

Antimicrobial Stewardship Strategy: Improved diagnostics

Improved diagnostics can aid in the diagnosis of infections and the identification of causative microorganisms.



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Priority Level: **C**

Difficulty Level: **3**

Program Stage:

- Early
- Intermediate
- ✓ Advanced

Antimicrobial Stewardship

Outcomes:

- Drug utilization outcomes
- Prescribing outcomes
- Clinical outcomes

For more information on these criteria and how they were developed, please see the [Antimicrobial Stewardship Strategy Criteria Reference Guide](#).

Description

This is an overview and not intended to be an all-inclusive summary. As a general principle, patients must be monitored by the health care team after changes to therapy resulting from recommendations made by the antimicrobial stewardship team.

New diagnostic methods for infection, including the use of serum biomarkers (e.g., procalcitonin) and various new rapid diagnostic tests (e.g., polymerase chain reaction, matrix-assisted laser desorption/ionization time-of-flight mass spectrometry, and peptide nucleic acid fluorescent in situ hybridization) can be used to improve antimicrobial therapy.

Procalcitonin serum levels increase during bacterial (but not viral) infections and decrease as the patient improves clinically. Although there are a number of limitations, procalcitonin has been used to help determine when antimicrobial therapy is indicated, monitor response to therapy and assist in determining the length of therapy.

Traditional microbiology laboratory techniques can take days to identify microorganisms and determine their susceptibilities. Recently developed technologies can produce results much more quickly, and so have an important role in enhancing antimicrobial stewardship. Use of rapid diagnostic tests can distinguish methicillin-sensitive from methicillin-resistant *Staphylococcus aureus*; quickly differentiate between *Escherichia coli*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*; and identify *Clostridium difficile*, all in minutes to hours.¹

Early communication of results in a timely fashion is essential for taking maximum advantage of this earlier information. Use of rapid diagnostic tests has been shown to reduce the wait time for a patient to receive optimal or effective therapy when performed in conjunction with an antimicrobial stewardship program. The antimicrobial stewardship team plays a pivotal role in disseminating

information and recommending appropriate alterations to therapy in a timely fashion,² since without real-time intervention, the benefits of earlier pathogen identification and susceptibility are lost.

The antimicrobial stewardship program also plays an important role in helping to document the clinical and economic benefits of new tests to justify their adoption.

Advantages

- More rapid reporting of organism identification and susceptibilities may allow earlier targeted therapy (streamlining/de-escalation) and/or shorter duration of therapy.
- Provides an opportunity for collaboration between the antimicrobial stewardship team and the microbiology laboratory.
- Introduction of such tests in conjunction with an antimicrobial stewardship program improve patient outcomes (length of hospital stay, mortality) and hospital costs and reduce total duration of therapy.²

Disadvantages

- May require new laboratory equipment and/or supplies, which can be costly and require justification based on benefits.
- May not be available in smaller institutions.
- Expertise required for new laboratory procedures and/or operation of new equipment, as well as interpretation of new tests (e.g., procalcitonin).
- Some tests (e.g., procalcitonin) have not been conclusively determined to be useful or safe for guiding treatment for certain conditions.
- Little experience with use of procalcitonin in Canada.
- Not universally accepted as a standard of care.
- Requires coordination with microbiology/diagnostic laboratory.
- Real-time notification of results may not be possible without regular antimicrobial stewardship services.
- May not hasten susceptibility testing unless the technique identifies a resistance gene (e.g., differentiates between methicillin-susceptible and methicillin-resistant *Staphylococcus aureus*).

Requirements

- Business case to acquire the necessary equipment and perform testing.
- Staff training to perform the new tests.
- Stewardship personnel to intervene in a timely fashion to maximize benefits of new efficient testing (rapid diagnostic tests).
- Education for clinicians regarding the appropriate ordering and interpretation of biomarkers (e.g., procalcitonin).

Associated Metrics

- Antimicrobial use/cost avoidance following introduction of new diagnostic method.
- Time to effective therapy or time to de-escalation.
- Patient outcomes such as length of stay (advanced).

References

1. Goff DA, Jankowski C, Tenover FC. Using rapid diagnostic tests to optimize antimicrobial selection in antimicrobial stewardship programs. *Pharmacotherapy*. 2012;32(8):677–87.

Reviews tests to rapidly identify Staphylococcus species, Enterococcus species, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Clostridium difficile and Candida species.

2. Bauer KA, Perez KK, Forrest GN, Goff DA. Review of rapid diagnostic tests used by antimicrobial stewardship programs. *Clin Infect Dis*. 2014;59(Suppl 3):S134–45. Available from:

http://cid.oxfordjournals.org/content/59/suppl_3/S134.long

Reviews use of polymerase chain reaction, multiplex polymerase chain reaction, peptide nucleic acid fluorescent in situ hybridization, and matrix-assisted laser desorption/ionization time-of-flight mass spectrometry for rapid identification of pathogens. Includes checklist for implementation of rapid diagnostic tests in a stewardship program.

Additional Useful References

Select articles to provide supplemental information and insight into the strategy described and/or examples of how the strategy was applied; not a comprehensive reference list. URLs are provided when materials are freely available on the Internet.

- Avdic E, Carroll KC. The role of the microbiology laboratory in antimicrobial stewardship programs. *Infect Dis Clin North Am*. 2014;28(2):215–35.

Reviews the role of microbiology in antimicrobial stewardship including rapid diagnostic tests, antibiograms and procalcitonin.

- Box MJ, Sullivan EL, Ortwine KN, Parmenter MA, Quigley MM, Aguilar-Higgins LM, et al. Outcomes of rapid identification for gram-positive bacteremia in combination with antibiotic stewardship at a community-based hospital system. *Pharmacotherapy*. 2015;35(3):269–76.

Used rapid identification of Gram-positive bacteria in the bloodstream to decrease the time to targeted antimicrobials, decrease length of stay and decrease overall costs.

- Bishop BM, Bon JJ, Trienski TL, Pasquale TR, Martin BR, File TM Jr. Effect of introducing procalcitonin on antimicrobial therapy duration in patients with sepsis and/or pneumonia in the intensive care unit. *Ann Pharmacother*. 2014;48(5):577–83.

Used procalcitonin-guided protocol to reduce the duration of antibiotic therapy for pneumonia and sepsis.

- Haubitz S, Mueller B, Schuetz P. Streamlining antibiotic therapy with procalcitonin protocols: consensus and controversies. *Expert Rev Respir Med*. 2013;7(2):145–57.

Links with Other Strategies

- [De-escalation and streamlining](#)
- [Preventing treatment of non-infectious conditions](#)
- [Targeted review of patients with bacteremia/fungemia](#)

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For further information

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