Objectives

- Describe current literature identifying pharmacy involvement in the Emergency Department
- Compare and contrast the emergency medicine pharmacist’s role in a community versus an urban academic medical center
- Illustrate strategies for justification of pharmacy services in the Emergency Department

ED Pharmacy in the Literature

Pharmacists in the ED

- Many large academic hospitals and some smaller community hospitals have dedicated pharmacy presence in the Emergency Department
- Academic health care facilities with emergency medicine residencies
  - 30% have some type of pharmacist coverage
  - 8% have 24/7 coverage
- 3.5% of hospitals in 2005 had a pharmacist assigned to the ED for any period of time
  - Increased to 6.8% in 2008


Question #1
Which of the following issues can lead to medication errors in the ED?
A. Unfamiliarity with patients’ medications
B. Use of high-risk medications
C. Verbal prescribing orders
D. Little knowledge of patient history
E. All of the above

Question #1
Which of the following issues can lead to medication errors in the ED?
A. Unfamiliarity with patients’ medications
B. Use of high-risk medications
C. Verbal prescribing orders
D. Little knowledge of patient history
E. All of the above
Unique System Challenges in the ED

Error prone environment that results in an increased risk of medication errors
- Unfamiliarity with patients’ medications
- Lack of pharmacist safety checks prior to drug administration
- Use of high-risk medications
- Verbal prescribing orders
- Little knowledge of patient medical history

IOM Report on Emergency Care in US

Major issues in the ED
- Overcrowding
- Fragmented care
- Lack of disaster preparedness
- Shortcomings in pediatric emergency care

Medication Errors

- Result in 98,000 deaths annually
- 6th leading cause of death in the US
- Account for 1/3 of medical errors that occur in hospitals
- Inpatient: 1 med error/inpatient day
- IOM: 1.5 million preventable ADE’s occur in the US each year

Medication Errors in the ED

Emergency departments in the US treat over 100 million patients every year
- Medications are given to 76.7% of these patients
- IOM report in 1999 revealed that the ED was one of the 3 hospital departments with the highest rate of preventable adverse drug reactions in the hospital

Drug-Related Problems in the ED

Eight categories of drug-related problems (DRPs)
- Untreated indication
- Improper drug selection
- Sub-therapeutic dosage
- Failure to receive drugs
- Overdose
- Adverse drug reaction
- Drug interaction
- Drugs without indication

Drug-Related Problems in the ED

- DRPs account for as many as 28% of ED visits
- 24% of these visits result in hospital admission
- Approximately 70% of DRPs in the ED are deemed preventable
Medication Reconciliation in the ED

• Drug related problems
  – Identify
  – Manage
• One of many duties of Emergency Medicine pharmacist
  – Should not eclipse/preclude other patient-care related activities

Medication History Errors

• 27% of all hospital prescribing errors can be accounted for by incomplete medication histories obtained at admission
• Up to 67% of medication histories have ≥1 error
• 46% of medication errors occur when a new prescription is written at admission or discharge

Medication History Errors

• ED medication history affects care in the ED and inpatient settings
• Errors in medication history may perpetuate to discharge
• Can have adverse clinical consequences for the patient

Question #2
Which of the following healthcare providers would obtain the most accurate medication history?

A. Pharmacist
B. Nurse
C. Physician
D. Mid-level practitioner (PA, NP)

Medication History Errors

• Incomplete/inaccurate lists
  – Duplication of medications
  – Unexpected interactions
  – Inadvertent discontinuation of medications
  – Failure to detect drug related problems
• Medication histories taken by ED providers are incomplete compared to those obtained by pharmacists
Study-Inaccurate ED Medication Lists

- Purpose: evaluate the accuracy of patient home medication list obtained in the ED
- Prospective, observational study
- Performed at an urban, Level 1 Trauma Center
- Triage or initial nurse obtained medication list from patient and patient's family
- ED research nurse then compiled a list by consulting the patient, patient's family, PCP, and pharmacist if needed
- Initial list and list obtained by the research RN were compared


Study-Inaccurate ED Medication Lists

Medication Errors by Type

<table>
<thead>
<tr>
<th>Number of Errors</th>
<th>Omission (%)</th>
<th>Duplication (%)</th>
<th>Dosing (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>44%</td>
<td>99%</td>
<td>20%</td>
</tr>
<tr>
<td>1 or more</td>
<td>56%</td>
<td>1%</td>
<td>80%</td>
</tr>
</tbody>
</table>


Study-Inaccurate ED Medication Lists

Medication Omissions by Drug Class

<table>
<thead>
<tr>
<th>Drug Class</th>
<th>Omissions (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>32%</td>
</tr>
<tr>
<td>Endocrine</td>
<td>8%</td>
</tr>
<tr>
<td>Vitamins/minerals</td>
<td>7.5%</td>
</tr>
<tr>
<td>Ophthalmologic</td>
<td>6.8%</td>
</tr>
<tr>
<td>Antiplatelet/Anticoagulant</td>
<td>6.8%</td>
</tr>
<tr>
<td>Psychiatric drugs</td>
<td>6.8%</td>
</tr>
<tr>
<td>Respiratory</td>
<td>6%</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>4.7%</td>
</tr>
<tr>
<td>Narcotic</td>
<td>4.7%</td>
</tr>
<tr>
<td>Other</td>
<td>15%</td>
</tr>
</tbody>
</table>


Study-Inaccurate ED Medication Lists

Conclusions
- Medication history in ED does not reflect a comprehensive and accurate list of home medications
- The most common errors are omission and dosing
- An incomplete or incorrect medication list can result in serious adverse events
- Strategies are needed for obtaining and communicating accurate histories


Pharmacist Interventions and Associated Cost Avoidance

- Academic urban Level 1 Trauma Center
- 85,000 annual visits
- Pharmacy coverage 24/7
- Objectives:
  - Perform descriptive analysis of pharmacist interventions and resuscitation experience in ED
  - Evaluate potential cost savings and cost avoidance associated with the interventions

Lada P. Am J Health-Syst Pharm 2007

Pharmacist Activities

- Drug information
- Pharmacokinetic consultations
- Anticoagulation consultations
- Medical staff in-services
- Resuscitation team
- Antimicrobial surveillance
- Research assistance
- Order entry/medication preparation and dispensing
- Formulary interchange
- Sample medication distribution

Lada P. Am J Health-Syst Pharm 2007
Pharmacist Activities

<table>
<thead>
<tr>
<th>Category</th>
<th>Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug information</td>
<td>362</td>
</tr>
<tr>
<td>Dosage adjustment</td>
<td>353</td>
</tr>
<tr>
<td>Nursing inquiries</td>
<td>316</td>
</tr>
<tr>
<td>Formulary interchanges</td>
<td>181</td>
</tr>
<tr>
<td>Initiation of meds</td>
<td>180</td>
</tr>
<tr>
<td>Order clarification</td>
<td>164</td>
</tr>
<tr>
<td>Change to alternative med</td>
<td>157</td>
</tr>
</tbody>
</table>

- 2,150 pharmacist interventions
  - Average: 539 interventions/month
  - Extrapolated to 6,468/year
- Cost analysis
  - $4.68-$16.70 return on investment
  - Averaged $3,745,720 in potential cost savings

Potential Cost Avoidance

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Number</th>
<th>Avg cost avoidance</th>
<th>Avg probability of harm</th>
<th>Cost avoidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug, disease, interactions or incompatibilities</td>
<td>334</td>
<td>1,647</td>
<td>0.54</td>
<td>$297,503</td>
</tr>
<tr>
<td>Therapeutic recommendation</td>
<td>523</td>
<td>1,188</td>
<td>0.44</td>
<td>$273,383</td>
</tr>
<tr>
<td>Adverse drug events</td>
<td>48</td>
<td>1,098</td>
<td>0.44</td>
<td>$23,190</td>
</tr>
<tr>
<td>Medication-error prevention</td>
<td>488</td>
<td>1,375</td>
<td>0.65</td>
<td>$436,150</td>
</tr>
<tr>
<td>Total</td>
<td>1,393</td>
<td></td>
<td></td>
<td>$1,030,226</td>
</tr>
</tbody>
</table>

Life in the ED: Daily Activities of an ED Pharmacist

University Hospital ED

- Urban, academic teaching institution
- Approximately 88,000 ED visits/year
- Level 1 Trauma Center
- Level 1 Stroke Center
- Air Care – air ambulance service
- Eighty ED beds

ED Pharmacy at TUH

- 1.4 FTE Staff Pharmacist
  - 7 days/week
  - 1530-2400
  - Activities:
    - Order entry/review and dispensing of ED medications
    - IV compounding
    - Review/verification of orders for boarded patients
    - Outpatient prescription dispensing
    - LMWH discharges
    - Drug information
ED Pharmacy at TUH

• 1 FTE Clinical Pharmacist
  – M-F Daytime hours
  – Activities:
    • LMWH discharges/anticoagulation counseling
    • Drug information
      – Compatibility
      – Dosing
      – Medication selection
    • Complex regimens/PMH
    • Medication reconciliation
    • Allergy clarification
    • Research/Quality improvement

ED Pharmacy at TUH

• Activities (continued):
  – JCAHO Core Measure compliance
  – Patient counseling
  – Participation in code blue, trauma stat, RSI and stroke team responses
  – Toxicology consults
  – STAT medication preparation
  – Medication profile reviews
  – Pyxis stock management
  – Shortage communication/management
  – Disaster preparation
  – Education
    • Nurse, physician, pharmacy
    • Committee involvement
    • Guideline review
    – Antibiotic stewardship/culture reviews

Outpatient Culture Review

Outpatient Culture Review

Outpatient Culture Review

Outpatient Culture Review
She Swallowed What?!?

- Ethylene Glycol is commonly found in automotive antifreeze
  - Colorless, odorless, sweet tasting
- When ingested, is rapidly and completely absorbed
- Metabolites, not parent compound, are toxic
  - Targets kidneys
- Accumulation of toxic metabolites leads to profound anion gap metabolic acidosis

She Swallowed What?!?

- Differential Diagnosis:
  - Ethylene Glycol poisoning
- Treatment options
  - Fomepizole is treatment of choice
  - $3,000/dose
  - Ethylene glycol/glycolic acid levels take about 12 hours (minimum) to turn around at your institution
She Swallowed What?!?

Laboratory Data:

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>144</td>
<td>118</td>
</tr>
<tr>
<td>6</td>
<td>143</td>
</tr>
<tr>
<td>21</td>
<td>14.6</td>
</tr>
<tr>
<td>45.2</td>
<td>386</td>
</tr>
<tr>
<td>pH: 7.04 &lt; 8/197</td>
<td></td>
</tr>
<tr>
<td>INR: 1.5</td>
<td></td>
</tr>
<tr>
<td>Lactic Acid: 2.2</td>
<td></td>
</tr>
<tr>
<td>Osmolality: 322</td>
<td></td>
</tr>
<tr>
<td>Osmolal Gap: 34</td>
<td></td>
</tr>
<tr>
<td>Anion Gap: 22</td>
<td></td>
</tr>
<tr>
<td>CXR: wnl</td>
<td></td>
</tr>
<tr>
<td>CT Head/Chest: wnl</td>
<td></td>
</tr>
<tr>
<td>CT angiography: negative</td>
<td></td>
</tr>
<tr>
<td>Urine: RBC 20-50</td>
<td></td>
</tr>
<tr>
<td>Amorphous crystals</td>
<td></td>
</tr>
</tbody>
</table>

She Swallowed What?!?

- Two antidotes currently available:
  - Fomepizole (Antizol®) IV, Ethanol IV
  - Fomepizole (Antizol®)
    - Competitively inhibits alcohol dehydrogenase
    - Superior antidote to ethanol
      - Its affinity for alcohol dehydrogenase is 8000 times greater than ethanol!

Fomepizole

- Available as IV solution only
- Dosing:
  - Loading dose = 15mg/kg IV x 1
  - Maintenance dose = 10mg/kg IV every 12 hrs x 4 doses
  - Then = 15mg/kg IV every 12 hrs thereafter until ethylene glycol levels are reduced less than 20 mg/dL
- **Dosing frequency increased to every 4hrs during hemodialysis for initial maintenance dosing**

Supplemental Therapies

- Co-factor therapy
  - Pyridoxine and thiamine are involved in minor elimination pathways of glycolate
  - Recommended to provide cofactors when receiving alcohol dehydrogenase inhibition
- Hemodialysis
  - Indicated in known or suspected ethylene glycol ingestion and the following:
    - Severe, and/or unexplained anion gap metabolic acidosis
    - Significant osmol gap
    - Ethylene glycol level greater than 50 mg/dL, glycolic acid level greater than 8 mg/dL
    - Evidence of end-organ damage

EM Pharmacist at Bethesda North

Bethesda North Hospital Emergency Department
- Serves Northeast Cincinnati
- Level III Trauma Center
- ~60,000 visits annually
- ~160 visits/day
- 49 beds
  - 2 trauma/critical care beds
  - 6 express care beds
  - 6 Pyxis® machines

EM Pharmacist at Bethesda North

- Emergency Medicine Pharmacist
  - Monday–Friday 2:30–11 pm
    - No pharmacist currently in ED outside of these hours!
- Full-time pharmacist FTE
  - Transferred from central pharmacy to ED
  - Salary covered by pharmacy
EM Pharmacist at Bethesda North

Duties
- Manage medications for arrests, intubations, AMIs, and strokes
- Prevent/detect adverse events and allergic reactions
- Provide drug information to physicians, nurses, and patients
- Perform medication histories
- Clarify medication orders
- Provide patient counseling
- Assist with pediatric dosing
- Provide pregnancy category and lactation information
- Educate staff (staff meetings, CE, newsletter)
- Precept pharmacy students on advanced rotations
- Enter orders for STAT and x1 dose medications
- Assist in developing medication-related departmental policies
- Attend committee meetings

Study-Med Rec in the ED at Bethesda North

Objectives
- Establish medical reconciliation as an important area of intervention for the pharmacist in the ED
- Emphasize the significance of the ED pharmacist with regard to ensuring accurate medication reconciliation

Interventions documented:
- Medication added
- Medication deleted
- Change in dose/strength
- Clarification of route
- Change in frequency
- Clarification or change in medication name
- PRN clarification (frequency/indication)
- Clarification of regimen/duration of therapy
- Miscellaneous

Study-Med Rec in the ED at Bethesda North

Results
- A total of 47 medication reconciliation forms were reviewed:
  - 44 (93.6%) required at least one intervention
  - 37 (78.7%) required at least two interventions
  - 32 (68.1%) required at least three or more interventions
- There was an average of 4.4 interventions per patient
- A total of 206 interventions were documented:
  - The minimum number of interventions documented for a single patient was 0
  - The maximum number of interventions documented for a single patient was 18

Study-Med Rec in the ED at Bethesda North

- Descriptive study
- Time frame: 1/3/12-1/25/2012
- 47 medication reconciliation forms reviewed by pharmacy intern:
  - Data initially collected by ED nurse
  - Pharmacy reviewed information after initial collection
- Data collection: chart in which the various interventions were documented
- Quantitative analyses: descriptive statistics were utilized to characterize the interventions
### Frequency of Interventions

<table>
<thead>
<tr>
<th>Intervention Type</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRN Clarification</td>
<td>29.1%</td>
</tr>
<tr>
<td>Medication Added</td>
<td>22.3%</td>
</tr>
<tr>
<td>Change in Dose/Strength</td>
<td>22.3%</td>
</tr>
<tr>
<td>Change in Frequency</td>
<td>11.7%</td>
</tr>
<tr>
<td>Medication Deleted</td>
<td>8.3%</td>
</tr>
<tr>
<td>Clarification/Change in Medication Name</td>
<td>3.4%</td>
</tr>
<tr>
<td>Clarification of Route</td>
<td>1.0%</td>
</tr>
<tr>
<td>Clarification of Regimen/Duration of Therapy</td>
<td>1.0%</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

### Study-Med Rec in the ED at Bethesda North

**Conclusions**
- Medication histories procured by ED nurses contain incomplete and inaccurate information
- Pharmacist intervention results in a more complete and accurate medication history

### Study-Med Rec in the ED at Bethesda North

**Limitations**
- Small sample size
- Short duration
- No systematic randomization
- Descriptive in nature so cannot be used to create a causal relationship

### Justification of Pharmacy Services in the Emergency Department

The emergency department is a natural laboratory for the study of error. – Dr Patrick Croskerry

### Reduction of Medication Errors

- It is estimated that:
  - The rate of adverse drug events resulting in harm in the ED is nearly double that of inpatient units
  - 3.6% of patients were prescribed an inappropriate medication in the ED
  - 5.6% of patients were prescribed an inappropriate medication upon ED discharge
  - 38% of patients reporting to a variety of EDs worried that a medical error might affect them

### Reduction of Medication Errors

- Consultation
- Prospective review of ED orders
- ED staff education
- Participation on code, trauma, stroke, MI teams
- Verify medication allergies and home medications
  - Identify drug interactions
- Patient education
- JCAHO compliance
**ED Staff Satisfaction**

- ED Staff value the presence of dedicated pharmacy coverage
- 26 question survey sent to ED staff members
  - 99% reported ED pharmacist improved the quality of care
  - 96% felt that ED pharmacist was an integral part of the ED team
  - 95% reported they had consulted with ED pharmacist at least a few times during last five shifts


**Cost Savings**

<table>
<thead>
<tr>
<th>Interventions</th>
<th>Estimated Cost Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,445</td>
<td>$103,221</td>
</tr>
</tbody>
</table>

Extrapolated annual savings: $1,238,652

**ED Pharmacist Interventions**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
</tr>
</thead>
<tbody>
<tr>
<td>1° Intervention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allergy Clarified/Prevented</td>
<td>215</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antibiotic Recommendation</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clarification of Orders</td>
<td>43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPR/Code Attended</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug Dose Provided</td>
<td>59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug Therapy Consultation</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug/Disease/Nonionization Interaction</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronic Chart Audit</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formulary Coverage</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formulary Guidance Review</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention Review/Ordered</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medication Reconciliation</td>
<td>1</td>
<td></td>
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<tr>
<td>Institutional Drug Use</td>
<td>4</td>
<td></td>
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</tr>
<tr>
<td>IV Drug Compatibility</td>
<td>19</td>
<td></td>
<td></td>
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<tr>
<td>IV Drug Order</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab Evaluation</td>
<td>74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medication History/Reconciliation</td>
<td>194</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacists Evaluation/Change</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Medication History/Reconciliation</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacist's Evaluation/Change</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary Interventions/Participation/Code Averted</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary Interventions/Participation/Code Averted</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unnecessary Drug Discontinued</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>937</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Strategies to Excel in the ED**

- Be visible!
  - Portable phone, make rounds every 30 minutes, befriend the staff
- Cover peak hours for your ED
- Focus on ED patients
  - Let inpatient specialists care for the boarded patients

**Strategies to Excel in the ED**

- Respond to all traumas, strokes, codes
- Be nosey!
- Try to watch orders proactively
- Talk to the patients
- Help nurses and physicians with tasks
  - Become involved in committees
  - Volunteer to review guidelines/pathways
Pharmacist 911

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Bethesda North Hospital