Main message

• Patient safety and adverse events should be monitored
• Patient safety indicators (PSI) are potentially useful
• PSI can be measured and used
• Need for further developments and validation of PSI
Itinerary

• Patient safety and adverse events
• Patient safety indicators
  – What are they?
  – Feasibility
  – Validity
  – Limitations
  – Future developments

Context of Patient Safety Indicators (PSI)

• Patient Safety
  – Worldwide issue
Puerperal fever mortality - I. Semmelweis

Context of Patient Safety Indicators (PSI)

• Healthcare Adverse Events (AEs)
  – Complications of healthcare interventions and processes leading to morbidity, mortality, or drawbacks (e.g., increased pain, prolonged hospital stay)

• Report “To err is human”
  Institute of medicine (IOM)
  USA (1999)
Adverse Events in Healthcare (AEs)

• Retrospective studies
  – Variations between studies
    • AEs in 3 - 19% hospital stays, “avoidability” 20% - 45% across studies
    • Systematic review of 8 “large studies” (75’000 patients): median AEs occurrence = 9% hospital stays
      - de Vries EN, Qual Saf Health Care 2008;17:216

• Prospective studies
  • France, ENEIS (2004 and 2009)
    – 6,2 (5,1 - 7,3) AEs for 1000 hospital patient-days
      - “avoidability” 47% (2009, Michel P, communication)

• Prevention Quality Indicators
  • Hospital admissions that may have been avoided
    – first released November 2000
    – last updated August 2011

• Inpatient Quality Indicators
  • Quality of care inside hospitals, including inpatient mortality for medical conditions and surgical procedures
    – first released May 2002
    – last updated August 2011
**Patient Safety Indicators**
- Quality of care inside hospitals, to focus on potentially avoidable complications and iatrogenic events
  - first released March 2003
  - last updated August 2011

**Pediatric Quality Indicators**
- Indicators from the other three modules with adaptations for use among children and neonates, to reflect quality of care inside and outside hospitals
  - first released April 2006
  - last updated August 2011

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**History & Development of PSI Project**

- **International Methodology Consortium for Coded Health Information**
- Independent Consortium ([www.imecchi.org](http://www.imecchi.org))
- Working sub-group for PSI (CA, CH, F, GER, AUS, USA)
- Process to adapt 15 PSI (AHRQ) from ICD-9-CM to ICD-10

**AHRQ**
- Initial Project
- 20 PSI developed (ICD-9-CM)

**OECD**
- Part of HCQI Project
- Common PSI list
- ICD-9-CM / ICD-10
- To achieve international comparisons
Selected Patient Safety Indicators

- **Hospital-acquired infections and lesions**
  - Infection due to medical care
  - Decubitus ulcer

- **Operative and post-operative complications**
  - Postoperative pulmonary embolism (PE) or deep vein thrombosis (DVT)
  - Postoperative sepsis

- **Sentinel events**
  - Foreign body left in during procedure

- **Obstetrics**
  - Birth trauma: injury to neonate
  - Obstetric trauma: vaginal delivery with/without instrument

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Definition

- Use of ICD codes algorithm from inpatient routine administrative data for detecting selected AEs in hospitals

- **1 PSI = 1 AE**

\[
\text{PSI} = \text{Secondary Diagnosis codes (ICD) corresponding to the healthcare adverse event's clinical definition} \\
\text{Population at risk defined by DRG codes, Diagnosis codes and procedure codes}
\]
### 13 PSI (1)

| PSI 1: | Complications of anaesthesia |
| PSI 3: | Decubitus ulcer |
| PSI 5: | Foreign body left in during procedure |
| PSI 7: | Infections due to medical care (replaced by catheter associated bloodstream infection) |
| PSI 10: | Postoperative physiologic and metabolic disorders |
| PSI 12: | Postoperative pulmonary embolism and deep vein thrombosis |
| PSI 13: | Postoperative sepsis |

### 13 PSI (2)

| PSI 15: | Technical difficulty during procedure / Accidental puncture and laceration |
| PSI 16: | Transfusion reaction |
| PSI 17: | Birth trauma - injury to neonate |
| PSI 18: | Obstetric trauma - vaginal delivery with instrument |
| PSI 19: | Obstetric trauma - vaginal delivery without instrument |
| PSI 20: | Obstetric trauma - caesarean delivery |
Feasibility

Proportion of inpatients with at least one PSI

- Relatively low for some PSI (<1 per 1000)
  - Complication of anesthesia, Foreign body left during procedure, Bloodstream infection related to vascular catheter, transfusion reaction
- Higher for some others (>1 per 1000, but most of them near 5 per 1000)
  - Postoperative sepsis, Postoperative pulmonary embolism and deep vein thrombosis, Postoperative physiological and metabolic disorders, decubitus ulcer
- Relatively high for obstetrics PSI (between 20 and 200 per 1000)
### PSI Occurrence / Nationwide Databases, 2005 (2)

<table>
<thead>
<tr>
<th>PSI #</th>
<th>France</th>
<th>Switzerland</th>
<th>France</th>
<th>Switzerland</th>
<th>France / Switzerland</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N</td>
<td>/1000 stays (SD)</td>
<td>/1000 stays (SD)</td>
<td>RR (95% CI)</td>
</tr>
<tr>
<td>17</td>
<td>2'392</td>
<td>740</td>
<td>3.16 (0.13)</td>
<td>10.70 (0.39)</td>
<td>0.30 (0.27-0.32)</td>
</tr>
<tr>
<td>18†</td>
<td>803</td>
<td>1715</td>
<td>13.97 (0.96)</td>
<td>221.06 (4.71)</td>
<td>0.08 (0.07-0.08)</td>
</tr>
<tr>
<td>18TT</td>
<td>- 512</td>
<td>-</td>
<td>-</td>
<td>66.00 (2.82)</td>
<td>0.22 (0.20-0.25)</td>
</tr>
<tr>
<td>19†</td>
<td>1'788</td>
<td>10682</td>
<td>3.13 (0.15)</td>
<td>353.09 (2.75)</td>
<td>0.01 (0.01-0.01)</td>
</tr>
<tr>
<td>19TT</td>
<td>- 813</td>
<td>-</td>
<td>-</td>
<td>26.87 (0.93)</td>
<td>0.12 (0.11-0.13)</td>
</tr>
<tr>
<td>20†</td>
<td>10</td>
<td>41</td>
<td>0.07 (0.04)</td>
<td>2.01 (0.31)</td>
<td>0.03 (0.02-0.07)</td>
</tr>
<tr>
<td>20TT</td>
<td>- 41</td>
<td>-</td>
<td>-</td>
<td>2.01 (0.31)</td>
<td>0.03 (0.02-0.07)</td>
</tr>
</tbody>
</table>

P-value for comparisons using Rate Ratio (RR) for France Prevalence divided by Swiss Prevalence.
† Included vs. †† Excluded procedure code 75.69 from CHOP (Ike ICD-9-CM): Repair of other current obstetric laceration. This label includes: episiotomies, repair of pelvic floor, perineum, vagina and vulva; and secondary repair of episiotomy. This label excludes: repair of routine episiotomy.

### Limitations for PSI Calculation

- Differences in coding rules interpretation and application between hospitals and, possibly, countries
- Differences in quality of coding between hospitals and, possibly, countries
- Absence of a «present on admission» code
- Need to adapt coding practices to capture specific information from ICD data
- Principal diagnosis is not the reason of hospitalisation (change in France in March 2009)
Validity of PSI measurement

- Positive Predictive Value (most often)
  - By comparison with medical record chart review
- PPV was heterogeneous
  - 22% to 89% (>20 studies - ICD-9-CM PSI)
- PPV might depend of many factors
  - Type of coders
  - Type of PSI
    - PSI 12: PPV = 73% to 85%
    - PSI 15: PPV = 16% to 68%
- Use other data sources as references for assessing comparisons
  - Data collected for surveillance (i.e., nosocomial infections)
  - Registry (i.e., AEs disclosure)

Post-op DVT/PE – Pooled occurrence
Thromboembolism after arthroplasty
Comparisons between 3 countries: PSI 12 occurrence rates and VTE, DVT and PE occurrence rates from a systematic review of the literature

<table>
<thead>
<tr>
<th>Type of Arthroplasty</th>
<th>Switzerland</th>
<th>Rhône-Alpes, France</th>
<th>Alberta, Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PSI 12 occurrence rates</td>
<td>VTE</td>
<td>DVT</td>
</tr>
<tr>
<td></td>
<td>N (%)</td>
<td>(95% CI)</td>
<td>N (%)</td>
</tr>
<tr>
<td>Hip</td>
<td>N=50'559</td>
<td>N=47'908</td>
<td>N≈11'148</td>
</tr>
<tr>
<td>VTE</td>
<td>236</td>
<td>0.46</td>
<td>(0.40-0.52)</td>
</tr>
<tr>
<td>DVT</td>
<td>97</td>
<td>0.19</td>
<td>(0.16-0.23)</td>
</tr>
<tr>
<td>PE</td>
<td>133</td>
<td>0.26</td>
<td>(0.22-0.31)</td>
</tr>
</tbody>
</table>

Knee

|                      | N=27'039 | N=24'261 | N≈10'719 | N≈10'719 |\| 100'000 | 100'000 |\| 100'000 | 100'000 |\| 100'000 | 100'000 |
| VTE                  | 149 | 0.55 | (0.47-0.63) | 861 | 3.96 | (3.72-4.21) | 98 | 0.51 | (0.42-0.60) | 97 | 0.51 | (0.42-0.60) |
| DVT                  | 100 | 0.37 | (0.30-0.45) | 640 | 3.57 | (3.34-3.81) | 45 | 0.42 | (0.30-0.54) | 44 | 0.41 | (0.29-0.52) |
| PE                   | 49 | 0.18 | (0.14-0.24) | 100 | 0.41 | (0.34-0.50) | 53 | 0.49 | (0.36-0.63) | 53 | 0.49 | (0.36-0.63) |

Comments 1

- **PSI**: conceptually interesting
  - Routinely collected data, acceptable cost, comparability
- **PSIs**: feasible, variable validity
- **Limitations**
  - ICD -10 classification not tailored to monitor patient safety
  - Selection and definitions of PSI
  - Validity needs to be checked in every country, and repetitively
  - International and local variations in coding rules and practices
  - Quality of coding
  - Diagnosis «present on admission»
Refining Patient Safety Indicators

- We propose to refine selected PSI to improve their accuracy
- To adjust the denominator to patients exposed to specific procedures or treatments (e.g., related to recommended prophylaxis, planned surgical procedures, specific devices)
- To revise the numerator codes (e.g., include more accurate codes taking into account the more recent version of ICD-10 rules, to add specific codes for medical and surgical complications like T-codes)

Refining PSI 12 – VTE adverse events

- PSI 12 PPV varied widely among patient population sub-groups (>90% for joint arthroplasty, ranged from 75% to 85% for other orthopedic surgery, <50% for digestive surgery)
- Recommended prophylaxis is applied widely for hip and knee arthroplasty
- Modifications of denominator
  - Joint arthroplasty (hip/knee) using procedure codes
  - Pelvic surgery (♀ vs. ♂) using procedure codes or DRG
- Modifications of numerator
  - Change secondary diagnosis code selection for assessing PSI 12 in pregnancy, childbirth, puerperium (denominator = MDC 14) by adding ICD-10 codes: O87.1 and O87.9
Comments 2

• Perspectives
  – Increased research and development of new PSI
  – Development of validation approaches and methods
  – Adapt coding rules to monitor quality and patient safety
  – Develop and test PSI adjusted prevalence rates taking into account PPV variable in models
  – New approaches, new indicators
    • Electronic medical records, information technologies ...
    – ICD-11 ...

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