

Section 5

Antimicrobial Resistance Surveillance

Background

Antibiotics are one of the most impressive medical achievements of the twentieth century. However, the continuing emergence and spread of antimicrobial resistance jeopardizes the utility of antibiotics and threatens health globally. Resistant pathogens are often associated with prolonged hospital stays, increased intensity and duration of treatment, and increased mortality.

As of January 2014, the Florida Department of Health (DOH) conducts surveillance for antibiotic susceptibility for three bacteria:

- Health care providers and laboratories must report antibiotic susceptibility testing results for isolates of *Streptococcus pneumoniae* from normally sterile sites, such as blood or cerebrospinal fluid.
- Health care providers and laboratories must report antibiotic susceptibility testing results for isolates of *Staphylococcus aureus* that are not susceptible to vancomycin.
- Laboratories participating in electronic laboratory reporting (ELR) must report antibiotic susceptibility testing results for all *S. aureus* isolates from normally sterile sites.
- Samples for all suspected or confirmed tuberculosis cases are forwarded to the DOH Bureau of Public Health Laboratories for *Mycobacterium tuberculosis* testing; any sample positive for *M. tuberculosis* undergoes a rapid test for isoniazid and rifampin resistance.

Note that Florida previously participated in the Gonococcal Isolate Surveillance Project (GISP), but participation was discontinued in 2014 and those data are no longer included in this report.

In June 2014, DOH expanded surveillance for antibiotic susceptibility for laboratories participating in ELR. These laboratories must report susceptibility testing results for isolates from normally sterile sites for *Acinetobacter baumannii*, *Citrobacter* species, *Enterococcus* species, *Enterobacter* species, *Escherichia coli*, *Klebsiella* species, *Pseudomonas aeruginosa*, and *Serratia* species. Data for these bacteria are not presented because limited data were received during the first reporting year.

A cumulative or community antibiogram can provide useful operational information for the selection of an empiric therapy for a presumptive diagnosis, help track antibiotic resistance patterns of clinically important microorganisms, and detect trends toward antimicrobial resistance.

Streptococcus pneumoniae

Streptococcus pneumoniae causes many clinical syndromes, depending on the site of infection (e.g., otitis media, pneumonia, bacteremia, meningitis, sinusitis, peritonitis, and arthritis). Invasive disease, for reporting purposes, includes cultures obtained from a normally sterile site, such as blood or cerebrospinal fluid.

A total of 792 *S. pneumoniae* invasive disease cases were reported to DOH in 2014 by health care providers and laboratories. Of those reported cases, 391 (49%) were classified as drug-resistant cases because they had an isolate that was resistant to at least one antibiotic. Tables 1-4 and Figure 1 include data on the percent of cases with isolates that were susceptible to selected antibiotics by 2014 Clinical and Laboratory Standards Institute (CLSI) groups A-C, age group, and geography. CLSI Group A includes antibiotics that are considered appropriate for inclusion in a routine, primary testing panel, as well as for routing reporting of results for the specific organism groups. Group B includes antibiotics that may warrant primary testing but facilities can decide whether to report results based on specific conditions. Group C includes antibiotics considered to be alternative or supplemental. Susceptibility to Group A antibiotics is lower than susceptibility to Group B antibiotics, but susceptibility to both groups has risen slightly since 2010.

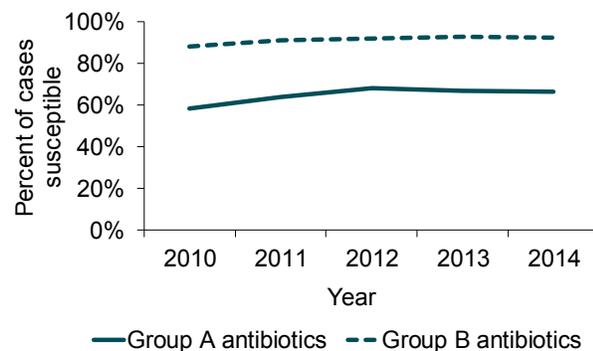
Please note that due to inconsistencies in laboratory reporting formats, meningitis and non-meningitis breakpoints for penicillin and ceftriaxone results cannot be separated. When both a susceptible and resistant result were reported for one of these antibiotics on the same laboratory result, the resistant result was used for analysis.

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Key points for *S. pneumoniae* data:

- Susceptibility by CLSI groups (Table 1, Figures 1 and 2):
 - Group A (appropriate for primary testing and routine reporting): the percent of cases with isolates susceptible to Group A antibiotics increased from 59% in 2010 to 67% in 2014.
 - Group B (may warrant primary testing, but reported selectively): the percent of cases with isolates susceptible to Group B antibiotics increased from 88% in 2010 to 93% in 2014.
 - Group C (alternative antibiotics): 63 to 100% of cases had isolates that were susceptible.
 - Note that susceptibility results for Group B and C antibiotics may underestimate the actual susceptibility rates in the community if only those isolates resistant to Group A antimicrobials are tested against Group B or C antibiotics.
 - From 2010 to 2014, susceptibility increased for all antibiotics except meropenem (no change), ofloxacin (decreased from 100% to 99%), and tetracycline (decreased from 97% to 95%).
- Most *S. pneumoniae* invasive disease cases are identified in adults ≥25 years old, so susceptibility data in children is sparse. Susceptibility to individual antibiotics doesn't vary substantially between adults 25-64 years old and adults ≥65 years old (Table 2).
- *S. pneumoniae* invasive disease cases are most common in central and southeastern Florida. Susceptibility varies by antibiotic between regions with little pattern (Table 3).

Figure 1. Percent of Reported *S. pneumoniae* Invasive Disease Cases With Isolates Susceptible to Clinical and Laboratory Standards Institute (CLSI) Antibiotic Groups A and B¹, Florida, 2010-2014



Note that this figure includes data from cases that were reported to DOH by health care providers and laboratories as part of mandatory case-based disease reporting.

¹ Group A includes antibiotics that CLSI considers appropriate for primary testing and routine reporting and group B includes antibiotics that may warrant primary testing but should be reported selectively.

Table 1. Percent of Reported *S. pneumoniae* Invasive Disease Cases With Isolates Susceptible to Selected Antibiotics by Clinical and Laboratory Standards Institute (CLSI) Antibiotic Groups A and B¹, Florida, 2010-2014

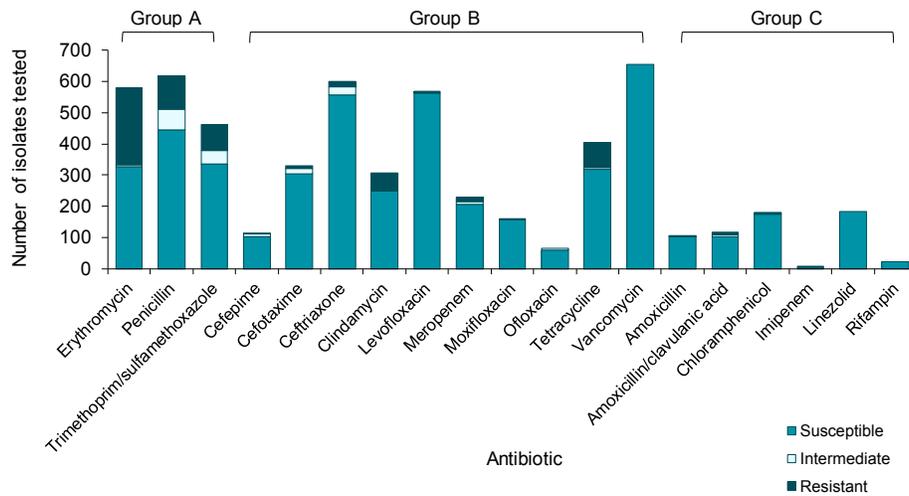
CLSI group ¹	Antibiotic name	5-year trend	Percent of cases with susceptible isolates by year				
			2010 (1,509 cases)	2011 (1,324 cases)	2012 (988 cases)	2013 (1,089 cases)	2014 (792 cases)
Group A	Erythromycin		54%	57%	61%	58%	56%
	Penicillin		60%	69%	72%	72%	72%
	Trimethoprim/sulfamethoxazole		62%	67%	72%	70%	73%
Group B	Cefepime		90%	94%	89%	96%	91%
	Cefotaxime		84%	86%	88%	92%	93%
	Ceftriaxone		89%	91%	91%	93%	93%
	Clindamycin		89%	91%	91%	93%	93%
	Levofloxacin		78%	80%	83%	82%	81%
	Meropenem		100%	99%	99%	99%	99%
	Moxifloxacin		77%	82%	85%	87%	90%
	Ofloxacin		100%	100%	100%	99%	99%
	Tetracycline		97%	97%	95%	96%	94%
	Vancomycin		73%	77%	79%	81%	78%

Note that this table includes data from cases that were reported to DOH by health care providers and laboratories as part of mandatory case-based disease reporting.

¹ Group A includes antibiotics that CLSI considers appropriate for primary testing and routine reporting and group B includes antibiotics that may warrant primary testing but should be reported selectively.

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Figure 2. Antibiotic Susceptibility Patterns for Reported *S. pneumoniae* Invasive Disease Cases by Clinical and Laboratory Standards Institute (CLSI) Antibiotic Groups¹, Florida, 2014



Note that this table includes data from cases that were reported to DOH by health care providers and laboratories as part of mandatory case-based disease reporting.

- Group A includes antibiotics that CLSI considers appropriate for primary testing and routine reporting, Group B includes antibiotics that may warrant primary testing but should be reported selectively, and Group C includes antibiotics considered to be alternative or supplemental.

Table 2. Percent of Reported *S. pneumoniae* Invasive Disease Cases With Isolates Susceptible to Selected Antibiotics by Clinical and Laboratory Standards Institute (CLSI) Antibiotic Groups¹ and Age Group, Florida, 2014

CLSI group ¹	Antibiotic name	Percent of cases with susceptible isolates by age group (in years)					
		<1 (20 cases)	1-4 (69 cases)	5-14 (37 cases)	15-24 (19 cases)	25-64 (358 cases)	65+ (289 cases)
Group A	Erythromycin	--	49%	--	--	59%	55%
	Penicillin	--	64%	--	--	74%	72%
	Trimethoprim/sulfamethoxazole	--	49%	--	--	73%	79%
Group B	Cefepime	--	--	--	--	94%	94%
	Cefotaxime	--	92%	--	--	95%	91%
	Ceftriaxone	--	97%	--	--	92%	94%
	Clindamycin	--	87%	--	--	78%	82%
	Levofloxacin	--	100%	--	--	99%	99%
	Meropenem	--	--	--	--	93%	88%
	Moxifloxacin	--	--	--	--	99%	100%
	Ofloxacin	--	--	--	--	--	--
	Tetracycline	--	78%	--	--	79%	77%
	Vancomycin	--	100%	--	--	100%	100%

Note that this table includes data from cases that were reported to DOH by health care providers and laboratories as part of mandatory case-based disease reporting.

- Group A includes antibiotics that CLSI considers appropriate for primary testing and routine reporting and Group B includes antibiotics that may warrant primary testing but should be reported selectively.
- Percent susceptible was suppressed if <30 isolates were tested for susceptibility to a particular drug.

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Table 3. Percent of Reported *S. pneumoniae* Invasive Disease Cases With Isolates Susceptible to Selected Antibiotics by Clinical and Laboratory Standards Institute (CLSI) Antibiotic Groups¹ and Region, Florida, 2014

CLSI group ¹	Antibiotic name	Percent of cases with susceptible isolates by region						
		Northwest (75 cases)	North Central (20 cases)	Northeast (94 cases)	West Central (183 cases)	East Central (161 cases)	Southwest (71 cases)	Southeast (188 cases)
Group A	Erythromycin	62%	--	68%	57%	56%	--	50%
	Penicillin	80%	--	76%	65%	73%	85%	68%
	Trimethoprim/sulfamethoxazole	78%	--	75%	74%	72%	--	69%
Group B	Cefepime	98%	--	--	--	--	--	--
	Cefotaxime	93%	--	92%	96%	96%	--	85%
	Ceftriaxone	96%	--	94%	90%	95%	96%	91%
	Clindamycin	96%	--	94%	90%	95%	96%	91%
	Levofloxacin	89%	--	86%	79%	83%	--	76%
	Meropenem	100%	--	100%	99%	98%	100%	99%
	Moxifloxacin	93%	--	87%	--	90%	--	--
	Ofloxacin	--	--	--	98%	100%	--	--
	Tetracycline	--	--	--	--	96%	--	--
	Vancomycin	86%	--	86%	75%	84%	--	69%

Note that this table includes data from cases that were reported to DOH by health care providers and laboratories as part of mandatory case-based disease reporting.

1 Group A includes antibiotics that CLSI considers appropriate for primary testing and routine reporting and group B includes antibiotics that may warrant primary testing but should be reported selectively.

-- Percent susceptible was suppressed if <30 isolates were tested for susceptibility to a particular drug.

Map of regions:



Staphylococcus aureus

Staphylococcus aureus bacteria are commonly found on the skin of healthy people, but have the potential to cause serious disease. The Centers for Disease Control and Prevention estimate that one in three healthy people are persistent carriers of *S. aureus*, usually in the nose and on the skin, and over 60% of the population may be intermittent carriers. Methicillin-resistant *S. aureus* (MRSA) is a strain of *S. aureus* that is resistant to all β -lactam antibiotics (including penicillins, cephalosporins, cephamycins, and monobactams) and may also be resistant to other antibiotics. Resistance testing for oxacillin is used to detect methicillin resistance.

Health care providers and laboratories are required to report all infections due to *S. aureus* that are not susceptible to vancomycin; however, DOH does not require health care providers to report individual MRSA infections. In 2008, antibiotic susceptibility testing results for all *S. aureus* isolates became reportable for laboratories participating in electronic laboratory reporting. This electronic laboratory data stream is still being improved and as of the time of this report, not enough data have been successfully submitted for meaningful analysis. In the interim, DOH partnered with one of the largest commercial laboratories in the state and has been receiving antibiotic susceptibility testing results for all *S. aureus* isolates tested there since 2004, which is the source of the data included in this report. Note that only the first isolate per person per 365 days was included in the analysis, per CLSI guidelines. Data collected from this one laboratory may or may not be representative of statewide trends.

Key points for *S. aureus* data:

- Overall resistance patterns (Table 4, Figure 3):
 - Penicillin is not recommended for treating *S. aureus* due to known resistance (excluded here).
 - Susceptibility to β -lactam antibiotics has increased over the past five years, but is still low (51-54%)
 - Empiric treatment of skin and soft tissue infections with β -lactam antibiotics is not recommended.
 - Susceptibility remained high for gentamycin, trimethoprim/sulfamethoxazole, linezolid, vancomycin, and tetracycline.

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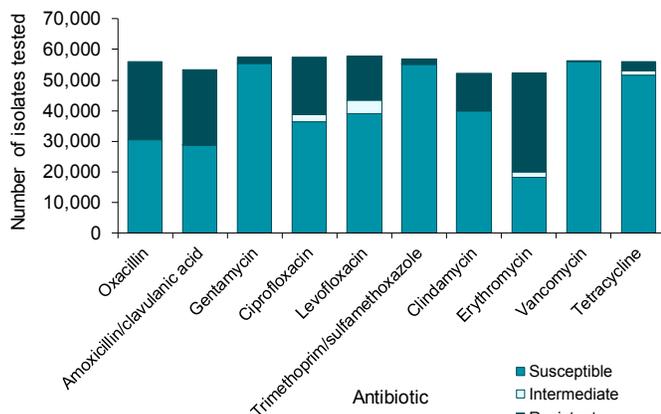
- Susceptibility to most antibiotics varied slightly by age group. Isolates from people aged 65 years and older have slightly reduced susceptibility to gentamicin, ciprofloxacin, levofloxacin, trimethoprim/sulfamethoxazole, and clindamycin (Table 5).
- North Florida had a higher proportion of MRSA isolates while central and south Florida had a lower proportion. This trend has been consistently observed since surveillance started in 2006 (Map 1, Table 6).

Table 4. Number Tested and Percent of *S. aureus* Isolates Susceptible to Selected Antibiotics, Commercial Outpatient Laboratory, Florida, 2010-2014

Antibiotic class	Antibiotic name	5-year trend	2010		2011		2012		2013		2014	
			Number tested	Percent susceptible								
β-Lactams	Oxacillin		56,544	49%	54,817	51%	52,949	52%	51,579	53%	55,990	54%
	Amoxicillin/clavulanic acid		58,079	49%	54,998	51%	51,665	51%	50,178	53%	53,455	54%
	Cefazolin		42,792	47%	39,156	49%	37,199	51%	16,740	52%	717	51%
Non-β-Lactams	Gentamicin		60,654	97%	59,084	97%	57,298	97%	56,032	97%	57,629	96%
	Ciprofloxacin		33,639	67%	44,629	68%	51,182	66%	55,714	66%	57,633	63%
	Levofloxacin		57,634	72%	56,949	72%	54,356	71%	56,151	70%	57,690	68%
	Trimethoprim/sulfamethoxazole		59,311	98%	57,573	98%	55,770	98%	54,468	97%	56,951	97%
	Clindamycin		53,166	80%	51,634	79%	49,440	78%	47,831	78%	52,191	76%
	Erythromycin		35,180	32%	51,639	34%	49,446	34%	47,843	35%	52,192	35%
	Linezolid		52,282	100%	34,210	100%	8,279	100%	189	100%	262	100%
	Vancomycin		56,652	100%	54,876	100%	52,996	100%	51,686	100%	56,097	100%
	Tetracycline		56,461	93%	54,872	93%	53,008	93%	51,678	93%	56,103	92%

Note that this table includes data from a single commercial outpatient laboratory that receives isolates from health care providers across the state.

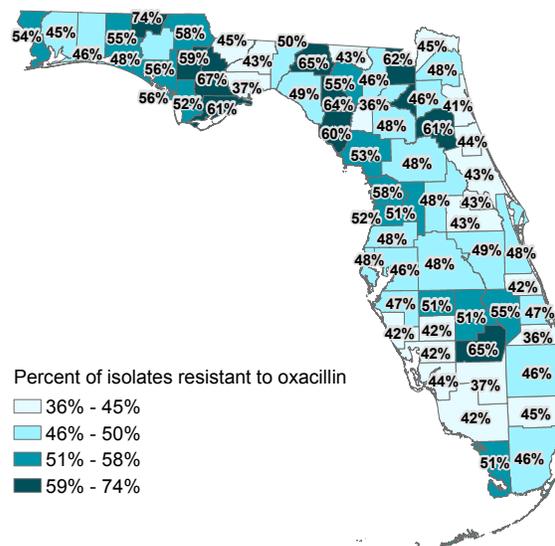
Figure 3. Antibiotic Susceptibility Patterns of *S. aureus* Isolates for Selected Antibiotics, Commercial Outpatient Laboratory, Florida, 2014



Note that this table includes data from a single commercial outpatient laboratory that receives isolates from health care providers across the state.

Cefazolin and linezolid are excluded from this figure due to the small number of isolates tested.

Map 1. Percent of *S. aureus* Isolates That Were Resistant to Oxacillin (MRSA) by County of Residence, Commercial Outpatient Laboratory, Florida, 2014



Note that this table includes data from a single commercial outpatient laboratory that receives isolates from health care providers across the state. Some counties had <30 isolates tested, so the proportion that were resistant to oxacillin is unreliable and should be interpreted with caution: Jefferson (12 isolates tested), Liberty (15 isolates tested), Madison (20 isolates tested), Hamilton (23 isolates tested), Washington (25 isolates tested), and Holmes (27 isolates tested).

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Table 5. Percent of *S. aureus* Isolates Susceptible to Selected Antibiotics by Age Group, Commercial Outpatient Laboratory, Florida, 2014

Antibiotic class	Antibiotic name	Age trend	Percent of isolates susceptible by age group (in years)					
			<1 (1,092 isolates)	1-4 (3,856 isolates)	5-14 (6,332 isolates)	15-24 (5,954 isolates)	25-64 (24,684 isolates)	65+ (15,813 isolates)
β-Lactams	Oxacillin		56%	44%	61%	59%	55%	52%
	Amoxicillin/clavulanic acid		56%	43%	60%	58%	54%	53%
	Cefazolin		—	53%	30%	65%	54%	49%
Non-β-Lactams	Gentamicin		99%	98%	98%	98%	97%	94%
	Ciprofloxacin		72%	64%	74%	73%	64%	53%
	Levofloxacin		77%	69%	78%	78%	69%	57%
	Trimethoprim/sulfamethoxazole		99%	99%	99%	99%	98%	94%
	Clindamycin		80%	84%	76%	78%	79%	69%
	Erythromycin		34%	27%	35%	37%	36%	34%
	Linezolid		—	—	—	—	100%	100%
	Vancomycin		100%	100%	100%	100%	100%	100%
	Tetracycline		94%	94%	92%	92%	92%	91%

Note that this table includes data from a single commercial outpatient laboratory that receives isolates from health care providers across the state.

— Percent susceptible was suppressed if <30 isolates were tested for susceptibility to a particular drug.

Table 6. Percent of *S. aureus* Isolates Susceptible to Selected Antibiotics by Region, Commercial Outpatient Laboratory, Florida, 2014

Antibiotic class	Antibiotic name	Percent of isolates susceptible by region						
		Northwest (1,302 isolates)	North Central (1,063 isolates)	Northeast (5,993 isolates)	West Central (8,784 isolates)	East Central (7,817 isolates)	Southwest (5,700 isolates)	Southeast (12,844 isolates)
β-Lactams	Oxacillin	49%	52%	52%	52%	56%	56%	54%
	Amoxicillin/clavulanic acid	48%	51%	52%	52%	55%	55%	54%
	Cefazolin	—	—	47%	52%	59%	44%	53%
Non-β-Lactams	Gentamicin	99%	99%	98%	97%	98%	98%	92%
	Ciprofloxacin	59%	66%	65%	62%	64%	63%	62%
	Levofloxacin	68%	72%	70%	67%	69%	67%	66%
	Trimethoprim/sulfamethoxazole	99%	99%	98%	95%	98%	96%	97%
	Clindamycin	81%	83%	78%	79%	77%	78%	72%
	Erythromycin	29%	34%	34%	35%	35%	37%	34%
	Linezolid	—	—	—	—	—	—	100%
	Vancomycin	100%	100%	100%	100%	100%	100%	100%
	Tetracycline	95%	94%	94%	93%	93%	93%	88%

Note that this table includes data from a single commercial outpatient laboratory that receives isolates from health care providers across the state.

— Percent susceptible was suppressed if <30 isolates were tested for susceptibility to a particular drug.

Map of regions:



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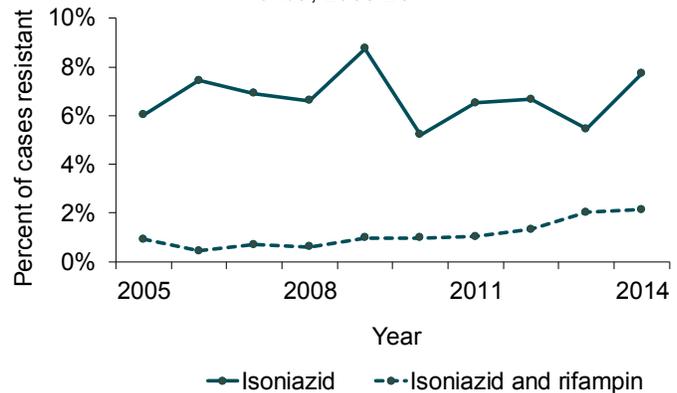
Mycobacterium tuberculosis

Mycobacterium tuberculosis bacteria cause tuberculosis (TB). The bacteria are spread through the air from one person to another and if not treated properly, infections can be fatal. *M. tuberculosis* usually attack the lungs, causing a severe cough and pain in the chest, but can attack any part of the body such as the kidney, spine, and brain. TB drug resistance is a major public health problem that threatens the progress made in TB care and control worldwide. Drug resistance arises due to improper use of antibiotics in chemotherapy of drug-susceptible TB patients. Multidrug-resistant TB is caused by *M. tuberculosis* that is resistant to at least isoniazid and rifampin, the two most potent TB drugs. In 2014, 466 TB cases were tested in Florida for resistance to isoniazid and rifampin.

Key points for *M. tuberculosis* (Figure 4):

- Resistance to isoniazid alone ranged from 5% to 9% over the past 10 years and was 8% (36 cases) in 2014.
- Multidrug-resistant TB remains uncommon but increased slightly in 2014, with 2.1% (10 cases) resistant to both isoniazid and rifampin.

Figure 4. Percent of Counted Tuberculosis Cases With Isolates Resistant to Isoniazid Alone and Isoniazid and Rifampin, Florida, 2005-2014



Note that this table includes data for all suspected or confirmed tuberculosis cases identified in Florida with specimens forwarded to the Bureau of Public Health Laboratories for additional testing.