR. Surveillance data is essential for informing strategies for control, monitoring effectiveness of interventions and detecting new resistance threats.

For 2014, the following were the most noteworthy findings from the surveillance data: high rates of ampicillin resistance among *Hemophilus influenzae*, increasing rates of ciprofloxacin resistance among Salmonella and *Shigella* isolates, high rates of methicillin resistance among staphylococci, increasing resistance of *Pseudomonas aeruginosa*, *Acinetobacter* and *Enterobacteriaceae* to many antimicrobial classes.

For 2015, it is planned to improve representation of the program to regions where no sentinel site exists, improve clinical correlation of resistance data, link antimicrobial resistance data with antibiotic use data once the surveillance for the latter is established and work closely with the Department of Agriculture towards the establishment of an integrated surveillance on antimicrobial resistance based on the "One Health" approach. Finally, the ARSP will continue to participate in activities which aim to improve public awareness on the serious problem of AMR and for the acquisition of much-needed regular funds from the DOH for it to be able to carry out its mandate.

Head

Antimicrobial Resistance Surveillance Program

Department of Health

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-Suballotted funds from the Department of Health

-**National Center for Pharmaceutical Access and Management**

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-Grant from the **European Union**

# ABBREVIATION, ACRONYMS AND DEFINITION OF TERMS

TABLE 1. Abbreviations, acronyms and definition of terms

| Acronyms & Abbreviations | Definition |
|---|---|
| AMR | Antimicrobial resistance |
| ARSP | Antimicrobial Resistance Surveillance Program |
| ARSRL | Antimicrobial Resistance Surveillance Reference Laboratory |
| AST | Antimicrobial susceptibility test |
| CLSI | Clinical Laboratory Standards Institute |
| CRE | Carbapenem-resistant Enterobacteriaceae |
| DMU | Data Management Unit |
| DOH | Department of Health |
| EQAP | External quality assessment program |
| ESBL | Extended spectrum-beta-lactamase |
| MDR | Resistance of the organism to at least 1 or more agents in 3 or more classes of anti-microbial categories |
| MRSA | Methicillin-resistant Staphylococcus aureus |
| NDM-1 | New Delhi Metallo-beta-lactamase 1 |
| PDR | Non-susceptibility to all agents in all antimicrobial categories |
| PRSP | Penicillin-resistant Streptococcus pneumoniae |
| WHO | World Health Organization |
| WHONET | Windows-based database software developed by the WHO Collaborating Centre for Surveillance of Antimicrobial Resistance based at the Brigham and Women's Hospital in Boston for the management and analysis of microbiology laboratory data with a special focus on the analysis of antimicrobial susceptibility test results |
| XDR | Resistance to at least 1 agent in all but 2 or fewer antimicrobial categories |

# INTRODUCTION: The Program and the Surveillance

Antimicrobial resistance (AMR) is the ability of microorganisms that cause disease to withstand attack by antimicrobials. ***AMR is a serious public health threat*** because of its far reaching and serious implications in health care as well as economies. [1] Infections caused by resistant microorganisms often fail to respond to standard treatment, resulting in prolonged illness and greater risk of death. AMR hampers the control of infectious diseases because patients remain infectious for a longer time increasing the risk of spreading resistant microorganisms to others. AMR increases the cost of health care as more expensive therapies must be used when infections become resistant to first-line medicines. Infections due to resistant microorganisms increases economic burden to families and societies as it often results in longer duration of illness and treatment.

When we lose antimicrobials to resistance, the achievements of modern medicine such as organ transplant, cancer chemotherapy and major surgery would be compromised as these would not be possible without effective antimicrobials for prevention and treatment of infections. Losing antimicrobials to resistance can result in many infectious diseases becoming untreatable and uncontrollable. This can bring us back to the pre-antibiotic era.

It is recognized that the issue of AMR must be addressed by concerted efforts of government agencies, health providers, drug industry, professional organizations, academe and civil society. ***Surveillance is a fundamental part of an effective response to AMR problem***. [2] It is needed to detect resistant microorganisms, enable correct decisions to be made about treatment options and guide policy recommendations. As the country's response to the recommendation of the World Health Organization (WHO) Working Group on the Regional Information Network on Antimicrobial Resistance that a surveillance program be initiated among member states of the Western Pacific Region to contain and prevent resistance to antimicrobials, the ***Philippine Committee on Antimicrobial Resistance Surveillance Program was created in 1988 by virtue of Department Of Health's Department Order 339-J.*** The program aims to provide critical inputs to the Department of Health's effort to promote rational drug use by determining the current status and developing trends of antimicrobial resistance of selected bacteria to specific antimicrobials. Currently participating in the program are 23 sentinel sites representing 14 regions of the country (FIGURE 1 & TABLE 1).

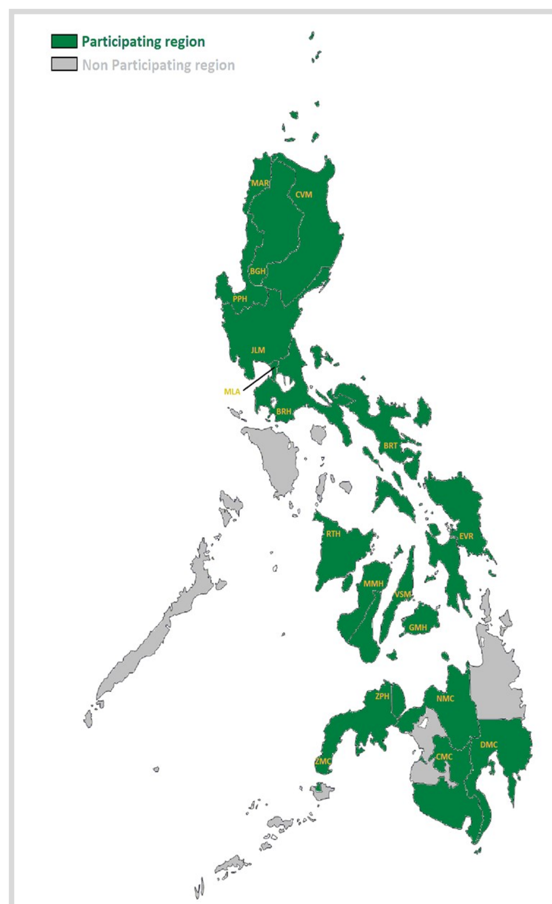



Figure 1. Regional representation by sentinel sites at the ARSP, 2014

TABLE 2. ARSP SENTINEL SITES BY REGION

| **Region** | **ARSP Sentinel Site** |
|---|---|
| NCR | Lung Center of the Philippines (LCP)<br>National Kidney Institute (NKI)<br>Rizal Medical Center (RMC)<br>San Lazaro Hospital (SLH)<br>Philippine General Hospital (PGH)<br>Research Institute for Tropical Medicine (RTM)<br>Sto. Tomas University Hospital (STU)<br>Far Eastern University Hospital (FEU) |
| CAR | Baguio General Hospital (BGH) |
| Region 1 | Mariano Marcos Memorial Medical Center (MAR) |
| Region 2 | Cagayan Valley Medical Center (CVM) |
| Region 3 | Jose B. Lingad Memorial General Hospital (JLM) |
| Region 4A | Batangas Regional Hospital (BRH) |
| Region 5 | Bicol Regional Training and Teaching Hospital (BRT) |
| Region 6 | Corazon Locsin Montelibano Memorial Hospital (MMH) |
| Region 7 | Gov. Celestino Gallares Regional Hospital (GMH)<br>Vicente Sotto Memorial Medical Center (VSM) |
| Region 8 | Eastern Visayas Regional Medical Center (EVR) |
| Region 9 | Zamboanga City Medical Center (ZMC)<br>Zamboanga del Norte Provincial Hospital (ZPH) |
| Region 10 | Northern Mindanao Medical Center (NMC) |
| Region 11 | Southern Philippines Medical Center (DMC) |
| Region 12 | Cotabato Medical Center (CMC) |

# METHODS

The DOH-ARSP implements an antimicrobial resistance surveillance on aerobic bacteria from clinical specimens. The surveillance collects culture and antimicrobial susceptibility data from its ***23 sentinel sites***. These sentinel sites participate in an annual external quality assessment scheme (EQAS) conducted by the reference laboratory to ensure quality of laboratory results. Periodic monitoring visits to sentinel sites are likewise done. All sentinel sites implement standard methods for culture and susceptibility testing based on the WHO Manual for the Laboratory Identification and Antimicrobial Susceptibility Testing of Bacterial Pathogens of Public Health Importance in the Developing World [3] and updated Clinical Laboratory Standards Institute (CLSI) references for antibiotic susceptibility testing and quality control. [4] [5] Using a standard format, routine culture and antimicrobial susceptibility test results are sent monthly by the sentinel sites to the coordinating laboratory of the program – the ***Antimicrobial Resistance Surveillance Reference Laboratory (ARSRL) at the Research Institute for Tropical Medicine***. Sentinel sites likewise send isolates with unusual antimicrobial susceptibility patterns to ARSRL for phenotypic and genotypic confirmatory testing.

The culture and antimicrobial susceptibility test results are encoded using a database software called ***WHONET***. WHONET is Windows-based database software developed by the WHO Collaborating Centre for Surveillance of Antimicrobial Resistance based at the Brigham and Women's Hospital in Boston for the management and analysis of microbiology laboratory data with a special focus on the analysis of antimicrobial susceptibility test results. [6] The ARSRL's Data Management Unit manages the cleaning, analysis, storage and security of the program's surveillance data.

In the analysis of antimicrobial susceptibility testing, an isolate is considered resistant to an antimicrobial agent when tested and interpreted as resistant (R) in accordance with the clinical breakpoint criteria based on the most recent Clinical Laboratory Standards Institute (CLSI) [4] [5] references for antibiotic susceptibility testing. Analysis is restricted to the first isolate received (per genus under surveillance) per patient in the calendar year. Data are expressed as a cumulative resistance percentage, i.e. the percentage of resistant isolates out of all isolates with antimicrobial susceptibility testing (AST) information on that specific organism–antimicrobial agent combination. For selected analyses, a 95% confidence interval is determined for the resistance percentage. Cumulative percentages of resistance are compared as proportions using the Fischer test, using a $p$ value of $<0.05$ as statistically significant. Only species with testing data for 30 or more isolates are included in the analysis.

An annual report with a summary of the surveillance data focusing on aerobic bacterial pathogens of public health importance causing common infectious diseases with significant morbidity and mortality locally are disseminated to the program's stakeholders.

# LIMITATIONS

Interpretation of data in this annual report should be undertaken with caution taking into consideration that there may be several factors that could influence and introduce bias to the data resulting in over- or underestimation of resistance percentages. Potential sources of bias include population coverage, sampling, and laboratory capacity.

- Most of the resistance data in the program come from regional hospitals which typically cater to patients from towns and cities within the vicinity of the hospital. Resistance variations in local areas not covered by regional hospitals are not represented in the program data.
- Data for the National Capital Region come from 8 sentinel sites while data for other regions come from 1 or 2 sentinel sites.
- Given that the program data are from routine clinical samples, differences in factors indicating need for microbiological cultures may introduce variations in the resistance data.
- Performance of culture and susceptibility tests in the sentinel sites is dependent on the diagnostic habits of the clinicians as well as the financial capability of patients for such test. Differential sampling can occur if cultures are typically only performed after empirical treatment shows no adequate therapeutic response. Predictably, this will lead to a serious overestimation of the percentage resistance by not including susceptible isolates in the denominator.
- Lastly, the ability of the laboratory to identify the microorganism and its associated antimicrobial susceptibility pattern may differ.

# EXECUTIVE SUMMARY

Resistance data for 47,280 bacterial isolates coming from 23 hospital bacteriology laboratories located in 14 regions of the Philippines were analyzed for 2014.

### *Streptococcus pneumoniae*

- Cumulative resistance rate of *S. pneumoniae* isolates from all specimen types reported for 2014 against penicillin, using meningitis breakpoints, was at 7% (n=257). When the pneumococcal isolates were analyzed by specimen type, penicillin resistance was at 10.3% among invasive (n=29 blood and CSF) isolates when analyzed using meningitis breakpoints but only 0.5% penicillin resistance rate for non-invasive isolates (n=189 respiratory and other non-invasive specimens) when analyzed using non-meningitis breakpoints.
- There was 1 confirmed report of levofloxacin-resistant *S. pneumoniae* for 2014.
- There was no confirmed ceftriaxone-resistant S. *pneumoniae* reported for 2014.
- The most common invasive *S. pneumoniae* serogroups/serotypes identified for 2014 were 5, 1, 4 and 6.
- The most common non-invasive *S. pneumoniae* serogroups/serotypes identified for 2014 were 3, 19 and 7.

### *Haemophilus influenzae*

- For 2014, 12% of *H. influenzae* isolates were resistant to ampicillin (n= 309) and 4.1% were resistant to amoxicillin-clavulanic acid (n=314). These rates did not differ significantly when compared to data from 2013 (*p* value > 0.05).
- All ampicillin-resistant *H. influenzae* isolates tested at the reference laboratory were positive for β -lactamase production.
- Resistance rates for 2014 isolates of *H. influenzae* are at 42.9% for co-trimoxazole (n= 312) and 13.4% for chloramphenicol (n=313).
- There were no reports of levofloxacin-resistant *H. influenzae* for 2014.

### *Salmonella enterica* serotype Typhi

- *S. enterica* ser. Typhi isolates have remained susceptible to first line antibiotics ampicillin and chloramphenicol with no reported resistant isolates for 2014. In contrast, resistance rate against co-trimoxazole for 2014 is at 6.7% (n=105).
- Although there was no ciprofloxacin resistant *S. enterica* ser. Typhi reported for 2014, there were 7 reported nalidixic acid resistant isolates. These were referred to the reference laboratory and were confirmed as nalidixic acid resistant and ciprofloxacin intermediate *S. enterica* ser. Typhi.

### Nontyphoidal *Salmonella*

- Increasing resistance of nontyphoidal salmonellae to ciprofloxacin (n= 125) is noted with rate at 21.6% for 2014.
- One nontyphoid *Salmonella* isolate from a sentinel site in Mindanao was confirmed as ceftriaxone resistant by MIC. Phenotypic analysis showed this isolate was negative for extended-spectrum β -lactamase (ESBL) production. The isolate was further identified as *S. enterica* serotype Lexington.
- The commonest nontyphoidal *Salmonella* species serovars identified for 2014 were *S. enterica* serotype Typhimurium and *S. enterica* serotype Enteritidis.

### *Shigella* species

- Combined 2011-2014 data reveals emerging resistance of *Shigella* species against the fluoroquinolones as seen with cumulative rate of resistance at 13.8% against ciprofloxacin (n=58).

### *Vibrio cholerae*

- *Vibrio cholerae* isolates remained susceptible to first line agents: chloramphenicol, co-trimoxazole and tetracycline with no reported resistant isolate to any of these antimicrobials for the combined 2011 to 2014 data.

### *Neisseria gonorrhoeae*

- Combined 2011 to 2014 *Neisseria gonorrhoeae* isolates have cumulative high rates of resistance against penicillin at 89.1% (n= 46); tetracycline at 55.3% (n=47); and ciprofloxacin at 84.8% (n=46).
- There were no reported streptomycin, ceftriaxone and cefixime resistant *N. gonorrhoeae* isolates for the 2011 to 2014 data.

### *Staphylococcus aureus*

- MRSA rate for 2013 is at 60.3% (n= 3,232). This was a statistically significant increase from the reported MRSA rate of 53.2% in 2013.
- For 2014, there was no confirmed report of vancomycin-resistant *S. aureus* isolates.
- MRSA isolates resistance rates against co-trimoxazole was at 26.1% (n=1,752); 14.6% against clindamycin (n=1,889); 10.9% against tetracycline (n=1,811) and 6% against rifampicin (n=1,249).

### *Staphylococcus epidermidis*

- Resistance rates of *S. epidermidis* isolates against penicillin is reported at 95.8% for 2014 (n=2,030) while oxacillin resistance is reported at 78.9% (n=1,847).
- For 2014 there were no confirmed reports of vancomycin-resistant *S. epidermidis*.

### *Enterococcus* species

- For 2014, we continue to report higher rates of ampicillin resistance in enterococci with rates at 8.8% for *E. faecalis* (n=565) and 72.7% for *E. faecium* (n= 172).
- For 2014, high level gentamicin and streptomycin resistance for *E. faecalis* was at 15.3% (n=274) and 20.5% (n=259), respectively. Similarly, higher high-level gentamicin and streptomycin rates of resistance are seen with *E. faecium* with reports at 48.6% (n=70) and 27.3% (n=66), respectively.
- There were no confirmed reports of vancomycin-resistant *E. faecalis* or *E. faecium* for 2014.

### *Escherichia coli*

- For 2014, extended-spectrum β-lactamase (ESBL) suspect rates for *E. coli* are at 25% (n=5,506 isolates).
- *E. coli* rates of resistance against the fluoroquinolones and third generation cephalosporins have been increasing for the past years with resistance rates against ciprofloxacin at 41% (n=5,540) and ceftriaxone at 32.2% (n=5,401) for 2014.
- Emerging resistance against the carbapenems are also reported for 2014 with rates of resistance at 2.8% for ertapenem (n=3,281); 2.1% for imipenem (n=5,791); and 2.3% for meropenem (n=5,206).
- *E. coli* extended-spectrum β–lactamase suspect rates for 2014 is at 25% (n=5,506).
- Urinary *E. coli* isolates from outpatients remain susceptible to nitrofurantoin with rate of resistance at 6.6% (n= 945). Comparatively, urinary *E. coli* isolates from hospitalized patients show variable susceptibility to parenteral agents with rates of resistance ranging from

2.8% against ertapenem (n= 1,300) to as high as 38.2% against ceftriaxone (n= 2,007).

### *Klebsiella* species

- For 2014, extended-spectrum β-lactamase (ESBL) suspect rates for *Klebsiella* species are at 35.7% (n=7,464 isolates).
- Resistance to the carbapenems are also rising with 2014 *Klebsiella* species resistance rates to imipenem at 7.6% (n=7,725); ertapenem at 11.8% (n=4,373) and meropenem at 8.8% (n=7,086).

### *Pseudomonas aeruginosa*

- Resistance rates of 2014 *P. aeruginosa* isolates were 15.6% for ciprofloxacin (n=3,926), 15.6% for ceftazidime (n= 4,108) and 9.5% against amikacin (n= 3,971). *P. aeruginosa* imipenem resistance rates were, relative to the other antibiotics tested, highest at 17.5% (n=3,997).

### *Acinetobacter baumannii*

- Rate of resistance of *A. baumannii* is reported at 39.2% for ampicillin-sulbactam (n= 1,874) for 2015.
- *A. baumannii* aminoglycoside resistance rates are at 40% for amikacin (n= 2,369) and 36.9% for gentamicin (n=2,648).
- Resistance of *A. baumannii* against imipenem have been increasing in the past 10 years with rates of resistance for 2014 reported as high as 45.3% (n=2,667).

### Multidrug-resistant *Pseudomonas aeruginosa* & *Acinetobacter baumannii*

- *P. aeruginosa* MDR and possible XDR rates were at 23% and 18%, respectively.
- *A. baumannii* MDR and possible XDR rates were at 61% and 46%, respectively.

# RECOMMENDATIONS

Based on the reported antimicrobial resistance surveillance data for 2014:

- Infections secondary to *Streptococcus pneumoniae* can still be covered with penicillin or one of the anti-pneumococcal macrolides, although there is a need to closely monitor the changing trends of resistance among pneumococci. Improved local data on serotype distribution will allow for better surveillance information for vaccination recommendations.
- Due to high resistance rate of *Haemophilus influenzae* to ampicillin, this is no longer recommended for empiric therapy for infections secondary to the pathogen. Recommended empiric treatment for suspected *H. influenzae* infections may consist of β-lactam-β-lactamase inhibitor combinations or the extended spectrum oral cephalosporins.
- Empiric treatment for suspected uncomplicated typhoid fever could still consist of either chloramphenicol, co-trimoxazole or amoxicillin/ampicillin. There are increasing reports of nalidixic acid resistance and ciprofloxacin non-susceptibility which may result to clinical treatment failures. Microbiological data is recommended to aid in pathogen directed therapy.
- Increasing rates of ciprofloxacin resistance should remind clinicians to use antibiotics judiciously in *Salmonella* gastroenteritis, as this is usually a self-limited disease.

- In view of the emerging resistance of *Shigella* to the quinolones and limited data available, more vigilant surveillance of the resistance pattern of this organism should be pursued by encouraging clinicians to send specimens for culture.
- Tetracycline, chloramphenicol and co-trimoxazole remain good treatment options for cholera cases.
- Limited data is available on *Neisseria gonorrhoeae* in recent years, although based on reported isolates, ceftriaxone remains as empiric antibiotic of choice for gonococcal infections. More vigilant surveillance of the resistance patterns of this organism should be pursued by encouraging clinicians to send specimens for culture.
- In view of the continued high rates of methicillin/oxacillin resistance among staphylococci there may be an indication to shift empiric treatment of suspected staphylococcal infections from oxacillin to alternative agents such as co-trimoxazole, doxycycline, clindamycin, linezolid or vancomycin.
- Increasing resistance among the bacterial organisms *Pseudomonas aeruginosa* and *Acinetobacter baumannii* continues to be a concern as both organisms carry intrinsic resistance to a number of antimicrobial classes and acquisition of additional resistance severely limits the available treatment options. Prudent antimicrobial use, monitoring of resistance patterns and antimicrobial use along with improved standards of infection control are essential in addressing this clinical and public health concern.
- Hospitals should base their treatment recommendations for the *Enterobacteriaceae* on their institution's prevailing resistance patterns as these have been found to be variable from hospital to hospital. High percentage of possible ESBL-producing *Enterobacteriaceae* complicate treatment of serious infections caused by these organisms and may lead to increased use of carbapenems that may favor the further spread of the carbapenemase-producing *Enterobacteriaceae*. Prudent use of antimicrobials and comprehensive infection control measures serve as cornerstones of interventions aimed at preventing selection and transmission of resistant bacteria.

# HIGHLIGHTS OF THE 2014 ARSP DATA

### The Isolates

- Resistance data for **47,280 isolates** were reported and analyzed for the year 2014. This was a 26% increase when compared to the reported 37,629 isolates for 2013.

### Sentinel Site Contribution

- The 2014 ARSP data came from the **23 sentinel site hospital laboratories of the program which represents 14 regions of the Philippines.** Of the total number of isolates for 2014, 65% were from Luzon, 18% were from Visayas and 17% were from Mindanao. The 8 Metro Manila sentinel sites contributed 48% of the total 2014 annual data. These percentage contribution by locality was similar in distribution to that of 2013. FIGURE 2 and TABLE 4 summarizes sentinel site contribution to the ARSP data for 2014 and throughout the years of the program.

### Specimen Type

- The most common specimen types comprising the 2014 ARSP data were respiratory, blood, urine and cutaneous specimens. Other specimen types contributing to the 2014 data were: tissues, cerebrospinal fluid, other fluids, genital specimens and stool (FIGURE 3).

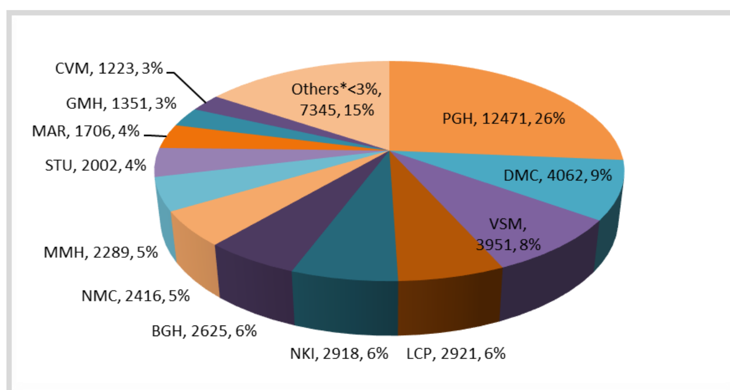
### Most Common Isolates

- For 2014, ***Klebsiella* species, followed by *Escherichia coli* and *Pseudomonas aeruginosa* were the most commonly isolated bacterial organisms** from all specimen types reported as seen in FIGURE 4. The commonest isolates by specimen type are shown in TABLE 3.

Table 3: Commonest isolate by specimen type, ARSP, 2014

| Respiratory Specimens | Blood |
|---|---|
| Klebsiella species | Staphylococcus, coagulase-negative |
| Pseudomonas aeruginosa | Klebsiella species |
| Acinetobacter baumannii | Staphylococcus aureus |
| **Cutaneous** | **Stool** |
| Staphylococcus aureus | Salmonella species |
| Escherichia coli | Shigella species |
| Klebsiella species | Vibrio cholerae |
| **Cerebrospinal Fluid** | **Urine** |
| Staphylococcus, coagulase-negative | Escherichia coli |
| Acinetobacter baumannii | Klebsiella species |
| Klebsiella species | Enterobacter species |

**Figure 2. Percent isolate contribution by sentinel site, ARSP, 2014 (N=47,280)**




Others: BRT 2.2%; BRH 2.2%; FEU 2%; CMC 1.8%; EVR 1.7%; ZMC 1.7%; JLM 1.3%; SLH 1.2%; RMC 0.7%; RTM 0.6%; ZPH 0.2%

**Figure 3. Percent isolate distribution by sentinel site, ARSP, 2014 (N=47,280)**

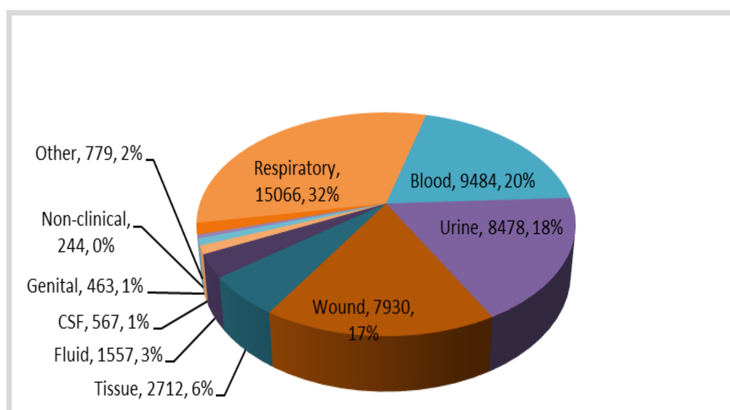
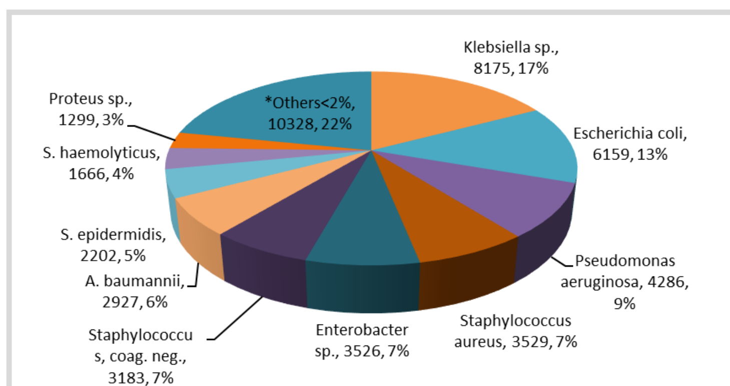



**Figure 4. Percent isolate distribution by organism identified, ARSP, 2014 (N=47,280)**




***Other isolates:*** *Acinetobacter sp., Enterococcus sp., S. viridans, alpha-hem., Pseudomonas sp., B. cepacia, E. faecalis, S. maltophilia, Citrobacter sp., Strep., beta-haemolytic, S. pneumoniae, H. influenzae, Serratia sp., Streptococcus sp., S. saprophyticus, Bacillus sp., Burkholderia sp., Moraxella sp., Other species <.5%*

**TABLE 4. Total number of annual isolate contribution by sentinel site, ARSP, 2005-2014**

| SENTINEL | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | % Δ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PGH | 9824 | 4511 | - | - | - | - | - | - | 7093 | 12471 | 43 |
| RMC | 497 | 506 | 757 | 757 | 878 | 962 | 845 | 942 | 1207 | 320 | -277 |
| NKI | 5331 | 4009 | 2996 | 3112 | 3345 | 3681 | 2726 | 2403 | 2179 | 2918 | 25 |
| LCP | 1949 | 5160 | 2548 | 2701 | 2694 | 2 | 1233 | 2083 | 2253 | 2921 | 23 |
| RTM | 515 | 414 | 361 | 335 | 280 | 348 | 328 | 383 | 303 | 303 | 0 |
| SLH | 698 | 881 | 461 | 662 | 468 | 615 | 409 | 318 | 1132 | 575 | -97 |
| GMH | 359 | 522 | 886 | 826 | 1151 | 936 | 1119 | 1521 | 1307 | 1351 | 3 |
| ZMC | 788 | 550 | 434 | 440 | 599 | 1060 | 686 | 721 | 822 | 819 | 0 |
| FEU | 1067 | 740 | 684 | 690 | 699 | 864 | 1064 | 931 | 1050 | 956 | -10 |
| STU | 1381 | 1124 | 1329 | 1180 | 1722 | 1470 | 752 | 1788 | 2050 | 2002 | -2 |
| EVR | 694 | 799 | 491 | 466 | 340 | 530 | 744 | 507 | 697 | 823 | 15 |
| MMH | 451 | 567 | 380 | 525 | 562 | 590 | 855 | 1153 | 1413 | 2289 | 38 |
| DMC | 2369 | 2487 | 2161 | 2374 | 2523 | 2870 | 2439 | 3332 | 3456 | 4062 | 15 |
| VSM | 1224 | 991 | 1063 | 1241 | 1447 | 1931 | 2142 | 2450 | 3171 | 3951 | 20 |
| BGH | 1344 | 1213 | 1041 | 1329 | 2129 | 2199 | 1916 | 1972 | 2583 | 2625 | 2 |
| CMC | 742 | 796 | 686 | 541 | 459 | 600 | 595 | 639 | 796 | 833 | 4 |
| BRT | 485 | 399 | 388 | 401 | 618 | 486 | 537 | 677 | 611 | 1047 | 42 |
| RTH | | 40 | 32 | 19 | - | - | - | - | - | - | - |
| ZPH | | 56 | 67 | 53 | 38 | 11 | - | - | - | 9 | - |
| MAR | | | | | 2275 | 1898 | 1851 | 1928 | 1773 | 1706 | -4 |
| BRH | | | | | 1008 | 791 | 304 | 38 | - | 1022 | - |
| CVM | | | | | 248 | 907 | 790 | 944 | 1100 | 1223 | 10 |
| JLM | | | | | 387 | 1024 | 643 | 655 | 502 | 638 | 21 |
| NMC | | | | | 814 | 1817 | 1776 | 1684 | 2131 | 2416 | 12 |
| **TOTAL** | 29782 | 25768 | 16765 | 17652 | 24684 | 25592 | 23754 | 27069 | 37629 | 47280 | |

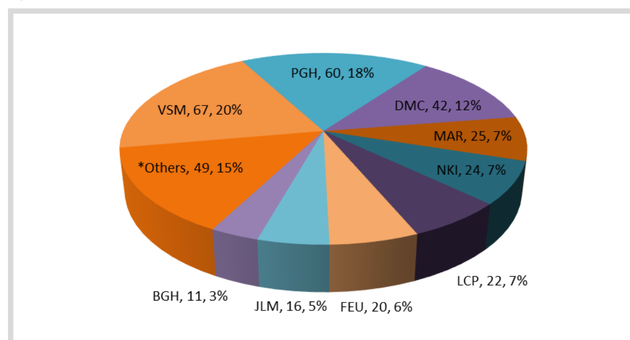
# *Streptococcus pneumoniae*

*Streptococcus pneumoniae* is a gram-positive diplococcus that is the leading cause of pneumonia and bacterial meningitis in children younger than 5 years and older adults worldwide. It also commonly causes otitis media, sinusitis, bacteremia, endocarditis and empyema. There are more than 92 distinct pneumococcal serotypes have been identified worldwide with a small number accounting for most invasive diseases. [7]

## Isolates

There were 336 reported *S. pneumoniae* isolates for 2014. This was 23% more than the 274 *S. pneumoniae* isolates reported for 2013. Major contributors making up 50% of the 2014 *S. pneumoniae* data were VSM (67 isolates), PGH (60 isolates) and DMC (42 isolates). Sentinel site contribution to the *S. pneumoniae* for 2014 is seen in FIGURE 5. Majority of the *S. pneumoniae* reported were respiratory isolates (67%) and invasive isolates (23%) from blood and cerebrospinal fluid cultures.

FIGURE 5. Percent sentinel site contribution for *S. pneumoniae*, ARSP, 2014, (N = 336)




## Antimicrobial Resistance

Since 2008, the Clinical and Laboratory Standards Institute (CLSI) recommends the use of different breakpoints for meningitis and non-meningitis pneumococcal infections when testing for penicillin. [4] The 2014 penicillin breakpoints for streptococci are summarized in TABLE 5. The recommended meningitis breakpoints are more stringent due to the poor penetration of penicillin thru the blood brain barrier. For 2014, penicillin resistance is at 7% (n=257; 95% CI: 5.9-13.4) when all *S. pneumoniae* isolates were analyzed using meningitis breakpoints. When analyzed according to specimen type, penicillin resistance was higher at 10.3% (using meningitis MIC breakpoints) among pneumococcal invasive isolates (29 blood and CSF isolates) than the 0.5% rate reported for non-invasive isolates (189 respiratory and other specimens) using the 1ug oxacillin disc for screening (FIGURE 7).

TABLE 5. Clinical Laboratory Standards Institute (CLSI) penicillin breakpoints for *S. pneumoniae*, 2014

| | Zone diameter (mm) | MIC (ug/ml) | | |
|---|---|---|---|---|
| IV Penicillin | Susceptible | Susceptible | Intermediate | Resistant |
| Meningitis | >20 | ≤0.06 | - | ≥0.12 |
| Non-meningitis | | ≤2 | 4 | ≥8 |

Among the 2014 respiratory and invasive isolates of *S. pneumoniae,* the rates of resistance to erythromycin at 4.3% (n=326; 95% CI: 2.5-7.3). Resistance against this macrolide has been at 5% or less for the past decade. There was 1 confirmed levofloxacin-resistant *S. pneumoniae* isolated in a sentinel site in the Visayas area but there was no confirmed report of ceftriaxone-resistant *S. pneumoniae* for the 2014 data. *S. pneumoniae* resistance data for 2014 and the past 10 years are illustrated in FIGURES 6-8.

FIGURE 6. Percent resistance of *S. pneumoniae*, ARSP, 2014

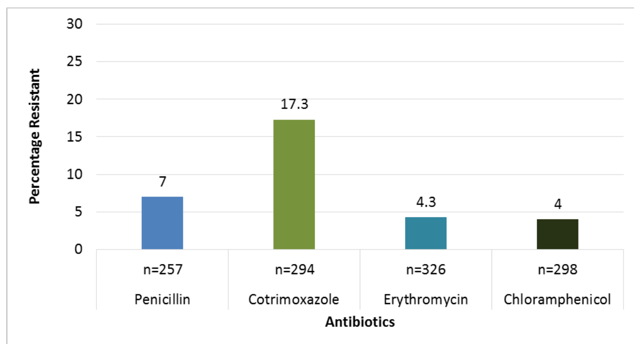



FIGURE 7. *S. pneumoniae* penicillin-resistance rates by specimen type, ARSP, 2014

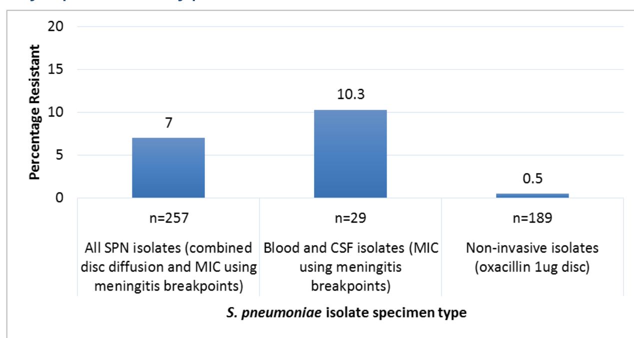
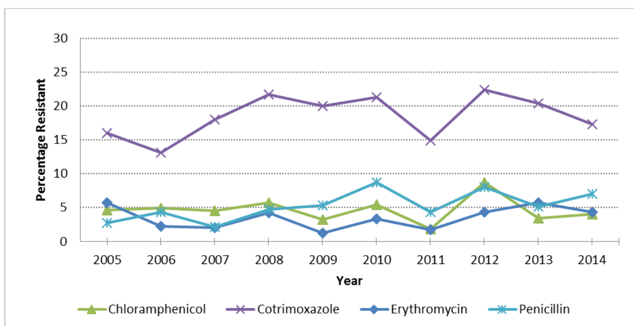



FIGURE 8. Yearly resistance rates of *S. pneumoniae*, ARSP, 2005-2014




### ***Streptococcus pneumoniae* Serotypes**

Serotyping of *S. pneumoniae* isolates referred to the reference laboratory was done to identify local prevailing serotype distribution. The method employed in the reference laboratory for pneumococci serotyping is the slide agglutination test (Denka Seiken). For 2014, there were 44 invasive (blood and CSF) and 74 non-invasive (respiratory and other non-invasive specimens) pneumococci isolates sent to the national reference laboratory for confirmatory testing and serotyping. The commonest serotypes from the blood and CSF isolates were serogroup/serotypes 5, 1, 4 and 6 comprising 64% of the referrals (FIGURE 9). Invasive serogroup/serotypes 4, 5 and 15 were associated with penicillin-resistance in the 2014 data. In contrast, most common serotypes from non-invasive isolates were: serogroup/serotype 3, 19 and 7 comprising 35% of the non-invasive referrals as seen in FIGURE 10. There were 3 invasive and 8 non-invasive isolates which were non-typable.

FIGURE 9. Distribution of invasive *S. pneumoniae* isolates by serogroup/serotypes, ARSP, 2014

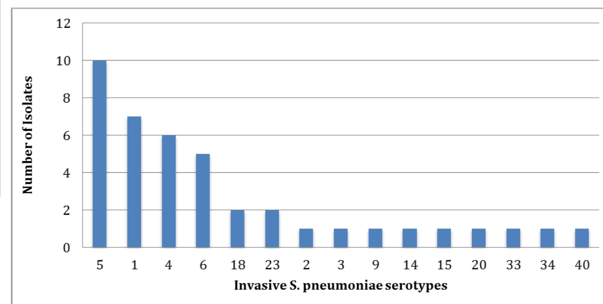
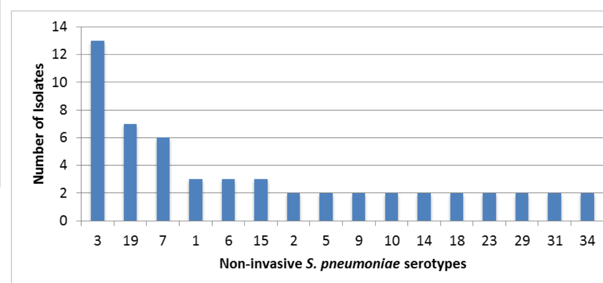



FIGURE 10. Distribution of non-invasive *S. pneumoniae* isolates by serogroups/serotypes, ARSP, 2014



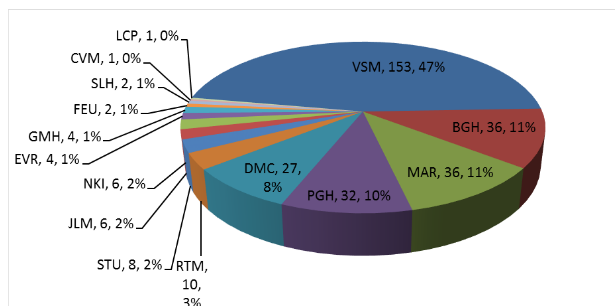
# *Haemophilus influenzae*

*Haemophilus influenzae* is a small gram-negative coccobacillus found mainly in the respiratory tract and commonly causes otitis media, sinusitis and community-acquired pneumonia. [7]

### Isolates

There were 328 reported *H. influenzae* isolates for 2014. This was 39% more than reported for 2013. Biggest contributors for the 2014 *H. influenzae* data were VSM (153 isolates), BGH (36 isolates), MAR (36 isolates) and PGH (32 isolates). Other sentinel sites contributors for *H. influenzae* 2014 data are seen in FIGURE 11. Majority of the 2014 *H. influenzae* isolates were from respiratory specimens (97%) while there were 5 invasive isolates (5 blood culture isolates). The 2 of the 3 invasive isolates were further identified as *H. influenzae* type b.

FIGURE 11. Percent sentinel site contribution for *H. influenzae*, ARSP, 2014, (N=328)




### Antimicrobial Resistance

Resistance rates among the isolates of *H. influenzae* for 2014 were: 12% for ampicillin (n=309; 95% CI: 8.7-16.3); 4.1% for amoxicillin-clavulanic acid (n=314; 95% CI: 2.3-7.1); 13.4% for chloramphenicol (n=313; 95% CI: 9.9-17.8); and 42.9% for co-trimoxazole (n=312; 95% CI: 37.4-48.6) as seen in FIGURE 12. When 2014 rates were compared to that reported for 2013, there was a significant increase in resistance against chloramphenicol from 6.6% in 2013 to 13.4% in 2014 (*p* value 0.0001); and a significant decrease in rates against amoxicillin-clavulanic acid from 10.5% in 2013 to 4.1% in 2014 (*p* value 0.0075). FIGURE 13 shows the trends of resistance of *H influenzae* isolates from 2005-2014. Of the 25 ampicillin-resistant *H. influenzae* isolates sent for confirmatory testing in ARSRL, 100% were β-lactamase producers. There was no reported levofloxacin-resistant *H. influenzae* isolate for 2014.

FIGURE 12. Percent resistance of *H. influenzae*, ARSP, 2014

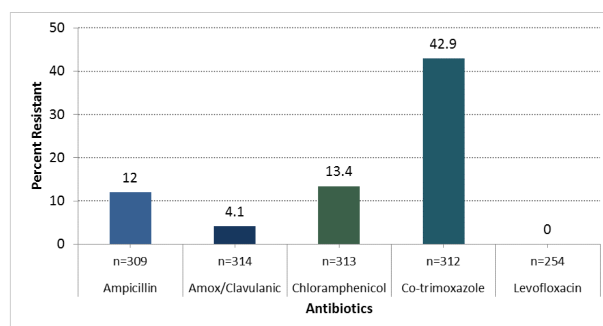
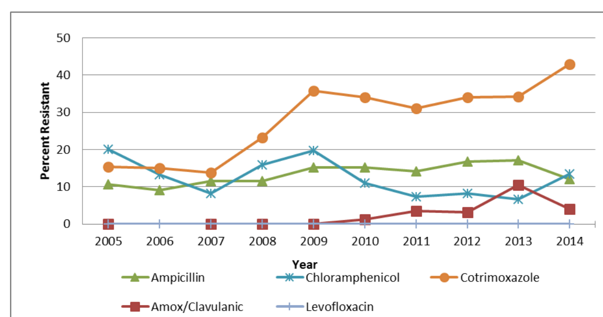



FIGURE 13. Yearly resistance rates of *H. influenzae*, ARSP, 2005-2014



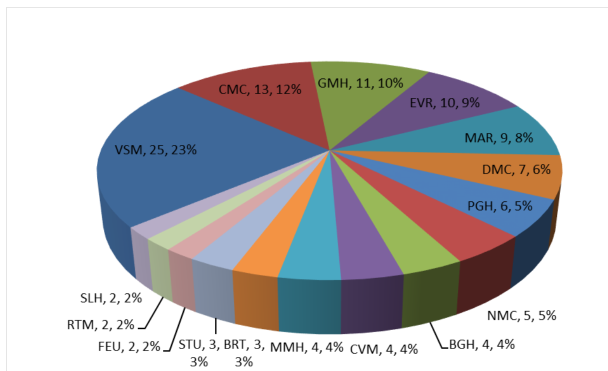
# *Salmonella enterica* serotype *Typhi*

*Salmonella enterica* serotype Typhi is a gram-negative rod that causes the systemic infection enteric or typhoid fever. S. Typhi is acquired only from human sources shedding to water, food or waste. [7]

### Isolates

There were 111 *S.* Typhi isolates reported and analyzed for 2014. This is 5% more than the total number of isolates reported for 2013. The largest sentinel site contributors making up 44% of the 2014 *S.* Typhi data were: VSM (25 isolates), CMC (13 isolates) and GMH (11 isolates). Sentinel site contribution to the 2014 data is seen in FIGURE 14. Most of the 2014 *S.* Typhi isolates were from blood specimens (94%). Others were isolated from stool, urine and other body fluids.

FIGURE 14. Percent sentinel site contribution for *S.* Typhi, ARSP, 2014




### Antimicrobial Resistance

*S.* Typhi isolates have mostly remained susceptible to first line agents ampicillin and co-trimoxazole with resistance rates at 2.9% (n=102; 95% CI: 0.7-8.9) and 6.7% (n=105; 95% CI: 3.0-13.8), respectively. No chloramphenicol resistant isolate was reported for 2014. These reported 2014 rates did not significantly differ from reported rates for 2013 ($p$ value > 0.05).

As in previous years, there were no reports of ciprofloxacin resistance for 2014 but resistance rate against nalidixic acid was at 8.9% (n=90; 95% CI: 4.2-17.3). Of the 8 reported nalidixic acid-resistant *S.* Typhi isolates, 7 were referred to ARSRL for confirmatory testing. All isolates tested as nalidixic acid-resistant, ciprofloxacin-intermediate S. Typhi. Nalidixic acid-resistance in extraintestinal Salmonella isolates may signify poor fluoroquinolone treatment outcomes. There were no confirmed reports of ceftriaxone-resistant *S.* Typhi for 2014. The *S.* Typhi 2014 rates of resistance and 10 year trends are seen in FIGURES 15-17.

FIGURE 15. Percent resistance of *S.* Typhi, ARSP, 2014

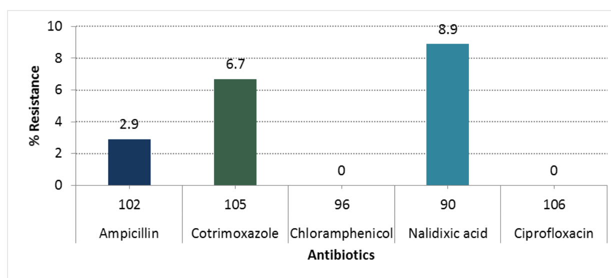



FIGURE 16. Yearly ampicillin, chloramphenicol and co-trimoxazole resistance rates of *S.* Typhi, ARSP, 2005-2014

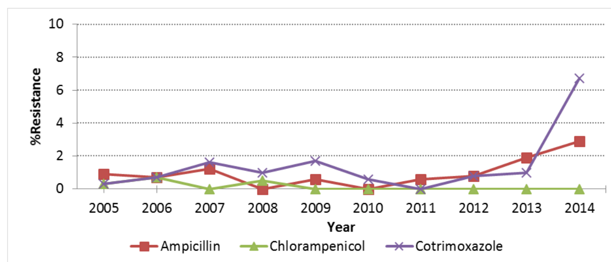
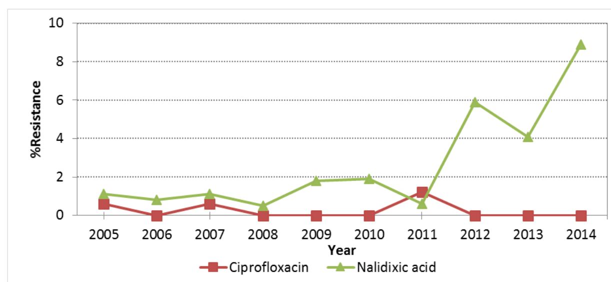



FIGURE 17. Yearly nalidixic acid and ciprofloxacin resistance rates of *S.* Typhi, ARSP, 2005-2014



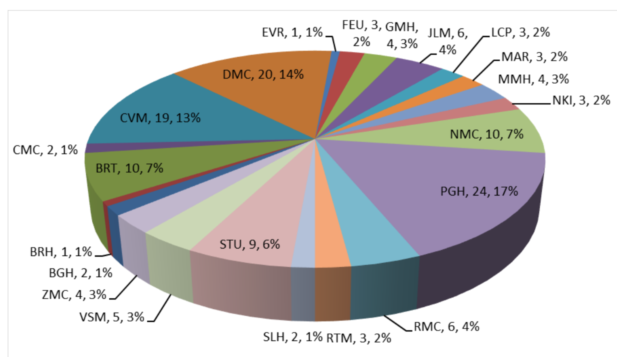
# Nontyphoidal *Salmonellae*

Nontyphoidal *Salmonella* (NTS) species are gram-negative rods that are a major bacterial cause of foodborne infections from diverse sources. [7]

### Isolates

There were 144 reported non-typhoid *Salmonella* isolates for 2014. This is 11% less than the 158 reported non-typhoid *Salmonella* isolates for 2013. The largest contributor of the 2014 isolates were PGH (24 isolates), DMC (20 isolates) and CVM (19 isolates) as seen in FIGURE 27. Most of the isolates were from blood specimens (35%). Other specimens from which non-typhoid *Salmonella* were isolated are: stool, wound, respiratory, urine, tissue and other body fluids.

FIGURE 18. Percent sentinel site contribution for nontyphoidal *Salmonellae*, ARSP, 2014, (N=144)




### Antimicrobial Resistance

For 2014, 21.6% (n=125; 95% CI: 14.9-30) of non-typhoid *Salmonella* isolates were reported to be resistant to ciprofloxacin. Of these, 2 were sent to the reference laboratory and confirmed as ciprofloxacin-resistant *Salmonella enterica* serotype Kentucky.

There were 123 nontyphoidal *Salmonella* tested against ceftriaxone for 2014, of these 13% were reported as resistant to ceftriaxone. Of these, only 1 isolate was sent for confirmatory testing at the national reference laboratory. This isolate was identified as *Salmonella enterica* serotype Lexington and was confirmed by MIC testing at the reference laboratory as ampicillin and ceftriaxone-resistant but susceptible to chloramphenicol, co-trimoxazole and ciprofloxacin. Further phenotypic analysis using disc approximation and E-test showed that this isolate was negative for production of the extended-beta-lactamase (ESBL) enzyme. Resistance rates of nontyphoidal *Salmonella* isolates for 2014 and the decade prior are illustrated in FIGURES 19-21.

FIGURE 19. Percent resistance of nontyphoidal *Salmonellae*, ARSP, 2014

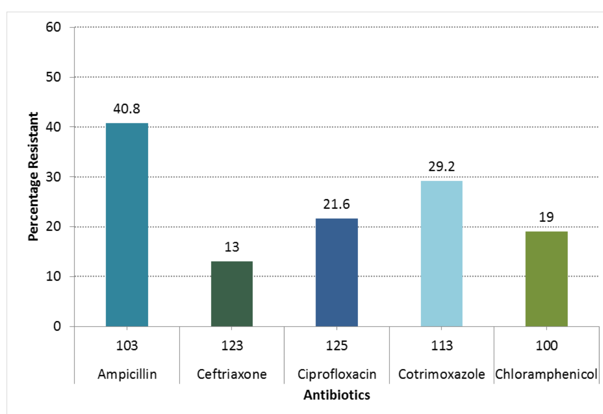



FIGURE 20. Yearly ampicillin, chloramphenicol and co-trimoxazole resistance rates of nontyphoidal *Salmonellae*, ARSP, 2005-2014

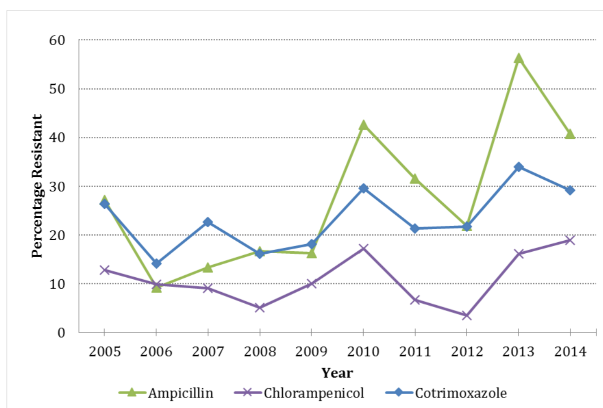


FIGURE 21. Yearly ciprofloxacin and ceftriaxone resistance rates of nontyphoidal *Salmonellae*, ARSP, 2005-2014

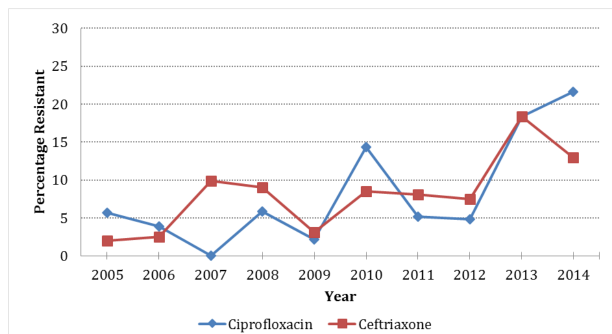



TABLE 6. ARSRL referrral *Salmonella* serotypes, ARSP, 2014

| Organism | Number of isolates |
|---|---|
| Salmonella Typhi | 85 |
| Salmonella Typhimurium | 10 |
| Salmonella Enteritidis | 7 |
| Salmonella Rissen | 2 |
| Salmonella Virchow | 2 |
| Salmonella Heidelberg | 2 |
| Salmonella Kentucky | 2 |
| Salmonella Weltevreden | 2 |
| Salmonella Anatum | 1 |
| Salmonella Group B (O:4) | 1 |
| Salmonella Javiana | 1 |
| Salmonella Agona | 1 |
| Salmonella Newport | 1 |
| Salmonella Saintpaul | 1 |
| Salmonella Paratyphi A | 1 |
| Salmonella Lexington | 1 |
| Salmonella Cholerasuis var Kurzendorf | 1 |
| ALL | 121 |

## *Salmonella* Serotypes

There were 85 *S. enterica* serotype Typhi, 1 *S.enterica* serotype Paratyphi A and 36 nonty-phoidal *Salmonella* serotyped at the reference laboratory for 2014. The most common nonty-phoidal *Salmonella* serotypes identified were *S. enterica* serotype Typhimurium and *S. enterica* serotype Enteritidis similar to that reported in the past year. A summary of the identified *Salmonella* serotypes for 2014 is seen in TABLE 6.

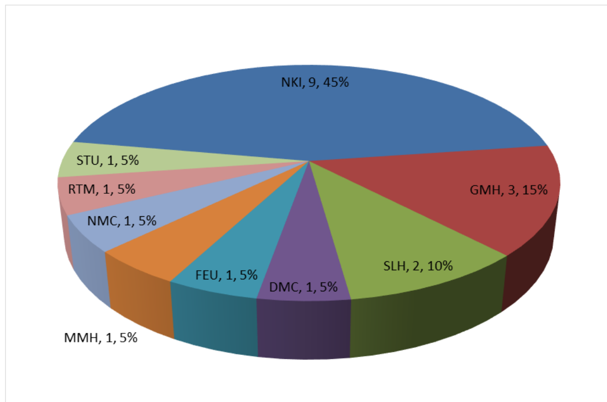
# *Shigella* species

*Shigella* species are gram-negative bacilli that cause a spectrum of illness from watery diarrhea to dysentery or bloody diarrhea. [7]

## Isolates

For 2014, there were only 20 *Shigella* species isolates reported. The largest sentinel site contributors for the 2014 data were: NKI (9 isolates), GMH (3 isolates) and SLH (2 isolates) as seen in FIGURE 22.

FIGURE 22. Percent sentinel site contribution for *Shigella* species, ARSP, 2014, (N=20)




## Antimicrobial Resistance

As there were very few *Shigella* isolates reported for 2014, we combined the results of isolates from 2011 to 2014 in order to obtain a reasonable statistical estimate of the cumulative percentage resistance for *Shigella* species.

High rates of resistance to the previous first line agents against Shigellosis: ampicillin, chloramphenicol and co-trimoxazole is reported with cumulative 2011-2014 rates at 62.7% (n=59; 95% CI: 49.1-74.6), 43.5% (n=46; 95% CI: 29.3-58.8), and 60.7% (n=61; 95% CI: 47.4-72.7), respectively. Lower 2011-2014 cumulative resistance rates of Shigella species is seen against ciprofloxacin at 13.8% (n=58; 95% CI: 6.6-25.9). There were no reported ceftriaxone-resistant *Shigella* species for 2014. *Shigella* species 2011-2014 rates and trends for the past 10 years are seen in FIGURES 23 and 24.

FIGURE 23. Percentage resistance of *Shigella*, ARSP, 2011-2014

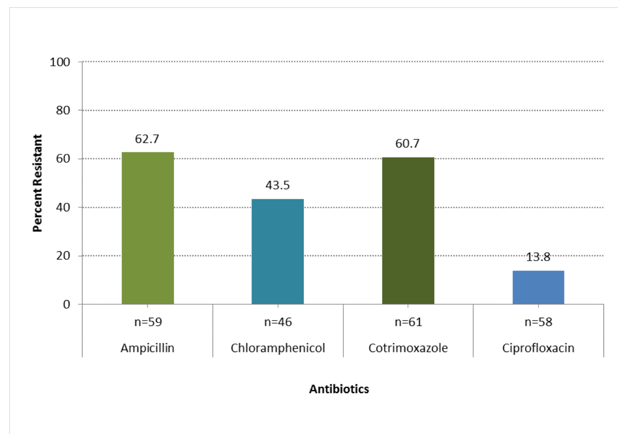
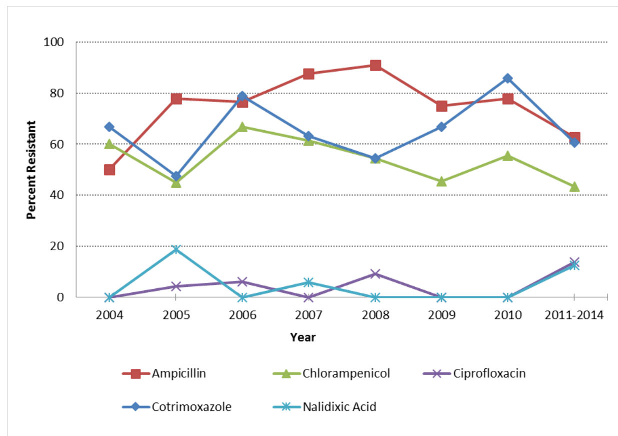



FIGURE 24. Trends of resistance rates of *Shigella*, ARSP, 2004-2014



# *Vibrio cholerae*

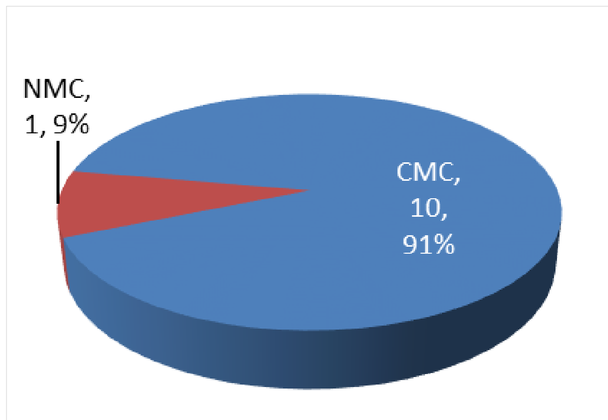
*Vibrio cholerae* is a gram-negative bacillus that has been known to cause epidemics of the secretory diarrheal syndrome, cholera. [7]

### Isolates

There were only 11 isolates of *Vibrio cholerae* reported for 2014. The sentinel site CMC in Mindanao contributed majority (91%) of the *V. cholera* 2014 isolates (FIGURE 25).

Of the 10 isolates referred to the reference laboratory for confirmatory testing, all were identified as *Vibrio cholerae* serogroup 01, biotype El tor, serotype Ogawa.

FIGURE 25. Percent sentinel site contribution for *V. cholerae*, ARSP, 2014, (N=11)




### Antimicrobial Resistance

Since few isolates were reported for 2014, we combined the results of isolates from 2013 and 2014 to arrive at a reasonable statistical estimate of cumulative percentage resistance for *V. cholerae*. For 2014, as in the past years, *V. cholerae* isolates have remained susceptible to co-trimoxazole, chloramphenicol and tetracycline with no reported resistant isolate for the past 2 years (FIGURE 26). These rates have remained stable for the past 5 years, with reported rates against each of these 3 antibiotics at 5% or less since 2006 (FIGURE 27).

FIGURE 26. Percent resistance of *V. cholerae*, ARSP, 2014

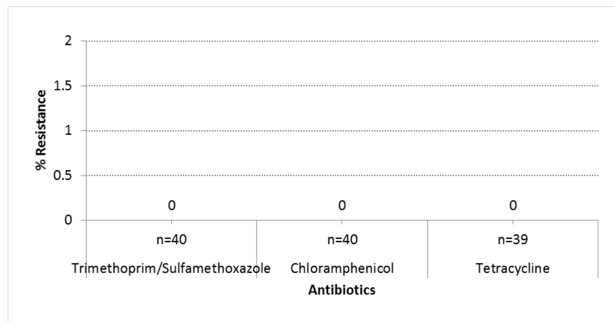
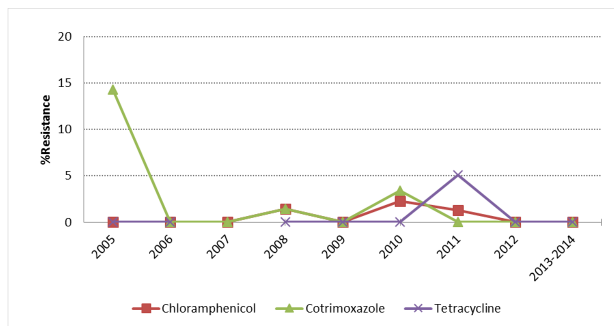



FIGURE 27. Trends in resistance rates of *V. cholerae*, ARSP, 2005-2014



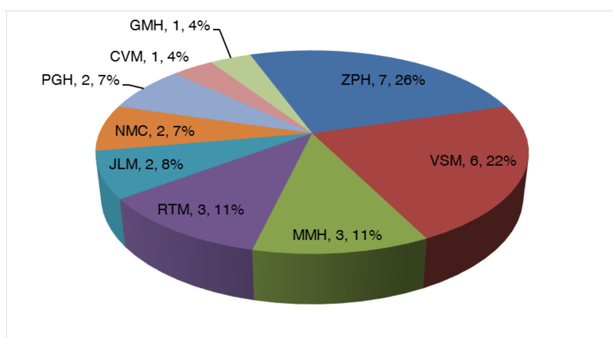
# *Neisseria gonorrhoeae*

*Neisseria gonorrhoeae* is a gram-negative diplococci that are one of the commonest sexually transmitted bacterial pathogens. It causes a spectrum of illness ranging from asymptomatic urethritis to a disseminated infection with possible complications associated with reproductive health. [7]

### Isolates

There were only 27 *Neisseria gonorrhoeae* isolates reported for 2014. This was 13% more than the reported 24 isolates of *N. gonorrhoeae* for 2013. Almost half of the isolates were from ZPH (7 isolates) and VSM (6 isolates) as seen in FIGURE 28.

FIGURE 28. Percent sentinel site contribution for *N. gonorrhoeae*, ARSP, 2014, (N=27)




### Antimicrobial Resistance

Since there were very few gonococcal isolates reported for 2014, we combined the results of isolates from 2013 to 2014 in order to obtain a reasonable statistical estimate of the cumulative percentage resistance for *N. gonorrhoeae*.

Rates of resistance against penicillin have been at least 80% for the past decade with 2013-2014 cumulative rate at 89.1% (n=46; 95% CI: 75.6-95.9). Of the subset *of N. gonorrhoeae* isolates referred to the reference laboratory for confirmatory testing, all (20 out of 20 isolates) were penicillin-resistant and positive for β-lactamase production (PPNG- penicillinase-producing *N. gonorrhoeae*). Rates of resistance for gonococci against tetracycline and ciprofloxacin have been increasing for the past few years with 2013-2014 rates at 55.3% (n=47; 95% CI: 40.2-69.50 and 84.8% (n=46; 95% CI: 70.5-93.2), respectively. There were no reported spectinomycin, ceftriaxone nor cefixime-resistant gonococcal isolate for the 2013-2014 data, as in the past years. Of the 20 *N. gonorrhoeae* isolates referred for confirmatory testing at the reference laboratory, no reduced susceptibility phenotypes to extended-spectrum cephalosporins were identified with susceptible ceftriaxone MICs ranging from <0.002 to 0.047 ug/ml and susceptible cefixime MICs ranging from <0.01 to 0.047 ug/ml. FIGURES 29 and 30 summarizes resistance rates of *N. gonorrhoeae* for 2013-2014 and the trends for the past 10 years.

FIGURE 29. Percent resistance of *N. gonorrhoeae*, ARSP, 2013-2014

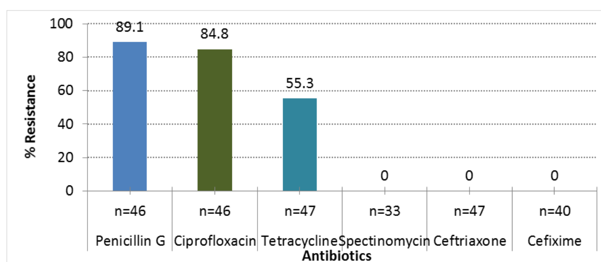
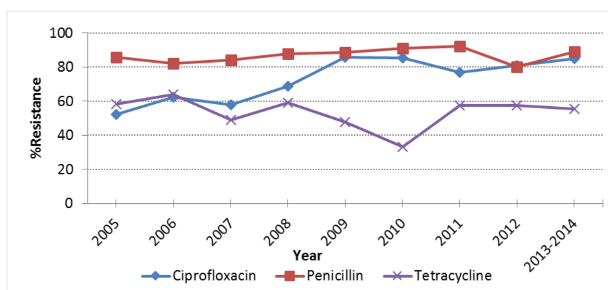



FIGURE 30. Trends of resistance for *N. gonorrhoeae*, ARSP, 2005-2014



# *Staphylococcus aureus*

*Staphylococcus aureus* is a gram-positive bacterial pathogen that causes both community and healthcare-associated infections. It also colonizes human skin and mucous membranes. Its methicillin or oxacillin-resistant form (MRSA) has been an important cause of antimicrobial-resistant community and healthcare-associated infections globally. [7]

## Isolates

For 2014, there were a total of 3,529 isolates of *Staphylococcus aureus* reported. These were most commonly isolated from cutaneous, blood and respiratory specimens. *S. aureus* was the most common isolate from cutaneous wound specimens (20% of 7,930 isolates) and 3rd most common isolate from blood cultures (6% of 9,484 isolates).

## Antimicrobial Resistance

The 2014 resistance rate of *S. aureus* against the β-lactam oxacillin is at 60.3% (n=3,323; 95% CI: 58.6-62). The 2014 rate of methicillin-resistant *S. aureus* (MRSA) increased significantly from 53.2% in 2013 to the 60.3% in 2014 (*p* value 0.0001). Resistance rates against the antibiotics tested against *S. aureus* for 2014 and the past decade are seen in FIGURES 31-34. The 2014 resistance rates to the rest of the antibiotics tested did not differ significantly from the reports from 2013 except for the significant increase in co-trimoxazole resistance from 14% in 2013 to 22% for 2014 (*p* value 0.0001). Although there were 17 isolates reported as vancomycin resistant, none of these *S. aureus* isolates were sent for confirmatory testing at the reference laboratory.

FIGURE 31. Percent resistance against penicillins, vancomycin, clindamycin and erythromycin of *S. aureus*, ARSP, 2014

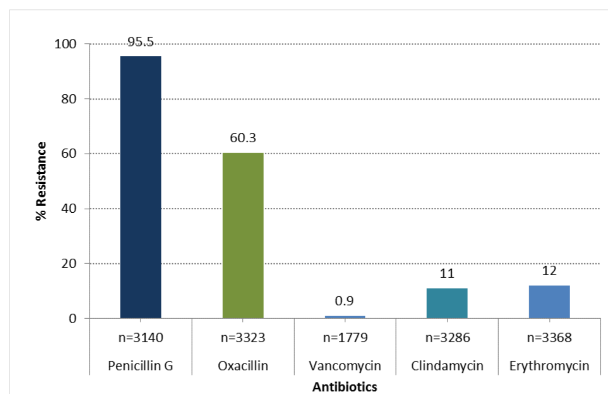



FIGURE 32. Percent resistance against rifampin, ciprofloxacin, co-trimoxazole, linezolid and tetracycline of *S. aureus*, ARSP, 2014

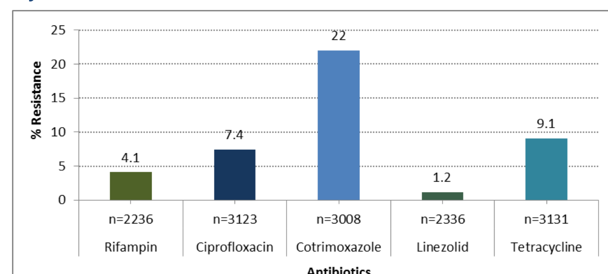



FIGURE 33. Yearly penicillin, oxacillin and vancomycin resistance rates of *S. aureus*, ARSP, 2005-2014

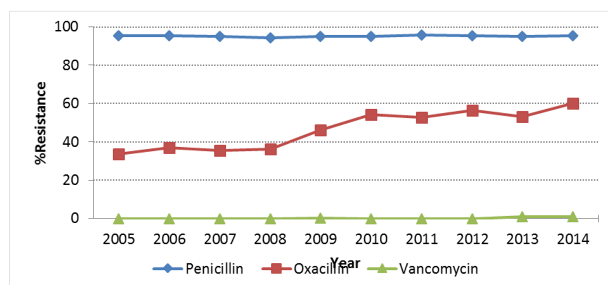
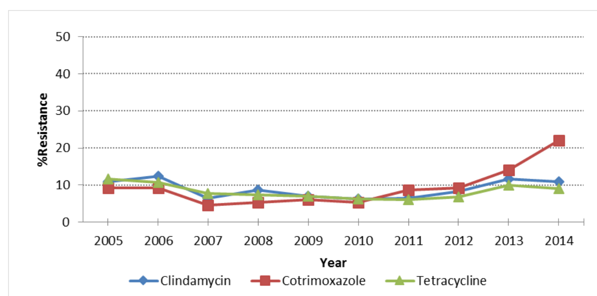


FIGURE 34. Yearly clindamycin, co-trimoxazole and tetracycline resistance rates of *S. aureus*, ARSP, 2005-2014




## Methicillin-resistant *Staphylococcus aureus* (MRSA)

There were 2,004 MRSA isolates reported from the ARSP sentinel sites for 2014. Most of these isolates were isolated from cutaneous and blood culture isolates. The overall cumulative MRSA rate for 2014 was at 60.3%. Sentinel site MRSA rates ranged from as low as 24.8% (NKI, n=137) to as high as 74.5% (LCP, n=31). FIGURE 36 shows the MRSA rates by region.

Of these 2014 MRSA isolates, 85% were from specimens taken from patients in the outpatient department, emergency room and admissions within their 1st 2 hospital days. When MRSA rates were analyzed by specimen type, 60% of all blood isolates (n=570) and 64.7% of all skin and soft tissue isolates (n=1,535) were methicillin-resistant**.**

Resistance rate of the MRSA isolates against available agents for treatment showed variable susceptibility to available antimicrobial agents as seen in FIGURE 35. Resistance rates have increased significantly for most of the antibiotics tested when compared to 2013 rates: rifampin from 4% in 2013 to 6% in 2014 (*p* value 0.0339); ciprofloxacin from 7% in 2013 to 10.5% in 2014 (*p* value 0.0017); co-trimoxazole from 18% in 2013 to 26.1% in 2014 (*p* value 0.0001); clindamycin from 12% in 2013 to 14.6% in 2014 (*p* value 0.0353); and tetracycline form 8% in 2013 to 10.9% in 2014 (*p* value 0.0103). The 2014 MRSA isolates rates of resistance did not differ significantly against erythromycin, linezolid and vancomycin from reported rates in 2013 (*p* value > 0.05).

FIGURE 35. Percentage resistance of MRSA, ARSP, 2014

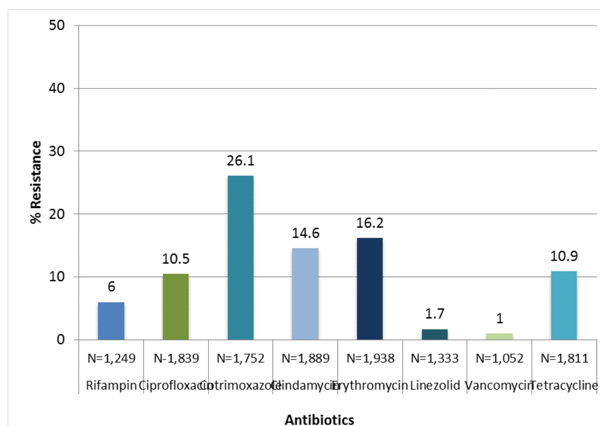
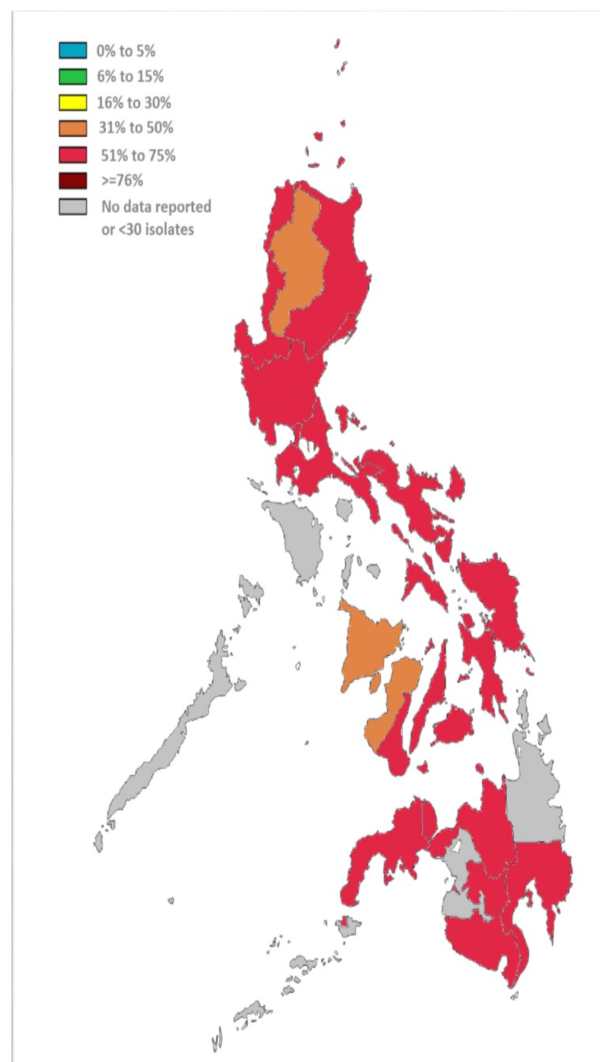



Figure 36. MRSA rates by sentinel site region



# *Staphylococcus epidermidis*

*Staphylococcus epidermidis* is one of the 40 recognized species of coagulase-negative staphylococci inhabiting human skin and mucous membranes. Although often a contaminant, it is recently becoming a common cause of primary bacteremia and infections associated with indwelling medical devices. [7]

## Isolates

For 2014, there were a total of 2,202 isolates of *Staphylococcus epidermidis* reported. Majority of these 2013 *S. epidermidis* isolates were from blood cultures and cutaneous or skin and soft tissue specimens.

## Antimicrobial Resistance

Resistance rates of *S. epidermidis* isolates against penicillin is reported at 95.8% for 2014 (n=2,030; 95% CI: 94.8-96.6) while oxacillin resistance is reported at 78.9% (n=1,847; 95% CI: 77.0-80.7). There was no confirmed vancomycin or linezolid resistant *S. epidermidis* isolates for 2014. Resistance rates of *S. epidermidis* against antibiotics for treatment for 2014 and for the past decade are seen in FIGURES 37-38. These 2014 resistance rates did not differ significantly from the reports from 2013.

FIGURE 37. Percent resistance of *S. epidermidis*, ARSP, 2014

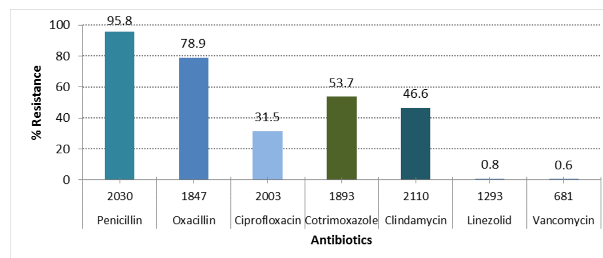
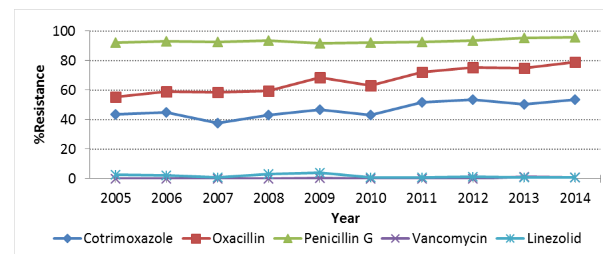



FIGURE 38. Yearly resistance rates of *E. epidermidis*, ARSP, 2005-2014



# *Enterococcus* species

Enterococci are gram-positive cocci that can cause a wide spectrum of infections including UTIs, bacteremia, meningitis, intraabdominal and cutaneous infections. These bacteria are intrinsically resistant to a wide spectrum of antibiotics. Acquisition of vancomycin-resistance among enterococci is an emerging cause of healthcare-associated infections. [7]

## The Isolates

For 2014, there were a total of 1,691 *Enterococcus* species reported of which the commonest were *Enterococcus faecalis* (663 isolates) and *Enterococcus faecium* (203 isolates). These were mostly isolated from blood and urine specimens.

## Antimicrobial Resistance

For 2014, ampicillin-resistance among *E. faecalis* was at 8.8% (n=565; 95% CI: 6.7-11.5). Comparatively, ampicillin-resistance against *E. faecium* was reported higher at 72.7% (n=172; 95% CI: 65.3-79.1). Testing for high-level aminoglycoside resistance identifies loss of the synergistic effect of aminoglycosides with **β**-lactams and glycopeptides when treating enterococcal infections. For 2014, high level gentamicin and streptomycin resistance for *E. faecalis* was at 15.3% (n=274; 95% CI: 11.4-20.2); and 20.5% (n=259; 95% CI: 16.6-26.9), respectively. Similarly, higher high-level gentamicin and streptomycin rates of resistance are seen with *E. faecium* with reports at 48.6% (n=70; 95% CI: 36.6-60.8) and 27.3% (n=66; 95% CI: 18.6-41.4), respectively. There was no confirmed report of vancomycin-resistant *E. faecalis* or *E. faecium* for 2014. FIGURES 39-40 shows 2014 rates of resistance for *E. faecalis* and *E. faecium*, respectively.

FIGURE 39. Percent resistance of *E. faecalis*, ARSP, 2014

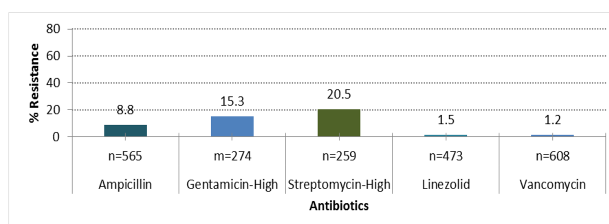
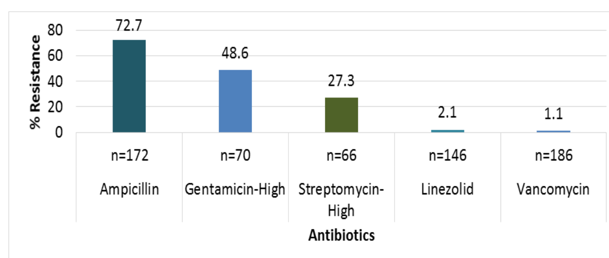



FIGURE 40. Percent resistance of *E. faecium*, ARSP, 2014



# *Escherichia coli*

*Escherichia coli* is the most common cause of urinary tract infection (UTI), and a frequent pathogen causing neonatal meningitis, traveler's diarrhea, intraabdominal infections, nosocomial pneumonia, post-operative cutaneous infections and central line infections. [7]

## The Isolates

A total of 6,159 *Escherichia coli* isolates were reported for 2014. Majority of the isolates were from urine specimens (54%). Others were isolated from respiratory, blood, CSF and cutaneous specimens. *E. coli* was the most common urine specimen isolate (39%) and the second most common gram-negative bacterial isolate from blood cultures.

## Antimicrobial Resistance

*E. coli* rates of resistance against the fluoroquinolones and third generation cephalosporins have been increasing for the past years with resistance rates against ciprofloxacin at 41% (n=5,540; 95% CI: 39.7-42.3) and ceftriaxone at 32.2% (n=5,401; 95% CI: 31.0-33.5) for 201**4.** Emerging resistance against the carbapenems are also reported for 2014 at: 2.8% for ertapenem (n=3,281; 95% CI: 2.4 -3.5); 2.1% for imipenem (n=5,791; 95% CI; 1.8-2.5); and 2.3% for meropenem (n=5,206; 95% CI: 1.9-2.8). These 2014 resistance rates for ciprofloxacin, ceftriaxone and the carbapenems did not differ significantly from reports from 2013.

Resistance rates for 2014 and the past 10 years to the antimicrobial agents tested against *E. coli* are seen in FIGURES 41-44. Reported resistance rates against ampicillin, ampicillin-sulbactam, co-trimoxazole, and gentamicin for 2014 did not differing significantly from that of the previous year except for the statistically significant decrease in rates against ampicillin-sulbactam from 31.8% in 2013 to 24.8% for 2014 (*p* value 0.0001).

FIGURE 41. Percent penicillins, cephalosporins and co-trimoxazole resistance of *E. coli*, ARSP, 2014

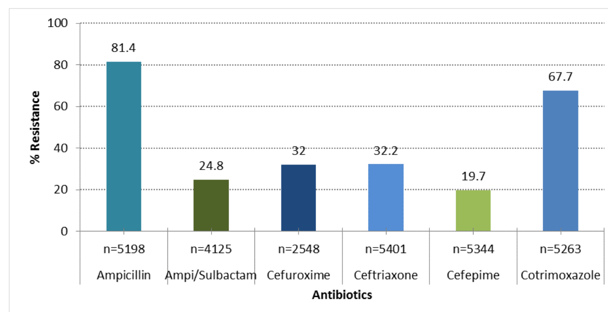



FIGURE 42. Percent carbapenem, aminoglycoside and fluoroquinolone resistance of *E. coli*, ARSP, 2014

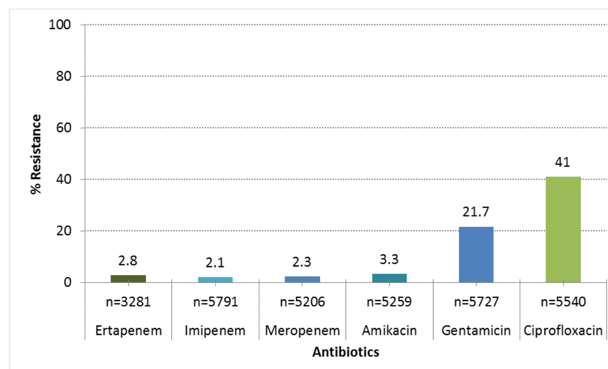



FIGURE 43. Yearly ampicillin, ampicillin-sulbactam, ciprofloxacin and co-trimoxazole resistance of *E. coli*, ARSP, 2014

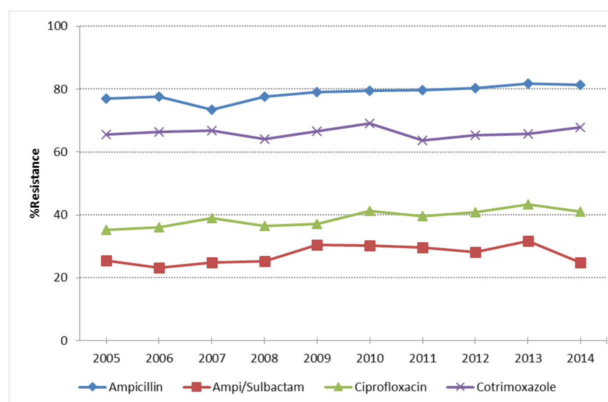
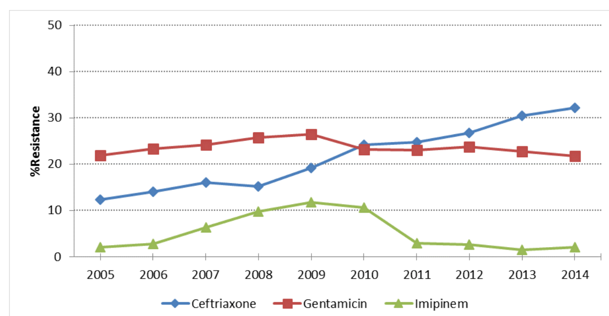


FIGURE 44. Yearly ceftriaxone, gentamicin and imipenem resistance of *E. coli,* ARSP, 2005-2014




## Urinary *Escherichia coli*

There were 3,340 urinary *E. coli* isolates reported for 2014 making this organism the most common bacterial isolate from urine specimens. Resistance data **of outpatient urinary *E. coli* isolates against commonly used oral antibiotics for urinary tract infections showed lowest resistance rate against nitrofurantoin at 6.6% (n=945; 95% CI: 5.2-8.5). In the subset of urinary *E. coli* isolated from admitted or hospitalized patients, rates of resistance against commonly used parenteral antibiotics for urinary tract infection was lowest against ertapenem at 2.8% (n=1,300; 95% CI: 2.4-3.6) and amikacin at 3.9% (n=1,897; 95% CI: 3.1-4.9).** Percentage resistance of 2014 urinary *E. coli* isolates against the panel of antimicrobials by are summarized in TABLE 7.

TABLE 7. Percentage resistance of urinary *E. coli* from outpatient versus inpatient, ARSP, 2014

| Antimicrobial | Outpatient | | Inpatient | |
|---|---|---|---|---|
| **Oral Agents** | N | %R | N | %R |
| Ampicillin | 971 | 79.8 | 1936 | 82.3 |
| Co-amoxiclav | 1084 | 18.5 | 2226 | 24.2 |
| Cefuroxime | 535 | 24.3 | 949 | 35.2 |
| Ciprofloxacin | 979 | 50.7 | 2073 | 43.1 |
| Co-trimoxazole | 1012 | 65.8 | 1966 | 68 |
| Nitrofurantoin | 945 | 6.6 | 1757 | 5.5 |
| **Intravenous Agents** | N | %R | N | %R |
| Piperacillin/ Tazobactam | 1037 | 3.1 | 2078 | 6 |
| Ceftriaxone | 917 | 27.5 | 2007 | 38.2 |
| Ertapenem | 554 | 1.3 | 1300 | 2.8 |
| Amikacin | 941 | 2.2 | 1897 | 3.9 |

Legend: N= number tested; %R= percentage resistant; Outpatient-specimen taken from patients at the outpatient department or emergency room; Inpatient- specimen taken from patient admitted or hospitalized

# *Klebsiella sp.*

*Klebsiella* species are gram-negative bacilli that commonly causes pneumonia, urinary tract infections and nosocomial infections. Multidrug-resistant *Klebsiella* species producing extended-spectrum β-lactamases and/or carbapenemases have been increasingly common pathogens especially in the healthcare setting. [7]

## The Isolates

A total of 8,175 *Klebsiella* species isolates were reported for 2014. Majority of the isolates were from respiratory specimens (53%). Others were isolated from urine, wound or cutaneous and blood specimens. *Klebsiella* species were the most common isolate from all specimens tested, from the subset of respiratory specimens, presumptive nosocomial specimens and presumptive nosocomial respiratory specimens.

## Antimicrobial Resistance

*Klebsiella* species rates of resistance against the carbapenems have been slowly rising for the past years with rates significantly increased statistics wise for ertapenem from 8.8% (n=3,385 isolates) in 2013 to 11.8% (n=4,373 isolates; 95% CI: 10.9-12.8) for 2014 (*p* value 0.0001); imipenem from 5.8% (n=6,189 isolates) in 2013 to 7.6% (n=7,725 isolates; 95% CI: 7-8.2) in 2014 (*p* value 0.0001); and meropenem from 7.1% (n=5,833 isolates) in 2013 to 8.8% (n=7,086 isolates; 95% CI: 8.2-9.5) in 2014 (*p* value 0.0004).

Resistance rates for the antimicrobial agents tested against *Klebsiella* sp. For 2014 and the past decade are seen in FIGURES 45-48.

FIGURE 45. Percent beta-lactams resistance of *Klebsiella* species, ARSP, 2014

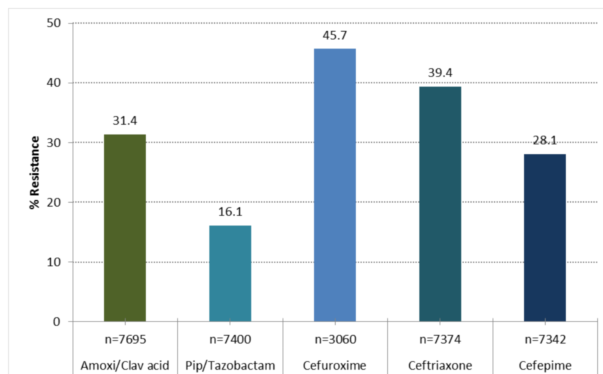



FIGURE 46. Percent carbapenems, aminoglycosides and ciprofloxacin resistance of *Klebsiella* species, ARSP, 2014

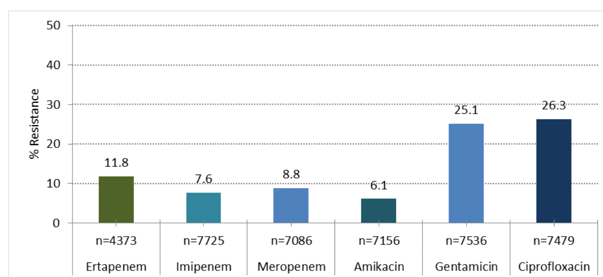



FIGURE 47. Yearly amoxicillin-clavulanic acid, ceftriaxone and ciprofloxacin resistance of *Klebsiella* species, ARSP, 2005-2014

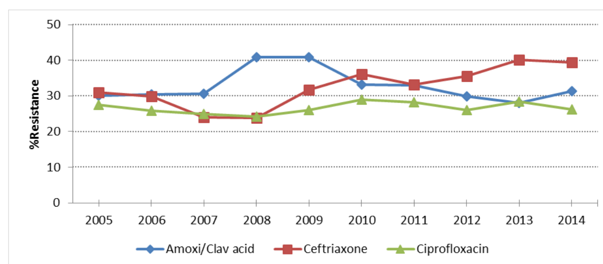
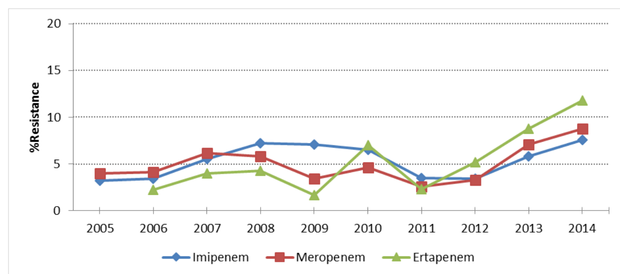


FIGURE 48. Yearly carbapenems and amikacin resistance of *Klebsiella* species, ARSP, 2005-2014




## Extended-spectrum β-lactamase-producing *Enterobacteriaceae*

Extended-spectrum β-lactamases (ESBLs) are enzymes that mediate resistance to extended-spectrum cephalosporins and monobactams but do not affect cephamycins or carbapenems. [7] Using ceftazidime disk diffusion as initial screening for ESBL production, *out of 5,506 E. coli isolates tested, 25% screened positive (ESBL suspect). Similarly, 7,464 Klebsiella species isolates were tested and 35.7% screened positive for ESBL production.* Of the subset of 267 ESBL-suspect *E. coli* isolates sent to the reference laboratory 48% were confirmed by phenotypic testing as ESBL-producing *E. coli*. Likewise, of the subset of 512 ESBL-suspect *Klebsiella* species isolates sent to the reference laboratory 50.4% were confirmed by phenotypic testing as ESBL-producing *Klebsiella* species.

Comparing 2014 *E. coli* ESBL-suspect rates from sentinel sites with at least 30 isolates tested, reports were variable with lowest rate reported by RTM at 9.4% (n=32) while highest ESBL-suspect rate noted from STU at 51.6% (n=153) as seen in FIGURE 49. Comparing 2014 *Klebsiella* species ESBL-suspect rates from sentinel sites with at least 30 isolates tested, reports were variable with lowest rate reported by BGH at 11.7% (n=496) while highest ESBL-suspect rate noted from STU at 78.4% (n=88) as seen in FIGURE 50.

FIGURE 49. Percentage of ESBL-suspect (ceftazidime-resistant) *E. coli,* ARSP, 2014

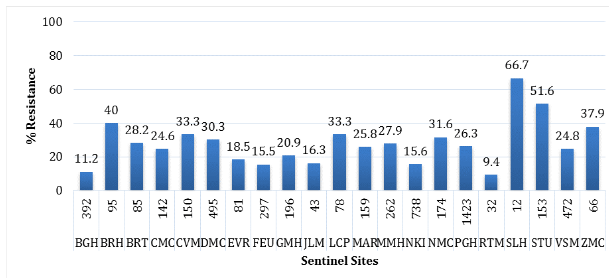
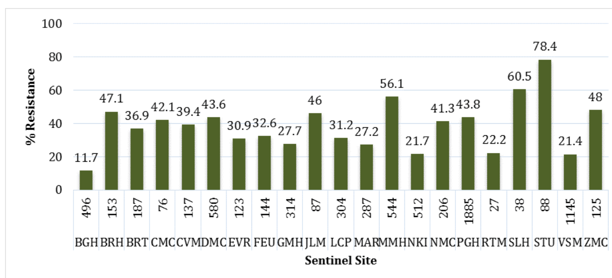



FIGURE 50. Percentage of ESBL-suspect (ceftazidime-resistant) *Klebsiella* species, ARSP, 2014



# *Pseudomonas aeruginosa*

*Pseudomonas aeruginosa* is a gram-negative bacteria known to be ubiquitous in nature and is commonly an opportunistic pathogen causing infections in hospitalized patients. [7]

## The Isolate

For 2014, there were 4,286 *P. aeruginosa* isolates which were most commonly isolated from respiratory, cutaneous, urine, tissue and blood specimens. *P. aeruginosa* in the 3rd most common presumptive nosocomial isolate (isolated from hospitalized patient from day 3 onwards) for the 2014 surveillance data.

## Antimicrobial Resistance

The 2014 resistance rates of *P. aeruginosa isolates to commonly used antimicrobials tested was lowest against amikacin at 9.5% (n=3,971; 95% CI: 8.6-10.5) and highest against imipenem at 17.5% (n=3,997; 95% CI: 16.3-18.7)*. When the 2014 reported resistance data to agents used for treating *P. aeruginosa* infections are compared to those from 2013, imipenem resistance rate significantly decreased from the reported 19.6% in 2013 to the 17.5% reported for 2014 (*p* value 0.0192); while piperacillin-tazobactam resistance increased from the 11.2% reported in 2013 to the 14.5% rate for 2014 (*p* value 0.0001). The rest of the antimicrobials resistance rates for 2014 did differ statistically from those reported the year prior. Resistance rates of *P. aeruginosa* to antimicrobials for treatment for 2014 and the past 10 years are seen in FIGURES 51-52.

FIGURE 51. Percent resistance of *P. aeruginosa*, ARSP, 2014

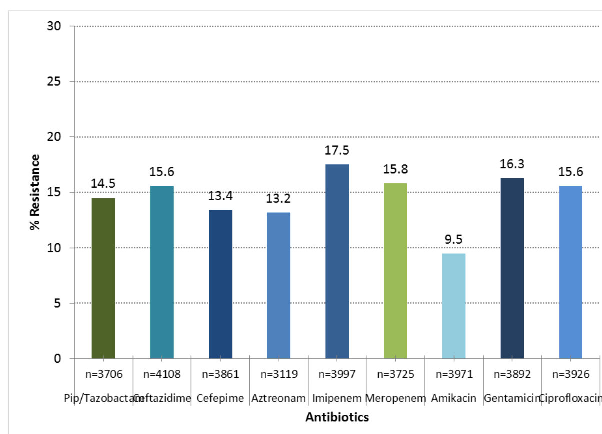
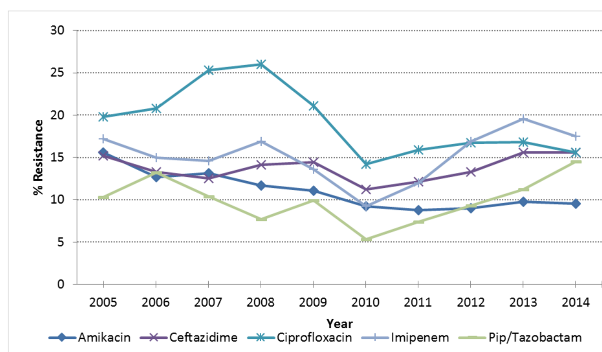



FIGURE 52. Yearly resistance rates of *P. aeruginosa*, ARSP, 2005-2014



Multidrug-resistant pathogens are increasingly recognized globally. Terminologies are summarized in TABLE 8 [8]. *P. aeruginosa* MDR and XDR rates are noticeably higher in the subset of invasive (blood culture) isolates (TABLE 9).

TABLE 8. Definition of MDR, XDR and PDR

| Term | Acronym | Definition |
| --- | --- | --- |
| Multidrug-resistant | MDR | Resistance of an organism to at least 1 or more agents in 3 or more classes of antimicrobial categories |
| Extensively drug-resistant | XDR | Resistance to at least 1 agent in all but 2 or fewer antimicrobial categories |
| Pandrug-resistant | PDR | Resistance to all available antibiotics |

TABLE 9. *P. aeruginosa* MDR and possible XDR rates

| ***Pseudomonas aeruginosa*** | **No. of Organisms** | **% MDR** | **% XDR** |
| --- | --- | --- | --- |
| All isolates | 4,286 | 23% | 18% |
| Blood culture isolates | 259 | 35% | 26% |

# Acinetobacter baumannii

*Acinetobacter baumannii* is a gram-negative non-fermentative organism that commonly causes nosocomial pneumonia, central-line associated bloodstream infections, urinary tract infections, surgical site infections and other types of cutaneous infections. [7]

## The Isolate

For 2014, there were 2,927 *A. baumannii* isolates which were most commonly isolated from respiratory, blood, urine and cutaneous wound specimens. This pathogen was the 2nd most common presumptive nosocomial (isolated from hospitalized patients from day 3 onwards) blood culture isolate and the 3rd most common presumptive nosocomial (isolated from hospitalized patients from day 3 onwards) respiratory specimens isolate.

## Antimicrobial Resistance

For the 2014 data, more than a third of the reported *A. baumannii* isolates are resistant to commonly used antimicrobials for treatment with rates at 39.2% for ampicillin-sulbactam (n=1,874; 95% CI: 37.3-41.8); 40% for amikacin (n=2,369; 955 CI: 43.4 -47.2); and gentamicin at 36.9% ( n=2,648; 95% CI: 35.1-38.8*). Imipenem-resistance rate of A. baumannii for 2014 is reported at 45.3% (n=2,667; 95% CI: 43.4-37.2).* This is thrice of the reported resistance rate of 14.5% a decade before. Resistance rates of *A. baumannii* to antimicrobials for treatment for 2014 and the past 10 years are illustrated on FIGURES 53-55.

FIGURE 53. Percent resistance of *A. baumannii*, ARSP, 2014

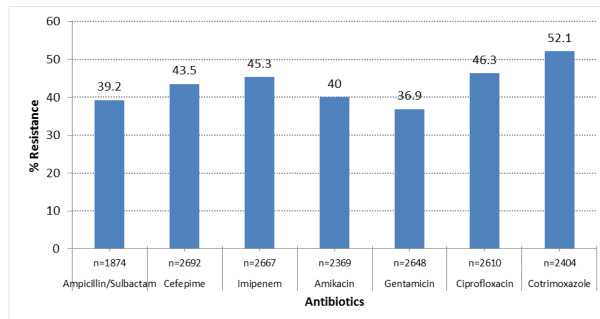



FIGURE 54. Yearly ampicillin-sulbactam, amikacin and gentamicin resistance rates of *A. baumannii*, ARSP, 2005-2014

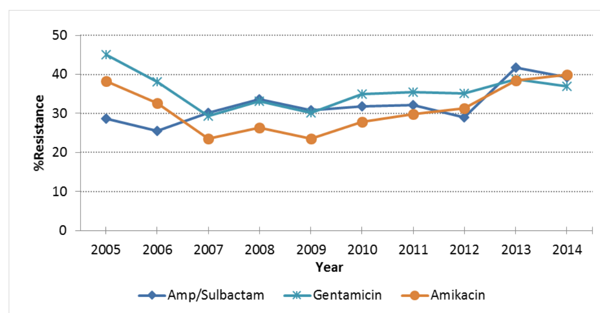
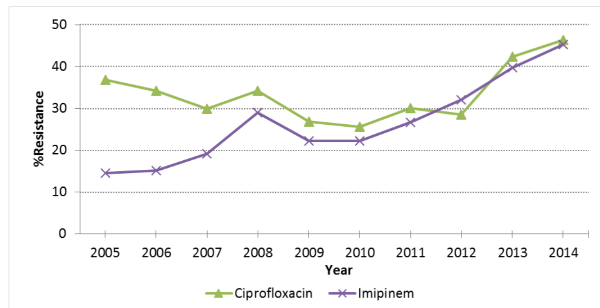



FIGURE 55. Yearly ciprofloxacin & imipenem resistance rates of *A. baumannii*, ARSP, 2005-2014




Multidrug-resistant pathogens are increasingly recognized globally. Terminologies are as summarized in TABLE 12 [8]. A. baumannii MDR and XDR rates are seen in TABLE 10.

TABLE 10. *A. baumannii* MDR and possible XDR rates, ARSP, 2014

| *Acinetobacter baumannii* | No. of isolates | % MDR | % possible -XDR |
|---|---|---|---|
| All isolates | 2927 | 61% | 46% |
| Blood culture isolates | 388 | 49% | 29% |

# CONCLUSIONS, RECOMMENDATIONS AND FUTURE DIRECTONS

Antimicrobial resistance has been increasing for most of the bacterial pathogens considered of public health importance included in this surveillance.

## Recommendations based on the reported the 2014 data:

- Infections secondary to *Streptococcus pneumoniae* can still be covered with penicillin or one of the anti-pneumococcal macrolides, although there is a need to closely monitor the changing trends of resistance among pneumococci. Continued surveillance on local pneumococcal serotypes distribution will allow for better evaluation of intervention and control efforts of this vaccine-preventable pathogen.
- Due to high resistance rate of *Haemophilus influenzae* to ampicillin, recommended empiric treatment for suspected *H. influenzae* infections may consist of ß-lactam-ß-lactamase inhibitor combinations and extended spectrum oral cephalosporins.
- Empiric treatment for suspected uncomplicated typhoid fever could still consist of either chloramphenicol or co-trimoxazole or amoxicillin/ampicillin. There are increasing reports of nalidixic acid resistant and ciprofloxacin non-susceptibility of *S.* Typhi which may result to clinical treatment failures. Microbiological data is recommended to aid in pathogen directed therapy.
- Increasing rates of ciprofloxacin resistance should remind clinicians to use antibiotics judiciously in *Salmonella* gastroenteritis, as this is usually a self-limited disease.
- In view of the emerging resistance of *Shigella* to the quinolones and limited data available, more vigilant surveillance of the resistance pattern of this organism should be pursued by encouraging clinicians to send specimens for culture.
- Tetracycline, chloramphenicol and co-trimoxazole remain good treatment options for cholera cases.
- Limited data is available on *Neisseria gonorrhoeae* in recent years, although based on the 2011-2014 reported isolates, ceftriaxone remains as empiric antibiotic of choice for gonococcal infections. More vigilant surveillance of the resistance patterns of this organism should be pursued by encouraging clinicians to send specimens for culture.
- In view of the continued high rates of methicillin/oxacillin resistance among staphylococci, there may be an indication to shift empiric treatment of suspected staphylococcal infections from oxacillin to alternative agents such as co-trimoxazole, doxycycline, clindamycin, linezolid or vancomycin.
- Increasing resistance among the bacterial organisms *Pseudomonas aeruginosa* and *Acinetobacter baumannii* continues to be a concern as both organisms carry intrinsic resistance to a number of antimicrobial classes and acquisition of additional resistance severely limits the available treatment options. Prudent antimicrobial use, monitoring of resistance patterns and antimicrobial use along with improved standards of infection control are essential in addressing this clinical and public health concern.
- Hospitals should base their treatment recommendations for the *Enterobacteriaceae* on their institution's prevailing resistance patterns as these have been found to be variable from hospital to hospital. High percentage of possible ESBL-producing isolates complicate treatment of serious infections caused by these organisms and may lead to increased use of carbapenems that may favor the fur-

ther spread of the carbapenemase-producing *Enterobacteriaceae*. Prudent use of antimicrobials and comprehensive infection control measures serve as cornerstones of interventions aimed at preventing selection and transmission of resistant bacteria.

## Future Direction

- Continued efforts to improve quality of data by sentinel site and reference laboratory capacity building thru training, efforts to improve facilities, equipment and services.
- Revive and expand the *Gonorrhoeae* surveillance network.
- Expand regional representation in the surveillance by inclusion of sentinel sites in regions IV-B and CARAGA.
- Network with Epidemiology Bureau to improve clinical correlation with resistance data.
- Harmonize antibiotic use data and antimicrobial resistance surveillance data on animal specimens with ARSP data by collaborating with the Department of Agriculture and the National Center on Pharmaceutical Access and Management to enhance the relevance and significance of the surveillance information generated and present a more cohesive picture of the local state of AMR.
- Integrate a community-based antimicrobial resistance surveillance to the program.
- Enhance reference laboratory capacity by enhancing technical staff expertise and skills in molecular diagnostics.
- Improve data management, security and sharing by personnel capacity building of the reference laboratory data management unit and equipment upgrade.
- Incorporate the technology of geographic information system and mapping in the surveillance.
- Develop a protocol for notification of reportable drug-resistant pathogens
- Apply for ISO 15189 accreditation for the reference laboratory.
- Generate more relevant collaborative and investigator initiated researches.

# REFERENCES

[1] World Health Organization, "World Health Organization Media Center Antimicrobial Resistance," 22 April 2015. [Online]. Available: http://www.who.int/mediacentre/factsheets/fs194/en/.

[2] World Health Organization, "Antimicrobial Resistance Global Report on Surveillance," World Health Organization, Geneva, 2014.

[3] World Health Organization and Center for Disease Control National Center for Infectious Diseases, Manual for the Laboratory Identification and Antimicrobial Susceptibility Testing of Bacterial Pathogens of Public Healh Importance in the Developing World, Geneva: World Health Organization, 2003.

[4] Clinical Laboratory Standards Institute, Performance Standards for Antimicrobial Susceptibility Testing; 23rd Information Supplement CLSI Document M100-S24, Pennsylvania: CLSI, 2014.

[5] Clinical Laboratory Standards Institute, Methods for Antimicrobial Dilution and Disk Diffusion Testing of Infrequentyl Isolated or Fasatidious Bacteria; Approved Guideline-Second Edition, M45A2, Pennsylvania: CLSI, 2010.

[6] World Health Organization, "World Health Organization Drug Resistance WHONET Software," 2015. [Online]. Available: http://www.who.int/drugresistance/whonetsoftware/en/. [Accessed 22 April 2015].

[7] M. R. D. M. a. M. J. B. M. John E. Bennett, in *Mandell, Douglas and Bennett's Principles and Practice of Infectious Diseases, 8th edition*, Philadelphia, Churchill Livingstone Elsevier, 2015.

[8] S. A. C. R. e. Magiorakos AP, "Multidrug-resistant, extensively drug-resistant and pandrug-resistnat bacteria: an international expert proposal for interim standrd definitions for acquired resistance," *Clin Microbiol Infect,* vol. 18, pp. 268-281, 2012.

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| Bicol Regional Training and Teaching Hospital | Rizal St. Legaspi City Albay | 052-483-1089 loc. 2648<br>Fax: 052-483-0016 |
| Cagayan Valley Medical Center | Carig, Tuguegarao City | 078-304-0033 loc. 160<br>Fax: 078-304-3789/ 846-7269 |
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| Dr. Rafael S. Tumbokon Memorial Hospital | Kalibo, Aklan | 036-268-7062/036-268-6299<br>Fax: 036-268-4917 |
| Eastern Visayas Regional Medical Center | Tacloban City, Leyte | 053-321-3136<br>Fax: 053-321-8724 |
| Far Eastern University Hospital | Regalado Ave., West Fairview | 02-427-0213 loc. 1129<br>Fax: 427-5755/ 983-5817 |
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| Mariano Marcos Memorial Hospital and Medical Center | San Julian, Batac Ilocos Norte 2906 | 077-792-3144<br>Fax: 077-792-3133/077-617-1517 |
| National Kidney and Transplant Institute | East Avenue, Quezon City 1100 | 02-981-0400 loc. 1048<br>Fax: 926 - 8921 |
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| Pangasinan Provincial Hospital | San Carlos, City Pangasinan | Fax: 075-532-2603 |
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| Southern Philippines Medical Center (formerly Davao Medical Center) | J.P.Laurel Avenue, Davao City<br>Davao del Sur 8000 | 082-227-2731<br>Fax: 082-221-7029 |
| University of Sto. Tomas Hospital | España St., Manila 1008 | 02-731-3001 loc. 2426<br>Fax: 02-731-1985 |
| Vicente Sotto Memorial Medical Center | B. Rodriguez St., Cebu City | 032-253-9891-99 loc. 123<br>Fax: 032-254-0057 |
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