Use of barcodes to improve the medication process in the hospital

Prof. Pascal BONNABRY

Slovenian Pharmaceutical Society

Ljubljana, October 26, 2009

To err is human
USA

- Serious adverse events in
  ≈ 3% [2.9-3.7%] of hospitalizations

- ≈ 10% [8.8-13.6%] of adverse
  events led to death

- Extrapolation: **44’000 to 98’000 deaths**
  each year in the USA (medication errors: 7’000)!

- 8th leading cause of death
  (motor vehicle accidents 43’500, breast cancer 42’000, AIDS 16’500)

**Equivalent of a BOEING 747 crash every 2 days...**

*To err is human, IOM, 1999*
Counterfeit drugs

\[ \approx 50 \% \, \text{of drugs illegally buy on the internet are counterfeit} \]

Source: Bobée JM, Sanofi-Aventis, 2009

Potential interests of IT

- **To improve**
  - **The safety** by improving the reliability of controls
    - five “R”
    - authentication of drugs
  - **The traceability** by facilitating the registration of logs
  - **The efficiency** by increasing the working performance
  - **The communication** by connecting the different steps of the processes
Human reliability

« On the 6th day, God created man … »

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

The addition of two errors

Commission error AND Control failure

- Selection error $P_{sel}$
- Check failure $P_{chk}$
- AND
- wrong drug / syringe swap error
- $P_{err} = P_{sel} \cdot P_{chk}$

Selection
Calculation
Counting

Check
Double-check
Check-list
Electronic
Limited performance of controls

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

Efficiency ≈ 85%
(known value in the industry)

Do not be too confident with the double-checks!

The medication process

- Physical flow
- Information flow

Industry stock

Pharmacy stock

Production stock

End-product analysis

Production

Raw-materials analysis

Ward stock

Dispensation

Production

EPR

Administration to patients

Prescription

Cytos

TPN

MP
Electronic systems to catch errors

- Electronic systems to avoid errors

- Industry stock
- Pharmacy stock
- Ward stock
- Dispensation
- Production
- Prescription
- Cytos
- TPN
- MP
- Administration
- to patients
- Physical flow
- Information flow
- Raw-materials analysis
- Production
- End-product analysis
- EDI
- CPOE
- Ward stock
- Dispensation
- Production
- Prescription
- Cytos
- TPN
- MP
- Administration
- to patients
• Error rate during manual distribution = 1%

![Pie chart showing distribution errors]

- Count: 24%
- Selection: 55%
- Omission: 21%

Gschwind L, HUG, 2006

• The consequences can be dramatic

Le Monde, 3 janvier 2009

Paris, december 2008
A kid death associated to a distribution error of a drug
Pharmacy stock
Management with barcodes

- **Stock entry**
  - Product ID → location ID → validation in software

- **Stock exit**
  - Product ID → quantity → validation in software

B. Hirschi, CHUV, 2009
Pharmacy stock
Impact of barcoding on adverse drug events

Churchill WW, Brigham and Women's Hospital, Boston

Traceability of delivery

- Cold chain / narcotics
  - RFID delivery man → barcode delivery sheet → RFID nurse
Dispensation

Error rates

• **Nurses**
  - 3.0% dispensation errors
  - Control not tested

• **Pharmacy**
  - 3.6% dispensation errors
  - 79% detected during control

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Dispensation

Automation

Centralised

Decentralised

Barcodes are needed to secure the process

Selection errors ≈ 2%

Dispensation
Impact on error rates

- 19% errors

<table>
<thead>
<tr>
<th>Error Category</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omission</td>
<td>183 (6)</td>
</tr>
<tr>
<td>Wrong dose</td>
<td>103 (3)</td>
</tr>
<tr>
<td>Unauthorized drug</td>
<td>22 (1)</td>
</tr>
<tr>
<td>Wrong form</td>
<td>20 (1)</td>
</tr>
<tr>
<td>Extra dose</td>
<td>10 (0)</td>
</tr>
<tr>
<td>Wrong route</td>
<td>6 (0)</td>
</tr>
<tr>
<td>Wrong technique</td>
<td>2 (0)</td>
</tr>
<tr>
<td>Wrong time</td>
<td>250 (8)</td>
</tr>
<tr>
<td>Total errors</td>
<td>685 (19)</td>
</tr>
<tr>
<td>No error</td>
<td>2511 (81)</td>
</tr>
<tr>
<td>Total Doses</td>
<td>3216 (100)</td>
</tr>
</tbody>
</table>

Observation study in 36 institutions

Barker KN, Arch Intern Med 2002;162:1897
Administration to patients
Objectives of bedside scanning

- Increase patient safety
- Increase patient satisfaction (safety feeling)
- Increase efficiency (documentation, stock management, billing, ...)
- Increase nurses satisfaction
- Reduce costs (especially related to errors)

Foote SO, Nursing Economics 2008;26:207

Administration to patients
Benefit of bedside scanning

- Positive impact
  - Wrong drug - 75%
  - Wrong dose - 62%
  - Wrong patient - 93%
  - Wrong administration time - 87%

Globally - 80%

Johnson, J Healthcare Inf Manag 2002;16:1
CPOE + Barcoding in surgical ward

- Prescribing errors: 3.8 → 2%
- Patient identity checked: 17 → 81%

**Table 4** Medication administration errors identified

<table>
<thead>
<tr>
<th>Type of error</th>
<th>Pre-intervention No. of errors (% of OE)</th>
<th>Post-intervention No. of errors (% of OE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrong drug</td>
<td>2 (0.1)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Wrong dose</td>
<td>2 (0.1)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Wrong patient</td>
<td>3 (0.3)</td>
<td>1 (0.1)</td>
</tr>
<tr>
<td>Wrong route</td>
<td>7 (0.7)</td>
<td>2 (0.2)</td>
</tr>
<tr>
<td>Wrong time</td>
<td>3 (0.3)</td>
<td>2 (0.2)</td>
</tr>
<tr>
<td>Extra dose</td>
<td>1 (0.1)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Expired drug</td>
<td>1 (0.1)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Omission due to availability</td>
<td>24 (1.6)</td>
<td>23 (2.1)</td>
</tr>
<tr>
<td>Other omission</td>
<td>42 (2.6)</td>
<td>17 (1.9)</td>
</tr>
<tr>
<td>Wrong diluent</td>
<td>1 (0.1)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Host administration</td>
<td>31 (1.9)</td>
<td>3 (0.4)</td>
</tr>
<tr>
<td>IV type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>141 (8.6)</td>
<td>38 (4.4)</td>
</tr>
</tbody>
</table>

IV, intravenous; OE, opportunities for error.

Dean B, Qual Saf Health Care 2007;16:279

Administration to patients

Cytostatics

Physicians → Database → Nurse → Drug → Patient

Pascal BONNABRY
Barcoding in the hospital, October 26, 2009
**Production**

**Weighing system**

- **Cytostatics - CATO®**
  - Direct calculation from the prescription
  - Operator guided step by step
  - Weighing control
  - Identity control by barcode *(version 2)*
  - Traceability

- **Batch production**
  - Raw material identity, expiry date
  - Computerized protocols
  - Identity / validity of raw material
  - Operator identity
  - Final product identity, batch expiry date
  - Weighing
• Cytostatics

Who? What? When?

• Batch production

Production Traceability
Prerequisite to successful scanning

- Electronic management of processes (CPOE, stocks, ...)
- Technical infrastructure (hard-, soft-)
- Actors identification (caregivers, patients, drugs)
- Acceptability (patients, caregivers)
- Adaptation to processes
- Project leadership
- Financing

Electronic patient record

Handwritten → electronic traceability

CPOE

Radiology

Laboratory

C. Lovis, HUG
Global process management

Prescription and electronic patient record

Retranscription

Automation of dispensation

Bedside scanning

Global process management

Cytostatics

Preparation with weighing control

Electronic prescription

Bedside scanning
Actors identification

The patient

The caregiver

Identification?

The drug

Actors identification

The patient

The caregiver

The drug
Acceptability by patients

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Support for identification bracelet among former patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>N</td>
</tr>
<tr>
<td>Overall</td>
<td>1289</td>
</tr>
<tr>
<td>Examples of situations in which patient identification was a concern</td>
<td></td>
</tr>
<tr>
<td>Given</td>
<td>648</td>
</tr>
<tr>
<td>Not given</td>
<td>641</td>
</tr>
<tr>
<td>Means of patient identification on bracelet</td>
<td></td>
</tr>
<tr>
<td>Patient name</td>
<td>626</td>
</tr>
<tr>
<td>Anonymous code</td>
<td>614</td>
</tr>
</tbody>
</table>

* p values based on χ² test.

Cléopas A, Qual Saf Health Care 2004;13:344

Acceptability by caregivers

- **Nurses satisfaction**

  + 1 point on a 6 point likert scale

MAS-NAS = Medication Administration System – Nurses Assessment of Satisfaction

Likert scale 1 - 6 (max satisfaction)

Hurley AC, JONA 2007;37:343
Adaptation to processes

- **Reasons for workaround**
  - **Process**
    - Training requirements
    - Process flow (administration of drug before scanning, shortage of time)
  - **Technology**
    - Hardware (performance of scanners)
    - Software (delays in response)
    - Barcode (difficulties in reading)
  - **Resistance**
    - Communication
    - Changing role
    - Negative perception of IT

Van Onzenoort HA, J Am Med Inform Assoc 2008;16:645
Nanji KC, J Am Med Inform Assoc 2009;16:645
Van Onzenoort HA, Am J Health-Syst Pharm 2008;65:644

Drug identification

- **Hierarchy**

  GS1 = international standard
Unit dose identification

Reconditioned by the pharmacy

Identified by the industry

Unit doses identification

Easily human readable

Panadol 500 mg
paracétamol
n°lot 420607
Exp. 08.2009

Safety
ID product (minimal)

Traceability
Batch number
Expiry date (ideal)
• Product identification mandatory
  (batch number and expiry date encouraged)
• Mandatory since April 26, 2006
• Prevention of 500,000 adverse events / year?

• Adoption of barcode medication administration

Schneider PJ, Am J Health-Syst Pharm 2007;64:S10
**Unit dose identification**

Europe - EAHP

- Unit doses blisters, with each single dose containing the whole information
  - Trade name
  - Active substance
  - Dosage
  - Expiry date
  - Batch number
  - Barcode
    - Including product ID, expiry date and batch number
    - Use of a recognized international standard (i.e. GS1)
    - Datamatrix

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**Secondary package**

**Safety**

ID product (minimal)

- EAN-13

**Traceability**

Batch number

Expiry date (Serial number) (ideal)

- GS1-128

Or

Datamatrix
**Data carrier**

- **Linear barcode**
  - Number of information
  - Limited space

- **Datamatrix**
  - Distance of lecture
  - Active storage of information (i.e. temperature)

- **RFID**

**Conclusion**

- Barcoding can improve the safety and the traceability of drug use at each step of the process

- The implementation requires
  - an exhaustive identification of drugs without reducing the human readability (industry)
  - the development of information technologies in the medication process (hospital)

- Each institution should define the room for such technologies and set priorities

- The implementation is a real challenge and resources must be dedicated to these projects
Perspective

- Will we be able to be as effective as supermarkets?

Thank you for your attention

This presentation can be downloaded:
http://pharmacie.hug-ge.ch/ens/conferences.html

Pascal.Bonnabry@hcuge.ch