IMPROVED QUALITY OF MEDICATION MANAGEMENT HELPS TO REDUCE MEDICATION ERRORS

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Carefusion
Singapore March 3, 2016

Medication: challenges

- **Safety**
  - Among the 3 main sources of avoidable adverse events

- **Efficiency**
  - Difficult to perform highly without appropriate tools for stock management

- **Economics**
  - Value of decentralized stocks

- **Traceability**
  - Increasing requirements by authorities
An obsolete organisation?

Avoidable adverse drug events: 6.5% of admissions

39% Interception 48%

11% Interception 33%

38% Interception 2%

How errors occur?

The addition of 2 errors
Commission error AND Control failure

Selection Dilution Calculation...

Check Double-check...

wrong drug / syringe swap error P_{err}-P_{err}\cdot P_{pk}
Quiz

- Order of magnitude of dispensing errors by healthcare professionals?
  A. 0.01%
  B. 0.1%
  C. 1%
  D. 10%

Quiz - answer

- Order of magnitude of dispensing errors by healthcare professionals?
  A. 0.01%
  B. 0.1%
  C. 1%
  D. 10%
**Dispensing errors**
(Experimental)

- Error rate = 3%

![Dispensing errors diagram](image)


**Quiz**

- Performance of controls to catch errors?
  Example: double-check of dispensed drugs?
  
  A. 70%
  B. 85%
  C. 95%
  D. 99%
Quiz - answer

- Performance of controls to catch errors?
  - Example: double-check of dispensed drugs?
  - A. 70%
  - B. 85%
  - C. 95%
  - D. 99%

Limited performance of controls

- Introduction of errors during unit dose dispensing
- Detection ability during human-performed control:
  - Pharmacists: 87.7%
  - Nurses: 82.1%

   *Facchinetti NJ, Med Care 1999;37:39-43*

Efficacy ≈ 85% (known value in the industry)

Do not be too confident with the double-checks!
Human reliability

« On the 6th day, God created man … »

… but God was tired, and his creation was not perfect …

In hospitals, many high-risk activities are based on human reliability, which is limited

Human factors

“Enhancing clinical performance through an understanding of the effects of teamwork, tasks, equipment, workspace, culture, organisation on human behaviour and abilities, and application of that knowledge in clinical settings.”
“We cannot change the human condition, but we can change the conditions under which humans work.”

James Reason

How to improve the safety?

- Implement strategies to reduce the frequency of errors.
- Increase the reliability of controls.
Human factors principles to progress

1. Avoid reliance on memory
2. Simplify
3. Standardize
4. Use constraints and forcing functions
5. Use protocols & checklists wisely
6. Improve information access
7. Reduce handoffs
8. Increase feedback

There is a role for IT and automation!

Hierarchy of risk reduction strategies

High
- Technology
- Constraints
- Forcing functions

Medium
- Standardisation
- Redundancies
- Check-lists

Low
- Procedures
- Education
- Vigilance

http://www.who.int/patientsafety/research/online_course/en/
### Medication safety: 3P’s

<table>
<thead>
<tr>
<th>Process</th>
<th>Persons</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information technologies (IT)</td>
<td>Healthcare professionals</td>
<td>In-house production (BPF)</td>
</tr>
<tr>
<td>Non - IT</td>
<td>Patients</td>
<td>Presentation (RTU, design)</td>
</tr>
</tbody>
</table>

#### Tools
- Medication process
- Production
- Clinical pharmacy

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### Hospital pharmacy and IT

- Medication process
- Production
- Clinical pharmacy
Medication process organisation
Individual (nominal) distribution

Prescription

Validation by a pharmacist

Patients doses preparation

Doses delivery

Administration to patient

Medication process organisation
Global distribution

Prescription

Ordering to the pharmacy

Ward stock

Distribution of packages

Dispensing

Delivery of packages

Administration to patient
Individual or global?

- Individual distribution is more convenient in some conditions
  - Few prescription modifications (chronic care)
  - Pharmacy close to the wards

- At the HUG, the global model was selected
  - Acute care in majority
  - Long distance between the pharmacy and some wards (multi-sites hospital)

The process of the future?

- Robotized distribution
- Automated dispensing system
- Central pharmacy stock
- Ward stock
- Logistic information system
- Distribution with scanning
- CPOE
- Smart Pumps
- Bedside scanning
The process of the future?
HUG situation 2016

- Logistic information system
- Clinical information system
- EDI
- Central pharmacy stock
- Ward stock
- Industry stock
- Robotized distribution
- Automated dispensing system
- Distribution with scanning
- CPOE
- Clinical information system
- Partial use (NICUPICU)
- Bedside scanning
- Robotized distribution

Gravimetric control
Impact on the safety (simulation)

- Gravimetric control is the only to have detected all errors (> 30%, but lack of power to conclude)

<table>
<thead>
<tr>
<th></th>
<th>Without double check n=144</th>
<th>With visual double check n=143</th>
<th>Gravimetric control n=151</th>
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</thead>
<tbody>
<tr>
<td>Number of errors</td>
<td>3</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Detected</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Undetected</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Carrez L, HUG, 2013
Cytotoxic compounding

Cytotoxics: a special process

Automated preparations (2015)

Electronic prescription + Dose-banding (2016)

Preparation with gravimetric control

Bedside scanning
How to improve the safety in cytotoxic compounding?

- **Reduce the frequency of errors**
  - Automation

- **Increase the reliability of controls**
  - In-process
    - Gravimetric control
  - Post-process
    - Quantitative analysis

**Gravimetric control**

- **Main objectives**
  - Detect and avoid product errors [robust if scanning]
  - Detect and avoid dose errors
  - Standardize the method and the speed of preparation
  - Increase the traceability
Robotized distribution

Impact on the safety

François O et al, HUG, 2015
Robotized distribution
Impact on the efficiency

![Bar chart showing efficiency comparison between scanning, manual distribution, robot with filling, and robot without filling. The chart indicates higher efficiency with robot dispensing systems.]

210 300 570 860

Packages / hour

Scanning  Manual distribution  Robot WITH filling  Robot WITHOUT filling

Automated dispensing systems

François O et al, HUG, 2015

29/02/2016
Automated dispensing system
Impact on the safety (simulation)

Du Pasquier C, Riberdy L, HUG, 2003

Automated dispensing system
Impact on the efficiency

Surgical ward, 28 beds

François O et al, HUG, 2013
Automated dispensing system
Nurses opinion on improvements

...improves the safety of care?

<table>
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<tr>
<th>Opinion</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>strongly agree</td>
<td>60%</td>
</tr>
<tr>
<td>agree</td>
<td>31%</td>
</tr>
<tr>
<td>disagree</td>
<td>3%</td>
</tr>
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<td>strongly disagree</td>
<td>0%</td>
</tr>
<tr>
<td>no opinion</td>
<td>3%</td>
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</table>

...improves the stock management?

<table>
<thead>
<tr>
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<th>Percentage</th>
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</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>agree</td>
<td>22%</td>
</tr>
<tr>
<td>disagree</td>
<td>9%</td>
</tr>
<tr>
<td>strongly disagree</td>
<td>0%</td>
</tr>
<tr>
<td>no opinion</td>
<td>0%</td>
</tr>
</tbody>
</table>

...improves medication traceability?

<table>
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François O et al. HUG, 2015

Facilitators and barriers for success
Facilitators and barriers

- **Facilitators**
  - Organisational stability
  - Implementation team leadership
  - Equipment availability and reliability
  - Flexible implementation timelines

- **Barriers**
  - Technical problems
  - Altered work practices
  - Weakened interpersonal communication
  - Poor access to computers
  - Logistics of training
  - Unsupportive management team
  - Cost
  - Security

Systematic review


Workaround

- **Process**
  - Training requirements
  - Process flow (administration of drug before scanning, shortage of time)

- **Technology**
  - Hardware (performance)
  - Software (delays in response)
  - Barcode (difficulties in reading)

- **Resistance**
  - Communication
  - Changing role
  - Negative perception of IT

Nanj K, J Am Med Inform Assoc 2009;16:645
Van Onzenoort HA, Am J Health-Syst Pharm 2008;65:644
Re-engineering

- The implementation of technologies is a real opportunity to re-engineer the whole process.
- If the technology is implemented without adapting the rest of the process, there is a high risk to create important problems (workaround, new risks, inefficiency,...)
- The use of process analysis tools is recommended:
  - Proactive risk analysis (FMECA)
  - Ergonomics
  - LEAN management

Return on investment (ROI)
Return on investment (ROI)

- Costs
  - Investment
    - Acquisition
    - Installation
  - Operation (annual)
    - Maintenance
    - Amortization

- Benefits
  - Direct purchase (e.g. drugs)
  - Direct staff costs
  - Efficiency (organizational costs)
  - Safety (less errors)
  -...

Partially based on estimations

ROI (years) = initial investment / annual balance

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**Return on investment (ROI)**

- Exemple: automated dispensing cabinets

<table>
<thead>
<tr>
<th>Fictive numbers</th>
<th>Investment [CHF]</th>
<th>Operation (annual) [CHF]</th>
<th>Time for ROI</th>
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<tbody>
<tr>
<td>Acquisition costs</td>
<td>+ 45'000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td></td>
<td>+ 1'500</td>
<td></td>
</tr>
<tr>
<td>Amortization (8 years)</td>
<td></td>
<td>+ 6'250</td>
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</tr>
<tr>
<td>Reduction stock value</td>
<td>- 5'000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduction drug purchase (- 5%)</td>
<td></td>
<td>- 7'500</td>
<td></td>
</tr>
<tr>
<td>Staff costs (technicians vs nurses)</td>
<td></td>
<td>- 6'000</td>
<td></td>
</tr>
<tr>
<td>Safety (cost of errors)</td>
<td></td>
<td>- 3'500</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>+ 40'000</td>
<td>- 9'250</td>
<td>4.3 years</td>
</tr>
</tbody>
</table>
Lessons learned

- Automation and robotisation are important strategies to optimize drug management
  - Safety, traceability and efficiency can be improved
  - The implementation must be intelligently and interdisciplinary decided and planified
  - These projects are very challenging and must be leaded by a competent and available team
  - A strategic vision should be elaborated by any hospital

The world is changing...
We have to take the best to improve the quality of care in hospitals

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Vision without action is merely a dream. Action without vision just passes the time. Vision with action can change the world. 

Joël Barker

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