Beers List:
Potentially Inappropriate Medications (PIM) in Elderly
Background
Background

Hospital Stays per 10,000 Population by Age, 1997 and 2009

- All Ages: 1,284 (1997), 1,278 (2009)
- 85+: 5,463 (2009), 6,047 (1997)
- 45-64: 1,213 (2009), 1,155 (1997)
- 1-17: 229 (2009), 271 (1997)
- <1: 10,977 (2009), 11,799 (1997)

Note: Excludes a small number of stays (10,000 or 0.3 percent in 1997, 52,000 or 0.1 percent in 2009) with missing age.
Adverse Drug Events

• ~770,000 people are injured or die annually\textsuperscript{1-3}
• Spend 8-12 days longer in hospital
• Costs $16,000-$24,000 +
• 9.7% of ADEs result in permanent disability\textsuperscript{4}

References

Background

• Adverse Drug Reactions
  – Common in elderly
  – Important cause of morbidity and death
• Type “A”
  – Dose related
• Predictable
• Potentially avoidable

Beers Criteria (List)
Beers Criteria (List)

- Originally conceived in 1991 by Mark Beers, MD (geriatrician)
- AGS Beers Criteria for Potentially Inappropriate Medication Use in Older Adults
- AKA Beers List, Beers Criteria
Beers Criteria (List)

- Identifies medications that pose potential risks outweighing potential benefits for people ≥65 years
- Informs clinical decision-making concerning the prescribing of medications for older adults
- Improves medication safety & quality of care
Beers List – Intended Use

**Goal**: To improve care of older adults by decreasing exposure to *potentially inappropriate* medications

- Assistance with identifying medications for which risks outweigh the benefits
- Not meant to be punitive
- Not meant to supersede clinical judgment or an individual patient’s values & needs
Beers Criteria – AGS 2012
Evidence Based Update

<table>
<thead>
<tr>
<th>1st Category</th>
<th>2nd Category</th>
<th>3rd Category</th>
</tr>
</thead>
</table>
| PIMs for older people:  
  • Pose high risks of adverse effects OR  
  • Appear to have limited effectiveness in older pts  
  • There are alternatives to these medications | PIMs for older people:  
  • Who have certain diseases/disorders  
  – b/c these drugs may exacerbate the specified health problems | Use with caution in older adults  
  • May be associated with more risks than benefits in general  
  – However, may be the best choice for a particular individual if administered with caution |

PIM = Potentially Inappropriate Medication

• 53 medications or medication classes that should be avoided in older adults  
• 14 that should be used with caution
Beers Criteria – AGS 2015  
Evidence Based Update

<table>
<thead>
<tr>
<th>4th Category</th>
<th>5th Category</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drug-Drug Interactions (Non Anti-Infectives):</strong></td>
<td><strong>PIMs based on Kidney Function</strong></td>
</tr>
<tr>
<td>• Highly associated with harmful outcomes in older adults</td>
<td>• Avoid OR</td>
</tr>
<tr>
<td>• Urinary Incontinence</td>
<td>• Adjust Dosage</td>
</tr>
<tr>
<td>• Risk of Falls</td>
<td>• Creatinine Clearance Thresholds</td>
</tr>
<tr>
<td>• Synergistic Effects</td>
<td>• &lt;25 mL/min</td>
</tr>
<tr>
<td>• Risk of Hyperkalemia</td>
<td>• &lt;30 mL/min</td>
</tr>
<tr>
<td>• &gt;18 Drug classes that interact with each other</td>
<td>• 30-50 mL/min</td>
</tr>
<tr>
<td></td>
<td>• &lt;60 mL/min</td>
</tr>
<tr>
<td></td>
<td>• &lt; 80 mL/min</td>
</tr>
<tr>
<td></td>
<td>• 21 Medications</td>
</tr>
</tbody>
</table>
Evidence Base

Inappropriate Prescribing for Elderly Americans in a Large Outpatient Population

Arch Intern Med. 2004;164:1621-1625
Lesley H. Curtis, PhD; Truls Østbye, MD, PhD; Veronica Sendersky, PharmD; Steve Hutchison, PhD; Peter E. Dans, MD; Alan Wright, MD, MPH; Raymond L. Woosley, MD, PhD; Kevin A. Schulman, MD

The Impact for Elderly Persons in the Medical Record
An Interrupted Time Series Evaluation
Arch Intern Med. 2006;166:1098-1104
David H. Smith, RPh, PhD; Nancy Perrin, PhD; Adrienne Feldstein, MS, MD; Xiuhai Yang, MS; Daniel Kuang, MS; Steven R. Simon, MD, MPH; Dean F. Sittig, PhD; Richard Platt, MS, MD; Stephen B. Soumerai, ScD

Preventing Potentially Inappropriate Medication Use in Hospitalized Older Patients With a Computerized Provider Order Entry Warning System
Arch Intern Med. 2010;170(15):1331-1336
Melissa L. P. Mattison, MD; Kevin A. Afonso, BSBA; Long H. Ngo, PhD; Kenneth J. Mukamal, MD

LESS IS MORE
Shabot “Let’s not Boil the Ocean” Beers List Proposal

• Design CDS intervention to help prevent falls, fractures and deaths

• Form review panel of clinicians, pharmacists & informaticists to select potentially inappropriate sedative & disorienting meds from Beers List

• Design CDS CPOE alert to advise users of risks of ordering selected Beers List drugs in patients >65 yrs, and suggest pharmacist consultation
Governance

- Clinical Decision Support Oversight
- Beers Criteria Workgroup
  - Physicians
  - Pharmacists
  - Medical Informatics
- Acute Care Medical Informatics Committee
Key Decisions

• Target Medications
  – Phased Approach
  – Alternative Medications

• CDS Interventions
  – Alerts
  – Order Sets
  – Order Sentences

• Measuring Processes
• Measuring Outcomes
## Target Medications

<table>
<thead>
<tr>
<th>Therapeutic Class</th>
<th>Drug Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzodiazepines (Short, Intermediate, &amp; Long Acting)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alprazolam</td>
</tr>
<tr>
<td></td>
<td>Estazolam</td>
</tr>
<tr>
<td></td>
<td>Lorazepam</td>
</tr>
<tr>
<td></td>
<td>Oxazepam</td>
</tr>
<tr>
<td></td>
<td>Temazepam</td>
</tr>
<tr>
<td></td>
<td>Triazolam</td>
</tr>
<tr>
<td></td>
<td>Chlorazepate</td>
</tr>
<tr>
<td></td>
<td>Chlordiazepoxide</td>
</tr>
<tr>
<td></td>
<td>Clonazepam</td>
</tr>
<tr>
<td></td>
<td>Diazepam</td>
</tr>
<tr>
<td></td>
<td>Flurazepam</td>
</tr>
<tr>
<td></td>
<td>Quazepam</td>
</tr>
<tr>
<td>Ketorolac, includes parenteral</td>
<td>Ketorolac, includes parenteral</td>
</tr>
<tr>
<td>Anticholinergics (excludes TCAs) - First-generation antihistamines</td>
<td>Promethazine</td>
</tr>
<tr>
<td></td>
<td>Meperidine</td>
</tr>
<tr>
<td>Antiarrhythmic drugs (Class Ia, Ic, III)</td>
<td>Nifedipine, immediate release</td>
</tr>
<tr>
<td></td>
<td>Amitriptyline</td>
</tr>
<tr>
<td></td>
<td>Clomipramine</td>
</tr>
<tr>
<td></td>
<td>Doxepin &gt; 6 mg/d</td>
</tr>
<tr>
<td></td>
<td>Imipramine</td>
</tr>
<tr>
<td></td>
<td>Perphenazine-amitriptyline</td>
</tr>
<tr>
<td></td>
<td>Trimipramine</td>
</tr>
<tr>
<td><strong>Therapeutic Class</strong></td>
<td><strong>Drug Name</strong></td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Sulfonylureas, long duration</td>
<td>Glyburide</td>
</tr>
<tr>
<td>Anticholinergics (excludes TCAs) - First-generation antihistamines</td>
<td>Hydroxyzine</td>
</tr>
<tr>
<td>Barbiturates</td>
<td></td>
</tr>
<tr>
<td>Amobarbital*</td>
<td></td>
</tr>
<tr>
<td>Butabarbital*</td>
<td></td>
</tr>
<tr>
<td>Mephobarbital*</td>
<td></td>
</tr>
<tr>
<td>Pentobarbital*</td>
<td></td>
</tr>
<tr>
<td>Phenobarbital</td>
<td></td>
</tr>
<tr>
<td>Secobarbital*</td>
<td></td>
</tr>
<tr>
<td>Trimethobenzamide</td>
<td>Trimethobenzamide</td>
</tr>
<tr>
<td>Sulfonylureas, long duration</td>
<td>Chlorpropamide</td>
</tr>
<tr>
<td>Chlordiazepoxide-amitriptyline</td>
<td>Chlordiazepoxide-amitriptyline</td>
</tr>
<tr>
<td>Skeletal Muscle Relaxants</td>
<td>Cyclobenzaprine</td>
</tr>
<tr>
<td>Skeletal Muscle Relaxants</td>
<td>Metaxalone</td>
</tr>
<tr>
<td>Non-COX-selective NSAIDS, oral</td>
<td>Oxaprozin</td>
</tr>
<tr>
<td>Non-COX-selective NSAIDS, oral</td>
<td>Piroxicam</td>
</tr>
<tr>
<td>Alpha agonists, central</td>
<td>Reserpine</td>
</tr>
</tbody>
</table>
IT Interventions

• Alerts
  – Notification alerts for using caution
  – Alternative medications included
  – Pharmacist consults

• Update Order Set Content
  – Add comments on PIM for elderly
  – Create “smart” orders
Beers Criteria Alert
Inclusion Criteria

• CPOE Alert (Pharmacy application excluded)
• Patients aged >65 Years
• Patient Encounter Type:
  – Emergency Room, Day Surgery, Inpatient and Observation
• Include alternate therapy in alert
• Different Alert for Providers vs. Non-Providers
Beers Criteria Alert
Exclusion Criteria

• Inpatient Hospice is excluded from the rule.
• Meperidine is excluded from firing in the PACU.
• Patients with active mechanical ventilation
  – Lorazepam alert will not fire
• Order Set Exclusion
  – Adult Status Epilepticus
  – Seizure Observation
You are placing an order for cyclobenzaprine on a patient that is > 65 years. cyclobenzaprine increases risk for anticholinergic adverse effects, sedation and fractures in this patient population. Please consider the following for alternative therapy:

Alternatives:

Baclofen 5 mg PO twice daily
Tizanidine 2 mg PO Q8H PRN Spasticity

Alert Action:

- [ ] Cancel cyclobenzaprine
- [ ] Override Alert and Continue Order
Alternatives for insomnia:
- Melatonin 3 mg PO QHS PRN sleep
- Trazodone 25 mg PO QHS PRN sleep
- Trazodone 50 mg PO QHS PRN sleep

Alternatives for anxiety:
- Buspirone 7.5 mg PO Q12H
- Citalopram 10 mg PO daily
- Sertraline 25 mg PO daily

Add Order for:
- trazodone → 50 mg, Route: PO, Drug form: TAB, Bedtime, PRN Sleep, ...
- trazodone → 25 mg, Route: PO, Drug form: TAB, Bedtime, PRN Sleep, ...
- sertraline → 25 mg, Route: PO, Drug form: TAB, Daily, ...
- melatonin → 3 mg, Route: PO, Bedtime, PRN Sleep, ...
- citalopram → 10 mg, Route: PO, Drug form: TAB, Daily, ...
- busPIRone → 7.5 mg, Route: PO, Drug form: TAB, Q12H, ...

History
You are placing an order for LORazepam on a patient that is > 65 years. LORazepam increases risk of cognitive impairment, delirium, falls, and fractures in this patient population. Please consider the following for alternative therapy:

**Alternatives for insomnia:**
- Melatonin 3 mg PO QHS PRN sleep
- Trazodone 25 mg PO QHS PRN sleep
- Trazodone 50 mg PO QHS PRN sleep

**Alternatives for anxiety:**
- Buspirone 7.5 mg PO Q12H
- Citalopram 10 mg PO daily
- Sertraline 25 mg PO daily

**Alert Action**
- [ ] Cancel LORazepam
- [ ] Override Alert and Continue Order

**Add Order for:**
- [ ] Trazodone 50 mg, Route: PO, Drug form: TAB, Bedtime, PRN Sleep...
- [ ] Trazodone 25 mg, Route: PO, Drug form: TAB, PRN Sleep...

[ ] Pharmacist Consult (Beers Criteria: Benzodiazepine Short/Intermediate)
Pharmacist Consult
Beers Criteria

Discern Orders to Sign

Clinical Pharmacist Consult (Pharmacist Consult (Beers Criteria: Zolpidem))

Requested Start Date/Time: 02/01/2015 22:58

Reason: Beers Criteria Drug
Details: Zolpidem

Priority: Routine
Translator Needed: Yes, No
Type of Translator:

Multi-Patient Task List

IP Consults

Task retrieval completed

All Patients
You are placing an order for temazepam on a patient that is > 65 years. Temazepam increases risk of cognitive impairment, delirium, falls, and fractures in this patient population.

Please contact the ordering prescriber and discuss alternatives OR obtain confirmation before proceeding with order.

Alternatives for insomnia:
- Melatonin 3 mg PO QHS PRN sleep
- Trazodone 25 mg PO QHS PRN sleep
- Trazodone 50mg PO QHS PRN sleep

Alternatives for anxiety:
- Buspirone 7.5 mg PO Q12H
- Citalopram 10 mg PO daily

Alert Action
- **Cancel temazepam**  (Cancel is Defaulted)
- Override Alert and Continue Order
**Order Set**

**Smart Orders**

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**Age:** 59 years

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**Gender:** Male

**Code Status:** None Specified = FULL CODE

**INS:** United Health Star Plus OON (HBP) PCP: Carruthers, Jacqueline Renee MD

**Dose Wt:** 86.108 kg

**Allergies:** nka, nkda

---

<table>
<thead>
<tr>
<th>Component</th>
<th>Status</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>acetaminophen</td>
<td></td>
<td>1,000 mg, Route: PO, Q6H, now. Maximum total acetaminophen dose should not exceed 3,000 mg/day.</td>
</tr>
<tr>
<td>Ketorolac</td>
<td></td>
<td>Ketorolac will be hidden in patients $\geq 65$ years as part of Beers Alert rules.</td>
</tr>
<tr>
<td>celecoxib</td>
<td></td>
<td>30 mg, Route: IVP, Q6H, now. Duration: 24 hr. Hold in all patients if CrCl $&lt; 30$ ml/min. May also be held in patients with CrCl $&lt; 30$ ml/min.</td>
</tr>
<tr>
<td>Ketorolac</td>
<td></td>
<td>200 mg, Route: PO, Q12H, now. For patients LESS than 65 yrs. Chronic Pain MPP. For patient LESS than 65 yrs.</td>
</tr>
</tbody>
</table>
Age: 81 years

Gender: Male
Code Status: None Specified = FULL CODE
Fin#: 4581143

Order Set
Smart Orders

Plan

Component: acetaminophen
Status: 1,000 mg, Route: PO, Q6H now
Maximum total acetaminophen dose should not exceed 400

Please choose ONE NSAID

Component: Ketorolac
Status: Will be hidden in patients ≥ 65 years as part of Beers Alert rules.

Component: celecoxib
Status: 200 mg, Route: PO, Q12H now, For patients LESS than 65 yrs
Chronic Pain MPP. For patient LESS than 65 yrs old, begin ce...
Functional Measures

• Are our alerts working?
  – Do we understand how often they are firing?
  – Are we at risk of over alerting?

• Are our order sets/order sentences working?
Alert Data
Daily/ Monthly Trends

Alerts Per Day

Day of Alert DT [January 2018]
Process Measures

• How are our clinicians responding to our alerts/notifications?

• How are our clinicians using the order sets/order sentences?
# Alert Data

## Override Rate/ Alert Volume

<table>
<thead>
<tr>
<th>Date of Creation</th>
<th>When Does it Fire?</th>
<th>Alerts</th>
<th>Patients Impacted</th>
<th>Override %</th>
<th>Good Catches</th>
<th>Alerts / 1000 Orders</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>Order Entry, MPP Signing, Medication Reconciliation</td>
<td>1,248</td>
<td>826</td>
<td>89%</td>
<td>59</td>
<td>313</td>
</tr>
</tbody>
</table>

**Position**

- **Alert Recipient**
  - Provider: 73%
  - Nursing: 22%
  - Pharmacist: 0%
  - Non-Provider: 0%
  - Ambulatory: 4%

- **Encounter**
  - Inpatient: 81%
  - ED: 5%
  - Clinic: 14%
  - Other: 0%

**Alerted Personnel**

- MD 12: 8
- MD: 7

**Location**

- Facility 1: 14%
- Facility 2: 12%
- Facility 3: 10%
- Facility 4: 10%

**Come From MPP?**

- 3%

- 97%
Outcome Measures

• Good Catches
  – Alerts backed out and therapy changed

• Volume of orders for elderly patients
  – Are we seeing more elderly patients (>65 yrs)?
  – # of Orders per 1000 elderly patients (>65 yrs)

• Serious Safety Events
  – Elderly patient falls
  – Related to medications
Alert Data
Override Rate/ Alert Volume

<table>
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<td>89%</td>
<td>59</td>
<td>313</td>
</tr>
</tbody>
</table>

Total of 33,070 Good Catches since alert implementation
Orders Data: Lorazepam
# of Orders per 1000 Patients

~18% Reduction

Alert Go-Live (4/15/14)

January 2014 -- December 2017
Orders Data: Alprazolam

# of Orders per 1000 Patients

January 2014 -- December 2017

Alert Go-Live (4/15/14)

~50% Reduction
Orders Data: Ketorolac
# of Orders per 1000 Patients

~36% Reduction

Alert Go-Live (4/15/14)

January 2014 -- December 2017
Orders Data: 7 Drugs
Account for 80% of all orders

~28% Reduction

Alert Go-Live (4/15/14)
# Financial Impact

## PIM in Elderly Patients

<table>
<thead>
<tr>
<th>Prevention Assumption</th>
<th>Estimated ADE’s</th>
<th>Estimated Cost Savings</th>
<th>Estimated Lives Saved</th>
<th>Estimated SSEs Prevented</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADE’s prevented per potential medication error prevented</td>
<td>Good Catches N=33,070</td>
<td>$ 2,595 per adverse drug event</td>
<td>1%</td>
<td>12%</td>
</tr>
<tr>
<td>1 in 2</td>
<td>16,535</td>
<td>$ 42,908,325</td>
<td>1,65</td>
<td>1984</td>
</tr>
<tr>
<td>1 in 4</td>
<td>8,267</td>
<td>$ 21,452,865</td>
<td>82</td>
<td>992</td>
</tr>
<tr>
<td>1 in 8</td>
<td>4,133</td>
<td>$ 10,725,135</td>
<td>41</td>
<td>496</td>
</tr>
<tr>
<td>1 in 16</td>
<td>2,066</td>
<td>$ 5,361,270</td>
<td>20</td>
<td>248</td>
</tr>
<tr>
<td>1 in 32</td>
<td>1033</td>
<td>$ 2,680,635</td>
<td>10</td>
<td>124</td>
</tr>
</tbody>
</table>

THANK YOU!