# The Use of Clinical Decision Support Systems to Enhance the Role of Antimicrobial Stewardship

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Nebraska Antimicrobial Stewardship Summit: August 12, 2022

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## Objectives

- Review regulatory requirements and the available clinical decision support systems (CDSSs) for antimicrobial stewardship (AMS)
- Implement AMS interventions using CDSSs and electronic health records (EHRs) into clinical workflow
- Utilize reports generated from CDSSs or EHRs to support AMS activities and interventions

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# Background

- Antimicrobial stewardship (AMS) standards and regulatory requirements increasing, with demands on healthcare systems to meet
- AMS activities have been shown to optimize antimicrobial use and clinical outcomes while decreasing costs
- Information technology (IT) incorporated into AMS practices = improved efficiency and effectiveness

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Kuper KM, *et al. Infect Control and Hosp Epidemiol* 2019, 40: 501-511.
Akpan MR, *et al. Antibiotics* 2016; 5(1): 1-16.

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# CDC Core Elements of AMS for Hospitals

- Key support needed for successful AMS in hospitals - **this includes IT staff!**
- **Examples of IT support for AMS:**
  - Embedding relevant information and protocols at the point of care
  - Implementing clinical decision support for antibiotic use and creating prompts for action to review antibiotics in key situations
  - Facilitating and maintaining antimicrobial use and resistance reporting

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CDC. US Department of Health and Human Services, CDC; 2019.

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# Regulatory Recommendations

**CDC Core Elements of Antimicrobial Stewardship for Hospitals**

- Tracking
  - Recommends monitoring antibiotic use through reporting to the National Healthcare Safety Network (NHSN) Antibiotic Use module or days of therapy per 1,000 patient days
- Reporting
  - Recommends sharing summary information on antibiotic use with leadership, providers, pharmacists, and other healthcare professionals

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CDC. US Department of Health and Human Services, CDC; 2019. 5

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# Regulatory Recommendations

**The Joint Commission**

- New recommendations will be effective January 1st, 2023
  - "EP 16 (new): The antibiotic stewardship program monitors the hospital's antibiotic use by analyzing data on days of therapy per 1000 days present or 1000 patient days, or by reporting antibiotic use data to the NHSN Antimicrobial Use Option of the Antimicrobial Use and Resistance Module."

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The Joint Commission. Issue 35, June 20, 2022. 6

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# Clinical Decision Support Systems (CDSSs)

- Two common types of CDSSs for antimicrobial stewardship:
  - **EHR Based Systems**
    - Availability and functionality varies between types of EHR
    - May be an add-on purchase for stewardship-specific module(s)
    - Examples: EPIC, Cerner, Meditech
  - **Add-on CDSSs**
    - Runs parallel to EHR
    - Dependent on data that can be extracted from EHR (data flows one way from EHR >> add-on CDSSs)
    - Examples: Sentri 7, TheraDoc, VigiLanz

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Forrest GN, *et al. Clin Infect Dis* 2014; 59(Suppl 3): S122-S133.
Kullar R, *et al. Clin Infect Dis* 2013; 57: 1005-13.
Kuper KM, *et al. Infect Control and Hosp Epidemiol* 2019, 40: 501-511.

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# CDSSs Strengths/Limitations

| | Strengths | Limitations |
|---|---|---|
| **EHR** | • Less initial interface development<br>• AMS recs accessible to provider at order entry<br>• One centralized system for communication and documentation<br>• Better access to retrospective admin and clinical data | • Tailoring rules/alerts requires more IT input initially and long-term - rely heavily on hospital IT team<br>• Offers less end user customization<br>• Less real time adaptability<br>• Stewardship program requires additional purchase<br>• Limited options for resource challenged settings |
| **Add-on CDSSs** | • Low cost alternatives for resource challenged settings<br>• Real time adaptability<br>• Rules and alerts can be modified with little IT support<br>• Version can be standardized across multiple institutions<br>• End-user friendly | • One way data stream (EHR >> Add-on CDSSs) requires more IT work up front<br>• Toggling between multiple systems less efficient<br>• Updates to EHR need to be tailored to Add-on CDSSs - may not be aware<br>• Less retrospective data available<br>• Duplication or omission of data from EHR |

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Forrest GN, *et al. Clin Infect Dis* 2014; 59(Suppl 3): S122-S133.
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Kuper KM, *et al. Infect Control and Hosp Epidemiol* 2019, 40: 501-511.

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# CDSSs Practical Role in AMS

- Helps improve efficiency and effectiveness of daily AMS workload/activities
- Can be used to track antimicrobial utilization and clinical outcomes
- Could help evaluate opportunities for improvement through well-built reports on regular basis

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Forrest GN, *et al. Clin Infect Dis* 2014; 59(Suppl 3): S122-S133.
Kullar R, *et al. Clin Infect Dis* 2013; 57: 1005-13.
Kuper KM, *et al. Infect Control and Hosp Epidemiol* 2019, 40: 501-511.

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# CDSSs and Daily Stewardship Functions

- Empiric antimicrobial selection
- Post prescription antimicrobial review
- Diagnostic testing stewardship
- Communication
- Syndrome specific management

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Forrest GN, *et al. Clin Infect Dis* 2014; 59(Suppl 3): S122-S133.
Kullar R, *et al. Clin Infect Dis* 2013; 57: 1005-13.
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# Clinical Workflow



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## Priority Interventions

- **Prospective audit and feedback**
  - External review of antibiotic therapy by an expert
  - Accompanied by suggestions to optimize use at some point after prescription
- **Preauthorization**
  - Requires approval prior to the use of certain antibiotics
  - Optimize use while also preventing unnecessary initiation
  - Focus to improve use, not drug cost!
- **Facility- specific treatment guidelines**
  - Enhance both prospective audit/feedback and preauthorization
  - Establishes clear recommendations for optimal use

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CDC. US Department of Health and Human Services, CDC; 2019. 12

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# Clinical Decision Support Alerts

PID: [redacted] Title: Relevant culture: Blood
Room: SFMC5MSORT Alert: 145796302 rev: 0 ()
[redacted]

**Relevant culture: Blood** Admit Diagnosis: Private

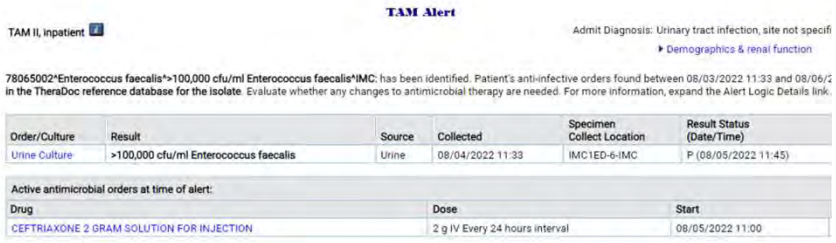
Demographics & renal function

| | |
|---|---|
| Age: Private | Sex: Private |
| SCr: 0.73 (08/05/2022) | Height: Private |
| CrCl: 50 mL/min(Cockcroft-Gault; weight used=64 kg) | Weight: Private |

Possible relevant Blood culture identified.

Blood Culture: ([redacted])
**Alert organism:** Escherichia coli detected.
**Specimen source:** Blood (Collected: 08/04/2022 21:08:00)

- Consider subscribing to email alerts for high-priority results
- Build alerts/reports to identify actionable AMS interventions



**TAM Alert**

TAM II, inpatient

Admit Diagnosis: Urinary tract infection, site not specifi

▸ Demographics & renal function

**78065002*Enterococcus faecalis*>100,000 cfu/ml Enterococcus faecalis*IMC:** has been identified. Patient's anti-infective orders found between 08/03/2022 11:33 and 08/06/2 **in the TheraDoc reference database for the isolate**. Evaluate whether any changes to antimicrobial therapy are needed. For more information, expand the Alert Logic Details link.

| Order/Culture | Result | Source | Collected | Specimen Collect Location | Result Status (Date/Time) |
|---|---|---|---|---|---|
| Urine Culture | >100,000 cfu/ml Enterococcus faecalis | Urine | 08/04/2022 11:33 | IMC1ED-6-IMC | P (08/05/2022 11:45) |

Active antimicrobial orders at time of alert:

| Drug | Dose | Start |
|---|---|---|
| CEFTRIAXONE 2 GRAM SOLUTION FOR INJECTION | 2 g IV Every 24 hours interval | 08/05/2022 11:00 |

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# Clinical Decision Support Alerts

- **Microbiology results**
  - Positive blood cultures*
  - Cdiff*
  - ESBL/CRE*
  - Influenza/COVID/viral pathogen panels
  - Meningitis PCR results
  - Pneumococcal and legionella urine antigens

**<u>*Recommend email alerts for quick action</u>**

- **Bug-drug alerts**
  - MRSA respiratory cultures on daptomycin
  - MRSA on vancomycin with MIC >/= 2
  - MSSA on anti-MRSA therapy
- **Therapy alerts**
  - Targeted antimicrobials
  - All antimicrobials > 72 hours
  - Redundant antimicrobial therapy (anaerobic, antifungal, beta-lactam)

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# EMR Patient Lists

- Organize patient lists to easily show important AMS information at a quick glance
- If available, utilize “My Sticky Note” or similar option to leave notes not able to be pulled in automatically from EHR (ex. micro results)


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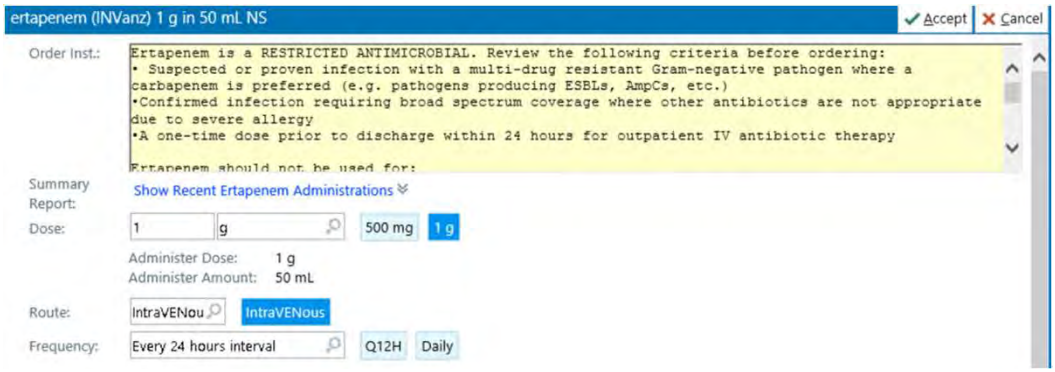
# Targeted Antimicrobials

- Appropriate use criteria/policy approved through AMS committee and P&T
- Criteria built into EHR and displays upon order entry, selection of appropriate criteria for use then required to complete order entry

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# Preauthorization Assessment and Documentation

- Utilize SmartPhrases in EHR to build preauthorization use criteria into checklist for pharmacist
- Simplifies process for those interpreting the criteria
- Allows for consistent and complete documentation among all pharmacists

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# Preauthorization Assessment and Documentation

**CHI Health Remdesivir Use Criteria**

**Name:** @NAME@
**Date of Service:** @FDATE@
**Reason for Admission**: @PPROB@

**{Is the patient requiring supplemental oxygen?:40967}**

**If any the above criteria are not met, please contact the ordering provider to clarify. The provider may need to contact the local site representative for approval.**

Provider contacted:
Date/time:

Brief notes from discussion and result:

**YES, patient is requiring supplemental oxygen**

**If the patient is requiring supplemental oxygen above their baseline, all of the following criteria must be met for remdesivir use:**

- Confirmed SARS-CoV-2: {YES / NO:23736}
- Positive test was within last 14 days: {YES / NO:23736}
- ALT < 780 (10x ULN): {YES / NO:23736}
- Requiring 2 or more liters of oxygen per nasal cannula, or requiring ECMO, invasive intubation, or non-invasive intubation: {YES / No:23736}
- Steroids ordered: {YES / NO:23736}

**NO, patient is NOT requiring supplemental oxygen**

**If the patient is NOT requiring supplemental oxygen (or is on baseline oxygen needs), the following criteria must be met to be considered for a 3 day course of remdesivir:**

- Confirmed SARS-CoV-2: {YES / NO:23736}
- Symptomatic (see below) with symptom onset within last 7 days: {YES / NO:23736}
  - Possible symptoms include: fever, cough, sore throat, nausea/vomiting/diarrhea, congestion/runny nose, new muscle pain or body aches, headaches, loss of taste or smell
- ALT < 780 (10x ULN): {YES / No:23736}
- Remdesivir order is for 3 days (200 mg IV x1 on day 1, followed by 100 mg IV Q24H on days 2 & 3): {YES / No:23736}
- {Please select ONE of the following:40970}

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# Infection and Syndrome Specific Interventions

- Community-acquired pneumonia
- Urinary tract infections
- Skin and soft tissue infections
- MRSA
- *Clostridioides difficile*
- Culture proven invasive infections

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CDC. US Department of Health and Human Services, CDC; 2019. 19

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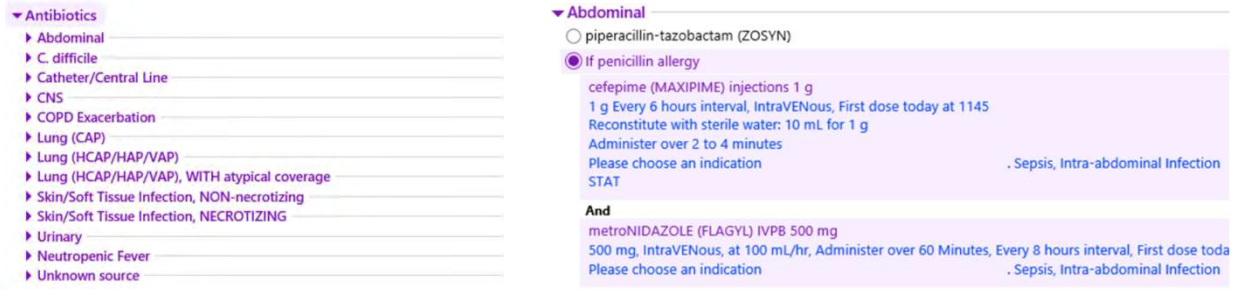
# Order Sets

**Incorporate facility-specific antimicrobial recommendations into order sets with clear guidance**

- Antibiotics sorted by suspected source of infection
- Offers alternatives for patients with allergies
- Make sure to include other diagnostic tests such as blood cultures, sputum culture, MRSA nares, and procalcitonin (consider pre-selecting for providers)

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# Order Sets

- Surgical prophylaxis recommendations are built into order panels that feed into all peri-operative order sets based on procedure type
- Ensures adequate dosing/timing/duration
- Ensures consistency with one location for updating when changes need to be made (versus each order set)

| Check Indication | Surgery Type | Pre-Op Antibiotic and Dose | Intra-Op Re-dosing Interval | Post-Op Antimicrobial and dose |
|---|---|---|---|---|
| ☐ | **ABDOMINAL** Appendectomy, biliary, colorectal surgery, gastroduodenal, or small intestine | Cefoxitin 2 grams (3 grams ≥120 kg) IV x1<br>OR<br>☐ Cefazolin 2 grams (3 grams ≥120 kg) IV x1 + Metronidazole 500 mg IV x1<br>OR<br>☐ Ceftriaxone 2 grams IV x1 + Metronidazole 500 mg IV x1<br>**Allergy:** Metronidazole 500 mg IV x1 + Levofloxacin 500 mg IV x1<br>**If allergic to above recommended options:** Gentamicin 5 mg/kg IV x1 + Metronidazole 500 mg IV x1 | Cefoxitin 2 grams IV q.2h.<br>Cefazolin 2 grams IV q.3h. | Cefoxitin 2 grams IV q.8h. x24 hrs<br>Cefazolin 2 grams IV q.8h. x24 hrs + Metronidazole 500 mg IV q.8h. x24 hrs<br>Ceftriaxone 2 grams IV x1 + Metronidazole 500 mg IV q.8h. x24 hrs<br>**Allergy:** Metronidazole 500 mg IV q.8h. x24 hrs + Levofloxacin 500 mg IV x1<br>OR<br>Metronidazole 500 mg IV q.8h. x24 hrs + Gentamicin 5 mg/kg IV x1<br>**Clinical evidence/guidelines do not support the need for post-op antibiotic prophylaxis in this surgery category, however if post-op dosing is desired, utilize the above options.* |
| ☐ | **CARDIAC** Coronary artery bypass graft (CABG), CABG with valve implant, transcatheter aortic valve replacement (TAVR), pacemaker and other implants | Cefazolin 2 grams IV (3 grams ≥120 kg) x1<br>(Substitute vancomycin in pre-op screening with scheduled procedures is positive for MRSA.)<br>**Allergy:** Vancomycin 15 mg/kg IV x1 | Cefazolin 2 grams IV q.3h. | ☐ **Open Heart:** Cefazolin 2 grams IV q.8h. x48 hrs **Allergy:** Vancomycin 15 mg/kg IV q.12h. x 48 hrs<br>☐ **TAVR, Pacer, Other:** Cefazolin 2 grams IV q.8h. x24 hrs **Allergy:** Vancomycin 15 mg/kg IV q.12h. x24 hrs |

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# Provider-Based Interventions

- **Antibiotic "timeouts" at 48-72 hrs of therapy**
  - Shown to improve appropriateness of antibiotic selection, but may not reduce overall antibiotic use
  - Consider best practice alert "pop up" or antibiotic "soft stop" to prompt provider review
- **Assessing penicillin allergy**
  - 15% of hospitalized patients report allergy, however, less than 1% of US population has serious reaction
  - Adequate history and physical examination, challenge doses, and skin testing
  - Note in EHR allergy history if patient has tolerated beta-lactams previously

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CDC. US Department of Health and Human Services, CDC; 2019. 22

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# Pharmacy-Driven Interventions

- Automatic IV to PO
- Dose adjustments for organ dysfunction
- Dose optimization
- Duplicate therapy alerts
- Time-sensitive automatic stop orders
- Drug-drug interactions

**Build alerts into CDSS for <u>all</u> pharmacists to incorporate into workflow!**

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CDC. US Department of Health and Human Services, CDC; 2019. 23

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# Microbiology-Based Interventions

- Selective reporting of antimicrobial susceptibility
- Comments in microbiology reports

| Component | |
|---|---|
| MICROBIOLOGY FINAL REPORT | !<br>>100,000 cfu/ml Escherichia coli Isolate produces an Extended Spectrum Beta-Lactamase and is considered resistant to all penicillins, cephalosporins and aztreonam. For infections caused by ESBL producing isolates, the drug of choice is a carbapenem.<br>Infectious Disease consult recommended. Use of piperacillin/tazobactam for the treatment of infections caused by ESBL producing isolates is controversial. |
| Organism ID, Bacteria | Escherichia coli ! |

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CDC. US Department of Health and Human Services, CDC; 2019. 24

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## Nursing-Based Interventions

- Optimizing microbiology culture collection
- IV to PO transitions
- Prompting antibiotic “timeouts”

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CDC. US Department of Health and Human Services, CDC; 2019. 25

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# Reports

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# Antibiotic Use Reports

- Days of therapy (DOT) / 1000 patient days
  - Uses the DOT for an antimicrobial divided by the number of patient days present for a facility
  - Examples of use:
    - Trend use over time following implementation of an intervention (i.e., new use criteria, education)
    - Combine antimicrobial types for trend (i.e., anti-Pseudomonal beta-lactams, anti-MRSA)

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# Antibiotic Use Reports


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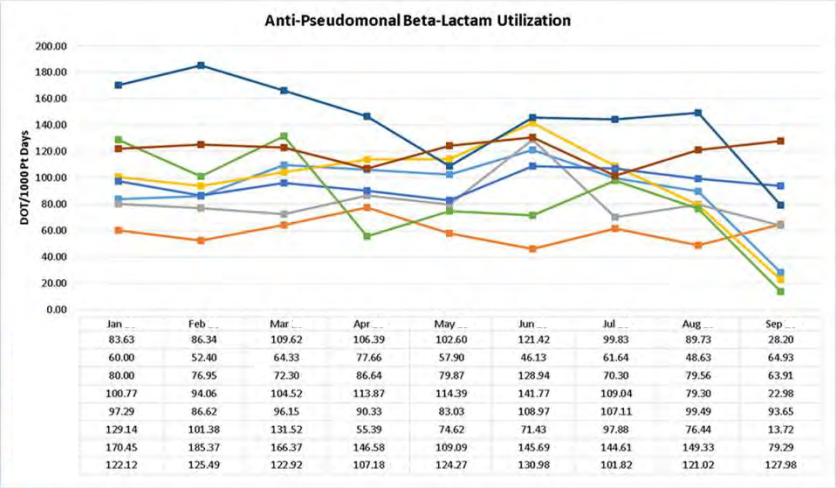
# Antibiotic Use Reports




| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|---|---|---|
| 83.63 | 86.34 | 109.62 | 106.39 | 102.60 | 121.42 | 99.83 | 89.73 | 28.20 |
| 60.00 | 52.40 | 64.33 | 77.66 | 57.90 | 46.13 | 61.64 | 48.63 | 64.93 |
| 80.00 | 76.95 | 72.30 | 86.64 | 79.87 | 128.94 | 70.30 | 79.56 | 63.91 |
| 100.77 | 94.06 | 104.52 | 113.87 | 114.39 | 141.77 | 109.04 | 79.30 | 22.98 |
| 97.29 | 86.62 | 96.15 | 90.33 | 83.03 | 108.97 | 107.11 | 99.49 | 93.65 |
| 129.14 | 101.38 | 131.52 | 55.39 | 74.62 | 71.43 | 97.88 | 76.44 | 13.72 |
| 170.45 | 185.37 | 166.37 | 146.58 | 109.09 | 145.69 | 144.61 | 149.33 | 79.29 |
| 122.12 | 125.49 | 122.92 | 107.18 | 124.27 | 130.98 | 101.82 | 121.02 | 127.98 |

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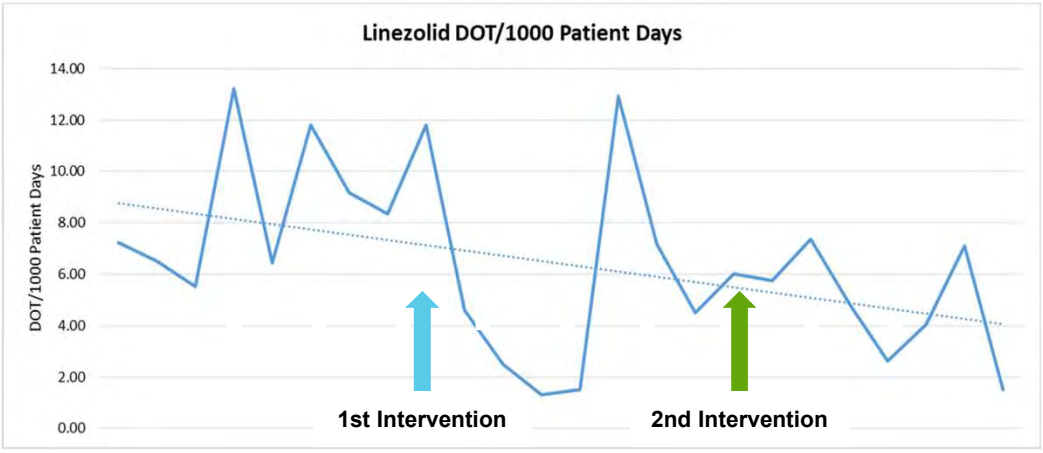
# Antibiotic Use Reports

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# Antibiotic Use Reports

- NHSN Antibiotic Use module
  - Some electronic systems allow users to submit antibiotic use data directly to NHSN after validation of the data
  - NHSN will generate a standardized antimicrobial administration ratio (SAAR), as well as DOT reports
  - Consider discussing this option with vendors about submission options

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# Other Types Reports

- IV vs PO reports
  - Review highly bioavailable antibiotics and the percent given PO
  - Consider setting a goal to encourage more PO antibiotic use

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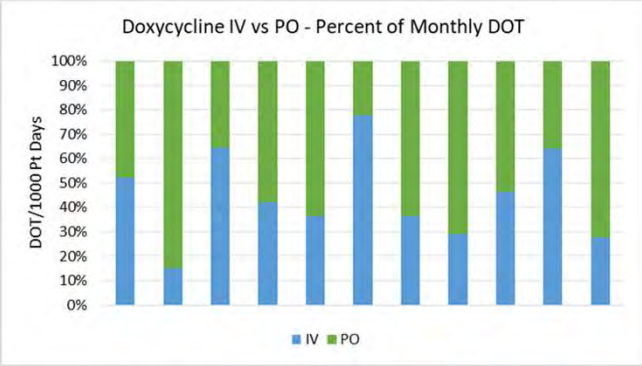
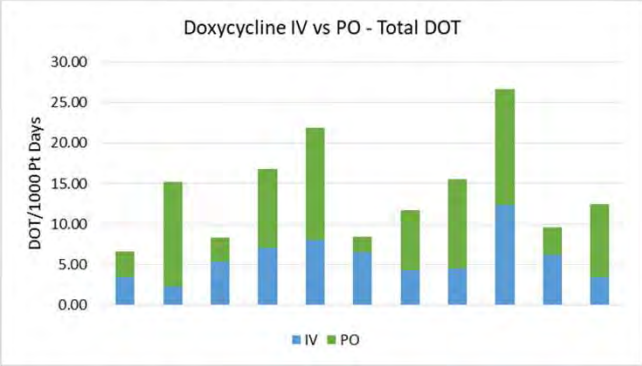
# Other Types Reports

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# Other Types of Reports

- Indication specific reports
  - Pull antibiotics used based on specific indications and review for adherence to local or national guidelines
  - Can target common infections (i.e., community acquired pneumonia) or antimicrobials (i.e., fluoroquinolones)

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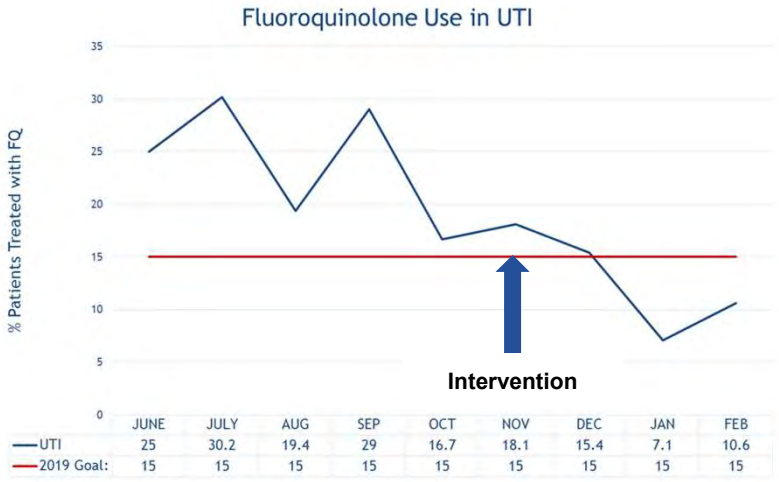
# Other Types of Reports




| | JUNE | JULY | AUG | SEP | OCT | NOV | DEC | JAN | FEB |
|---|---|---|---|---|---|---|---|---|---|
| UTI | 25 | 30.2 | 19.4 | 29 | 16.7 | 18.1 | 15.4 | 7.1 | 10.6 |
| 2019 Goal: | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |

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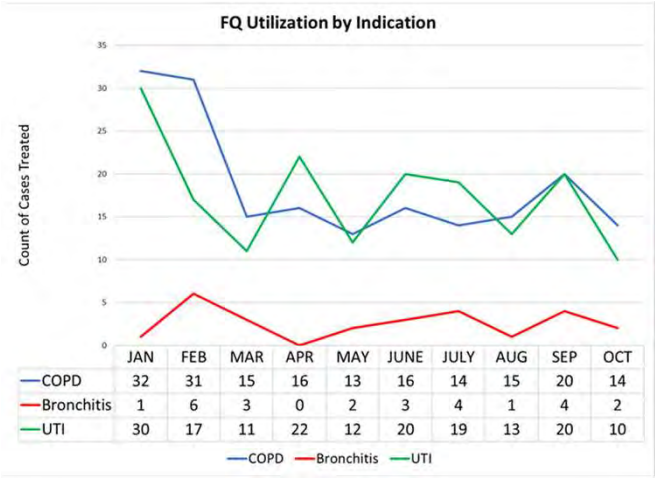
# Other Types of Reports




| | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEP | OCT |
|---|---|---|---|---|---|---|---|---|---|---|
| COPD | 32 | 31 | 15 | 16 | 13 | 16 | 14 | 15 | 20 | 14 |
| Bronchitis | 1 | 6 | 3 | 0 | 2 | 3 | 4 | 1 | 4 | 2 |
| UTI | 30 | 17 | 11 | 22 | 12 | 20 | 19 | 13 | 20 | 10 |

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# Other Types of Reports

- Provider report cards
  - Create reports to compare providers to based on use of specific antimicrobials or durations of therapy
  - Allows for peer-to-peer comparison which can influence prescribing habits
  - May require export to another program for analysis

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# Where do we go from here?

- **First step:** consider an IT needs assessment and resource evaluation
  - What data is accessible under current model?
  - How easy is it to obtain information in a usable format/upon request?
- **Examples of antimicrobial stewardship specific needs:**
  - What metrics are available to track antibiotic use?
  - Ability to track interventions and acceptance rates?
  - Ability to customize list for monitoring?
  - Identifies common interventions (ex. duplicate therapy, treatment duration, IV to PO)
  - Dashboard present?

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Kuper KM, *et al. Infect Control and Hosp Epidemiol* 2019, 40: 501-511. 38

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# Where do we go from here?

- Based on needs assessment can further determine if purchasing an EHR module or add-on CDSSs would be warranted or feasible
  - Financial implications
  - IT support and functionality
- Crucial to identify key stakeholders before determining which CDSS is best for your institution

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Kuper KM, *et al. Infect Control and Hosp Epidemiol* 2019, 40: 501-511. 39

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# Summary

- CDSSs available for AMS programs include both EHR and add-on CDSSs - both of which can be used to help meet regulatory requirements and optimize AMS daily workflow/patient outcomes
- AMS interventions can be implemented in a variety of ways using CDSSs and the EHR
- Reports generated from CDSS or EHR data can be utilized to demonstrate the effectiveness of an AMS program

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