

# Assessing the Impact of Molecular Testing on Antimicrobial Stewardship in the Treatment of Pneumonia

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KHA Quality Conference

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# Objectives

- Describe the use of molecular testing as a component of antimicrobial stewardship at a community hospital.
- Discuss barriers to implementation of rapid diagnostic technology and how to mitigate them.

# Saint Joseph Hospital

- 433 bed tertiary medical center
- 50 ICU beds
  - Medical/Surgical
  - Neurosurgery
  - Cardiothoracic Surgery
  - Coronary
- Antimicrobial Stewardship Program was established in July 2009.
  - Infectious Disease Physician
  - Infectious Disease Pharmacist
  - Director of Infection Control



# Project and Purpose

Project: Pilot of the BioFire® FilmArray® Pneumonia Panel in mechanically ventilated patients with suspected pneumonia in the intensive care units

Purpose:

- Streamline identification of pathogens in patients with suspected pneumonia
- Decrease the time to effective antibiotics
- Decrease the time to de-escalation of antimicrobial therapy

# Current Pulmonary Pathogen Identification

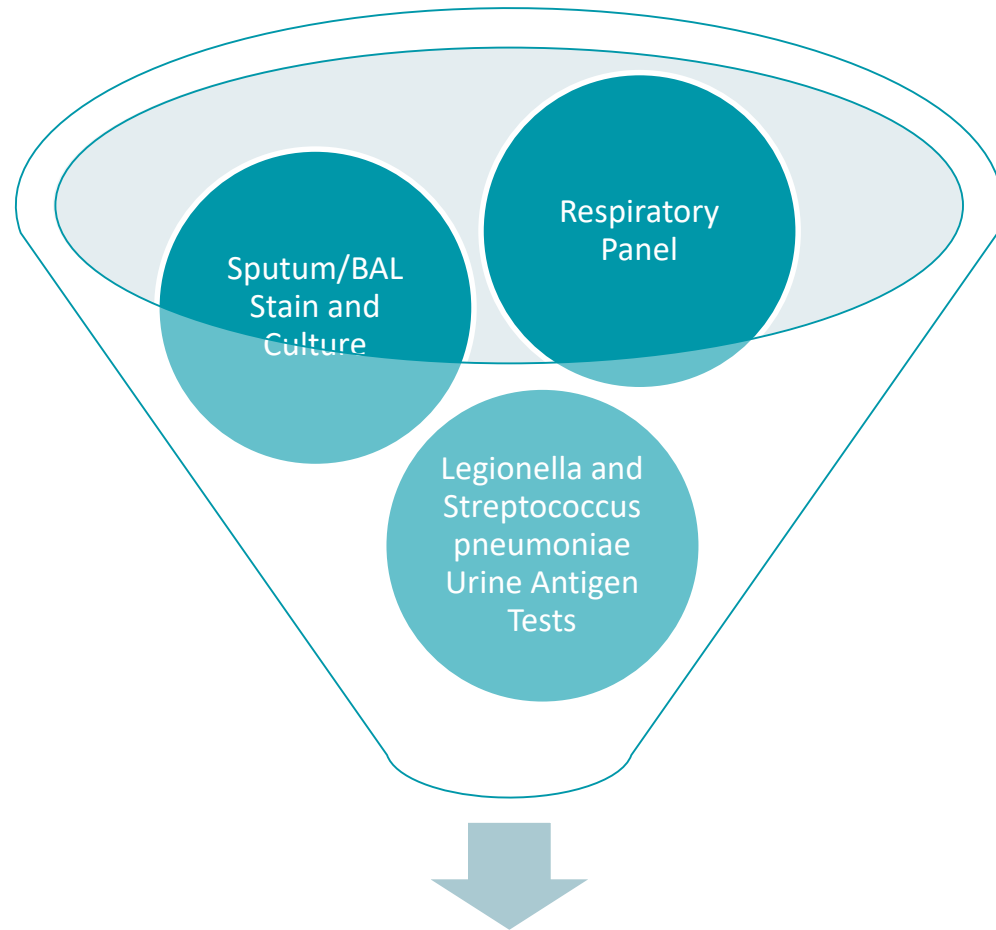
## Respiratory Panel

### Viruses

- Adenovirus
- Coronavirus HKU1
- Coronavirus NL63
- Coronavirus 229E
- Coronavirus OC43
- Human Metapneumovirus
- Human Rhinovirus/Enterovirus
- Influenza A
- Influenza A/H1
- Influenza A/H3
- Influenza A/H1-2009
- Influenza B
- Parainfluenza Virus 1
- Parainfluenza Virus 2
- Parainfluenza Virus 3
- Parainfluenza Virus 4
- Respiratory Syncytial Virus

### Bacteria

- Bordetella pertussis
- Chlamydia pneumoniae
- Mycoplasma pneumoniae



# Implementation

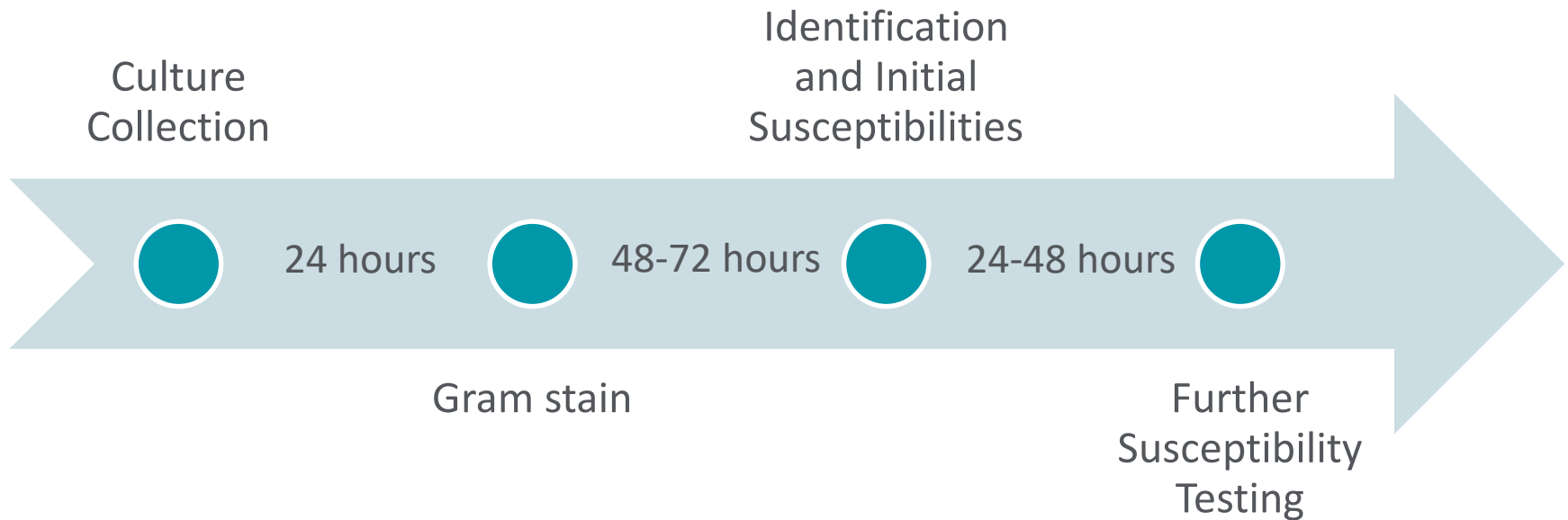
- BioFire® FilmArray® Pneumonia Panel
  - 33 Targets including bacteria, viruses, and resistance genes

Bacteria (semi-qualitative)		Atypical Bacteria (qualitative)	Viruses	Resistance Genes
<ul style="list-style-type: none"> <li>• <i>Acinetobacter calcoaceticus-baumannii</i> complex</li> <li>• <i>Enterobacter cloacae</i> complex</li> <li>• <i>Escherichia coli</i></li> <li>• <i>Haemophilus influenza</i></li> <li>• <i>Klebsiella aerogenes</i></li> <li>• <i>Klebsiella oxytoca</i></li> <li>• <i>Klebsiella pneumoniae</i> group</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Moraxella catarrhalis</i></li> <li>• <i>Proteus</i> spp.</li> <li>• <i>Pseudomonas aeruginosa</i></li> <li>• <i>Serratia marcescens</i></li> <li>• <i>Staphylococcus aureus</i></li> <li>• <i>Streptococcus agalactiae</i></li> <li>• <i>Streptococcus pneumoniae</i></li> <li>• <i>Streptococcus pyogenes</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Chlamydia pneumoniae</i></li> <li>• <i>Legionella pneumophila</i></li> <li>• <i>Mycoplasma pneumoniae</i></li> </ul>	<ul style="list-style-type: none"> <li>• Adenovirus</li> <li>• Coronavirus</li> <li>• Human Metapneumovirus</li> <li>• Human Rhinovirus/Enterovirus</li> <li>• Influenza A</li> <li>• Influenza B</li> <li>• Parainfluenza Virus</li> <li>• Respiratory Syncytial Virus</li> </ul>	Methicillin resistance: <ul style="list-style-type: none"> <li>• <i>mecA/C</i> and MREJ</li> </ul> Carbapenemases: <ul style="list-style-type: none"> <li>• KPC</li> <li>• NDM</li> <li>• Oxa-48-like</li> <li>• VIM</li> <li>• IMP</li> </ul> ESBL: <ul style="list-style-type: none"> <li>• CTX-M</li> </ul>

# 2019 Antibigram Data

- Lower Respiratory Isolates in 2019:
  - Gram negative isolates:
    - ESBL producing - 12/220 (5%)
    - Resistance to at least one carbapenem – 22/220 (10%)
  - Gram positive isolates:
    - MRSA – 48/114 (42%)
  - Total Resistance:
    - 82/334 (~25%)

# Determining Resistance





# Pneumonia Panel

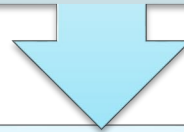
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# Current Practices with Molecular Testing

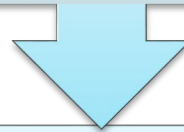
Cultures and Diagnostics

BioFire<sup>®</sup> FilmArray<sup>®</sup> Panels



Electronic Clinical Surveillance

TheraDoc<sup>®</sup>



Intervention

# Rapid Diagnostics

- BioFire® FilmArray® Blood Culture ID
- BioFire® FilmArray® Gastrointestinal Panel
- BioFire® FilmArray® Meningitis/Encephalitis Panel
- BioFire® FilmArray® Respiratory Panel

# Electronic Clinical Surveillance

- Email

<b>PID:</b>	<b>Title:</b> EZ Alert: PNEUPCRPNL
<b>Room:</b>	<b>Alert:</b> 65346164 rev: 0 ()

**EZ Alert: PNEUPCRPNL** Admit Diagnosis: Private

Demographics & renal function

Age: Private	Sex: Private
SCr: 1.2 (02/21/2020)	Height: Private
CrCl: 89 mL/min(Cockcroft-Gault; weight used=99 kg)	Weight: Private

This patient matches the EZ Alert criteria: 'EZ Alert: PNEUPCRPNL'

**Nonculture Micro:** Streptococcus agalactiae= Detected ( PNEUPCRPNL Collected: 02/20/2020 15:00:00)

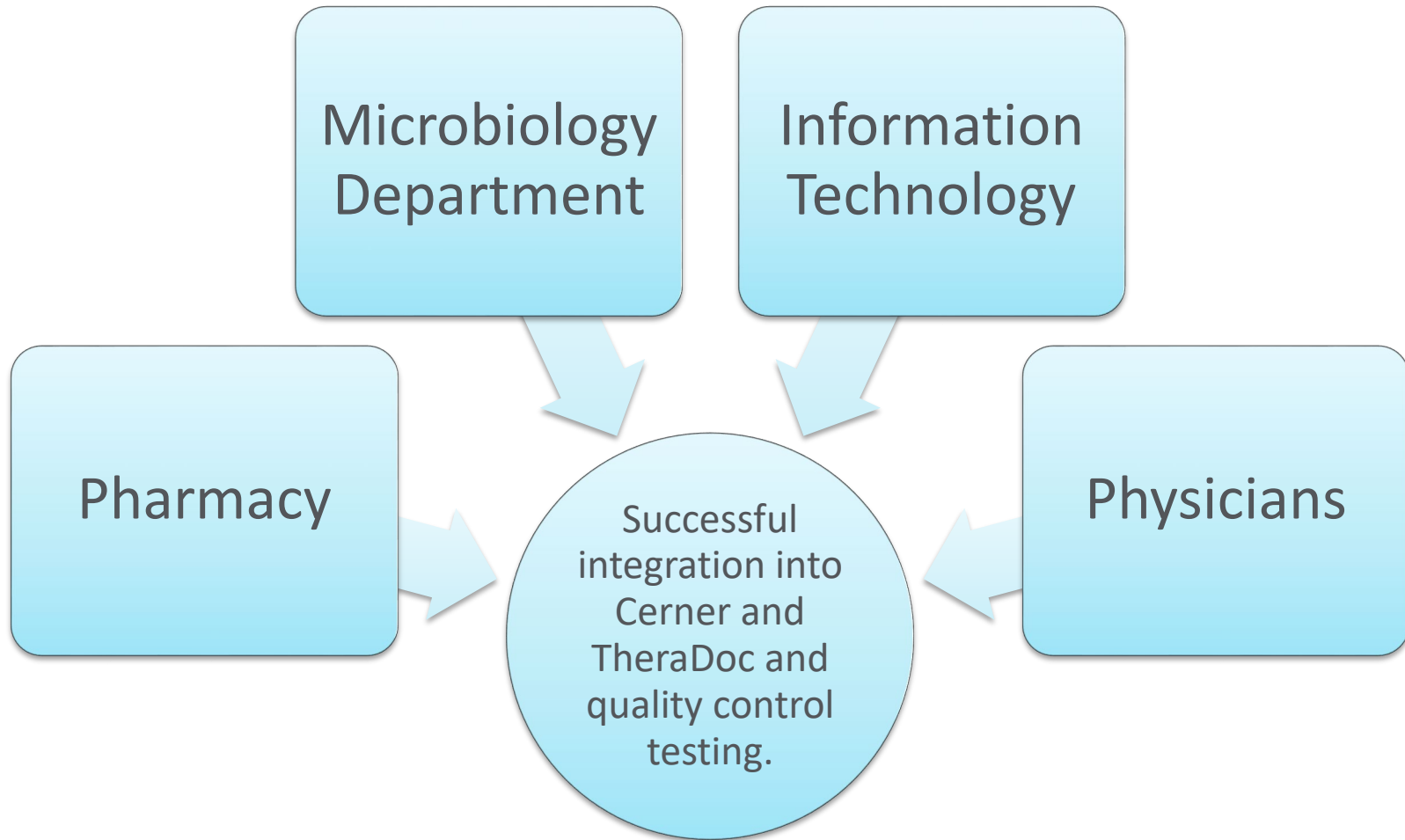
- Online

Alert Time	Alert																				
<input type="button" value="Dismiss"/> <input type="button" value="Suppress"/>  <input type="button" value="Intervention"/>	<p><b>EZ Alert: PNEUPCRPNL</b> ⓘ <span style="float: right;">Admit Diagnosis: PNEUMONITIS DUE TO INHALATION OF FOOD AND VOMIT</span></p> <table> <tr> <td>Age:</td> <td>Sex: M</td> </tr> <tr> <td>SCr: 4 (02/24/2020)</td> <td>Height: 69 in (175 cm)</td> </tr> <tr> <td>CrCl: 16 mL/min(Cockcroft-Gault; weight used=71 kg) ⓘ</td> <td>Weight: 163 lb (74.1 kg)</td> </tr> </table> <p>This patient matches the EZ Alert criteria: 'EZ Alert: PNEUPCRPNL'</p> <table border="1"> <thead> <tr> <th>Order/Culture</th> <th>Result</th> <th>Source</th> <th>Collected</th> <th>Result Status (Date/Time)</th> <th>Specimen #</th> <th>Ordering Provider</th> </tr> </thead> <tbody> <tr> <td>PNEUPCRPNL</td> <td><b>Respiratory Syncytial Virus = Detected</b></td> <td>Sput Suction</td> <td></td> <td>F</td> <td></td> <td></td> </tr> </tbody> </table> <p>Medications <span style="margin-left: 150px;">Lab Review</span> <span style="float: right;">Microbiology Review</span></p>	Age:	Sex: M	SCr: 4 (02/24/2020)	Height: 69 in (175 cm)	CrCl: 16 mL/min(Cockcroft-Gault; weight used=71 kg) ⓘ	Weight: 163 lb (74.1 kg)	Order/Culture	Result	Source	Collected	Result Status (Date/Time)	Specimen #	Ordering Provider	PNEUPCRPNL	<b>Respiratory Syncytial Virus = Detected</b>	Sput Suction		F		
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# Barriers to Implementation



- Information Technology
  - Quality Control Testing
  - Integration into Cerner
  - Integration into TheraDoc
- Provider Education
  - Ordering Test
  - Interpreting Results
  - Antibiotic Selection
- Contaminated Specimens vs. Questionable Quality Specimens







# Information Technology



# Provider Education




- Ordering Test






Search: pneumonia  Advanced Options 

      Folder:

Pneumonia Education  
[Pneumonia PCR Panel w/Respiratory Culture](#)


**Details for Pneumonia PCR Panel w/Respiratory Culture**


 **Details**  Order Comments  Diagnoses


**\*Specimen type:**   
Body site: **Bronchial Alveolar Lavage**  
Sputum  
**\*Collection priority:** Sputum, Suctioned  
Tracheal Aspirate

**\*Requested Collection Date and Time:** 01/09/2020  EST

Collected by:  

Frequency: 1-Time 

Duration:

Duration unit:  

# Provider Education: Interpreting Results

Lab Results	1/9/2020 16:09 EST
<b>Bacteriology</b>	
Staphylococcus aureus	Not Detected
Streptococcus agalactiae	Not Detected
Streptococcus pyogenes	Not Detected
Streptococcus pneumoniae	Not Detected
Haemophilus influenzae	Not Detected
Pseudomonas aeruginosa	Not Detected
Enterobacter cloacae complex	Not Detected
Escherichia coli	Not Detected
Klebsiella oxytoca	Not Detected
Proteus	Not Detected
Serratia marcescens	Not Detected
KPC	Not Applicable
Respiratory Culture	See Result
Legionella Pneumophila	Detected (A)
Chlamydia pneumoniae PCR	Not Detected
CTX-M	Not Applicable
IMP	Not Detected
mecA/C and MREJ	Not Applicable
NDM	Not Applicable
OXA-48-like	Not Applicable
VIM	Not Applicable
A. baumannii complex	Not Detected
K. aerogenes	Not Detected
K. pneumoniae group	Not Detected
M. catarrhalis	Not Detected
<b>Virology</b>	
Influenza A	Not Detected
Influenza B	Not Detected
Rhinovirus/Enterovirus	Not Detected
Human Metapneumovirus	Not Detected
Adenovirus	Not Detected
Coronavirus	Not Detected
Respiratory Syncytial Virus	Not Detected
Parainfluenza virus	Detected (A)

CTX-M	Not Detected
IMP	Not Detected
mecA/C and MREJ	Not Detected
NDM	Not Detected
OXA-48-like	Not Detected
VIM	Not Detected



# Provider Education

- Antimicrobial Selection
  - Laminated cards were printed and given to physicians
  - Using antibiogram data, empiric antimicrobial therapies were determined
  - Special comments such as isolation precautions added, where necessary

Viruses		
Adenovirus	Supportive care	Droplet + contact precautions
Coronavirus OR Rhinovirus/Enterovirus	Supportive care	Droplet precautions
Human Metapneumovirus OR Parainfluenza Virus	Supportive care	Contact precautions
Influenza A/B	Oseltamivir 75mg PO BID	Droplet precautions
Respiratory Syncytial Virus	Supportive care ± ribavirin* *In consultation with ID	Contact precautions
Antimicrobial-Resistance Genes		
KPC (carbapenemase)	Vabomere (meropenem-vaborbactam) 4g IV q8h	Consult ID and implement containment precautions
NDM, VIM, IMP (carbapenemase)	Aztreonam 2g IV q8h	Consult ID and implement containment precautions
Oxa-48-Like (carbapenemase)	Avycaz (ceftazidime-avibactam) 2.5g IV q8h	Consult ID and implement containment precautions
CTX-M (ESBL)	Meropenem 500mg IV q6h	Containment precautions

# Contaminated Specimens vs. Questionable Quality Specimens

- Sepsis committee determined how to proceed based on type of specimen:
  - **Sputum** – must be screened prior to performing the Pneumonia PCR panel.
    - > 25 epithelial cells per LPF – Contaminated Specimen – specimen rejected
    - < 25 WBC per LPF – Questionable Quality Specimen – specimen accepted and reflexed, comments added to culture results indicating specimen of questionable quality
  - **BAL, induced sputum, and tracheal aspirate** – always acceptable specimens.
    - No screening, cannot be rejected

# Outcomes

- In-hospital mortality
- Overall and ICU length-of-stay
- 30-day readmission
- Total cost of hospitalization
- Time to initiation of effective antimicrobial therapy
- Time to antibiotic de-escalation (i.e., reduction in the # of agents or conversion to a more narrow-spectrum agent)
- Weighted value of antibiotics received during admission (based on weighted scoring system)
- Time to speciation (i.e., routine microbiological testing vs. rapid molecular diagnostics)
- Duration of mechanical ventilation

# Successes

- Education of all hospitalists, pulmonary, critical care, and infectious disease physicians
- Identified areas of improvement and have implemented resolutions
- Pneumonia Panels are continuing to be successfully completed and continuously monitored since the go-live date

# Next Steps

- Evaluate and Expand

January 2020  
(Go-live)

- Pilot in mechanically ventilated patients in the ICU with suspected pneumonia.



May 2020  
(3 months)

- Evaluate patient data and endpoints.
- Consider expanding to all pneumonia patients in the critical care units.



August 2020  
(6 months)

- Evaluate patient data and endpoints.
- Consider expanding to the entire facility.

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