Using Clinical Decision Support (CDS): Meeting Quality Measures and Beyond

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Learning Objectives

At the conclusion of this presentation, the learner should be able to:

1. List ways clinical decision support can be used to assist pharmacists in patient care activities
2. Describe examples of clinical decision support utilization by an antimicrobial stewardship team at one health system and the impact on national quality measures and patient outcomes

Clinical Decision Support (CDS) and Clinical Decision Support Software (CDSS)

- Rules that integrate order information, patient information, and clinical practice guidelines into computer system logic that provide feedback to clinicians

<table>
<thead>
<tr>
<th>Examples of EHR Systems and Stand-Alone CDSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allscripts Summit (EHR)</td>
</tr>
<tr>
<td>Cerner Corporation (EHR)</td>
</tr>
<tr>
<td>Epic Systems Corporation (EHR)</td>
</tr>
<tr>
<td>i2tNet</td>
</tr>
<tr>
<td>InSight by Asolva, Inc</td>
</tr>
<tr>
<td>MedMined by CareFusion</td>
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<tr>
<td>MedNet</td>
</tr>
<tr>
<td>MyScript by Vecru Technologies</td>
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<td>Pathfinder by Vecru Technologies</td>
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<tr>
<td>RL Solutions</td>
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<tr>
<td>Premier SafetySurveillor</td>
</tr>
<tr>
<td>Senti7 by PharmacyOneSource</td>
</tr>
<tr>
<td>TheraDoc by Premier</td>
</tr>
<tr>
<td>VigiLanz Corporation</td>
</tr>
<tr>
<td>WHONET</td>
</tr>
</tbody>
</table>

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CDS: Meeting Quality Measures and BEyond
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Examples of Clinical Decision Support (CDS) Functionality

- Pre-populate orders/order sets
- Require criteria/documentation during order entry
- Warnings at time of order entry
  - Informational
  - “Soft Stops”
  - “Hard Stops”
- Alert generation based on criteria
- Automated contact (pager, phone/text, e-mail)
- Documenting interventions

Potential Roles of Clinical Decision Support Software (CDSS) in Pharmacists’ Practice

- Efficiently identify target patients
- Facilitate communication
- Customizable and rapid documentation
- Integrated data retrieval and analysis
- Real-time alerting through text page, phone or email

Potential Impact of CDS / CDSS

- Reduce medication errors
- Increase efficiency
  - Identify target population(s) or interventions
  - Increase pharmacist time for direct patient care
- Decrease inappropriate medication utilization
- Improve documentation/analysis of interventions
- Improve cost-savings / cost-avoidance
- Improve compliance with quality measures
- Improved patient outcomes

**Infectious Diseases-Related Performance Measures**

- Increasing focus on quality & patient outcomes
- 85 quality performance measures or clinical outcomes measures publicly reported
  - Management of *S. aureus* bacteremia
  - Outcomes and readmissions for pneumonia
  - Outcomes for bacteremia in dialysis patients
  - Hospital-acquired *C. difficile* infection
- Unique opportunity to collaborate with other healthcare providers to demonstrate value
- Optimization of CDS to improve compliance with quality measures and improve patient outcomes

**Examples of CDSS to Improve Outcomes**

- **Bacteremia Management**
  - MALDI-TOF/CDSS real-time alerting
  - *S. aureus* Bacteremia Bundle
  - Candidemia Bundle
- **SCIP-Inf-2: UMHS OR White Board Project**
- **Anticoagulation/VTE Measures**
  - VTE Prophylaxis
  - Anticoagulation Education/Transition of Care
- **Other examples:**
  - HIV Medication Review

**Using CDS for Real-Time Review of Blood Cultures**

- **Pre-Intervention Group (3 months, n = 256):**
  - Patients/pathogens identified via standard identification methods
  - No additional stewardship team notification or intervention
- **Intervention Group (3 months, n = 245):**
  - Rapid organism identification via Matrix-Assisted Laser Desorption/Ionization-Time Of Flight (MALDI-TOF)
  - CDS to notify stewardship team in real-time (paging/e-mail)
  - Intervention on Gram-stain, pathogen identification, and susceptibility results

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Utilizing CDSS to Receive Real-time Alerts for Positive Blood Cultures

Impact of MALDI-TOF on Microbiologic Outcomes

Antibiotic-Related Outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Pre-Interv (n=256)</th>
<th>Interv (n=245)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Received Effective Therapy (%)</td>
<td>237 (92.6)</td>
<td>231 (94.3)</td>
<td>0.476</td>
</tr>
<tr>
<td>Time to Effective Therapy (hrs)</td>
<td>30.1±67.7</td>
<td>20.4±20.7</td>
<td>0.021</td>
</tr>
<tr>
<td>Received Optimal Therapy (%)</td>
<td>223 (87.1)</td>
<td>237 (96.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Time to Optimal Therapy (hrs)</td>
<td>90.3±75.4</td>
<td>47.3±121.5</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
### Clinical Outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Pre-Interv (n=256)</th>
<th>Interv (n=245)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-day all-cause Mortality (%)</td>
<td>20.3%</td>
<td>12.7%</td>
<td>0.021</td>
</tr>
<tr>
<td>Clinical Cure (%)</td>
<td>86.7%</td>
<td>90.2%</td>
<td>0.254</td>
</tr>
<tr>
<td>Time to Clinical Cure (days)</td>
<td>3.97</td>
<td>2.50</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Microbiological Cure (%)</td>
<td>86.7%</td>
<td>90.6%</td>
<td>0.205</td>
</tr>
<tr>
<td>Time to Micro Cure (days)</td>
<td>3.3 ± 4.8</td>
<td>3.3 ± 5.7</td>
<td>0.928</td>
</tr>
<tr>
<td>Recurrence of BSI</td>
<td>5.9%</td>
<td>2%</td>
<td>0.038</td>
</tr>
<tr>
<td>Length of Hospitalization (days)</td>
<td>14.2 ± 20.6</td>
<td>11.4 ± 12.9</td>
<td>0.066</td>
</tr>
<tr>
<td>Length of ICU Stay (days)</td>
<td>14.9 ± 24.2</td>
<td>8.3 ± 9</td>
<td>0.014</td>
</tr>
</tbody>
</table>

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### Kaplan Meier Analysis for 30-Day All-Cause Mortality

![Kaplan Meier Analysis](image)

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### Cost Avoidance per Patient Based on Billing Data

![Cost Avoidance](image)

Cost avoidance for 3-month intervention period: $4.8 million

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Stewardship Interventions

- The Stewardship team made a total of 210 interventions
  - 189 interventions were accepted (90.4% acceptance rate)

### Time of Intervention (N=210)

- Gram stain
- Organism ID
- Sensitivities

### Type of Intervention (N=210)

- Broadened Therapy
- Narrowed Coverage (based on organism)
- Narrowed Coverage (excess coverage stopped)
- Other

Comprehensive Collaborative Approach to Improving Outcomes with *S. aureus* Bacteremia

- Initiate empiric antibiotics
- Recommend obtaining cultures until clearance
- If MSSA, recommend β-lactam therapy
- Make antibiotic adjustments, if necessary

Pharmacy:
- Receives real-time alerts for positive blood cultures, speciation, and susceptibilities from Microbiology
- Optimizes vancomycin dosing

GPC in clusters:
- *S. aureus* identification via MALDI-TOF
- Susceptibilities

Reassess therapy at 72 hours and 5 days

- Recommend ID Consultation
- Eliminate foci of infection, obtain echo if complicated bacteremia, prescribe appropriate duration of therapy

Overall Bundle Compliance to Quality Performance Measures for *S. aureus* Bacteremia

- n = 88
- n = 152

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Compliance with Individual Measures for S. aureus Bacteremia

<table>
<thead>
<tr>
<th>Performance measure</th>
<th>Historic Group</th>
<th>Intervention Group</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empiric antibiotics w/in 24 hrs of Gram Stain</td>
<td>97.4%</td>
<td>98.9%</td>
<td>0.656</td>
</tr>
<tr>
<td>Appropriate duration of therapy</td>
<td>84.4%</td>
<td>94.9%</td>
<td>0.025</td>
</tr>
<tr>
<td>Beta-lactam therapy for MSSA</td>
<td>88.9%</td>
<td>94%</td>
<td>0.386</td>
</tr>
<tr>
<td>Appropriate vancomycin trough</td>
<td>91.9%</td>
<td>97.6%</td>
<td>0.419</td>
</tr>
<tr>
<td>Echo for complicated bacteremia</td>
<td>92.9%</td>
<td>98.3%</td>
<td>0.26</td>
</tr>
<tr>
<td>Source control</td>
<td>85.9%</td>
<td>97.2%</td>
<td>0.09</td>
</tr>
<tr>
<td>Repeat cultures</td>
<td>85.7%</td>
<td>96.5%</td>
<td>0.008</td>
</tr>
</tbody>
</table>

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Outcomes: S. aureus Bacteremia Bundle

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Historic Group</th>
<th>Intervention Group</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>15.1%</td>
<td>11.4%</td>
<td>0.445</td>
</tr>
<tr>
<td>Length of stay (days, median)</td>
<td>10</td>
<td>12</td>
<td>0.044</td>
</tr>
<tr>
<td>30-Day re-admission with bacteremia</td>
<td>9.2%</td>
<td>1.1%</td>
<td>0.012</td>
</tr>
<tr>
<td>Full Bundle Compliance w/ ID Consult</td>
<td>62.3%</td>
<td>81.2%</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

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Management of Candidemia through a Comprehensive Bundle

- Appropriate and timely antifungal therapy*
- Repeat blood cultures till negative*
- Ophthalmology exam*
- Remove intravenous catheters*
- Appropriate duration of antifungal therapy
- Determine if risk factors for disseminated disease were present and recommend ID consult

*IDSA Performance Measures
Comprehensive Candidemia Bundle

<table>
<thead>
<tr>
<th></th>
<th>Control Group (n=37)</th>
<th>Stewardship Group (n=42)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Bundle Compliance</td>
<td>40.5%</td>
<td>78%</td>
<td>0.0012</td>
</tr>
<tr>
<td>Appropriate therapy</td>
<td>86.5%</td>
<td>100%</td>
<td>0.0488</td>
</tr>
<tr>
<td>IV catheter removal</td>
<td>86.5%</td>
<td>95.1%</td>
<td>0.0494</td>
</tr>
<tr>
<td>Microbiologic clearance</td>
<td>78.4%</td>
<td>85.4%</td>
<td>0.0128</td>
</tr>
<tr>
<td>Appropriate duration</td>
<td>67.7%</td>
<td>97.6%</td>
<td>0.0012</td>
</tr>
<tr>
<td>Ophthalmology exam</td>
<td>75.7%</td>
<td>97.6%</td>
<td>0.0388</td>
</tr>
</tbody>
</table>

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SCIP-Inf: Antimicrobial Prophylaxis for Surgical Patients

• SCIP-Inf-2: Appropriate antibiotic prophylaxis

<table>
<thead>
<tr>
<th>Preferred Antibiotic</th>
<th>Alternative Antibiotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cefuroxim 1gm (2gm if &gt;80kg) OR</td>
<td>Levofoxacin 500mg (750mg if &gt;80kg) &amp; Clindamycin 600mg (900mg if &gt;80kg) OR</td>
</tr>
<tr>
<td>OR cefazolin 1gm (2gm if &gt;80kg) OR</td>
<td>Gentamicin 2mg/kg &amp; Clindamycin 600mg (900mg if &gt;80kg) OR</td>
</tr>
<tr>
<td>Or Ampicillin/subactam 1.5 gm (3gm if &gt;80kg) OR</td>
<td>Aztreonam 1gm (2gm if &gt;80kg) &amp; Clindamycin 600mg (900mg if &gt;80kg) OR</td>
</tr>
</tbody>
</table>

SCIP-Inf-2: UMHS OR White Board Project

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VTE-1: VTE Prophylaxis

- June – Dec 2013 = 26 interventions, 100% accepted, none based on alert
- Jan – May 2014 = 37 interventions, 100% accepted, 10 based on alert

VTE-5: Warfarin Patient Education

- Pt initiated on anticoagulant
- Page sent to service-based pharmacist pager
- Pharmacist evaluates documents, completes education during visit
- Discharge order -> page to pharmacist
- Pharmacist ensures education complete documented, completes summary info

Other Examples of CDS Impact on Quality Measures and Outcomes

- HIV Daily Therapy Review
  - Appropriate antiretroviral regimen
  - Drug-drug interactions
  - Appropriate prophylaxis
  - Need for hepatic or renal dose adjustment of prophylaxis or antiretroviral regimen
Potential Future Directions for CDSS

- Improve ability to identify patients based on diagnosis
- Improve ability to identify high-risk complex patients that may require intervention
  - Example: multiple comorbidities and pneumonia diagnosis are risk factors for 30-day readmission
- Link interventions with outcomes
- Increase documentation in medical record

NO SMALL FEAT...

- **Substantial** time & effort, input/expertise from all disciplines and IT team
- **No standard** amongst EHR or external CDS program vendors
- Lack of resources can be a major limitation
- Alerts/CDS may vary – what are the goals?
  - Cost management?
  - Medication utilization?
  - Clinical/patient outcomes?
  - Meeting quality measures?
  - All of the above!

Limitations to Technology and CDS

- Alerts overridden in 46% - 98% of cases (17 studies)
- Adverse events in 2.3 – 6% of cases with alert override

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Summary

- Use of CDS to improve quality measures and patient outcomes involves many factors:
  - Shifting focus can improve safety, outcomes
  - Multidisciplinary effort to implement, optimize & maintain
  - Requires significant time, effort, resources
  - Progress needed to improve systems, optimize use, avoid alert fatigue
- We ALL need to contribute!

THANK YOU!!

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