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Antimicrobial Stewardship Strategy:
Clinical decision support systems/computerized physician order entry

Technological applications that assist the clinician in selecting and ordering tests and therapy. They can also be used to communicate information and generate reports.

@istock.com/MutluKurtbas

Priority Level: **C**

Difficulty Level: **3**

Program Stage:

- Early
- Intermediate
- ✓ Advanced

Antimicrobial Stewardship Outcomes:

- Drug utilization outcomes
- Prescribing outcomes
- Clinical outcomes
- Reduction in *Clostridium difficile* infection

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.

Computerized clinical decision support systems (CDSSs) and computerized physician order entry (CPOE) are two types of automation that can facilitate the practice of antimicrobial stewardship.

CDSSs

CDSSs may include capabilities embedded in electronic health record platforms or external vendor products that offer a variety of stewardship-related functions.

They can communicate information and alert the clinician during the ordering process. They can also generate reports to help the antimicrobial stewardship team identify patients for review based on prescribed antimicrobial therapy and/or microbiology and laboratory data, such as:

- Patients prescribed restricted antimicrobial agents.
- Patients on therapy for 72–96 hours.
- Possible candidates for intravenous to oral (IV to PO) conversion.
- New cultures available and/or specific organisms identified.
- Cases of inappropriate pathogen/antimicrobial combinations ("bug-drug mismatch")—can be used to ensure patients are on adequate therapy and to expedite streamlining or de-escalation.

- CDSS can be used to facilitate the communication and documentation of stewardship interventions and the generation of reports.
- CDSS software can often include capabilities as described under CPOE.

CPOE

Certain CPOE platforms may support antimicrobial stewardship by:

- Allowing for customized alerts and information according to local practice.
- Facilitatating formulary restriction and improving documentation by requiring the clinician to identify the indication for therapy at the time of prescribing (e.g., providing a drop-down menu with approved criteria for use).
- Embedding decision supports to guide physicians at the time of prescribing; examples include restriction criteria, customized order sets, clinical and/or institutional guidelines or pathways, treatment algorithms, IV to PO algorithms, dosing recommendations and educational links and references.
- Notifying prescribers of stop dates, allergy conflicts and dosing alerts.

Automated system alerts are meant to improve the identification of patients with potential antimicrobial issues (e.g., bug-drug mismatch, IV to PO potential). Clinical evaluation by a knowledgeable clinician is still required before any changes to therapy.

Advantages

- Can facilitate many stewardship activities such as de-escalation and streamlining, scheduled antimicrobial reassessments (antibiotic "time outs"), formulary restriction with preauthorization and prospective audit with intervention and feedback, and improved antimicrobial documentation (of indication and intended duration of therapy).
- Provides an opportunity for on-the-spot prescriber education using criteria, alerts, and access to guidelines and educational links.
- The incorporation of forcing functions (e.g., mandating the rationale for prescribing a restricted antimicrobial prior to completion of an order) can facilitate data collection and audits.
- Consistent messaging is provided to all prescribers in the institution.

Disadvantages

- Selection and purchasing of a new electronic health record platform is a high-level administrative decision and requires significant planning time and resources.
- System costs may be prohibitive:
  - Commercial CDSSs may present significant costs up-front, with ongoing yearly subscription fees.
  - Hardware, vendor software and maintenance costs must be considered.
  - Costs may be especially prohibitive for institutions with smaller budgets.
- Requires complex information technology knowledge, capabilities and support for implementation.
  - Local customization is required.
  - Interface between the institution's pharmacy and microbiology systems (and possibly infection prevention and control) is needed, depending on the system.

- Requires significant ongoing human resources:
  - Information technology resources for validation and staff training.
  - Ongoing information technology support and system maintenance.
  - Ongoing system programming and updating of desired clinical decisions, educational links (e.g., changes to formulary, guidelines, criteria for use) and system changes (e.g., drug codes).
  - Alerts must be reviewed and updated yearly.
  - Some institutions report extensive time required by the antimicrobial stewardship program and information technology personnel for system implementation and maintenance.
- Too many system alerts may result in "alert fatigue" for prescribers.
- Options often available in the system for prescribers to override forcing functions and alerts (e.g., "physician decision" or "clinical decision") may limit system functionality.

Requirements

- Significant: decision to implement system and choice of vendor by administration; capital for the hardware/software and customization.
- Implementation team.
- Ongoing technical expertise for support and maintenance.

Associated Metrics

- Number and quality of clinical interventions by the antimicrobial stewardship program before and after system implementation.
- Effectiveness of alert system (total number of alerts versus clinical recommendations made based on alerts).
- Cost-effectiveness of system.

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.

- Forrest GN, Van Schooneveld TC, Kullar R, Schulz LT, Duong P, Postelnick M. Use of electronic health records and clinical decision support systems for antimicrobial stewardship. Clin Infect Dis. 2014;59(Suppl 3):S122–33. Available from: http://cid.oxfordjournals.org/content/59/suppl_3/S122.long

  Useful review of various electronic systems and their application to stewardship.

- Thursky K. Use of computer technology to support antimicrobial stewardship. In: Duguid M, Cruickshank M, editors. Antimicrobial stewardship in Australian hospitals 2011. Sydney, Australia: Australian Commission on Safety and Quality in Health Care; 2010. Chapter 10. Available from: http://www.safetyandquality.gov.au/wp-content/uploads/2011/01/Antimicrobial-stewardship-in-Australian-Hospitals-2011.pdf

Includes general information, as well as recommendations for implementation.

- Calloway S, Akilo HA, Bierman K. Impact of a clinical decision support system on pharmacy clinical interventions, documentation efforts, and costs. Hosp Pharm. 2013;48:744–52. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3857121/
- Hermsen ED, Van Schooneveld TC, Sayles H, Rupp ME. Implementation of a clinical decision support system for antimicrobial stewardship. Infect Control Hosp Epidemiol. 2012;33(4):412–5.
- McGregor JC, Weekes E, Forrest GN, Standiford HC, Perencevich EN, Furuno JP, et al. Impact of a computerized clinical decision support system on reducing inappropriate antimicrobial use: a randomized controlled trial. J Am Med Inform Assoc. 2006;13:378–84. Available from: http://jamia.oxfordjournals.org/content/13/4/378.long
- Elligsen M, Walker SAN, Simor A, Daneman N. Prospective audit and feedback of antimicrobial stewardship in critical care: program implementation, experience, and challenges. Can J Hosp Pharm. 2012;65(1):31–6. Available from:

  http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3282196/

  Describes the development of a custom-built database for Sunnybrook Health Sciences Centre's antimicrobial stewardship program, which integrates patient information, facilitates clinical tracking and identifies patients who meet criteria for review by the stewardship team.

Tools and Resources

- Consult with individuals at other institutions who have experience implementing and/or customizing electronic CDSSs.

Samples/Examples

- Example: The Scarborough Hospital - ICNet System Sample Automated Alerts

These documents have been generously shared by various health care institutions to help others develop and build their antimicrobial stewardship programs. We recommend crediting an institution when adopting a specific tool/form/pathway in its original form.

Examples that contain clinical or therapeutic recommendations may not necessarily be consistent with published guidelines, or be appropriate or directly applicable to other institutions. All examples should be considered in the context of the institution's population, setting and local antibiogram.

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Links with Other Strategies

- Can facilitate many stewardship activities and therefore has links with many strategies.

Disclaimer

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For further information

Antimicrobial Stewardship Program, Infection Prevention and Control, Public Health Ontario.

Email: asp@oahpp.ca

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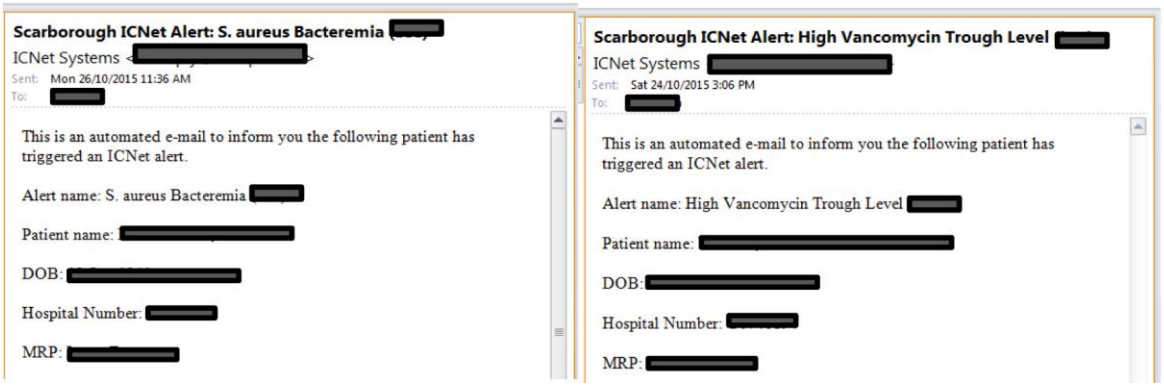
Example: The Scarborough Hospital - ICNet System Sample Automated Alerts

Sample Automated Email Alerts for +ve cultures or drug levels that exceed a predefined level



Scarborough ICNet Alert: S. aureus Bacteremia [redacted]

ICNet Systems <[redacted]>

Sent: Mon 26/10/2015 11:36 AM

To: [redacted]

This is an automated e-mail to inform you the following patient has triggered an ICNet alert.

Alert name: S. aureus Bacteremia [redacted]

Patient name: [redacted]

DOB: [redacted]

Hospital Number: [redacted]

MRP: [redacted]

Scarborough ICNet Alert: High Vancomycin Trough Level [redacted]

ICNet Systems [redacted]

Sent: Sat 24/10/2015 3:06 PM

To: [redacted]

This is an automated e-mail to inform you the following patient has triggered an ICNet alert.

Alert name: High Vancomycin Trough Level [redacted]

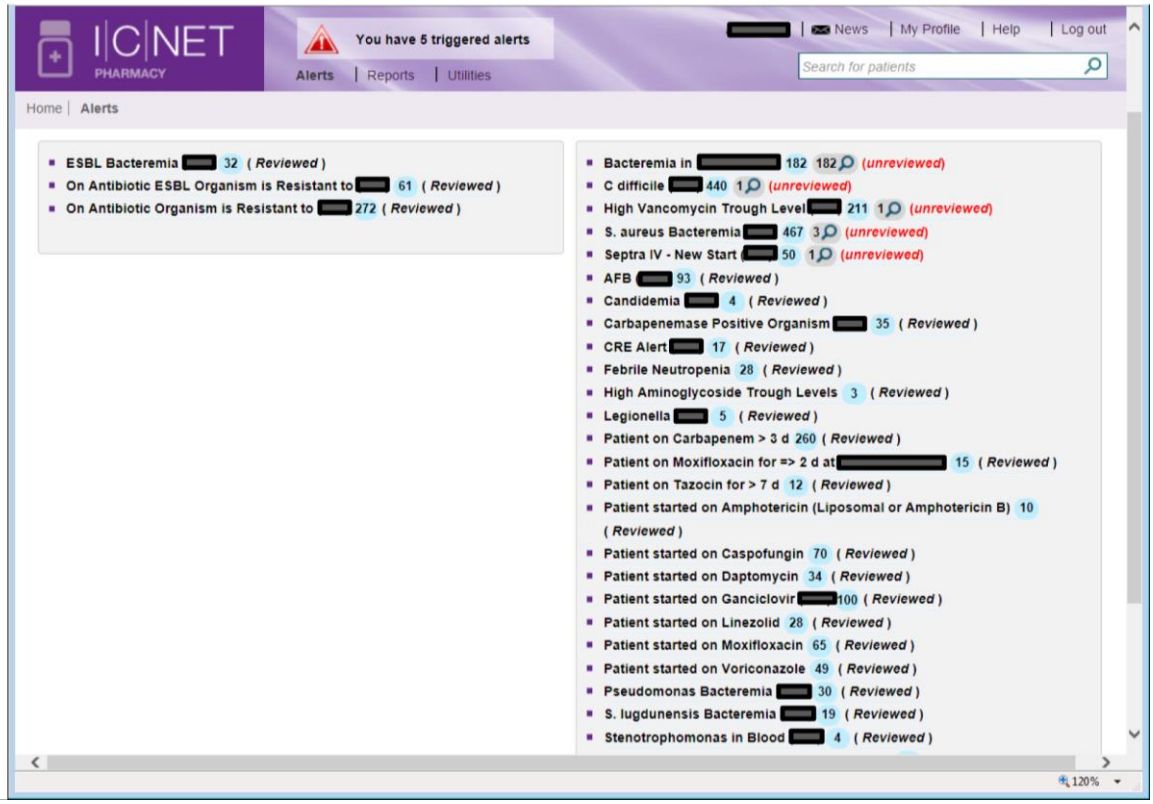
Patient name: [redacted]

DOB: [redacted]

Hospital Number: [redacted]

MRP: [redacted]

Other alerts (browser view)



ICNET PHARMACY

You have 5 triggered alerts

Alerts | Reports | Utilities

[redacted] | News | My Profile | Help | Log out

Search for patients

Home | Alerts

- ESBL Bacteremia [redacted] 32 (*Reviewed*)
- On Antibiotic ESBL Organism is Resistant to [redacted] 61 (*Reviewed*)
- On Antibiotic Organism is Resistant to [redacted] 272 (*Reviewed*)

- Bacteremia in [redacted] 182 182 (*unreviewed*)
- C difficile [redacted] 440 1 (*unreviewed*)
- High Vancomycin Trough Level [redacted] 211 1 (*unreviewed*)
- S. aureus Bacteremia [redacted] 467 3 (*unreviewed*)
- Septra IV - New Start [redacted] 50 1 (*unreviewed*)
- AFB [redacted] 93 (*Reviewed*)
- Candidemia [redacted] 4 (*Reviewed*)
- Carbapenemase Positive Organism [redacted] 35 (*Reviewed*)
- CRE Alert [redacted] 17 (*Reviewed*)
- Febrile Neutropenia 28 (*Reviewed*)
- High Aminoglycoside Trough Levels 3 (*Reviewed*)
- Legionella [redacted] 5 (*Reviewed*)
- Patient on Carbapenem > 3 d 260 (*Reviewed*)
- Patient on Moxifloxacin for => 2 d at [redacted] 15 (*Reviewed*)
- Patient on Tazocin for > 7 d 12 (*Reviewed*)
- Patient started on Amphotericin (Liposomal or Amphotericin B) 10 (*Reviewed*)
- Patient started on Caspofungin 70 (*Reviewed*)
- Patient started on Daptomycin 34 (*Reviewed*)
- Patient started on Ganciclovir [redacted] 100 (*Reviewed*)
- Patient started on Linezolid 28 (*Reviewed*)
- Patient started on Moxifloxacin 65 (*Reviewed*)
- Patient started on Voriconazole 49 (*Reviewed*)
- Pseudomonas Bacteremia [redacted] 30 (*Reviewed*)
- S. lugdunensis Bacteremia [redacted] 19 (*Reviewed*)
- Stenotrophomonas in Blood [redacted] 4 (*Reviewed*)

120%

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