Risk Factors For Drug-Related Problems Causing Emergency Department Visits In Older Adults

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David Persaud PhD (Supervisor)

MSVU: Our Future is Aging

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Outline

• Background
• Literature Review
• Objective
• Hypotheses
• Methods
• Results
• Discussion
• Conclusions
• Polypharmacy and Medication Inappropriateness
Polypharmacy and Medication Inappropriateness
Literature Review

• 30.4% of hospital admissions in adults aged 75 years or older could be attributed to a drug-related problem

• Of 718 adults over 50 years that were admitted to a medical ward in a four month period and were taking drugs on admission 23% were deemed to have a drug-related cause for admission
Literature Review: Risk Factors

Factors that have been shown to increase the incidence of an adverse drug event leading to contact with the healthcare system include:

(1) number of medications
(2) drug interactions
(3) specific medications such as digoxin, non-steroidal anti-inflammatory drugs, antiplatelet or anticoagulent drugs, diuretics, calcium channel antagonists, chemotherapeutic agents and antibacterial drugs
(4) older age
(5) increased number of comorbidities
(6) impaired cognition
(7) impaired renal function
(8) dependence for activities of daily living
(9) incontinence
(10) falls
(11) self-medication management
(12) lack of social support
(13) frailty
(14) malnutrition
(15) medication non-adherence
Literature Review: Medication appropriateness

• Beer’s List
  – 98.7% of veterans 65 years or older were taking at least one Beer’s list medication and this predicted a subsequent adverse drug reaction
  – 97.7% of 251,305 subjects 65 years of age or older who were likely taking a potentially inappropriate medication according to Beers list were at a significantly increased risk of unplanned hospitalization which increased as the subject was exposed to more potentially inappropriate medications
Literature Review: Medication appropriateness

• **STOPP & START: 80 STOPP criteria and 34 START criteria**
  – In 302 frail inpatients 75 years or older, admitted for acute illness 210 events of potentially inappropriate medication were detected with STOPP and START
  – A prevalence of 47.7% were receiving a potentially inappropriate medication
  – Contributed to 27.1% of the subjects being admitted to hospital

  (Dalleur, O., Spinewine, A., Henrard, S., Losseau, C., Speybroeck, N., & Boland, B. (2012). Inappropriate prescribing and related hospital admissions in frail older persons according to the STOPP and START criteria. Drugs Aging, 29(10), 829-837.)

• **Medication Appropriateness Index**
  – Correlates with risk of adverse drug events

<table>
<thead>
<tr>
<th>Answer the question for each drug and give the applicable score</th>
<th>Indicated</th>
<th>Marginally Indicated</th>
<th>Not Indicated</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is there an indication for the drug?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2. Is the medication effective for the condition?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3. Is the dosage correct?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4. Are the directions correct?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5. Are there clinically significant drug-drug interactions?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>6. Are there clinically significant drug-disease/condition interactions?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>7. Are the directions practical?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>8. Is there necessary duplication with other drug(s)?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>9. Is the duration of therapy acceptable?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>10. Is this drug the least expensive alternative compared to others of equal utility?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>
Objective

• To examine medication appropriateness in relation to medical, social and economic factors as risk factors for drug-related emergency department visits
Methods

- Comprehensive Geriatric Assessment (CGA) Excel database
- The data collection began in the summer of 2006 and contains entries until fall 2013
- All subjects in the database of 65 years of age or older were evaluated
- Over 900 entries were contained in the database
  - Not all entries were complete...
Methods

• Due to problem with the database only data for 360 subjects was available
• Of these 159 could not be included in the study
  – 17 were too young (<65 years of age), 36 did not have an identifiable corresponding medical record, 99 potential subjects had ID numbers that did not correspond to any patient, 6 were subsequent visits for previously included individuals and one subject had no medication information
• This left complete data for 201 subjects available for analysis
• Patient records were consulted to collect missing data
Methods

• Risk Factor Variables and their Measurement
  – Sex
  – Digoxin
  – Non-steroidal anti-inflammatory drugs
  – Antiplatelet or anticoagulant drugs
  – Diuretics
  – Calcium channel antagonists
  – Chemotherapeutic agents
  – Antibacterial agents
  – Any psychoactive medication
  – Anticholinergics
  – Sedatives
  – Antipsychotics
  – Antidepressants

  – Anti-epileptics
  – Lithium
  – Narcotics
  – Age
  – Number of medications
  – Number of comorbidities
  – Impaired cognition by MMSE score
  – Impaired cognition by previous diagnosis
  – Dependence for activities of daily living
  – Presence of kidney dysfunction
  – Incontinence
  – History of falls
  – Social support
  – Self-medication management
  – Frailty
  – Medication appropriateness index score
  – Impaired hearing
  – Impaired vision
  – Baseline education
  – Living alone
Hypotheses

• $H_1$: A high medication appropriateness index is a risk factor for drug-related emergency department visits in adults 65 years of age or older assessed by a geriatric internal medicine service.

• $H_2$: Social vulnerability as lack of social support is a risk factor for drug-related emergency department visits in adults 65 years of age or older assessed by a geriatric internal medicine service.

• $H_3$: Lower cognitive status is a risk factor for drug-related emergency department visits in adults 65 years of age or older assessed by a geriatric internal medicine service.

• $H_4$: Low educational level is a risk factor for drug-related emergency department visits in adults 65 years of age or older assessed by a geriatric internal medicine service.

• $H_5$: Frailty is a risk factor for drug-related emergency department visits in adults 65 years of age or older assessed by a geriatric internal medicine service.
The primary outcome measure is a drug-related healthcare system visit

**Drug-Related Problems**

1. untreated indication
2. improper drug
3. sub-therapeutic dosage
4. over-dosage
5. adverse drug reaction
6. drugs are used at appropriate doses and may include abnormal laboratory values
7. drug interaction
8. drug use without indication


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Methods

• Naranjo Score
  • >9 definite drug-related event
  • 5-8 probable drug-related event
  • 1-4 possible drug-related event
  • 0 doubtful drug-related event

## Results

<table>
<thead>
<tr>
<th>Continuous Variable</th>
<th>Total number of subjects (N)</th>
<th>Mean (± standard deviation)</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>201</td>
<td>81.1 ± 8.1</td>
<td>65</td>
<td>102</td>
</tr>
<tr>
<td>Number of Medications</td>
<td>201</td>
<td>9.0 ± 5.6</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>Number of Comorbidities</td>
<td>201</td>
<td>8.8 ± 3.3</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>MMSE Score</td>
<td>170</td>
<td>20.9 ± 8.7</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>Education in Years</td>
<td>174</td>
<td>10.2 ± 2.7</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Medication Appropriateness Index</td>
<td>201</td>
<td>12.5 ± 13.0</td>
<td>0</td>
<td>76</td>
</tr>
<tr>
<td>Clinical Frailty Scale</td>
<td>198</td>
<td>5.6 ± 1.6</td>
<td>2</td>
<td>9</td>
</tr>
</tbody>
</table>
## Results

<table>
<thead>
<tr>
<th>Categorical Variable</th>
<th>Total number of subjects (N)</th>
<th>Number of subjects (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Sex</td>
<td>201</td>
<td>94 (46.8%)</td>
</tr>
<tr>
<td>Digoxin</td>
<td>201</td>
<td>5 (2.5%)</td>
</tr>
<tr>
<td>NSAID</td>
<td>201</td>
<td>11 (5.5%)</td>
</tr>
<tr>
<td>Antiplatelet or Anticoagulent</td>
<td>201</td>
<td>109 (54.2%)</td>
</tr>
<tr>
<td>Diuretic</td>
<td>201</td>
<td>87 (43.3%)</td>
</tr>
<tr>
<td>Calcium Channel Blocker</td>
<td>201</td>
<td>55 (27.4%)</td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>201</td>
<td>5 (2.5%)</td>
</tr>
<tr>
<td>Antibiotic</td>
<td>201</td>
<td>35 (17.4%)</td>
</tr>
<tr>
<td>Any Psychoactive Agent</td>
<td>201</td>
<td>107 (53.2%)</td>
</tr>
<tr>
<td>Antipsychotic</td>
<td>201</td>
<td>11 (5.5%)</td>
</tr>
<tr>
<td>Sedative</td>
<td>201</td>
<td>54 (26.9%)</td>
</tr>
<tr>
<td>Antidepressant</td>
<td>201</td>
<td>62 (30.8%)</td>
</tr>
<tr>
<td>Antiepileptic</td>
<td>201</td>
<td>13 (6.5%)</td>
</tr>
<tr>
<td>Lithium</td>
<td>201</td>
<td>1 (0.5%)</td>
</tr>
<tr>
<td>Narcotic</td>
<td>201</td>
<td>39 (19.4%)</td>
</tr>
<tr>
<td>Any Anticholinergic Medication</td>
<td>201</td>
<td>155 (77.1%)</td>
</tr>
<tr>
<td>Normal Hearing</td>
<td>192</td>
<td>133 (66.2%)</td>
</tr>
<tr>
<td>Normal Vision</td>
<td>181</td>
<td>116 (57.7%)</td>
</tr>
<tr>
<td>Baseline Cognition</td>
<td>182</td>
<td></td>
</tr>
<tr>
<td>Normal Cognition</td>
<td>197</td>
<td>101 (50.2%)</td>
</tr>
<tr>
<td>Mild Cognitive Impairment</td>
<td>201</td>
<td>26 (12.9%)</td>
</tr>
<tr>
<td>Dementia</td>
<td>199</td>
<td>55 (27.4%)</td>
</tr>
<tr>
<td>Dependent for any ADL(s)</td>
<td>183</td>
<td>73 (36.3%)</td>
</tr>
<tr>
<td>Known Kidney Dysfunction</td>
<td>201</td>
<td>51 (25.4%)</td>
</tr>
<tr>
<td>Incontinence of either bowel or bladder</td>
<td>193</td>
<td>46 (22.9%)</td>
</tr>
<tr>
<td>Prior Fall(s)</td>
<td>183</td>
<td>73 (36.3%)</td>
</tr>
<tr>
<td>Social Support</td>
<td>187</td>
<td></td>
</tr>
<tr>
<td>No Support</td>
<td>187</td>
<td>55 (27.4%)</td>
</tr>
<tr>
<td>Informal Support</td>
<td>198</td>
<td>74 (36.8%)</td>
</tr>
<tr>
<td>Formal Support</td>
<td>198</td>
<td>58 (28.9%)</td>
</tr>
<tr>
<td>Living Alone</td>
<td>197</td>
<td>60 (29.9%)</td>
</tr>
<tr>
<td>Self Medication Management</td>
<td>198</td>
<td>82 (40.8%)</td>
</tr>
</tbody>
</table>
Hypothesis 2: social vulnerability as described by lack of social support is a risk factor for drug-related emergency department visits in adults 65 years of age or older as assessed by a geriatric internal medicine service was supported.

**Methods: Binary Logistic Regression**

<table>
<thead>
<tr>
<th>Step 1a</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>.018</td>
<td>.026</td>
<td>.514</td>
<td>1</td>
<td>.473</td>
<td>1.019</td>
</tr>
<tr>
<td>SEX(1)</td>
<td>.733</td>
<td>.421</td>
<td>3.030</td>
<td>1</td>
<td>.082</td>
<td>2.081</td>
</tr>
<tr>
<td>NSAID(1)</td>
<td>-1.110</td>
<td>.737</td>
<td>2.268</td>
<td>1</td>
<td>.132</td>
<td>.330</td>
</tr>
<tr>
<td>NARCOTIC(1)</td>
<td>-1.024</td>
<td>.486</td>
<td>4.435</td>
<td>1</td>
<td>.035</td>
<td>.359</td>
</tr>
<tr>
<td>ANTICHOLINERGIC(1)</td>
<td>-1.218</td>
<td>.600</td>
<td>4.125</td>
<td>1</td>
<td>.042</td>
<td>.296</td>
</tr>
<tr>
<td>SUPPORTS</td>
<td></td>
<td></td>
<td>8.622</td>
<td>2</td>
<td>.013</td>
<td></td>
</tr>
<tr>
<td>SUPPORTS(1)</td>
<td>1.575</td>
<td>.576</td>
<td>7.480</td>
<td>1</td>
<td>.006</td>
<td>4.832</td>
</tr>
<tr>
<td>SUPPORTS(2)</td>
<td>1.421</td>
<td>.542</td>
<td>6.870</td>
<td>1</td>
<td>.009</td>
<td>4.140</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.245</td>
<td>2.170</td>
<td>1.071</td>
<td>1</td>
<td>.301</td>
<td>.106</td>
</tr>
</tbody>
</table>
Methods: Binary Logisitic Regression by Naranjo Score

- Hypothesis 1: a high medication appropriateness index is a risk factor for drug-related emergency department visits in adults 65 years of age or older assessed by a geriatric internal medicine service was supported

<table>
<thead>
<tr>
<th>Step 1&lt;sup&gt;a&lt;/sup&gt;</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEX(1)</td>
<td>-.088</td>
<td>.833</td>
<td>.011</td>
<td>1</td>
<td>.916</td>
<td>.916</td>
</tr>
<tr>
<td>AGE</td>
<td>-.002</td>
<td>.054</td>
<td>.002</td>
<td>1</td>
<td>.967</td>
<td>.998</td>
</tr>
<tr>
<td>MAI</td>
<td>.057</td>
<td>.021</td>
<td>7.406</td>
<td>1</td>
<td>.007</td>
<td>1.058</td>
</tr>
<tr>
<td>Constant</td>
<td>-4.148</td>
<td>4.391</td>
<td>.893</td>
<td>1</td>
<td>.345</td>
<td>.016</td>
</tr>
</tbody>
</table>
Findings

• This study showed that
  1. narcotic drug use
  2. any anticholinergic drug use
  3. lack of social supports
  4. increased MAI
    – increase the risk of drug-related hospital visits

• These results support hypotheses 1 and 2
Discussion: Drug Use

Narcotic Use

• Narcotic use increased the risk of a drug-related emergency department visit
• Previously demonstrated by Merle, et al. (2005)
  – Showed that morphine derivatives increase the incidence of clinically meaningful drug-interactions that lead to hospital visits
• Pharmacologic effects of narcotics
  – Cause drowsiness
  – Precipitate delirium
• In Nova Scotia we monitor narcotic prescriptions but do not review for appropriateness
• No incentive for family physicians to minimize narcotic use as a goal of care

Anticholinergic Drug Use

• Anticholinergic drugs as a group were implicated as a risk factor for drug-related hospital visit
• Pharmacologic effects of anticholinergic drugs
  – Hallucinations
  – Confusion
  – Urinary retention
  – Constipation
    • Precipitate delirium
Lack of social supports increases the risk of drug-related emergency department visits.

Previously demonstrated by Vliet, et al. (2006)
- Social supports decrease pressure on the healthcare system by reducing drug-related emergency department visits
- Therefore hypothesis 2 was supported

Education had no relationship to the risk of drug-related emergency department visits
- Therefore hypothesis 4 was not supported

Impaired cognition had no relationship to the risk of drug-related emergency department visits
- Therefore hypothesis 3 was not supported

Frailty had no relationship to the risk of drug-related emergency department visits
- Therefore hypothesis 5 was not supported
Discussion: Limitations

- Retrospective
  - Changes in practice over time
- Missing data
  - For the 201 subjects included in the analysis there was still unavailable data
- Small study size
  - Only initial entries were included for each subject
- Unable to include medication non-adherence
- Limited in its generalizability
- The data collected was recorded by a variety of clinicians
  - Medications were not consistently recorded on the CGA form
  - How drugs are prescribed may not be how they were taken
- Only emergency department records were consulted so if subsequent information came to light that the visit was likely drug-related this would not be captured
- Clinical frailty scale versus frailty index
- Did not include cholinesterase inhibitors as a potential drug risk factor
- Chronic kidney disease was only included if it was listed as a known medical condition
- The maximum number of years of education was considered to be 13
Discussion: Biases

- Completed by one reviewer
- Patients seen by geriatric internal medicine may be more complicated, more likely to have polypharmacy and may be inherently more likely to have drug-related problems
Conclusions

• This study showed narcotic use, any anticholinergic use, lack of social supports and increased MAI increased the risk of drug-related emergency department visits for seniors
• Highlights importance of social supports
• A high medication appropriateness index is a risk factor for drug-related emergency department visits
Bibliography

- Dalleur, O., Spinewine, A., Henrard, S., Losseau, C., Speybroeck, N., & Boland, B. (2012). Inappropriate prescribing and related hospital admissions in frail older persons according to the STOPP and START criteria. Drugs Aging, 29(10),829-837.
Bibliography