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Utilizing Mind-Mapping Technique to Describe an Antimicrobial Stewardship Program for Clinical Implementation of a 7-hour Fast Antibiotic Sensitivity System

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Background

A novel fast antibiotic sensitivity diagnostics platform, with de novo FDA marketing authorization, provides sensitivities with the MIC an average of 40 hours faster to clinicians treating sepsis than current laboratory methodologies. The delay in standard blood culture lab procedures of 48-72 hours results in overuse of empiric antibiotics that can result in inadequate treatment and development of adverse outcomes, such as potential development of multiple drug resistant organisms and Clostridium difficile. Clinical laboratories want to adopt new life-saving technologies but they have to go through a timely process of justifying the purchase or convincing the C Suite of its value.

Therefore, in order to evaluate the usefulness of fast ID/AST technology, the antimicrobial stewardship team can use quality tools in their efforts to adopt this new device. One of the tools that is useful in teamwork is a mind-map - a diagram used to visually organize information to which associated representations of ideas and processes are added to enhance clinical implementation. This quality tool can be effectively used in clinical settings to enhance teamwork and present information to the C Suite for clinical adoption. In addition, information outlining delays in standard procedures can be presented in a process pathway and fishbone diagram. After the brainstorming session is completed, a gap analysis can be completed for future action plans.

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

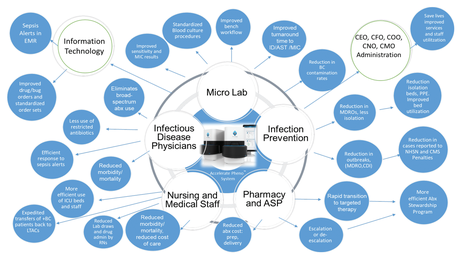
Methods

The Agency for Healthcare Research and Quality (AHRQ), the National Quality Forum, the Joint Commission, and many other national organizations endorse the use of valid and reliable measures and tools of quality and patient safety to improve health care. There are many useful tools that can be applied to the different settings of care and care processes. The use of quality tools during clinical implementation and adoption foster teamwork and enhanced communication among diverse members.

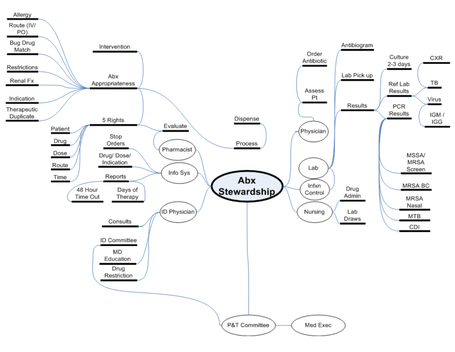
A team of 10 key opinion leaders (KOLs) that included pharmacists, infection preventionists, microbiologists, and infectious disease physicians were introduced to the use of mind-mapping, process pathways, gap analysis, and fishbone diagrams as useful tools to engage staff and obtain input into clinical implementation. KOLs worked in teams to draw mind-maps and process pathways, and to share conceptual ideas on making the business case for product adoption and implementation.

Mind-map is a diagram used to visually organize information. It is often created around a single concept, drawn as an image in the center of a blank landscape page. Associated representations of ideas such as images, words and parts of words are added to the central image. Major ideas are connected directly to the central concept, and other ideas branch out from the major ideas, either as hand-drawn "rough notes" during a lecture, meeting, or planning session (for example), or as higher quality pictures.

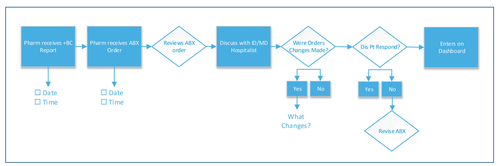
Mind-Map Example



Example of a Mind-Map Session on Antimicrobial Stewardship

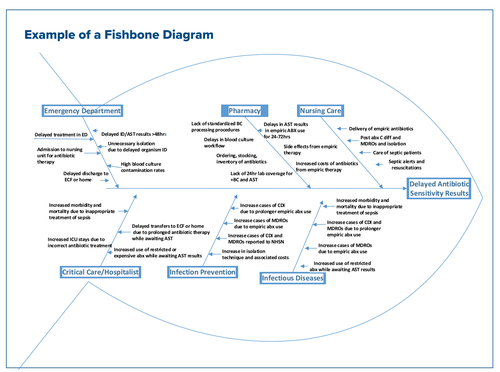


Process pathways describe the sequence of steps of procedures or processes in various hospital settings. They illustrate the route (or way of access) to reach or achieve a procedure. They are useful to identify defects in a process before implementation of new equipment, and can be used to measure areas of improvement or correction prior to clinical adoption.



The fishbone diagram identifies many possible causes for an effect or problem. It can be used to structure a brainstorming session. It immediately sorts ideas into useful categories.

Example of a Fishbone Diagram



Gap analysis involves the comparison of actual performance with potential or desired performance. If an organization does not make the best use of current resources, or forgoes investment in capital or technology, it may produce or perform below its potential.

Example of a Gap Analysis

Current State

Current Blood Culture 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 sensitivities are processed

Current Lab Reporting of Results
6. Gram stain result is called to the nurse
7. Blood culture ID/AST results are available in the electronic health record
8. Physician and Pharmacist review ID/AST results and review/change antibiotic therapy

Gaps

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

Gaps

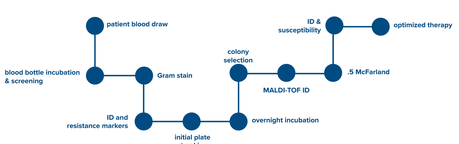
Reporting Gaps
1. Nurse has difficulty contacting ID physician due to lack of 24hr coverage
2. Pharmacist has challenges with ID physicians responding to their de-escalation recommendations

Future/Desired State

Future Desired State
1. Reduce blood culture delivery time to <1hr to core lab 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<7hrs
4. Make blood culture ID/AST a critical value in the electronic health record
5. Hire additional ID coverage on weekends

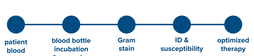
Typical ID & AST Workflow

Time to final result typically 48-72hrs



Accelerate Workflow

Time to result in about 7hrs



Results

The KOL team used the quality tools to develop an extensive list of cost avoidance and return on investment opportunities. The list included items that could be measured after clinical adoption of a fast ID/AST blood culture system (the Accelerate Pheno™ system). The attendees used the quality tools to identify the following potential benefits of adopting this system:

1. Reduced morbidity and mortality
2. Enhanced patient and family satisfaction
3. Enhanced bed utilization in ED, ICU, Nursing Units, Diagnostic areas
4. Potential reduction in MDROs, C. difficile, and cross-infection
5. Reduced pharmacy costs and standardization of the pharmacy formulary
6. More efficient lab processes and standardization of blood culture process
7. Reduced hospital supplies as a result of targeted versus empiric antimicrobial therapy
8. Potential for reduced CMS penalties (readmissions with sepsis, progression to septic shock, C. difficile)
9. Expedited transfers back to ECF or LTAC from fast ID/AST results
10. Faster reporting of positive blood cultures and sensitivities in ED setting and ICUs, resulting in decreased length of stay and improved bed management
11. More efficient use of clinical staff - reduced pharmacy med preps and nurse medication passes, enhanced micro blood culture lab processes, potential for reduced sepsis responses from sepsis teams, reduced isolation for MDROs and C. difficile, reduced infection preventionist reporting of HAIs, and reduced progression to sepsis cases.

Conclusion

The use of quality tools is an effective method to engage KOLs and hospital staff when implementing a multi-disciplinary approach to patient care, including adoption of new technology. In the exercise presented here, attendees were able to identify items that would be important when considering implementing a new system. In this case, use of the mind-mapping, fishbone diagram, process pathways, and gap analysis allowed the attendees to identify that a fast ID/AST blood culture system could allow the healthcare team to de-escalate antibiotic therapy, provide more targeted therapy, enhance care of critically ill patients, and improve antibiotic stewardship efforts.

References

1. Ronda Hughes: Patient Safety and Quality: An Evidence-Based Handbook for Nurses. 2008
2. Joint Commission Tools for Performance Measurement, 2008
3. Brazelton de Cárdenas JN, et al. Evaluation of rapid phenotypic identification and antimicrobial susceptibility testing in a pediatric oncology center. Diagnostic Micro and Infec Dis 2017