Human Factors Considerations for Contraindication Alerts

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Alert fatigue

Mental state that is the result of
Alerts consuming too much time and mental energy
Which can cause relevant alerts to be **unjustifiably overridden**
along with clinically irrelevant ones

Ignoring alerts
Misinterpretation of alerts
Wrong selection of handling options

Counteracting alert fatigue

- **Specificity**
  - Patient-tailored (relevant) alerts, preventing irrelevant alerts

- **Training**
  - Teaching how to understand and value alerts

- **Usability**
  - Attracting attention: color, visibility, signal words
  - Facilitating handling: corrective actions
Human Factors in Alerting

- **I-MeDeSA**: Instrument Medication-Related Decision Support Alerts
  - Quantitative instrument DDI alerting
  - 9 human factors principles, 26 items
    - Placement, visibility, prioritization, color
    - Textual information
    - Proximity task components, corrective actions
    - Learnability and confusibility, alarm philosophy


Contraindications (CIs)

- Condition of a patient that makes administration of a drug undesirable or dangerous
  - Patient morbidity (epilepsy, diabetes)
  - Patient status (pregnancy, lactation)
  - Allergy or intolerance
    - Drug-disease alerts, drug-allergy alerts
- CI alerts dependent on medication orders + patient characteristics
- Severity level, text messages important
- Quantitative human-factors instrument lacking
Research questions

- Can the DDI-instrument be used to some extent to CIs?

- Which other (drug safety alert) human factors principles apply to CIs?

- How should human factors principles for CIs be operationalized?
  - Test cases

- Is it feasible to test design quality of CI alerting with this test?
## Test items

<table>
<thead>
<tr>
<th>Test item</th>
<th>New principle or equal or similar to DDI instrument</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alarm philosophy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description of alert classification logic (Australian pregnancy risk classification)</td>
<td>Simil.</td>
<td>0.07</td>
</tr>
<tr>
<td>Description of alert classification logic when severity is patient dependent (intolerance and allergy)</td>
<td>New</td>
<td></td>
</tr>
<tr>
<td><strong>False alarms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is a pregnancy alert only generated when action is required?</td>
<td>New</td>
<td></td>
</tr>
<tr>
<td>Is trimester taken into account?</td>
<td>New</td>
<td></td>
</tr>
<tr>
<td>Is allergy alert only generated after entry of allergy (symptoms)</td>
<td>New</td>
<td></td>
</tr>
<tr>
<td><strong>Placement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are different types of alerts meaningfully grouped?</td>
<td>Equal</td>
<td>0.53</td>
</tr>
<tr>
<td>Is action directly possible from alert screen?</td>
<td>Equal</td>
<td></td>
</tr>
<tr>
<td>Is contraindication alert generated directly after prescribing the drug (not after completion of the order)?</td>
<td>Simil.</td>
<td></td>
</tr>
<tr>
<td>Is the information easily visible (contraindicated drug, patient risk, recommended action)?</td>
<td>Equal</td>
<td></td>
</tr>
<tr>
<td><strong>Visibility</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the size of the alert message able to draw the attention of the user?</td>
<td>Equal</td>
<td>0.89</td>
</tr>
<tr>
<td>Does the background contrast allow the reader to easily read the message?</td>
<td>Equal</td>
<td></td>
</tr>
<tr>
<td>Is the font used appropriate to easily read the message (mixture of upper and lower case)?</td>
<td>Equal</td>
<td></td>
</tr>
</tbody>
</table>
False alarms

Is a pregnancy alert only generated when action is required?

Is trimester taken into account?

Is allergy alert only generated after entry of allergy (symptoms)
Dutch Drug Database G-Standard

- All licensed drugs: logistical and safety information
  - Included in pharmacy software, CPOEs for hospitals, GPs
- Professional standard
- Monthly update

- CI mentioned in the literature
  - Really a CI? Action required?
    - Yes/yes CI → alert in CPOE
    - Yes/no CI → no alert
    - No/no CI → no alert
# Severity levels and test drugs

<table>
<thead>
<tr>
<th>Pregnancy Risk Category</th>
<th>Drug</th>
<th>Action required?</th>
<th>Severity level</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Ribavirin</td>
<td>Yes</td>
<td>High</td>
</tr>
<tr>
<td>D</td>
<td>Doxycyclin</td>
<td>Yes</td>
<td>Medium</td>
</tr>
<tr>
<td>C</td>
<td>Metoprolol</td>
<td>Yes</td>
<td>Low</td>
</tr>
<tr>
<td>B3</td>
<td>Aciclovir</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>Allopurinol</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>Rabeprazol</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Clindamycin</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Allergy</th>
<th>Drug</th>
<th>Action required?</th>
<th>Severity Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin</td>
<td>Coamoxiclav</td>
<td>Yes</td>
<td>Combination product</td>
</tr>
<tr>
<td>Metoprolol</td>
<td>Metoprolol</td>
<td>Yes</td>
<td>Cross-sensitivity</td>
</tr>
<tr>
<td>Penicillin</td>
<td>Cefuroxim</td>
<td>Yes</td>
<td>Dependent on entered patient symptoms</td>
</tr>
</tbody>
</table>
- Enter CI pregnancy (4 months)
  - Trimester can be entered (1)
  - No question on trimester or estimated end date (0)
- Prescribe ribavirin capsule 200mg QID
  - An CI alert is generated (1)
  - No alert is shown (0)
- When in the prescribing process the alert is generated?
  - Directly after selecting the drug (1)
  - After prescribing the dose (0)
  - At order completion (0)
Contraindication alert

Order complete
Interruptive
Screen overlap
Severity
Wording
Handling OK
Results

- 30 items, 10 human factors principles
  - 21 items ‘as is’
  - 5 items slightly modified
  - 4 items new (false alarms, alarm philosophy)

- 1 CPOE: Medicatie/EVS®
- 3 independent raters
- Scores 0.00 (false alarms not filtered out) – 0.89 (visibility)
- Inter-rater variability $\kappa=0.540$ (moderate agreement)
Discussion

- False alarms
  - Pregnancy risk category A and B2 (yes/no CI) shown in CPOE
  - Trimester not encoded in G-standard

- Allergies
  - Not possible to enter severity level in CPOE
  - Severity not distinguishable (color, prioritization)

- Interrater-variability: moderate agreement
  - Raters no experience in human factors principles
Conclusion

- New instrument derived to large extent from I-MeDeSA for DDIs
- False alarms is extra human factors principle to be included
- Drugs contraindicated in pregnancy and allergy adequate for testing
- Feasible to test design quality of CI alerting
Thank you for your attention!

Questions?

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