What is the effect of electronic pathology ordering on test re-ordering patterns for paediatric patients?

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Presentation outline

Background
- Electronic pathology ordering
- Repeat testing
- Paediatric patients

Objective

Methods

Results
- Paper-based ordering
- Electronic ordering

Discussion
Pathology testing

- One of the highest-volume medical activities
- Across specialties and in multiple medical contexts

- “70% of medical diagnoses are confirmed by pathology investigations”
- “60% of Australians will have at least one pathology testing episode each year, and many with chronic disease will have far more”

From: Australian Medical Association (AMA) Position Statement – Pathology Policy 2011
Repeat testing

- Accounts for 17-40% of overall pathology testing
- What is a repeat test?
  Identical to a previously ordered test for the same patient
- Necessary and appropriate
- Unnecessary and redundant
  - Increase workload and costs
  - Patient discomfort and safety risks
Paediatric patients
Electronic ordering has the potential to improve the efficient utilisation of pathology services.
Objective:

To examine the effect of electronic pathology ordering on repeat testing for paediatric patients.
Study setting

• Two hospitals with 4 ICUs
• Age (0-18 years)

• A pathology laboratory service, providing comprehensive laboratory testing
Electronic ordering system

- Cerner PowerChart system in October 2009

- Presenting clinicians with
  1) Information about previous tests
  2) Duplicate order alerts (mostly triggered <24 hours)
Existing information, including pathology tests

A calcium test was ordered at 12:03 on 7\textsuperscript{th} March 2014

A new test ordered (within 24 hours)
A duplicate order alert

The ordering clinician could elect to
• Cancel the order, or
• Override the alert and proceed with the order
A before and after study


Analysis stratified by

1) age (<1 or ≥1 year)
2) ICU status (ICUs or non-ICU wards)
## Results

<table>
<thead>
<tr>
<th>Ordering</th>
<th>No. of children</th>
<th>Avg. No. of tests per patient (95% CI)</th>
<th>( p )-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper-based</td>
<td>2,700</td>
<td>19 (17-21)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Electronic</td>
<td>2,500</td>
<td>14 (12-15)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5,200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>ICU</td>
<td>Time interval</td>
<td>Paper % (95%CI)</td>
</tr>
<tr>
<td>----------</td>
<td>------</td>
<td>---------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>&lt;1 year</td>
<td>Yes</td>
<td>≤ one-hour</td>
<td>3.0 (2.7-3.3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤ 24-hours</td>
<td>54.2 (53.3-55.0)</td>
</tr>
</tbody>
</table>

Children aged under one in ICUs
<table>
<thead>
<tr>
<th>Age</th>
<th>ICU</th>
<th>Time interval</th>
<th>Paper</th>
<th>Electronic ordering</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥1 year</td>
<td>Yes</td>
<td>≤ one-hour</td>
<td>2.2 (1.8-2.5)</td>
<td>0.9 (0.6-1.2)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>≤ 24-hours</td>
<td>55.2 (53.9-56.5)</td>
<td>47.2 (45.4-48.9)</td>
<td>&lt;0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>ICU</td>
<td>Time interval</td>
<td>Paper</td>
<td>Electronic ordering</td>
<td>$p$-value</td>
</tr>
<tr>
<td>------------</td>
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<td>---------------</td>
<td>--------</td>
<td>---------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>&lt;1 year</td>
<td>No</td>
<td>≤ one-hour</td>
<td>0.7 (0.5-0.9)</td>
<td>0.9 (0.6-1.2)</td>
<td>0.2</td>
</tr>
<tr>
<td>≤ 24-hours</td>
<td></td>
<td>≤ 24-hours</td>
<td>14.0 (13.2-14.8)</td>
<td>14.6 (13.6-15.7)</td>
<td>0.4</td>
</tr>
</tbody>
</table>
## Children aged one and above in non-ICU wards

<table>
<thead>
<tr>
<th>Age</th>
<th>ICU</th>
<th>Time interval</th>
<th>Paper % (95%CI)</th>
<th>Electronic ordering % (95%CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥1 year</td>
<td>No</td>
<td>≤ one-hour</td>
<td>1.7 (1.5-1.8)</td>
<td>0.3 (0.2- 0.3)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤ 24-hours</td>
<td>20.7 (20.2-21.1)</td>
<td>23.2 (22.6-23.7)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>
In summary…

After the introduction of electronic ordering:

– tests per patient ↓

– repeat tests ordered, esp. in ICUs ↓
Discussion

• Paediatric patients – vulnerable
• Electronic pathology ordering – effective
• Appropriateness of repeat tests – complex

Way forward…

• Further improvements: decision support systems
• Improve paediatric patient safety
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Analysis stratified by age and ICU status

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Non-ICU</th>
<th>ICU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &lt; 1 year</td>
<td>12,428</td>
<td>17,522</td>
</tr>
<tr>
<td></td>
<td>(41%)</td>
<td>(59%)</td>
</tr>
<tr>
<td>Age ≥ 1 year</td>
<td>46,939</td>
<td>8,839</td>
</tr>
<tr>
<td></td>
<td>(84%)</td>
<td>(16%)</td>
</tr>
</tbody>
</table>

P < 0.0001
<table>
<thead>
<tr>
<th>Ordering</th>
<th># of children</th>
<th># of tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper-based</td>
<td>2,747</td>
<td>52,331</td>
</tr>
<tr>
<td>Electronic</td>
<td>2,469</td>
<td>33,397</td>
</tr>
<tr>
<td>Total</td>
<td>5,073</td>
<td>85,728</td>
</tr>
</tbody>
</table>
Repeat testing

• Repeat testing of 8 blood tests accounted for 40% of overall test utilisation (van Walraven 2003)

• Repeat testing made up to 17% of total laboratory workload (Kwok 2005)
