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Using Implementation Science for Fast Phenotypic Diagnostic for Bloodstream Infections and Antimicrobial Stewardship

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Introduction

A substantial proportion of antibiotics used in healthcare may be inappropriate or unnecessary, which can lead to adverse drug reactions, *C. difficile* infection, and antimicrobial resistance. A major contributing factor is the 2 - 4 day delay with current lab procedures for positive blood cultures, resulting in over use of empiric therapy. Faster diagnostic tests can provide these results in less than 7 hrs. Effective clinical adoption can be achieved using implementation science with action-oriented & mission-driven teamwork enhancing communication among diverse clinical team members.

Objectives

- To describe four tools used in clinical implementation stages
- To describe how antimicrobial stewardship programs can be more effective with the use of implementation science
- To describe how fast phenotypic diagnostics for bloodstream infections can play a significant role in reducing the inappropriate use of antibiotics and adverse outcomes

Description of the Project

- Antimicrobial stewardship programs (ASPs) have been at the forefront of the effort to curtail inappropriate antibiotic use.
- With faster identification and susceptibilities, clinicians can de-escalate or target appropriate therapy; thereby reducing mortality, length of stay, days on therapy, adverse outcomes, and cost.
- The use of implementation science can be an effective method to guide clinicians in clinical adoption sessions for successful use of molecular diagnostics for blood cultures in septic patients.

Methods/approaches

During the exploration stage, readiness is assessed by a clinical intervention solution team including:

1. A retrospective chart review of current lab procedure for 30 positive blood cultures
2. A process analysis of the lab, pharmacy, infectious disease, and infection prevention line correct response to positive blood cultures
3. A business analysis using publicly reported metrics, such as length of stay, mortality, sepsis readmissions, *C difficile* infections and CMS (Center for Medicare and Medicaid Services) penalties for healthcare associated conditions (HACs)

Following the analysis a diverse group of clinicians are invited to the session, including infectious disease physicians, pharmacists, infection preventionists, microbiologists, nursing staff, sepsis coordinators, information technology specialists and administrators.

- Implementation tools that may be used include:
- mind-mapping session (Figure 1)
- process pathway analysis (Figure 2)
- developing a fishbone diagram (Figure 3)
- determining a gap analysis (Figure 4)
- developing an action plan and participating in follow-up sessions to assure full clinical implementation.

Elements of robust program management for the evaluation and implementation of new technologies or processes

Program management: Identify required resources and timing of tasks and deliverables

- **Retrospective Chart Review:** Targeted review of 25-30 cases of current patient care continuum overlaid with the opportunity for intervention and associated impact
- **Evaluation and Performance Data:** Provide post evaluation and verification data review
- **ID/Pharm Consultancy:** Provide an expert consultancy on antibiotic best practices
- **Process Analysis:** Provide an expert consultancy regarding operational/information flows that impact the way antibiotics are utilized
- **Clinical/Business Justification:** Provide performance data, literature, quote/contract, glossy presentation, and deliverables for the clinical coach to share within their organization
- **Clinical Adoption:** Guide clinical practice in the adoption of fast phenotypic diagnostic technologies and associated work and information flows

Figure 1. Mind-maps visually organize hierarchical information around a central concept. Major ideas are connected directly to the central concept, and other ideas branch out from the major ideas.

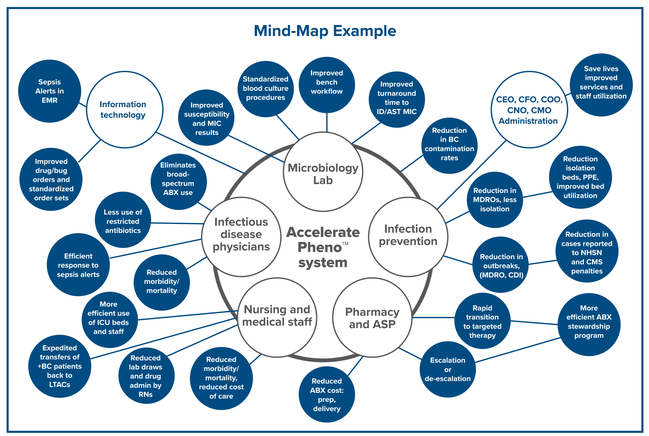


Figure 2. Process pathways describe the sequence of steps in a procedure and are useful in identifying weaknesses before implementation.

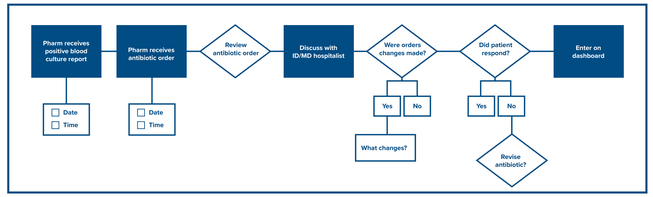
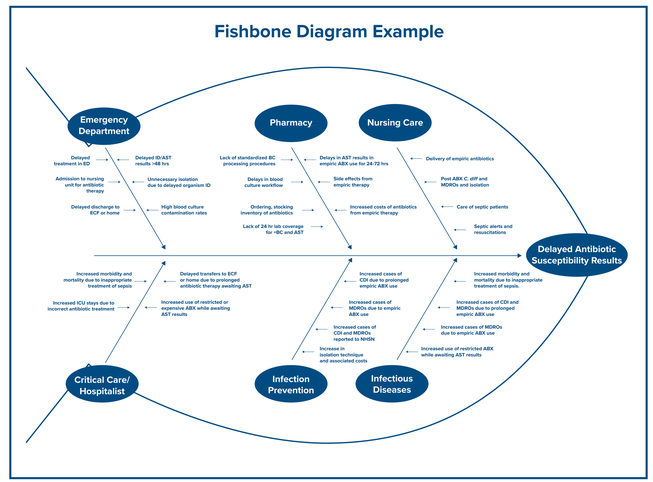
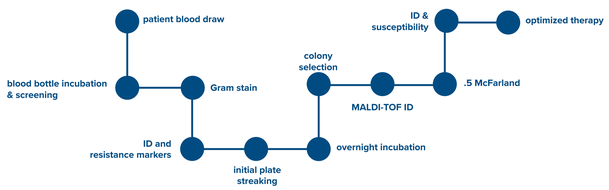


Figure 3. Fishbone Diagram is a visualization tool for categorizing potential sources of a problem to identify its root causes.



Typical ID & AST Workflow

Time to final result typically 48-72hrs from positive blood culture



Accelerate Workflow

Time to result in about 7hrs from positive blood culture

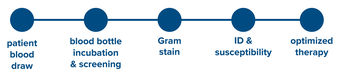


Figure 4. Gap analysis compares the actual performance with potential or desired performance, and identifies areas of potential improvement.

Gap Analysis Example

Current State

Procedure in Lab

1. Blood cultures are delivered to a core lab
2. Blood cultures are incubated in core lab
3. Positive blood culture is Gram stained
4. Blood culture organism is identified
5. Blood culture antibiotic susceptibilities are processed

Reporting of Results

1. Gram stain result is called to the nurse
2. Blood culture ID/AST results are available in the electronic health record
3. Physician and Pharmacist review ID/AST results and review/change antibiotic therapy

Lab Gaps

- Delivery delays to core lab >2-4 hrs
- Incubated blood cultures may not be processed for 12-18 hrs due to lack of 24 hr coverage
- Blood culture identification from time of positivity is >24 hrs
- Blood culture susceptibilities are available > 48-72 hrs

Reporting Gaps

- Nurse has difficulty contacting ID physician due to lack of 24 hr coverage
- Pharmacist has challenges with ID physicians responding to their de-escalation recommendations

Future/Desired State

1. Reduce blood culture delivery time to core lab to <1 hr with enhanced transport services
2. Reduce blood culture processing times with increased staff.
3. Implement a fast ID/AST blood culture system to finalize results in <7 hrs
4. Make blood culture ID/AST a critical value in the electronic health record
5. Hire additional ID coverage on weekends

ID and AST with MICs in about 7 hours from positive blood culture

Lessons learned

- The adoption of faster phenotypic diagnostic technologies can decrease the time to critical lab results.
- The use of implementation science can maximize the benefits of obtaining ID and AST results for optimizing antibiotic therapy and instituting isolation precautions for MDROs.

References

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