Management of the Hospitalized Patient

Computers in Hospital Medicine
CPOE and EMRs

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UCSF Medical Center
Computers in Hospital Medicine
CPOE and EMRs

Agenda

★ CPOE – everybody’s doing it, why don’t we?
★ What the practicing Hospitalist can do
★ Policy Trends – NHII, RHIOs, and CCHIT
★ Industry Trends – arrival of the big players
★ Open Discussion
Computers in Hospital Medicine
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★ Open Discussion
CPOE – the rationale

Errors in order writing are extremely common

Prospective, randomized examination of 4031 admissions to 11 care units at 2 hospitals:

- Adverse drug event rate of 6.5 per 100 admissions
- 56% were errors in drug ordering

CPOE – the rationale

**Errors in order writing are extremely common**

770,000 injuries and deaths from adverse drug events annually

- 28% are preventable medication errors
- 56% are professional errors at the time of ordering


Errors - magnitude of the problem

- ADEs are very expensive:
  - $2461 per ADE
  - $4555 per preventable ADE
- Excludes costs of:
  - Injury to patient
  - Malpractice coverage
  - Litigation
- Nationally, cost is $2.85B for Medicare alone
- UCSF numbers
  - $4.8M ADEs
  - $2.5M preventable ADEs

Bates, D., et. al., JAMA 1997; 277:307-311
Errors - magnitude of the problem

• Error rates vary widely
  – Voluntary reporting
  – Surveillance techniques
  – Patient populations

• 0.5% of orders contain an error
  – 7% result in potential ADEs
  – 1% result in an ADE

• 6.7% of admissions experience an ADE
Errors - magnitude of the problem

- 6.5 ADEs/100 admissions
- 28% preventable
- 3x potential ADEs for each preventable
- 62% of errors at ordering and transcription

Errors - Solutions

- Important to take a “systems” focus
  - Humans are error-prone
  - Punishing the individuals doesn’t work

- Culture of safety, not of blame
- Airline and nuclear power industries
- Fix the entire medication process
- cPOE with CDS can reduce preventable ADEs by 83%

Bates, et. al., J Am Med Informatics Assn, July 1999
It Is Hard to Crash an Airbus 340

• Can’t overspeed
• Can’t roll too steeply
• Can’t dive too quickly
• Can’t pull too many g’s
• Can’t crash it in to the ground
• Soon, can’t crash it in to anything (e.g. a building)

How hard is it to crash your patient?
Challenge

- Alert fatigue
  - First thorough description in the F4 Phantom
  - Evolving data demonstrate that desired behavior is rapidly extinguished
    - Puget Sound VA
      - 75% of drug-allergy alerts ignored
    - Harvard, BIDMC
      - In ambulatory world, of 3481 consecutive alerts, 91% of drug-allergy and 89% of high-severity drug interaction alerts ignored

CPOE – not always harmless

• CPOE is studied in some places under some conditions

• It is not proven that all CPOE does good in all places
Computers in Hospital Medicine
CPOE and EMRs

Agenda

- CPOE
- What the practicing Hospitalist can do
- Policy Trends – NHII, RHIOs, and CCHIT
- Industry Trends – arrival of the big players
- Hardware Innovations
- Open Discussion
What You Can Do

The implementation of a clinical information system is a clinical project.

It is not an Information Technology project.
How to be an effective member of your hospital’s CPOE committee

It's the workflow stupid!
“Workflow”

- A definition
  - The sequence of steps or tasks involved in completing a procedure

- Another one
  - How you get through each day

- The challenge
  - Implementing the CPOE system while enhancing your workflow. Or at least not messing it up
  - This means thinking about what you do and anticipating the ways in which the new computer system can assist or hinder you in the process
A typical hospitalist workflow

- Log in to system from home when discussing new admissions with housestaff*
- Arrive at hospital
- Sign on to office computer to see list of patients; quickly scan vitals / labs
- Cosign any unsigned verbal / telephone orders
- Print patient list; head off to nursing unit
- Start see patients
- Review results, place orders, document visit; repeat
- Sit and review cases with team*
- Review results, new documents throughout day
- Signout
- Submit billing sheet at end of the day

* Academic hospitalists
Physician Portal

Welcome Peter Lindenauer

Complete the Connections Contest

How much food did it take to feed employees at the 2007 Baystate Health Employee Picnics? Click above for your chance to win tickets to City Stage in Springfield. In photo, Mike Wesley, cook, flips burgers at the BMC picnic.

Employee Directory

Applications

- Baystate Practice Guidelines
- CIS
- CIS Office
- IDX
- New Innovations
- SRIS - Report a Safety Event

Resources

- baystatehealth.com
- eMail (Outlook via the Internet)
- Forms
- Help Desk
- Jobs
- MD Bulletin

Today at Baystate

Programs
- United Way
- Baystate Best
- Baystate Healthy

News
- Franklin County EMT of the Year
- New Surgeons in Greenfield
- Supplies for Springfield Schools
- Annual Report in BH Magazine
- BMP Mary Lane Adult Medicine Opens
- More News and BH Publications

Announcements
- Bath Beauty Collection
- Gary's Shoes
- 9-10 North Cafe Menu.doc
- 9-11 (6th) A Service of Remembrance
- Elmo Grows Up Oct 18-21
- Carroll Travel Weekly Specials
- Recreation Calendar of Events
- Domestic Violence Advocate
- Recruitment
- 2007-2008 Continuing Ed Preview
- More Announcements
Patient lists

• Purpose
  – Tells me who my patients are, where they located, etc
  – Eliminates need to conduct ad-hoc search for patients in the EMR
• Considerations
  – Multiple potential lists types:
    • Individual relationship (eg Attending, Consulting)
    • Relationships of permanent members of a group (eg Hospitalist Group A)
    • Ad-hoc membership of a care team (eg Red team)
    • Custom (Stroke study patients)
  – Ideally these lists are populated automatically; but not always possible
    • From registration system
    • From orders
  – Several options exist for addressing access to lists
    • Everyone
    • Pre-established members of groups
    • Self-declared members of care teams
    • Cross / weekend coverage presents additional challenge (proxy or temporary privilege)
<table>
<thead>
<tr>
<th>Note</th>
<th>Location</th>
<th>Name</th>
<th>Visit Reason</th>
<th>Length of Stay</th>
<th>DOB</th>
<th>MRN</th>
<th>Attending Physician</th>
<th>Primary Care Physician</th>
<th>Consulting Physician</th>
<th>Admitted</th>
</tr>
</thead>
<tbody>
<tr>
<td>S66</td>
<td>S6608A</td>
<td></td>
<td>INFECTION IMMUNO DEFICIENCY</td>
<td>0.5 Days</td>
<td>7/7/1960</td>
<td>0926318</td>
<td>Gruhn MD, Audrey S</td>
<td>Not on Staff, PCP</td>
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<td>8/27/2007 21:22</td>
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<tr>
<td>S67</td>
<td>S6607A</td>
<td></td>
<td>PYELONEPHRITIS</td>
<td>2.2 Days</td>
<td>1/22/1948</td>
<td>1051997</td>
<td>Borden MD, Samuel H</td>
<td>Banco MD, Robert J</td>
<td>Granowitz MD, Eric V</td>
<td>8/26/2007 2:50</td>
</tr>
<tr>
<td>S2</td>
<td>S2424 E</td>
<td></td>
<td>PNEUMONIA</td>
<td>2.4 Days</td>
<td>7/21/1938</td>
<td>0337173</td>
<td>Liu MD, Xiao J</td>
<td>Mailloux DC, Patrick T</td>
<td></td>
<td>8/26/2007 0:02</td>
</tr>
<tr>
<td>S3</td>
<td>S3430 E</td>
<td></td>
<td>SEPSIS RESP FAILURE</td>
<td>21.6 Days</td>
<td>2/10/1930</td>
<td>0539496</td>
<td>Liu MD, Xiao J</td>
<td>Not on Staff, PCP</td>
<td>Cicero MD, Lori Ellen</td>
<td>9/6/2007 17:49</td>
</tr>
</tbody>
</table>
Other considerations

- Printable version can be helpful
  - Jot notes / to-do items as you go along
  - Embed billing codes
- “Rounds reports”
  - Extract from the EMR that presents data in a format defined by clinicians
  - Can overcome shortcomings in the data display of commercial EMR
  - Always available, even when a computer isn’t
- These printable versions are often not included ‘off the shelf’ and need to be developed (or shared) by each hospital
## Printed patient list

<table>
<thead>
<tr>
<th>Location</th>
<th>MR</th>
<th>Name</th>
<th>Acct#</th>
<th>DOB</th>
<th>Day</th>
<th>Admit</th>
<th>Disch</th>
<th>Attending MD</th>
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</thead>
<tbody>
<tr>
<td>S2</td>
<td>S2421-B</td>
<td>Liu MD, Xiao J</td>
<td>485551742</td>
<td>12/01/43</td>
<td>3</td>
<td>06/25/07</td>
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<td></td>
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<tr>
<td></td>
<td>Inpatient</td>
<td>Chief Complaint: COPD EXACERBATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1=99221</td>
<td>2=99222</td>
<td>3=99223</td>
<td>4=99231</td>
<td>5=99232</td>
<td>6=99233</td>
<td>99234</td>
<td>99235</td>
</tr>
<tr>
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<td>C4=99254</td>
<td>C5=99255</td>
<td>C6=99261</td>
<td>C7=99262</td>
<td>C8=99263</td>
<td>No Charge</td>
<td>Not Seen</td>
<td>- QI</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>MR</th>
<th>Name</th>
<th>Acct#</th>
<th>DOB</th>
<th>Day</th>
<th>Admit</th>
<th>Disch</th>
<th>Attending MD</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
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<td></td>
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</tr>
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<td>Not Seen</td>
<td>- QI</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
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<th>MR</th>
<th>Name</th>
<th>Acct#</th>
<th>DOB</th>
<th>Day</th>
<th>Admit</th>
<th>Disch</th>
<th>Attending MD</th>
</tr>
</thead>
<tbody>
<tr>
<td>S3</td>
<td>S3430-B</td>
<td>Liu MD, Xiao J</td>
<td>485146863</td>
<td>02/10/30</td>
<td>22</td>
<td>08/06/07</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inpatient</td>
<td>Chief Complaint: SEPSIS RESP FAILURE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Working Diagnosis: Aspiration pneumonia</td>
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<td></td>
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<td></td>
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<td>C6=99261</td>
<td>C7=99262</td>
<td>C8=99263</td>
<td>No Charge</td>
<td>Not Seen</td>
<td>- QI</td>
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</tbody>
</table>
# Rounds Report

**Location**

<table>
<thead>
<tr>
<th>Location</th>
<th>Name</th>
<th>MR</th>
<th>DOB (age)</th>
<th>Admit Date (Day)</th>
<th>Attending</th>
<th>Code</th>
<th>PCT</th>
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</thead>
<tbody>
<tr>
<td>S3 S340B</td>
<td>MORIN, ARTHUR</td>
<td>5094B5</td>
<td>02/10/30(77)</td>
<td>06/06/21</td>
<td>Liu MD, Xiao J</td>
<td>Not on Staff, FCP</td>
<td></td>
</tr>
</tbody>
</table>

**Temperature & Vital Signs**

- **Temperature**: 99.3°F (97.1-99.3°F), Pulse 60 (60-62), BP 121/88 (127-158/63-72), Respiratory Rate 18 (18-20), Sat 95% (94-97%) (2L Nasal cannula)
- **Weight**: 160 lbs (59 kg)
- **Temperature**: 99.3°F
- **Pulse**: 60 bpm
- **Respiratory Rate**: 18 per minute
- **Saturation**: 95%

**Problems**

- No Problems found for patient.

**Diagosis**

- Septicemia
- Respiratory failure
- Parkinson disease
- Aspiration pneumonia

**Allergies**

- Amoxicillin

**Diet Orders**

- Tube feeding: Additive: ProCell, 1 per 50 mL water (450 mL), 2 times a day, 08/07/20 15:41:00
- Tube feeding: 500 mL (450 mL), Full stomach, No Tube, Every 6 hours, 08/12/20 12:05:00
- NP0 Orders:
  - No Exceptions. Start: now, 08/25/20 10:07:00

**Scheduled Meds**

- **Albuterol/Salbutamol Inhalation**: 4 times a day
- **Aspirin**: 5 mg by Mouth 1 time a day
- **Cefazolin-levofloxacin**: 1 tablet by mouth every 3 days
- **Doxazosin**: 1 mg by Mouth 2 times a day
- **Flucloxacillin**: 1 mg by Mouth 2 times a day
- **Levofloxacin**: 750 mg by Mouth every 24 hours
- **Risperidone**: 0.5 mg 2 times a day
- **Tolcapone**: 100 mg every 3 times a day
- **Tolcapone**: 100 mg every 3 times a day

**General Lab Results in last 24 hours**

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
<th>Date</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUN</td>
<td>17 mg/dL</td>
<td>08/27</td>
<td>08/27</td>
</tr>
<tr>
<td>Creatinin</td>
<td>1.2 mg/dL</td>
<td>08/27</td>
<td>08/27</td>
</tr>
<tr>
<td>WBC</td>
<td>8.6 x 10^3</td>
<td>08/27</td>
<td>08/27</td>
</tr>
</tbody>
</table>

**Other Info**

- (DVT, Prophylaxis, Urinary Catheters, Restraints, Code Status)
- Full Resuscitation
- No Hemorrhage/Sticky Notes

**Heparin**

- Pneumatic Compression Boots
- Restraints (Med/Surg)
Result viewing

- Some results are well suited to flowsheet display
  - Vital signs
  - Chemistry, Hematology
- Others lend themselves less well
  - Microbiology, pathology
  - Cannot view result directly on screen
  - Requires lots of ‘clicking’
- Consider options for the display of text based results to overcome the tyranny of the cell
### Flowsheet View for Chemistry

#### Laboratory Data

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5:40</td>
<td>23:50</td>
<td>19:55</td>
<td>18:35</td>
<td>18:14</td>
</tr>
<tr>
<td>INR</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td></td>
<td>133</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
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<td>3.8</td>
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<td></td>
<td></td>
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<td>Chloride</td>
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<td>102</td>
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<tr>
<td>CO2</td>
<td></td>
<td>22</td>
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<td>Anion Gap</td>
<td></td>
<td>9</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Glucose Level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>86</td>
</tr>
<tr>
<td>Glucose, POC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>BUN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Creatinine-Blood</td>
<td></td>
<td>1.1</td>
<td></td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>Estimated GFR, Non African American</td>
<td>&gt;60 *</td>
<td></td>
<td></td>
<td>&gt;60 *</td>
<td></td>
</tr>
<tr>
<td>Estimated GFR, African American</td>
<td></td>
<td></td>
<td>&gt;60 *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7.9*L</td>
</tr>
<tr>
<td>Phosphorus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.4*L</td>
</tr>
<tr>
<td>Magnesium</td>
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<td>1.6*</td>
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<tr>
<td>Alkaline Phosphatase</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Lipase</td>
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<td></td>
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<td>77</td>
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<td>ALT (SGPT)</td>
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<td>45</td>
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<td>Bilirubin, Total</td>
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<td></td>
<td></td>
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<td>0.4</td>
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</tbody>
</table>
Contents of flowsheet cell

* Preliminary Report *

BLOOD CULTURE

SPECIMEN DESCRIPTION : BLOOD
A more user friendly alternative: text based presentation of Micro data

<table>
<thead>
<tr>
<th>Orders</th>
<th>Med Profile</th>
<th>MAR</th>
<th>MAR Summary</th>
<th>Vital Signs</th>
<th>I/O</th>
<th>Lab</th>
<th>Micro</th>
<th>Rad</th>
<th>All Results</th>
<th>Documentation</th>
<th>Clinical Notes</th>
</tr>
</thead>
</table>

**Micro Cultures: (13 cultures)**

```
<table>
<thead>
<tr>
<th>Culture/Event_id:</th>
<th>Blood Culture, Second Order/481748617</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collect date:</td>
<td>08/23/07 18:47</td>
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<tr>
<td>Result Status:</td>
<td>Preliminary</td>
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<td>Result Date:</td>
<td>08/27/07 23:13</td>
</tr>
</tbody>
</table>
```

SPECIMEN DESCRIPTION: BLOOD

CULTURE: NO GROWTH 4 DAYS

```
<table>
<thead>
<tr>
<th>Culture/Event_id:</th>
<th>Blood Culture/481748679</th>
</tr>
</thead>
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<tr>
<td>Collect date:</td>
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<td>Result Status:</td>
<td>Preliminary</td>
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<tr>
<td>Result Date:</td>
<td>08/27/07 23:13</td>
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</tbody>
</table>
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SPECIMEN DESCRIPTION: BLOOD

CULTURE: NO GROWTH 4 DAYS

```
<table>
<thead>
<tr>
<th>Culture/Event_id:</th>
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<tr>
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<tr>
<td>Result Status:</td>
<td>Preliminary</td>
</tr>
<tr>
<td>Result Date:</td>
<td>08/27/07 19:29</td>
</tr>
</tbody>
</table>
```

SPECIMEN DESCRIPTION: BLOOD
Order Entry
You want to do better than this
Or even this

Lindenauer PK et al. JHM 2006
Ordering considerations

- Efficiency / Quality aides
  - Order sentences
  - Order sets
  - Favorite orders

- Special issues
  - Linking or Nesting order sets
  - Complex orders (tapers, high risk drugs)
  - Dealing with core measures / public reporting
  - Cosignature
Order sentences

• Building individual orders from scratch in CPOE is especially laborious
  – drug → dose → form → route → frequency → duration → duration unit

• Preconstructed order sentences can reduce the time required to place orders dramatically
  – Provide simple but important decision support

• Pharmacy / IT types, with input from clinicians define content for order sentences
This
vs. This
Order Sentences for: Hydrochlorothiazide (Hydrochlorothiazide Tablet)

- 12.5 mg, Tablet, By Mouth, Daily
- 25 mg, Tablet, By Mouth, Daily
- 50 mg, Tablet, By Mouth, Daily
Guided, weight-based dosing
Order sets

• Definition
  – A group of orders organized along a common theme
    • Signs or symptoms, Diagnosis, Procedure, etc
• General benefits in paper or electronic environments
  – Help to speed and improve accuracy of ordering process
  – Serve as checklists / reminders
  – Actionable representation of guideline recommendations
  – Reduce unnecessary variation in practice
### HOSPITALIZED PATIENTS: NON-ICU

- If CrCl greater than 50 mL/min
  - **Select Azithromycin PLUS Ceftriaxone OR Levofloxacin alone**
    - Azithromycin (Azithromycin 500 mg/250 mL 0.9% NaCl) 500 mg, IVPB, Injection, Every 24 hours
    - Ceftriaxone (CEFTRIAXONE 1 Gm/50 mL D5W) 1 Gm, IVPB, Premix, Every 24 hours
    - OR
    - Levofloxacin (LEVOFLOXACIN 500 mg/100 mL D5W) 500 mg, IVPB, Premix, Every 24 hours

- If CrCl 20 - 49 mL/min
  - **Select Azithromycin PLUS Ceftriaxone OR Levofloxacin alone**
    - Azithromycin (Azithromycin 500 mg/250 mL 0.9% NaCl) 500 mg, IVPB, Injection, Every 24 hours
    - Ceftriaxone (CEFTRIAXONE 1 Gm/50 mL D5W) 1 Gm, IVPB, Premix, Every 24 hours
    - OR
    - Levofloxacin (LEVOFLOXACIN 500 mg/100 mL D5W) 500 mg, IVPB, Premix, Once for 1 doses/times, Initial Dose - Start Today, ASAP
    - Levofloxacin (LEVOFLOXACIN 250 mg/50 mL D5W) 250 mg, IVPB, Premix, Daily, Start Tomorrow, T+1:0800

- If CrCl less than 20 mL/min
  - **Select Azithromycin PLUS Ceftriaxone OR BOTH Levofloxacin alone**
    - Azithromycin (Azithromycin 500 mg/250 mL 0.9% NaCl) 500 mg, IVPB, Injection, Every 24 hours
    - Ceftriaxone (CEFTRIAXONE 1 Gm/50 mL D5W) 1 Gm, IVPB, Premix, Every 24 hours
    - OR
    - Levofloxacin (LEVOFLOXACIN 500 mg/100 mL D5W) 500 mg, IVPB, Premix, Once for 1 doses/times, Initial Dose - Start Today, ASAP
    - Levofloxacin (LEVOFLOXACIN 250 mg/50 mL D5W) 250 mg, IVPB, Premix, Every 48 hours

### HOSPITALIZED PATIENTS: ICU

- If Pseudomonas infection is not an issue, refer to the recommendations for NON-ICU patients
- If Pseudomonas infection is not an issue, but patient has a β-Lactam allergy choose Levofloxacin WITH OR WITHOUT Clindamycin

- If CrCl greater than 50 mL/min
  - **MAY Select BOTH orders when ordering from this group if Clinically Indicated**
    - Levofloxacin (LEVOFLOXACIN 500 mg/100 mL D5W) 500 mg, IVPB, Premix, Every 24 hours
    - Clindamycin (CLINDAMYCIN 900 mg/50 mL D5W) 900 mg, IVPB, Premix, Every 8 hours
Advantages compared to paper

- Guaranteed availability regardless of location
- Embed or link to evidence / referential sources
- Allow customization of care at the patient level
  - Assistance with calculation of drug dose based on patient weight
  - Presentation of related laboratory data at moment of ordering
    - eg Latest Hct, PTT, Creatinine, K+, Dig level etc etc
- Order checking for safety
  - Drug-allergy, drug-drug, dose range checking warnings
- Nesting capability
  - Can link multiple order sets to address contingencies
Design considerations - 1

• What kinds of order sets should you build
  – Diagnosis or procedure based
    • eg Community Acquired Pneumonia, Thoracentesis
  – Problem or condition
    • eg Fever work up, Hyponatermia
  – General
    • General medicine admit
  – Bundling of related orders
    • Insulin + glucose checks, Aminoglycoside + creatinine, levels
  – Problem prone meds
    • Phenytoin
  – Utility orders
    • Steroid taper
<table>
<thead>
<tr>
<th>Component</th>
<th>Order Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADMIT</td>
<td></td>
</tr>
<tr>
<td>Status</td>
<td>Daystay</td>
</tr>
<tr>
<td>Condition</td>
<td>Good</td>
</tr>
<tr>
<td>MONITORING</td>
<td></td>
</tr>
<tr>
<td>Vital Signs per Unit Standard</td>
<td>Every 15 minutes until stable</td>
</tr>
<tr>
<td>Consent for</td>
<td>Thoracentesis, Procedure explained to patient</td>
</tr>
<tr>
<td>Consent for</td>
<td>Pleural Biopsy, Procedure explained to patient</td>
</tr>
<tr>
<td>MD TO RN</td>
<td></td>
</tr>
<tr>
<td>DIAGNOSTIC IMAGING</td>
<td></td>
</tr>
<tr>
<td>Chest Single Frontal View</td>
<td>ASAP, S/S, Postop S/P Thoracentesis, C/D; Pleural Effusion, Pt Cannot Stand Alone</td>
</tr>
<tr>
<td>Chest Special View</td>
<td>Routine, S/S, Postop S/P Thoracentesis, C/D; Pleural Effusion, Pt Cannot Stand Alone, Bilateral Decubitus</td>
</tr>
<tr>
<td>Chest Portable</td>
<td>ASAP, S/S, Postop S/P Thoracentesis, C/D; Pneumothrax, Pt Cannot Stand Alone, Ds Respiratory Distress</td>
</tr>
<tr>
<td>LABORATORY</td>
<td></td>
</tr>
<tr>
<td>Body Fluids</td>
<td></td>
</tr>
<tr>
<td>Right Lung</td>
<td></td>
</tr>
<tr>
<td>Albumin Fluid</td>
<td>Routine, Pleural Fluid Right, Collected</td>
</tr>
<tr>
<td>Amylase Fluid</td>
<td>Routine, Pleural Fluid Right, Collected</td>
</tr>
<tr>
<td>Cell Count Fluid</td>
<td>Routine, Pleural Fluid Right, Collected</td>
</tr>
<tr>
<td>Chylous Effusion</td>
<td>Routine, Pleural Fluid Right, Collected</td>
</tr>
<tr>
<td>Glucose Fluid</td>
<td>Routine, Pleural Fluid Right, Collected</td>
</tr>
<tr>
<td>LDH Fluid</td>
<td>Routine, Pleural Fluid Right, Collected</td>
</tr>
<tr>
<td>pH Fluid</td>
<td>Routine, Pleural Fluid Right, Collected</td>
</tr>
</tbody>
</table>
# Prednisone taper

<table>
<thead>
<tr>
<th>Component</th>
<th>Order Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prednisone (Prednisone Tablet)</td>
<td>50 mg, Tablet, By Mouth, Daily for 3 doses/times, ASAP</td>
</tr>
<tr>
<td>Prednisone (Prednisone Tablet)</td>
<td>40 mg, Tablet, By Mouth, Daily for 3 doses/times, T+3:0800</td>
</tr>
<tr>
<td>Prednisone (Prednisone Tablet)</td>
<td>30 mg, Tablet, By Mouth, Daily for 3 doses/times, T+6:0800</td>
</tr>
<tr>
<td>Prednisone (Prednisone Tablet)</td>
<td>20 mg, Tablet, By Mouth, Daily for 3 doses/times, T+9:0800</td>
</tr>
<tr>
<td>Prednisone (Prednisone Tablet)</td>
<td>10 mg, Tablet, By Mouth, Daily for 3 doses/times, T+12:0800</td>
</tr>
</tbody>
</table>
## Guided phenytoin ordering

<table>
<thead>
<tr>
<th>Component</th>
<th>Order Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phenytoin Total Level (Dilantin Level)</strong></td>
<td></td>
</tr>
<tr>
<td>(albumin level must be obtained with this level)</td>
<td></td>
</tr>
<tr>
<td><strong>Phenytoin Free Level</strong></td>
<td></td>
</tr>
<tr>
<td>Phenytoin free level does not require albumin level</td>
<td></td>
</tr>
</tbody>
</table>

"**Dilantin (Phenytoin) is highly plasma protein bound; plasma albumin levels affect the "free" or active amount of drug.""

"**7-10 days is required to achieve steady-state blood levels; dose adjustments should not be made at intervals shorter than 7-10 days."

### IV LOADING

"**DO NOT exceed IV administration rate of 50mg/min; slower infusions (over a maximum of 60 minutes) should be considered in patients not actively convulsing, over 70 years of age, or those with heart disease."

"**Dilantin (Phenytoin) loading dose is 15-20mg/kg as an intravenous infusion mixed in normal saline only."

**Dilantin (Phenytoin) level should be checked 2 hours after the end of the loading dose infusion, and before the first maintenance dose.

| Phenytoin (Dilantin IV/PB)                      | 1,500 mg, in 250 mL NaCl 0.9%, IV/PB, Injection, Once, to be infused preparatory to maintenance dose. |
| Phenytoin (Dilantin IV/PB)                      | 1,250 mg, in 250 mL NaCl 0.9%, IV/PB, Injection, Once, to be infused preparatory to maintenance dose. |
| Phenytoin (Dilantin IV/PB)                      | 1,000 mg, in 250 mL NaCl 0.9%, IV/PB, Injection, Once, to be infused preparatory to maintenance dose. |
| Phenytoin (Dilantin IV/PB)                      | 750 mg, in 250 mL NaCl 0.9%, IV/PB, Injection, Once, to be infused preparatory to maintenance dose. |
| Phenytoin (Dilantin IV/PB)                      | 500 mg, in 250 mL NaCl 0.9%, IV/PB, Injection, Once, to be infused preparatory to maintenance dose. |

"**Follow loading dose with IV or PO maintenance dose of 100mg every 6 to 8 hours."

### ORAL LOADING

"**Patients with a history of renal or liver disease should not receive the oral loading dose regimen."

"**Recommended oral loading dose is 1,000mg divided into 3 doses according to the following regimen (Select all 3 orders)."

| Phenytoin (Dilantin Capsule)                  | 400 mg, ER Capsule, By Mouth, Once, ASAP |
| Phenytoin (Dilantin Capsule)                  | 300 mg, ER Capsule, By Mouth, Once, 2 hours after previous dose |
| Phenytoin (Dilantin Capsule)                  | 300 mg, ER Capsule, By Mouth, Once, 2 hours after previous dose |
| Phenytoin (Dilantin-125 (Ped) Liquid)         | 300 mg, Suspension, By Mouth |

### Maintenance Dosing

"**There is no specific dose adjustment in renal failure. HOWEVER, the fraction of unbound phenytoin increases as the renal function decreases."

| Phenytoin (Dilantin Inj)                      | 100 mg, Injection, IV Push, Every 8 hours |
| Phenytoin (Dilantin Inj)                      | 100 mg, Injection, IV Push, Every 6 hours |
| Phenytoin (Dilantin Inj)                      | mg, Injection, IV Push |
Design Considerations - 2

- Role of order preselection
  - Are you asking physicians to ‘opt in’ or ‘opt out’
- How many variations of each order will you create
  - Speed versus space constraints
- What is the best way to incorporate referential material
  - Embed vs hyperlink.
    - Will busy physicians read it?
- What corollary results would be useful for ordering
- How to handle patients with multiple problems
Example: Acute Pancreatitis
### RECOMMENDATION:

- Begin feeding when patient is clinically improving, is no longer nauseated or vomiting, and is hungry. Pain should be minimal.
- Consult Nutrition Services
- NPO
- Clear Liquid Diet

### ENTERAL FEEDING

- Enteral feeding is safe and feasible in many patients with acute severe Pancreatitis. **"Whenever possible, endoscopic or radiologic placement of a jejunal feeding tube should be attempted."**
- Consider in patients who are expected to be NPO for more than 48 hours or earlier in those with poor nutritional status at time of admission.

### TPN/IV

- Consider TPN in patients with severe Pancreatitis who do not tolerate Enteral feeding or in whom a period of prolonged bowel rest is likely. **"When possible, tube feeding is preferable to parenteral nutritional support [TPN should contain MVI, Thiamine, Folic Acid, KCl, Ca]."**

### CARDIO-PULMONARY

- Oxygen via Cannula

### DIAGNOSTIC IMAGING

- Select from the following as appropriate:
  - Chest Single Frontal View
  - Abdomen AP
  - Abdomen AP
  - Abdomen US
  - Abdominal CT Scan
    - Abdominal CT Scan
    - Abdominal CT Scan

### US Abdomen Comp (Abdomen Comp US)

- Abdominal CT Scan
  - Abdominal CT Scan
    - Abdominal CT Scan
      - Abdominal CT Scan
        - Abdominal CT Scan
          - Abdominal CT Scan

### CONTINUOUS INFUSIONS/IV DOSES

- Select from the following as appropriate:
  - Sodium Chloride 0.9% (Boule NaCl 0.9%)
  - Sodium Chloride 0.9% (Boule NaCl 0.9%)
  - Dextrose 5% / 8.5% NaCl (55% NaCl)
  - Dextrose 5% 8.5% NaCl (55% NaCl)
  - LVP solution with potassium (4%) NaCl 0.9% 1000 mL I.V. NACL 20 mEq
  - Dextrose 5% 0.45% NaCl (55% NaCl)

### Details for US Abdomen Comp (Abdomen Comp US)

<table>
<thead>
<tr>
<th>Order</th>
<th>Details</th>
<th>Order Comments</th>
<th>Detail values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority</td>
<td>[Routine]</td>
<td>Signs and Symptoms</td>
<td>Abdominal CT Scan</td>
</tr>
</tbody>
</table>
Nested order sets
<table>
<thead>
<tr>
<th>Component</th>
<th>Order Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADMIT</td>
<td></td>
</tr>
<tr>
<td>Status Inpatient</td>
<td></td>
</tr>
<tr>
<td>Status Observation</td>
<td></td>
</tr>
<tr>
<td>CONDITION</td>
<td></td>
</tr>
<tr>
<td><strong>Select from the following as appropriate:</strong></td>
<td></td>
</tr>
<tr>
<td>Condition</td>
<td></td>
</tr>
<tr>
<td>Isolation</td>
<td></td>
</tr>
<tr>
<td>Restrictions</td>
<td></td>
</tr>
<tr>
<td>Precautions</td>
<td>Seizure</td>
</tr>
<tr>
<td>CODE STATUS</td>
<td></td>
</tr>
<tr>
<td><strong>Select from the following as appropriate:</strong></td>
<td></td>
</tr>
<tr>
<td>Full Resuscitation</td>
<td></td>
</tr>
<tr>
<td>Limited Resuscitation</td>
<td></td>
</tr>
<tr>
<td>No Resuscitation</td>
<td></td>
</tr>
<tr>
<td>MONITORING</td>
<td></td>
</tr>
<tr>
<td>Vital Signs per Unit Standard</td>
<td></td>
</tr>
<tr>
<td>Vital Signs</td>
<td></td>
</tr>
<tr>
<td>Vital Signs</td>
<td>Every 8 hours</td>
</tr>
<tr>
<td>Vital Signs</td>
<td>Every 4 hours</td>
</tr>
<tr>
<td>Cardiac Monitor</td>
<td>Continuously</td>
</tr>
<tr>
<td>Monitor O2 Sat</td>
<td>With Vital Signs</td>
</tr>
<tr>
<td>Monitor O2 Sat</td>
<td>Every 8 hours</td>
</tr>
<tr>
<td>Monitor O2 Sat</td>
<td>Every 4 hours</td>
</tr>
<tr>
<td>Monitor O2 Sat</td>
<td>Continuously</td>
</tr>
</tbody>
</table>

Details

Order details

Detail values

OK  Cancel
### Laboratory Tests

<table>
<thead>
<tr>
<th>Component</th>
<th>Order Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose Level</td>
<td>Scheduled, Daily</td>
</tr>
<tr>
<td>Glucose (POC)</td>
<td>Scheduled, 3 times a day before meals and bedtime</td>
</tr>
<tr>
<td>CBC w/ Differential</td>
<td>Routine</td>
</tr>
<tr>
<td>Electrolytes</td>
<td>Routine</td>
</tr>
<tr>
<td>BUN</td>
<td>Routine</td>
</tr>
<tr>
<td>Creatinine</td>
<td>Routine</td>
</tr>
<tr>
<td>AST (SGOT)</td>
<td>Routine</td>
</tr>
<tr>
<td>ALT (SGPT)</td>
<td>Routine</td>
</tr>
<tr>
<td>Calcium Level</td>
<td>Routine</td>
</tr>
<tr>
<td>Magnesium Level</td>
<td>Routine</td>
</tr>
<tr>
<td>Phosphorus Level</td>
<td>Routine</td>
</tr>
<tr>
<td>Alk. Phos</td>
<td>Routine</td>
</tr>
<tr>
<td>Albumin Level</td>
<td>Routine</td>
</tr>
<tr>
<td>Bilirubin Total (Total Bilirubin)</td>
<td>Routine</td>
</tr>
<tr>
<td>INR</td>
<td>Routine</td>
</tr>
<tr>
<td>PTT</td>
<td>Routine</td>
</tr>
<tr>
<td>Digoxin Level</td>
<td>Routine</td>
</tr>
<tr>
<td>Urinalysis (UA)</td>
<td>Routine</td>
</tr>
</tbody>
</table>

### Common Problems

- Alcohol Withdrawal
- Pneumonia
- COPD
- Stroke
### Laboratory

Select from the following as appropriate:

<table>
<thead>
<tr>
<th>Component</th>
<th>Order Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose Level</td>
<td>Scheduled, Daily</td>
</tr>
<tr>
<td>Glucose (POC)</td>
<td>Scheduled, 3 times a day before meals and bedtime</td>
</tr>
<tr>
<td>CBC w/ Differential</td>
<td>Routine</td>
</tr>
<tr>
<td>Electrolytes</td>
<td>Routine</td>
</tr>
<tr>
<td>BUN</td>
<td>Routine</td>
</tr>
<tr>
<td>Creatinine</td>
<td>Routine</td>
</tr>
<tr>
<td>AST (SGOT)</td>
<td>Routine</td>
</tr>
<tr>
<td>ALT (SGPT)</td>
<td>Routine</td>
</tr>
<tr>
<td>Calcium Level</td>
<td>Routine</td>
</tr>
<tr>
<td>Magnesium Level</td>
<td>Routine</td>
</tr>
<tr>
<td>Phosphorus Level</td>
<td>Routine</td>
</tr>
<tr>
<td>Alk Phos</td>
<td>Routine</td>
</tr>
<tr>
<td>Albumin Level</td>
<td>Routine</td>
</tr>
<tr>
<td>Bilirubin Total</td>
<td>Routine</td>
</tr>
<tr>
<td>INR</td>
<td>Routine</td>
</tr>
<tr>
<td>PTT</td>
<td>Routine</td>
</tr>
<tr>
<td>Digoxin Level</td>
<td>Routine</td>
</tr>
<tr>
<td>Urinalysis (UA)</td>
<td>Routine</td>
</tr>
</tbody>
</table>

### Common Problems

- Alcohol Withdrawal
- Pneumonia
- COPD
- Stroke
### Steroids

**Recommended Dosing:** IV Methylprednisolone 0.5 - 1 mg/kg every 6 hrs for 72 hrs.

- **MethylPREDNISolone (MethylPREDNISolone Sodium Succinate Inj)**
  - mg, Injection, IV Push Slowly, Every 6 hours for 48 hr
- **MethylPREDNISolone (MethylPREDNISolone Sodium Succinate Inj)**
  - mg, Injection, IV Push Slowly, Every 6 hours for 72 hr, Nsg to contact MD for steroid orders after 72 hr

**Recommended Dosing:** IV Methylprednisolone 125 mg every 6 hrs for 72 hrs.

- **MethylPREDNISolone (MethylPREDNISolone Sodium Succinate Inj)**
  - 125 mg, Injection, IV Push Slowly, Every 6 hours for 72 hr, Nsg to contact MD for steroid orders after 72 hr

**Recommended Dosing:** patients who have not used steroids: 30 mg by mouth, Daily

- **PredniSONE (PredniSONE Tablet)**
  - mg, Tablet, By Mouth, Daily

**Recommended Dosing:** patients who have used steroids within 3 - 6 months: double baseline dose

- **PredniSONE (PredniSONE Tablet)**
  - mg, Tablet, By Mouth, Daily

### Antibiotic Therapy

**Select BOTH orders from the following Empiric Therapy selection groups:**

- **Ceftriaxone**
  - Ceftriaxone (CEFTRIAXONE 1 Gm/50 mL D5%W)
    - 1 Gm, IVPB, Premix, Once, STAT
  - Ceftriaxone (CEFTRIAXONE 1 Gm/50 mL D5%W)
    - 1 Gm, IVPB, Premix, Every 24 hours doses/times

- **Azithromycin**
  - Azithromycin (Azithromycin Tablet)
    - 500 mg, Tablet, By Mouth, Once, STAT
Other considerations

• Will you allow personal order sets or will they be shared
  – Balance benefits of personalization against desire to reduce variation

• How will you ensure the quality / validity of the content
  – Develop in-house vs. purchase from 3rd party vendor

• Naming and organizing conventions
  – How will other physicians know how to find your order set

• Governance / Oversight issues
  – Who is accountable for validating and blessing content
  – How will you obtain feedback from other members of the medical staff

• Can you measure use? Effectiveness?
• How will you ensure that order sets do not become stale
Improving MI Care with Order sets

Use of Secondary Prevention Measures Among Patients Treated With and Without Order Sets

Use of Secondary Prevention Measures Among Patients Treated With and Without Order Sets

<table>
<thead>
<tr>
<th>Treatment</th>
<th>ASA &lt; 24h</th>
<th>ASA on DC</th>
<th>BB &lt; 24h</th>
<th>BB on DC</th>
<th>Lipid Profile Done</th>
<th>LLT</th>
<th>Smoking Cessation</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS + (N=172)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>OS - (N=65)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

% Patients
Improving MI Care with Order sets

Use of Secondary Prevention Measures Among Patients Treated With and Without Order Sets

- ASA < 24h
- ASA on DC
- BB < 24h
- BB on DC
- Lipid Profile Done
- LLT
- Smoking Cessation

% Patients

OS + (N=172)
OS - (N=65)
Improving MI Care with Order sets

Use of Secondary Prevention Measures Among Patients Treated With and Without Order Sets

- ASA < 24h
- ASA on DC
- BB < 24h
- BB on DC
- Lipid Profile Done
- LLT
- Smoking Cessation

% Patients

OS + (N=172)
OS - (N=65)
Some remaining challenges

• Dependent on physicians actively seeking out
  – Design alerts based on
    • Specific order or result (eg troponin). Limited applicability
    • Documented problem (eg pneumonia). How will you obtain info?

• Hospital medicine patients often defy easy categorization
  – Single condition order sets cover only a minority of required orders for complex patients and can disrupt the physicians ordering workflow
  – General order sets can be used to address common elements
    • DVT prophylaxis, Immunizations, Smoking cessation
  – Nesting can be used to overcome
Cosignature in CPOE

• As in the paper world, there are times when verbal and telephone orders are required
  – Need a mechanism for cosignature: eg Inbox

• Some / all PA/NP orders may require cosignature
  – This is a medical staff policy issue that needs to be worked through carefully since it can create major headaches for the physicians who work with PA’s and NPs.
    • Example: Before we changed our policy our cardiac surgeons would often receive 200-300 orders to cosign each day!!

• Need a mechanism for dealing with orders that get assigned to the wrong provider.
  – This happens all the time
  – Send to administrative inbox (eg Refused Orders)
    • Will someone review / adjudicate these?
<table>
<thead>
<tr>
<th>Order Name:</th>
<th>Miscellaneous Medication (Testing Suspends Monday)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order Comment:</td>
<td>None</td>
</tr>
</tbody>
</table>

---

**Action:**
- [ ] Sign (no dose range)
- [x] Refuse
- [ ] Forward only
Clinical decision support

• Concept highly appealing
• Making it work is harder than it seems
• Some issues to consider
  – What is worth interrupting the physician for
    • How will you decide which alerts are important
  – Should all physicians be treated equally?
    • Is a July intern the same as a Senior Attending?
  – What happens after physicians override alerts?
    • Role of pharmacy, nursing, other
  – Asynchronous alerting
    • What kinds of alerts lend themselves to distribution through an inbox
Drug allergy

- General considerations
  - Exact match vs class conflicts
    - Amoxicillin allergy → All PCNs → Cephs
  - Severity of interaction
    - Should alerts be limited to only high severity reactions?
      - Will you require this to be completed
        » Do nurses / physicians have standard ways of grading allergic reactions
  - Should side effects be treated differently than allergies?
    - eg Nausea, tardive dyskinesia
  - Narcotics are the key offenders
    - This is not appealing to me as a clinician
An especially common scenario
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>E</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
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</tbody>
</table>
We didn’t plan for this…
Clinician Leadership for CIS

Control Expectations

- a modern CIS makes things harder and less efficient for the first few months

- Eventually, a CIS makes things better, not perfect
Computers in Hospital Medicine
CPOE and EMRs

Agenda

★ CPOE
★ What the practicing Hospitalist can do
★ Policy Trends – NHII, RHIOs, and CCHIT
★ Industry Trends – arrival of the big players
★ Hardware Innovations
★ Open Discussion
The National Health Information Infrastructure

- three State of the Unions
- the (persistently unoccupied) Office of the National Coordinator for Health Information Technology
The National Health Information Infrastructure

Every American should have an electronic health record

• not every hospital or every clinic

• what do we mean by “every American”?
The National Health Information Infrastructure

Every *American* should have an electronic health record

- Not a Scandinavian country
- Not the military
The National Health Information Infrastructure

Every *American* should have an electronic health record

- No national medical record
- Perhaps national interoperability standards
- Perhaps national backbone infrastructure
The National Health Information Infrastructure

Regional Health Information Organizations, RHIOs

- Decentralized, distributed collaborations for information sharing

- Chartered by whom?
  - States
  - Counties
  - Ad hoc collaboratives
  - NGOs
  - Quangos
  - Individual health systems
The National Health Information Infrastructure

Regional Health Information Organizations, RHIOs

- How will they interoperate?
- Who will fund them?
- Is this going to work?

Stay tuned …
The National Health Information Infrastructure

Hospitals, groups, and payors may donate EHR hardware and software to physicians and groups.

“Entities … may donate to physicians … interoperable electronic health records software, information technology and training services.

Hospitals .. may provide physicians … with hardware, software, or information technology and training services necessary and used solely for electronic prescribing.”

Federal Register August 8, 2006
CCHIT
The Certification Commission for Health Information Technology

Voluntary, private-sector certifying body
- American Health Information Management Association (AHIMA)
- Healthcare Information and Management Systems Society (HIMSS)
- National Alliance for Health Information Technology

“Underwriters Laboratories” (UL) for Clinical IS
Computers in Hospital Medicine
CPOE and EMRs

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What is Microsoft up to?

Purchased Azyxxi (rhymes with “Trixie”) in July of 2006

- do they just want to sell more .NET based tools and SQL Server?
- or do the want to get seriously in to clinical information systems software?
Intel Digital Health

- A way to integrate Intel chips into healthcare IT hardware

- Intel / Motion Computing C5
  - healthcare targeted tablet
General Electric

- Acquired SEC in 2000
- Acquired MedicaLogic (Logician) in 2002
- Acquired Triple G in 2003
- Acquired Instrumentarium (manufacturer of anesthesia machines and ventilators) in 2003
- Acquired IDX (CareCast et al.) in 2006

Vertically integrated portfolio of medical hardware and software
Why can’t we just install the VA system??

- Only the software is “free”
- Much of it written in MUMPS
- Limited support for billing, pediatrics, and OB

www.worldvista.org
Personal Health Records

• Why is your medical record owned and maintained by someone else?
  – traditional and historical reasons
  – practical reasons

• The individual as the keeper of their medical record
  – how to make it interoperable
  – how to keep it updated with various streams of data
  – medicolegal implications
Computers in Hospital Medicine
CPOE and EMRs

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