Faculty Disclosure

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Dr. Mansuri has listed no financial interest/arrangement that would be considered a conflict of interest.

icu complications
what is a complication?

complications vs. errors

<table>
<thead>
<tr>
<th>Types of Errors</th>
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<tbody>
<tr>
<td>Diagnoslic</td>
</tr>
<tr>
<td>Error or delay in diagnosis</td>
</tr>
<tr>
<td>Failure to employ indicated tests</td>
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<tr>
<td>Use of outdated tests or therapy</td>
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<tr>
<td>Failure to act on results of monitoring or testing</td>
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<tr>
<td>Treatment</td>
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<tr>
<td>Error in the performance of an operation, procedure, or test</td>
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<tr>
<td>Error in administering the treatment</td>
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<tr>
<td>Error in the dose or method of using a drug</td>
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<tr>
<td>Avoidable delay in treatment or in responding to an abnormal test</td>
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<tr>
<td>Inappropriate (not indicated) care</td>
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<tr>
<td>Preventive</td>
</tr>
<tr>
<td>Failure to provide prophylactic treatment</td>
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<tr>
<td>Inadequate monitoring or follow-up of treatment</td>
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<tr>
<td>Other</td>
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<tr>
<td>Failure of communication</td>
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<tr>
<td>Equipment failure</td>
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<tr>
<td>Other system failure</td>
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</tbody>
</table>

## complications | fact or fiction

**fiction**
- only sick patients
- mistake
- important to find someone to blame
- always preventable

**fact**
- any patient
- not necessarily
- prevention
- ?

## complications | why do we care?

- patient
- costs
- research
- regulations
- policy
complications | costs

- urinary tract infection: $3000
- pneumonia after stroke: $15,000
- adverse drug event: $6,000
- dvt dx and rx: $13,000
- fall with injury: $34,000
- vap: $40,000
- decubitus: $500 to $40,000
- mrsa infection: $27,000
- c. diff infection: $40,000
- surgical site infection: $13,000


complications | adverse events | costs

<table>
<thead>
<tr>
<th>Feature Articles</th>
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<tbody>
<tr>
<td>Costs of adverse events in intensive care units</td>
</tr>
<tr>
<td>Role: Clinical, MT, MPH; Frank W. Salke, MD, MSc; Cédric Fabozzi, PhD; Kevin R. Scalise, MSc; Jeffrey R. Hershkowitz, MD, MPH</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 4. Adjusted paired analysis</th>
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<tbody>
<tr>
<td>Cases</td>
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<tr>
<td>-------</td>
</tr>
<tr>
<td>MICU</td>
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<tr>
<td>Costs after AE to unit discharge or second event, $</td>
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<tr>
<td>CCU</td>
</tr>
<tr>
<td>Costs after AE to unit discharge or second event, $</td>
</tr>
<tr>
<td>Combined</td>
</tr>
<tr>
<td>Costs after AE to unit discharge or second event, $</td>
</tr>
</tbody>
</table>

MICU, medical intensive care unit; LOS, length of stay; AE, adverse event; CCU, cardiac intensive care unit.

Data are mean values and are adjusted for pre-event unit costs, age, sex, race, in-hospital mortality, primary insurer, diagnosis-related group weight, Charlson Index score, and Acute Physiology and Chronic Health Evaluation score.

source: crit care med 2007 vol. 35, no. 11

- micu
  - $3,961
  - los: 0.77d

- ccu
  - $3,857
  - los: 1.08d
complications | hac

- foreign object retained after surgery
- air embolism
- blood incompatibility
- stage iii and iv pressure ulcers
- falls and trauma
  - fractures
  - dislocations
  - intracranial injuries
  - crushing injuries
  - burn
  - other injuries
- manifestations of poor glycemic control
  - diabetic ketoacidosis
  - nonketotic hyperosmolar coma
  - hypoglycemic coma
  - secondary diabetes with ketoacidosis
  - secondary diabetes with hyperosmolarity
- catheter-associated urinary tract infection (uti)
- vascular catheter-associated infection
- surgical site infection, mediastinitis, following coronary artery bypass graft (cabg):
  - surgical site infection following bariatric surgery for obesity
    - laparoscopic gastric bypass
    - gastroenterostomy
    - laparoscopic gastric restrictive surgery
  - surgical site infection following certain orthopedic procedures
    - spine
    - neck
    - shoulder
    - elbow
  - deep vein thrombosis (dvt)/pulmonary embolism (pe) following certain orthopedic procedures:
    - total knee replacement
    - hip replacement

source: centers for medicare & medicaid services | hospital-acquired conditions (payment implications began october 1, 2008)

icu complications

- dvt
- vap
- crbsi
- gi stress ulcers
- glucose control
- medication errors
complications | dvt

- icu patients at risk
  - trauma
  - sepsis
  - central lines
  - picc lines
- developed by 22-80% critically ill patients
- symptoms:
  - leg pain
  - edema
  - erythema
  - warmth
  - no symptoms

- virchow’s triad:
  - hypercoagulability
  - stasis
    - immobility in the trauma/icu patient
  - endothelial damage
    - surgery
    - injury
    - lines
- ultrasound
  - level 1: duplex ultrasound for symptomatic patients
  - level 3: serial duplex screening may be cost-effective and decrease pe incidence in high-risk asymptomatic patients

complications | dvt

- 50%-70% of proximal dvt will result in pulmonary embolism
- pe symptoms
  - shortness of breath
  - chest pain
  - tachypnea
  - tachycardia

- dvt prevention
  - heparin 5000 units sq q8-q12
  - enoxaparin 30mg sq q12 or 40mg sq daily
- scds: sequential compression devices
  - no level 1 or 2 data
  - level 3: spine or head injury
  - increased venous velocities, direct effect on fibrinolytic pathway, increased coagulation cascade inhibitor molecules

Treatment considerations:
- anti-coagulation with heparin drip / enoxaparin bridge to warfarin therapy
complications | vap

• 80% of hospital acquired pneumonia (hap) associated with mechanical ventilation
• 9% of mechanically ventilated patients develop vap
• increases los by 10days
• cost increase by $40,000/case
• usually occurs >48 hours after intubation
  – within 4 days: streptococcus pneumonia, hemophilus influenza, staphylococcus aureus (mrsa)
  – greater than or =5 days: staphylococcus aureus (mrsa), pseudomonas aeruginosa, acinetobacter, gram negatives

• prevention
  – hand-washing
    • non-compliance 50%
  – hob >30°
  – daily sedation vacations / extubation
  – oral care
  – antibiotic use control
    • risk factors for drug-resistant vap
      – mechanical vent >7 days
      – prior broad spectrum antibiotic use

• treatment
  – antibiotic therapy
    • empiric and broad spectrum
    • pseudomonas aeruginosa: double-coverage
    • mrsa
    • hospital antibiogram

complications | crbsi

• 80,000 crbsi every year in usa icus
• more than 5 million cvcs placed annually in the us
• crbsi cost: $300 million - $2.3 billion
• most common bacteria:
  – coagulase-negative staphylococci
  – s. aureus
  – aerobic gram-negative bacilli
  – candida albicans
• considerations
  – need
  – site
  – manipulation
  – placement situation

• prevention
  – hand hygiene
  – sterile placement (barrier precautions)
  – teflon and/or coated/impregnated with antimicrobial/antiseptic compounds
    (cost considerations)
  – clear dressings to allow for regular inspection of site
  – insertion site: better: subclavian >> ij, femoral
  – avoid femoral catheters (venous thrombosis and infection)
  – ultra-sound guided (avoid mechanical complications)

• treatment
  – empiric antibiotics
    • treatment course: 10-14days to 4-6 weeks (depending on infection, response, and patient condition)
    • remove source | catheter
complications | gi stress ulcers

- clinically important bleeding in 1-4% of icu patients
- mortality may be increased as high as 50%
- no universal determination of need for stress ulcer prophylaxis
- recommendations for prophylaxis
  - level 1
    - mechanical ventilation
    - coagulopathy
    - traumatic brain injury
    - major burn injury
  - level 2
    - multi-trauma
    - sepsis
    - acute renal failure
- agents for prophylaxis
  - level 1
    - no difference between h2 antagonists, cytoprotective agents, and some ppis (do not use antacids)
- duration
  - level 1
    - no level 1 recommendations
  - level 2
    - during mechanical ventilation or icu stay

complications | glucose control

- common even if patient does not have history of dm
- critical value of blood glucose maintained at 130 mg/dl
- balance between acute hypoglycemia and tight control
- management
  - insulin infusion gtt
    - if bg > 110 mg/dl
    - maintain between 80-110 md/dl
    - algorithm is key
  - sliding scale of insulin
    - frequent checks
complications | medication error

- ades: adverse drug events
  - quantity
  - complexity
  - interactions
  - lack of familiarity
  - limited pharmacist availability

- prevention
  - standardized procedures
  - communication
  - electronic order entry

complications | the future

- research, research, research
- change, change, change
- back to square one
- judgement and journals
- speak up
complications | references

- EAST Guidelines. Stress Ulcer Prophylaxis. 2008