Evaluation of Michigan's Surveillance System and Reporting for Susceptible and Drug Resistant Invasive *Streptococcus pneumoniae*

2005 through 2008

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Surveillance for Healthcare Associated and Resistant Pathogens (SHARP) Unit

Objectives

- Background to Healthcare Associated Infection (HAIs)/ Multiple Drug Resistant Organisms (MDROs)
  - Definitions, incidence, and severity
- Michigan's Response to HAIs and MDROs
  - Introduction to Surveillance of Healthcare Associated and Resistant Pathogens (SHARP) Unit and current activities
- Focus on particular MDRO in Michigan
  - *Streptococcus pneumoniae (S. pneumoniae)* surveillance evaluation and recommendations and improvements

Definitions

Healthcare-Associated Infections :

(HAIs) are infections that are acquired within a healthcare facility, and which were not present or incubating at the time of admission to the facility. Frequently acquired from invasive procedure or equipment.

Definitions

Multi-Drug Resistant Organisms :

(MDROs) are organisms (commonly bacteria) with decreased susceptibility to multiple classes of antimicrobial agents. MDROs are often associated with HAIs.

Healthcare-Associated Infections (HAIs)

Problem

- Bloodstream infections, urinary tract infections, pneumonia, surgical site infections

Annual Impact

- 1.7 million HAIs in hospitals — unknown burden in other healthcare settings
- 99,000 deaths and $28–33 billion in additional costs

Solution

- Implementing what we know for prevention can reduce HAI's by 70% or more

Klevens RM, Edwards J, Richards C, Horan T, Gaynes R, Pollock D, Cardo D. Estimating Health Care-Associated Infections and Deaths in U.S. Hospitals, 2002. *Public Health Reports* 2007; 122:160-166.

Harbarth S, Sax H, Gastmeier P. The preventable proportion of nosocomial infections: an overview of published reports. *J Hosp Infect* 2003;54:258-266

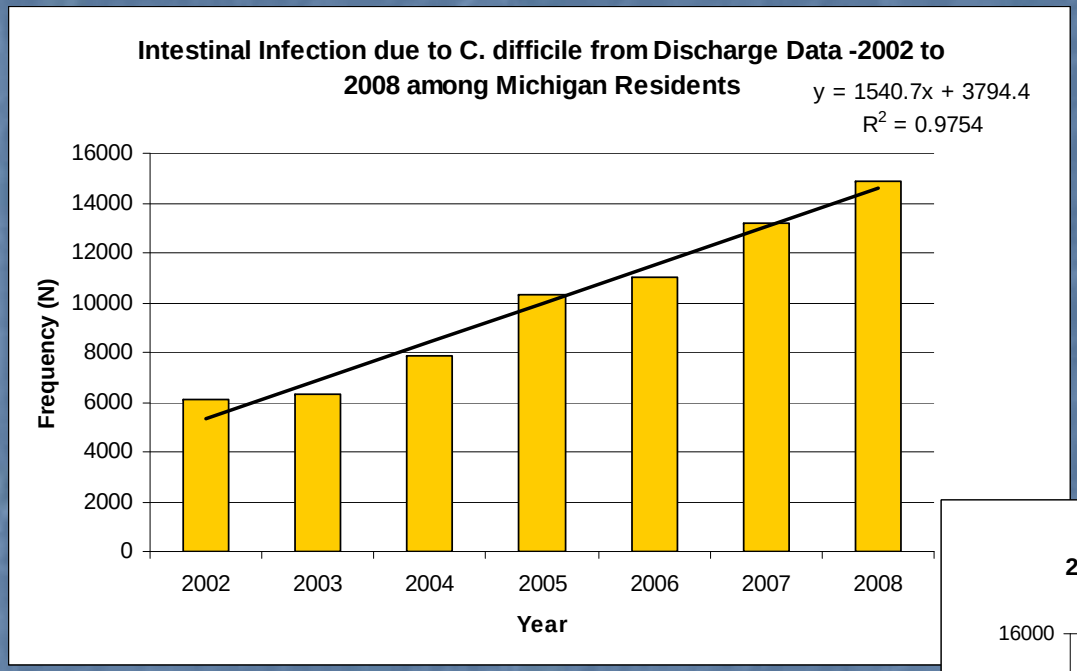
Why Concerned about MDROs?

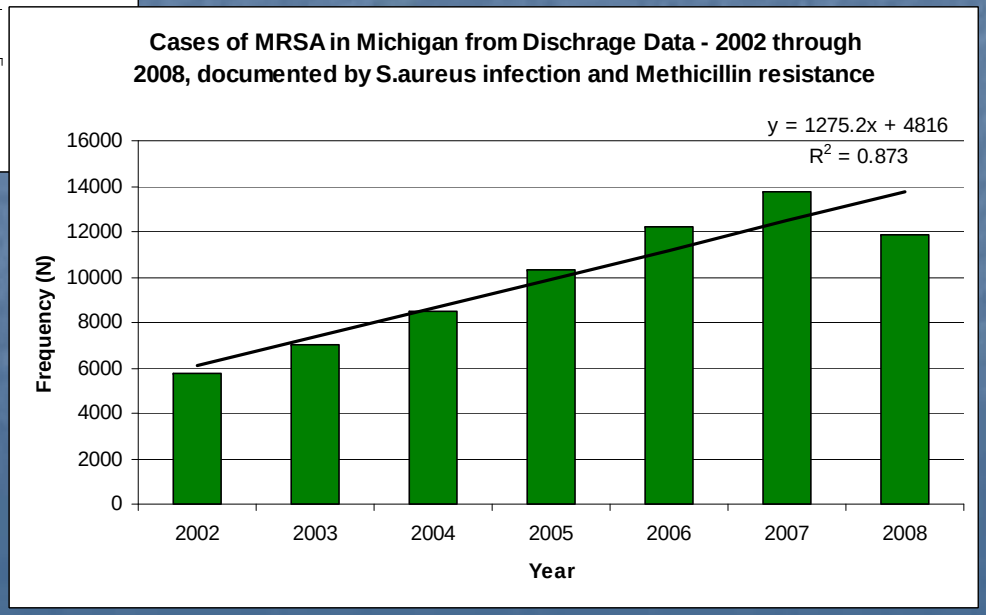
- Resistant to multiple antibiotics
- Difficult to treat
- Becoming increasingly common in community
- New emerging pathogen / resistance combinations

National Trends

- Increase in multidrug-resistant organisms
- Increasing attention to HAIs
  - March 2010 Consumer Reports article
- Push for mandatory and public reporting

Michigan Trends in MRSA and *C. difficile* Incidence





What is MDCH doing about HAI/ MDRO Organisms?

Established SHARP Unit

- Feb 2009: Created new unit
  - Surveillance of Healthcare-Associated and Resistant Pathogens (SHARP) Unit
- June 2009: Applied for funding under American Recovery and Reinvestment Act (ARRA)
  - Funded Sept 2009 to Dec 2011

Main Activities of SHARP

- ARRA grant focus on HAI prevention
  - Infrastructure
    - Advisory committee
    - State HAI plan
  - Surveillance
    - Recruiting hospitals to share their HAI and MDRO data
    - Using CDC's national reporting database for hospitals to share data related to MRSA and *C. difficile* infections
    - Monitoring drug resistances reported through MDSS
  - Prevention Initiative
    - Targeting HAI — CAUTI with Michigan Health and Hospital Association
    - Targeting MDRO — MRSA with Quality Improvement agency in Michigan

Current HAI/MDRO Surveillance

- Reporting Requirements for HAI:
  - Michigan: outbreaks only
  - At least 28 states mandatory reporting requirements
  - 21 states mandatory **public** posting of hospital data
- Michigan Reporting Requirements for MDROs:
  - Methicillin resistant *Staphylococcus aureus* (MRSA) outbreaks
  - Vancomycin-intermediate and -resistant *Staphylococcus aureus* (VISA/VRSA)
  - *Streptococcus pneumoniae*

Encourage Prevention of MDRO

- MRSA – hand hygiene, contact precautions
- VISA – appropriate antibiotic usage
- *S. pneumoniae* – appropriate antibiotic usage as well as vaccination
  - PCV7 for infants < 2 years, 4 series shot
  - PPV23 for those ≥ 2 years with high risk condition, and everyone ≥ 65
  - PCV13 for infants/ toddlers < 5 years, for children ≥ 5 years with underlying conditions

Surveillance Evaluation of *S. pneumoniae*

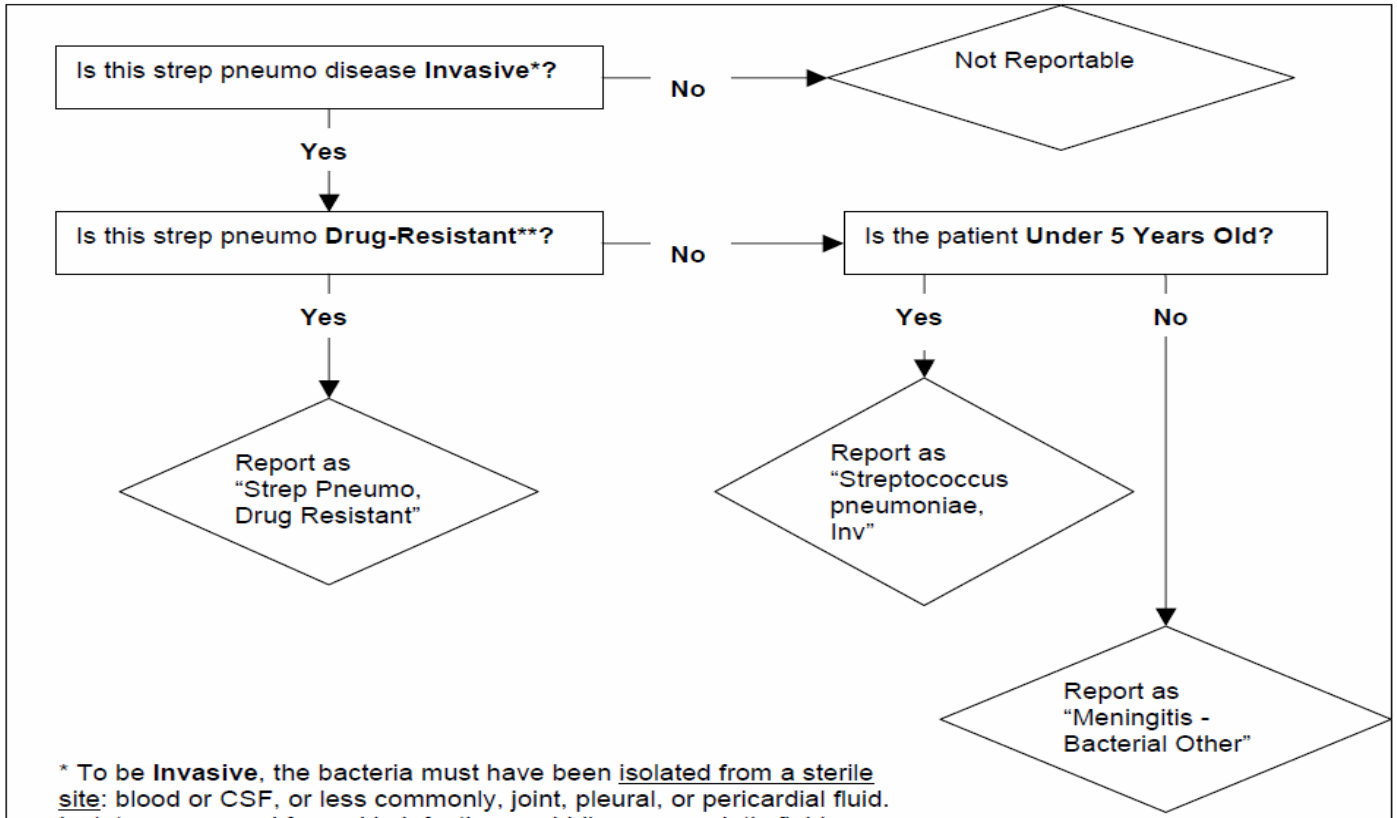
Background to *S. pneumoniae*

- Gram positive human pathogen
- Ecologic niche = nasal passages
  - 5-10% adults colonized
  - 20-40% children colonized
- Significant morbidity and mortality through pneumonia, meningitis, and other various infections
- Nationally notifiable disease

Types of *S. pneumoniae* Infections

- Lung – pneumonia, pleural effusion, emphyema
- Sinus – sinusitis
- Middle Ear – otitis media
- CNS – meningitis
- Joint – septic arthritis
- Peritoneum – spontaneous bacterial peritonitis
- Heart – purulent pericarditis, endocarditis
- Skin – cellulitis
- Eye – conjunctivitis

Michigan's Previous Reporting Diagram



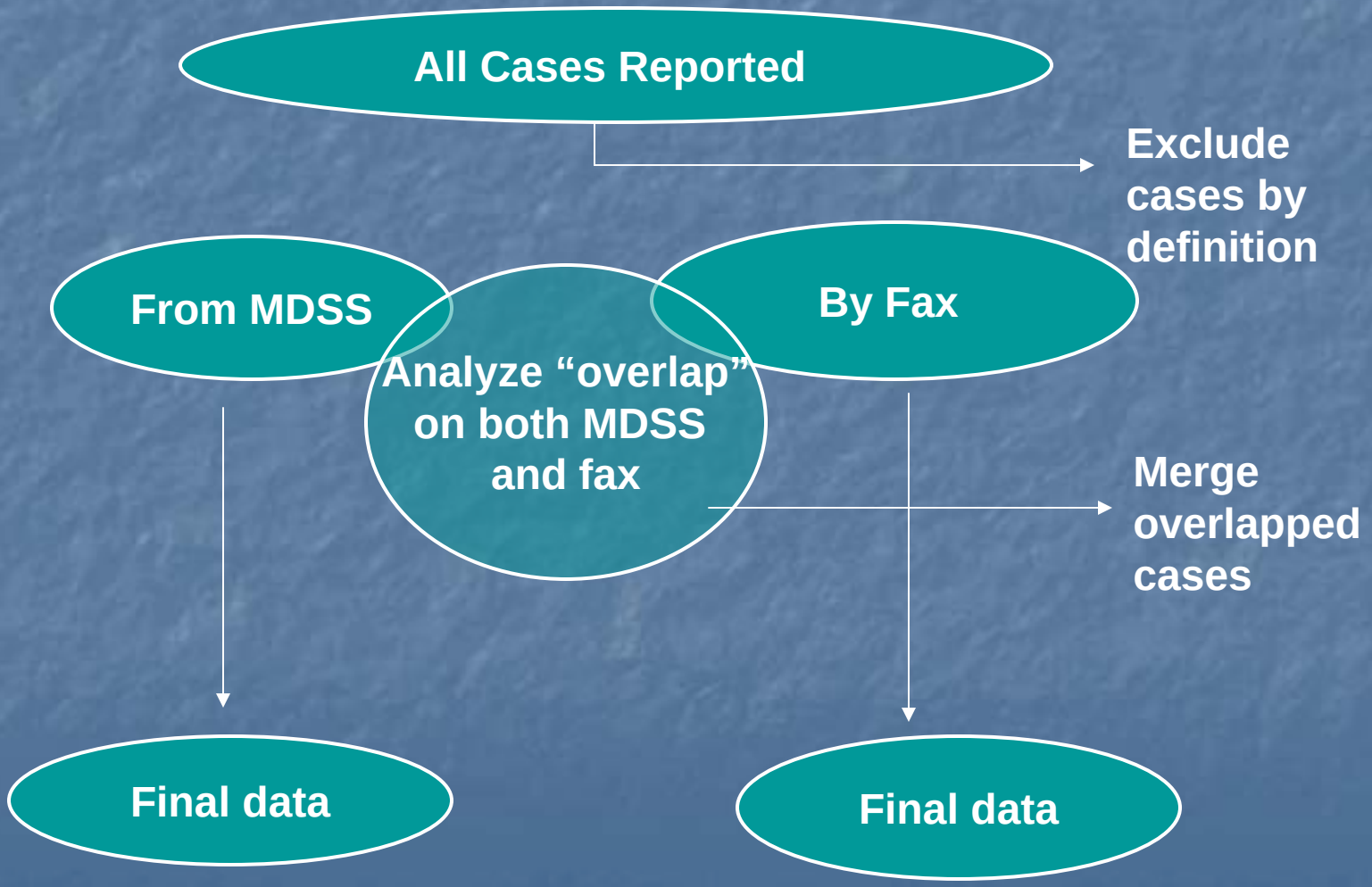
* To be **Invasive**, the bacteria must have been isolated from a sterile site: blood or CSF, or less commonly, joint, pleural, or pericardial fluid. Isolates recovered from skin infections, middle ear, amniotic fluid, placenta, sinus, wound, lung, gallbladder, appendix, cornea, cord blood or throat are not considered sterile sites. Isolates recovered from sputum are not considered invasive, because sputum is not a sterile sample.

** To be **Drug-Resistant**, the isolate must be intermediate or resistant to one or more antimicrobials. Please also complete the MDCH drug-resistant strep pneumo paper form and fax to 517-335-8263.

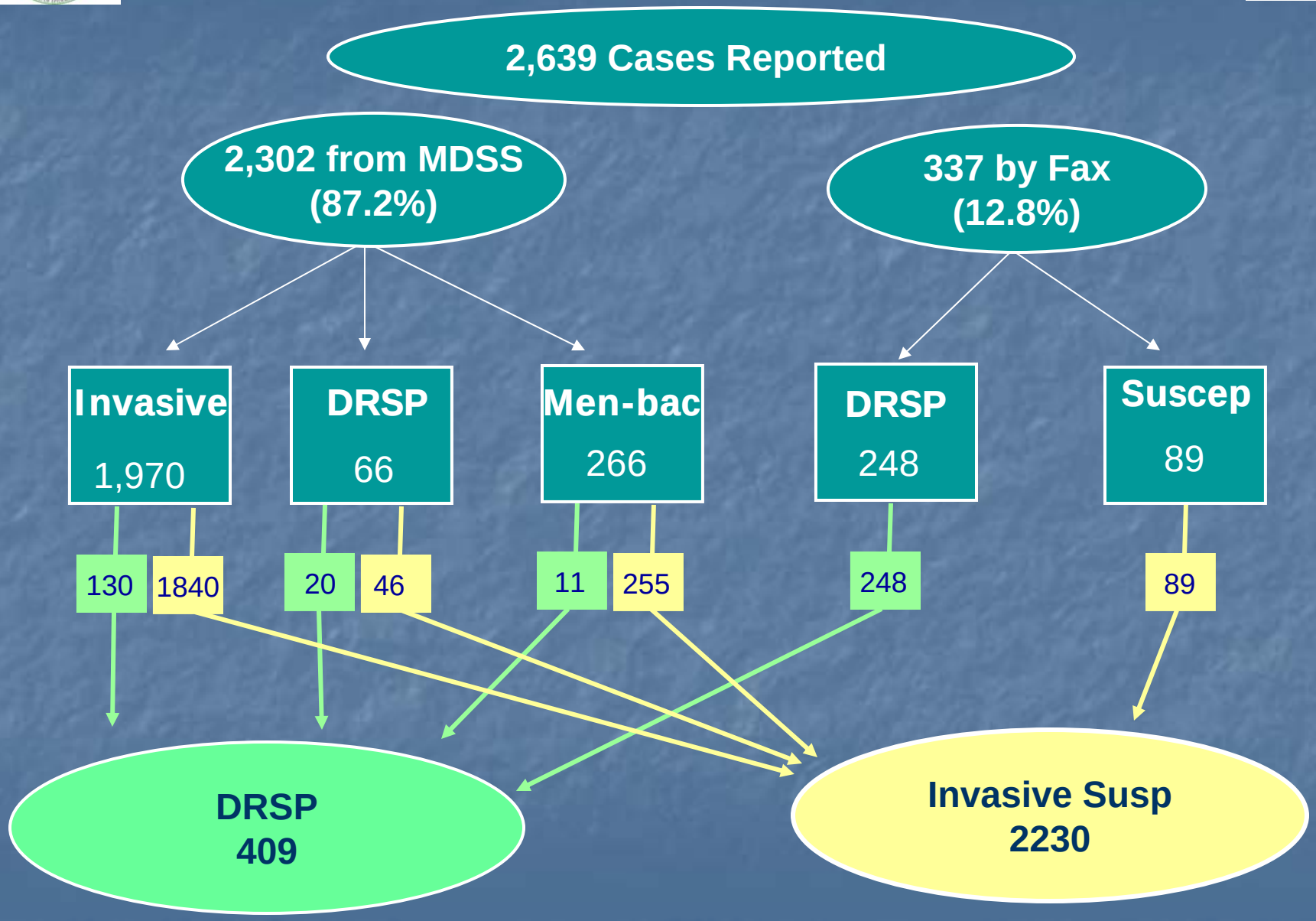
Surveillance System Analysis Methods

- The Michigan Disease Surveillance System (MDSS) - an electronic disease reporting system - captures *S. pneumoniae* cases using three different categories:
  - Invasive *Streptococcus pneumoniae*
  - Drug Resistant *Streptococcus pneumoniae* (DRSP)
  - Meningitis- bacterial other
- Additional information, including drug-susceptibility profiles, are faxed separately to the Michigan Department of Community Health
- Searches for all *S. pneumoniae* cases reported during 1/1/2005 to 12/31/2008 were exported and analyzed for incidence, drug resistance trends, and underlying conditions

Method: Overview of Data Analysis



Results 2005-2008

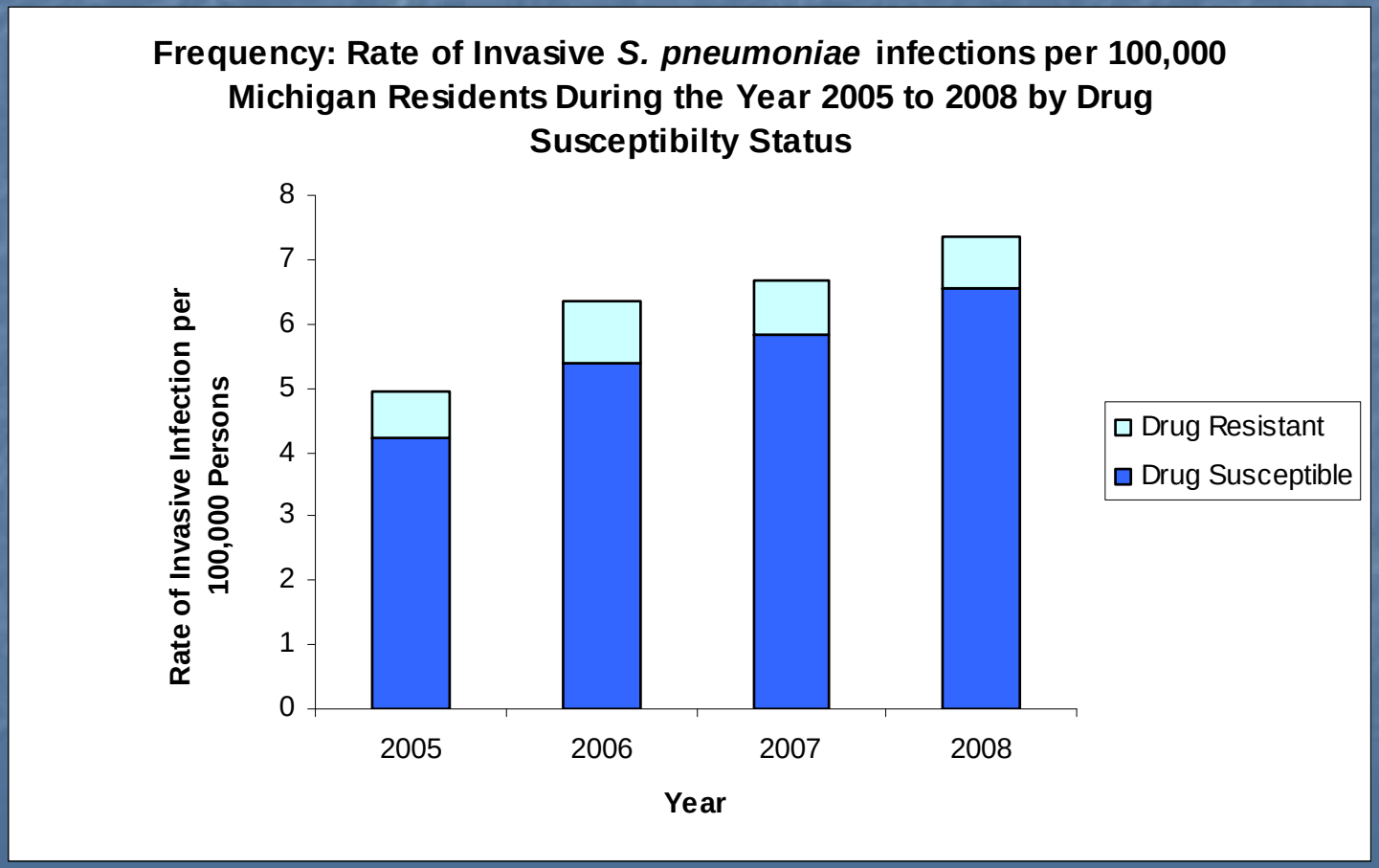


Overlap Results

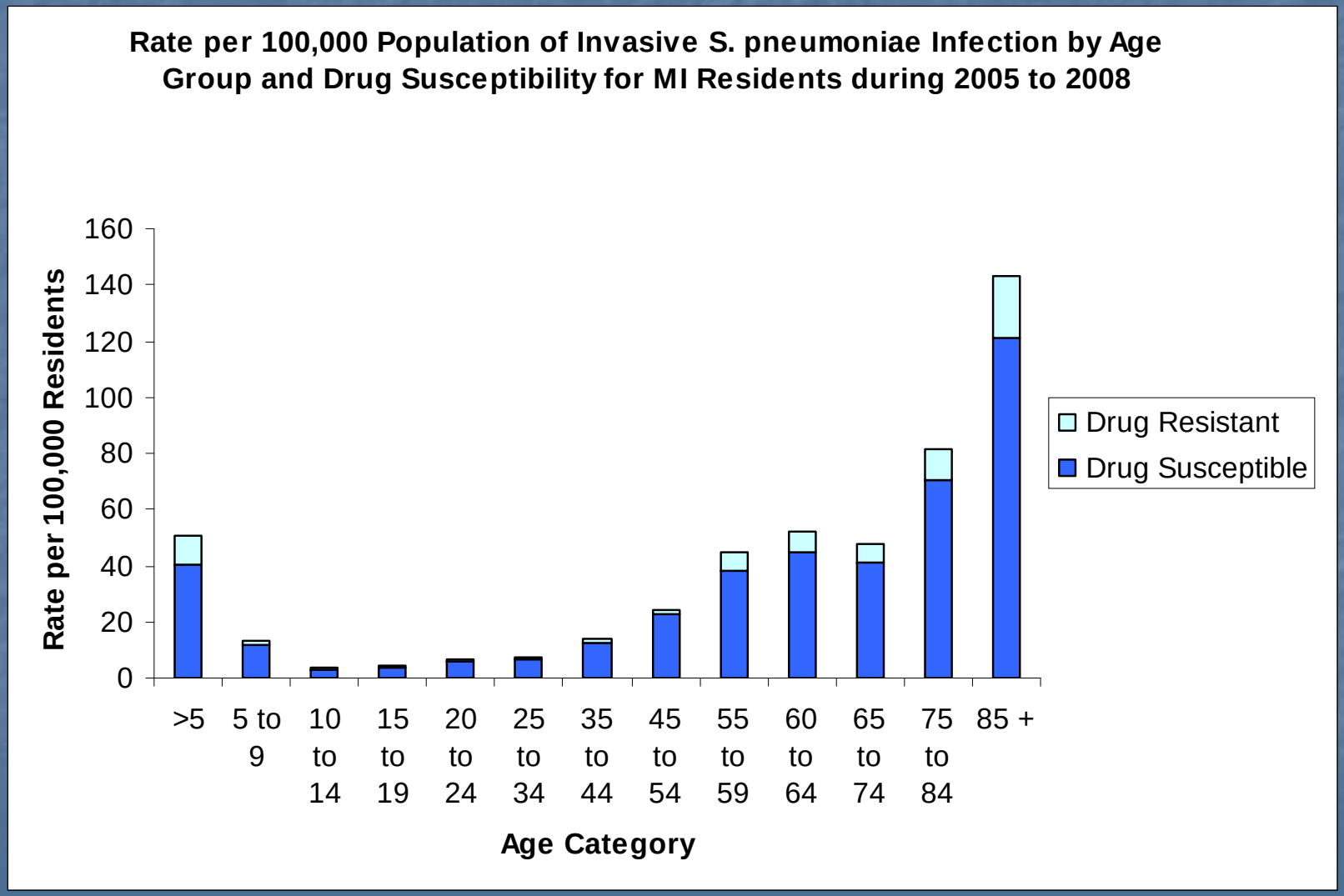
	Faxed Report: *Using as the Referent Group as "Gold Standard"*			
Electronic Reports		Resistant	Susceptible	Total
	Resistant	76	6	82
	Susceptible	111	48	159
	Total	187	54	241

- 241/2302= 10.5% of All MDSS Cases
- PPV = 76/82 = 92.7% agreement between information on MDSS and faxed report for resistant cases
- NPV = 48/159 = 30.2%
- Overall agreement (76+48)/241 = 51.5%

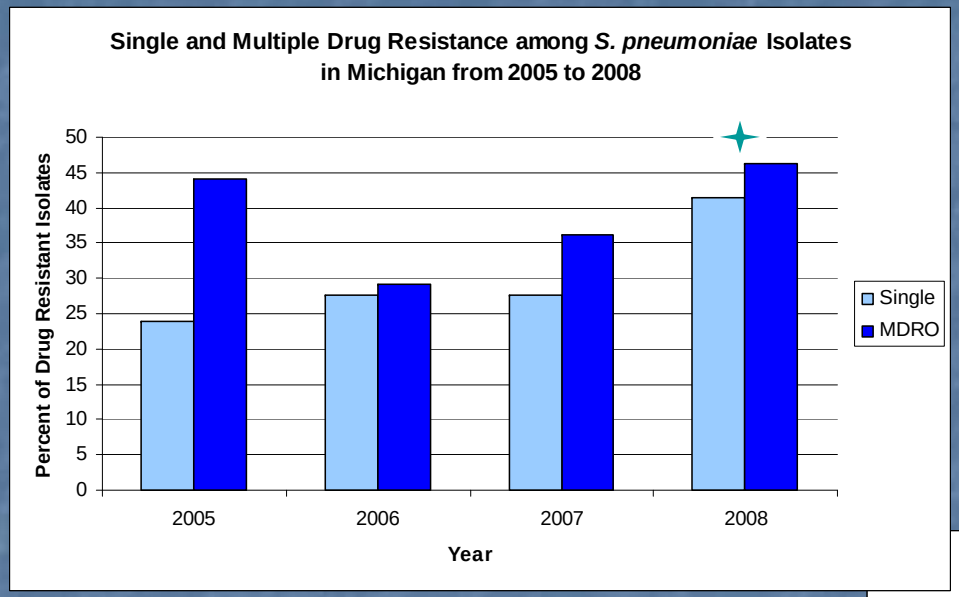
Rate of Resistant and Susceptible Invasive *S. pneumoniae* Infections 2005 to 2008

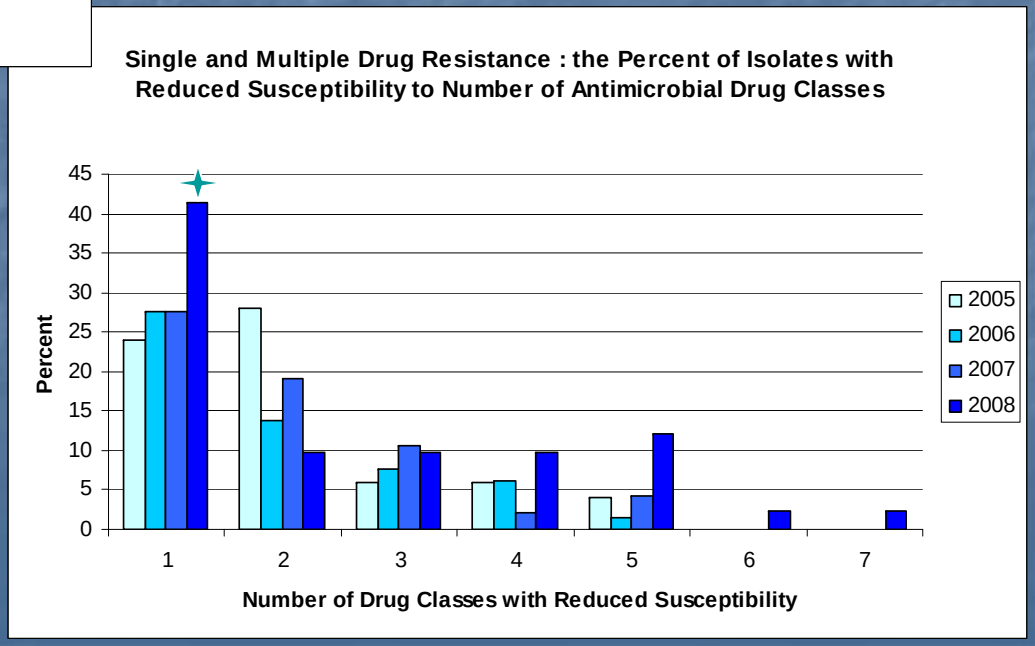


Rate by Age Group



MDR by Year





✧ Denotes change in MIC for Penicillin

Michigan's Antibiogram of *S. pneumoniae* by Year

Antimicrobial Class (N= 240)	2005		2006		2007		2008	
N(%)	S	I/R	S	I/R	S	I/R	S	I/R
Penicillins	6 (10.9)	49 (89.1)	12 (18.2)	54 (81.8)	9 (15.8)	48 (84.2)	34 (75.6)	11 (24.4)
β-Lactams/ β - Lactamase inhibitor combination	7 (77.8)	2 (22.2)	8 (80.0)	2 (20.0)	7 (100.0)	0 (0.0)	2 (40.0)	3 (60.0)
Cephems	15 (55.6)	12 (44.4)	24 (60.0)	16 (40.0)	17(58.6)	12(41.4)	10 (37.0)	17 (63.0)
Carbapenems	2 (40.0)	3 (60.0)	1 (33.3)	2 (66.7)	4 (57.1)	3 (42.9)	4 (50.0)	4 (50.0)
Ansamycins	3 (100.0)	0 (0.0)	1 (50.0)	1 (50.0)	0 (0.0)	0 (0.0)	1 (100.0)	0(0.0)
Quinolones	30 (100.0)	0 (0.0)	38 (100.0)	0 (0.0)	27 (100.0)	0 (0.0)	30 (96.8)	1 (3.2)
Folate Pathway Inhibitor	7 (30.4)	16 (69.6)	8 (38.1)	13 (61.9)	8 (33.3)	16 (66.7)	5 (21.7)	18 (78.3)
Lincosamides	2 (33.3)	4 (66.7)	3 (50.0)	3 (50.0)	1 (50.0)	1 (50.0)	3 (60.0)	2 (40.0)
Macrolides	9 (24.3)	28 (75.7)	10 (26.3)	28 (73.7)	4 (16.0)	21 (84.0)	3 (9.0)	30 (91.0)
Oxaxolidinones	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Glycopeptides	28 (100.0)	0 (0.0)	39 (100.0)	0 (0.0)	27 (100.0)	0 (0.0)	31 (100.0)	0 (0.0)
Phenicols	9 (90.0)	1 (10.0)	13 (100.0)	0(0.0)	2 (100.0)	0 (0.0)	7 (100.0)	0 (0.0)
Tetracyclines	13 (72.2)	5 (27.8)	12 (63.2)	7 (36.8)	16 (69.6)	7 (30.4)	8 (33.3)	16 (66.7)

Vaccine Coverage of those with Invasive Infection

- PPV vaccine coverage among those with DRSP
  - 9% vaccinated, 12% unvaccinated, and 79% unknown status
- PCV coverage among those with DRSP
  - 10% vaccinated, 10% no PCV and 80% status unknown

Clinical Characteristics of those with Invasive Infection

- Infection of those with DRSP
  - 57% pneumonia, 56% bacteremia, 10% other, 6% meningitis
- Underlying conditions of those with DRSP
  - 80% reported: 20% chronic obstructive pulmonary disorder, 17% coronary artery disease, 15% diabetes mellitus, 12% smoker, 7% asthma

Demographic Characteristics of those with Invasive Infection

- Mortality increases greatly with age:
  - Rate rose from 5 to 30 deaths per 100,000 persons
- Differ by Gender:
  - Higher DRSP in Females than males (53%, small N)
  - Invasive susceptible rates same as state percentage (49% M, 51% F)
- Rate of infection:
  - Higher in African American population (4/100,000) compared to Caucasian (2.75/100,000)
  - Protective in Asian and Native American population (1.6/100,000 for both)

Surveillance System Summary from 2005 to 2008

- Simplicity (-)
- Current level of Usefulness (=)
- Data quality (-)
- Acceptability (+)
- Sensitivity (-)
- Representativeness (=)
- Timeliness (-)
- Stability (+)

(+) positive aspect (-) could use improvement (=) equivocal

Recommendations for *S. pneumoniae* reporting

- Streamline classifications on single electronic form with the inclusion of drug resistance fields and MIC breakpoints
- Encourage increased reporting of MIC value
- Refine the specific antimicrobials collected
- Encourage participation by clinical labs in MDSS
  - improve timeliness, drug susceptibility results
- Integrate MCIR with MDSS for vaccination status

Introduction to the new MDSS *S. pneumoniae* Algorithm

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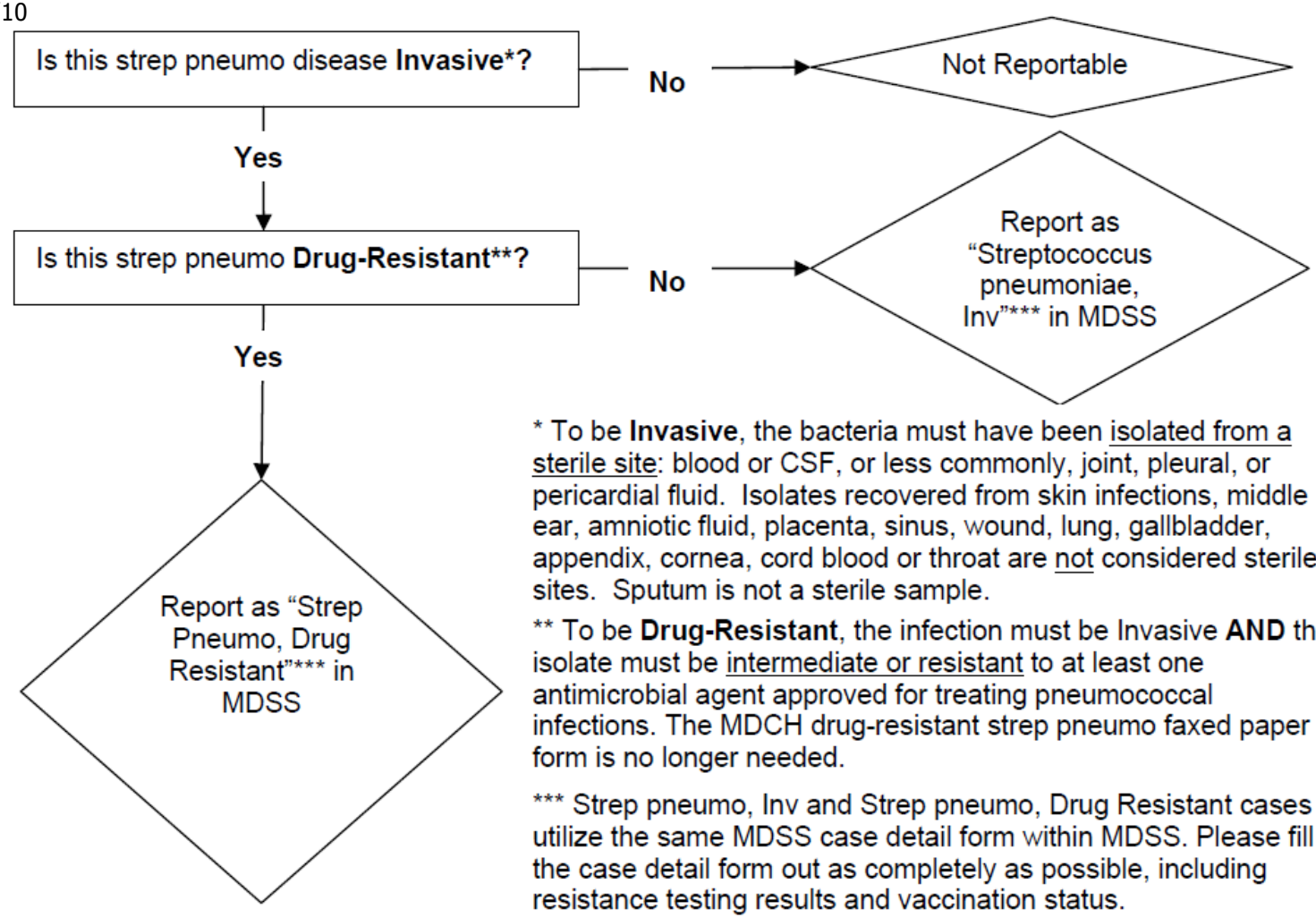

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** To be **Drug-Resistant**, the infection must be Invasive **AND** the isolate must be intermediate or resistant to at least one antimicrobial agent approved for treating pneumococcal infections. The MDCH drug-resistant strep pneumo faxed paper form is no longer needed.

*** Strep pneumo, Inv and Strep pneumo, Drug Resistant cases utilize the same MDSS case detail form within MDSS. Please fill the case detail form out as completely as possible, including resistance testing results and vaccination status.

New Form Highlights

- One form for all *S. pneumonia* isolates
- Inclusion of all conditions (i.e. meningitis) under *S. pneumoniae* form
- Electronic drug susceptibility

Streptococcus pneumoniae
Michigan Department of Community Health
Communicable Disease Division
Invasive pneumococcal disease and drug resistant S. pneumoniae

Investigation Information					
Investigation ID	**Onset Date** mm/dd/yyyy	**Diagnosis Date** mm/dd/yyyy	**Referral Date** mm/dd/yyyy	**Case Entry Date** mm/dd/yyyy	**Case Completion Date** mm/dd/yyyy

Conclusions

- HAIs and MDRO are a very serious problem
- SHARP Unit was created to help address HAI/MDRO's in Michigan
- Frequency of drug resistant organisms is rising, including *S. pneumoniae*
- Improvements have been made in surveillance
- Continue vaccination and prevention efforts

Thanks!

CSTE
MDCH
SIDE SECTION
SHARP UNIT
BUREAU OF LABS