INTERNATIONAL INFORMATION MODEL FOR PATIENT SAFETY (2IMPS): ENHANCING CARE, PATIENT SAFETY AND OUTCOME

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Copenhagen 21 Aug. 2013

World Congress on Medical and Health Informatics MedInfo 2013 Workshop
Introduction

- Presentation of the group
- Objectives

Outline of the presentations

- **Itziar Larizgoitia**: Overview of WHO work in harmonizing Incident reporting systems (from ICPS to MIMPS) and purpose of IMPS.
- **Jean-Marie Rodrigues, Julien Souvignet**: Description of MIMPS and the underlying methodology
- **Manasori Akiyama**: The role of Natural Language Processing in developing MIMPS
- **Stefan Schulz**: Reaction from the academia to MIMPS development
- **Jorgen Hansen**: Opportunities and Challenges posed by MIMPS to users of Reporting Systems

Discussion (key points)
Objectives

1. To disseminate the WHO work on PS to develop tools to support comparable PS reporting systems at international and national levels;
2. To receive feedback from PS reporting systems and adverse effects researchers on a worldwide basis.
Itziar Larizgoitia

WHO Department PS, Geneva, Switzerland
Error Identification, Analysis, Reporting and Correction

WHO efforts to facilitate an International harmonization of Reporting & Learning Systems

2013

Dr Itziar Larizgoitia, Patient Safety Programme, WHO
WHO Patient Safety is set up as a **Special Programme** following WHA Resolution 55.18 in 2002.

To coordinate, disseminate and accelerate improvements in patient safety worldwide.
First Global Patient Safety Challenge
Clean Care is Safer Care

WHO Guidelines for Hand Hygiene in Health Care
Innovative solutions for safer care: checklists

Safe Surgery Saves lives

Surgical Safety Checklist

Before induction of anaesthesia
(with at least nurse and anaesthetist)

- Has the patient confirmed his/her identity, site, procedure, and consent?
  - Yes
  - No

- Is the site marked?
  - Yes
  - Not applicable

- Is the anaesthesia machine and medication check complete?
  - Yes
  - Not applicable

- Is the pulse oximeter on the patient and functioning?
  - Yes
  - No

- Does the patient have a: Known allergy?
  - Yes
  - No

- Difficult airway or aspiration risk?
  - Yes
  - No
  - Yes, and equipment/assistance available

- Risk of >500ml blood loss (7ml/kg in children)?
  - Yes
  - No
  - Yes, and two IVs/central access and fluids planned

Before skin incision
(with nurse, anaesthetist and surgeon)

- Confirm all team members have introduced themselves by name and role.

- Confirm the patient’s name, procedure, and where the incision will be made.

- Has antibiotic prophylaxis been given within the last 60 minutes?
  - Yes
  - Not applicable

- Nurse Verbally Confirms:
  - The name of the procedure
  - Completion of instrument, sponge and needle counts
  - Specimen labelling (read specimen labels aloud, including patient name)
  - Whether there are any equipment problems to be addressed

- Anticipated Critical Events
  - To Surgeon:
    - What are the critical or non-routine steps?
    - How long will the case take?
    - What is the anticipated blood loss?

  - To Anaesthetist:
    - Are there any patient-specific concerns?

  - To Nursing Team:
    - Has sterility (including indicator results) been confirmed?
    - Are there equipment issues or any concerns?

Before patient leaves operating room
(with nurse, anaesthetist and surgeon)

- To Surgeon, Anaesthetist and Nurse:
  - What are the key concerns for recovery and management of this patient?

This checklist is not intended to be comprehensive. Additions and modifications to fit local practice are encouraged.
Surgical Safety Checklist

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(with at least nurse and anaesthetist)

- Has the patient confirmed his/her identity, site, procedure, and consent?
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  - Yes

- Is the pulse oximeter on the patient and functioning?
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    - Are there any patient-specific concerns?
  - To Nursing Team:
    - Has sterility (including indicator results) been confirmed?
    - Are there equipment issues or any concerns?

- Is essential imaging displayed?
  - Yes
  - Not applicable

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Revised 1 / 2009
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Towards building learning organizations

- One of the most frustrating aspects of healthcare is the apparent failure of health-care systems to learn from their mistakes.
- Too often neither health-care providers nor health-care organizations advise others when a mishap occurs, nor do they share what they have learned when an investigation has been carried out.
- As a result, the same mistakes occur repeatedly in many settings and patients continue to be harmed by preventable errors.
When will healthcare pass the Orange Wire Test?

Imagine a jet aircraft which contains an orange coloured wire essential for its safe functioning. An engineer in one part of the world in a pre-flight inspection spots that the wire is frayed suggesting a critical fault. What would happen next?
Rationale for reporting in healthcare

When things go wrong in health care, it is essential to understand:

- What happened?
- Why did it happen?
- What were the consequences?
- What can be done to mitigate the harm caused by it?
- And, what can be done to avoid this from happening again?

However, there are no common standards for monitoring, reporting, classifying, analyzing and interpreting patient safety incident data.
Core principles for developing learning organizations through systematic and organized data collection
The Conceptual Framework (CF) for the International Classification for Patient Safety
A **patient safety incident** is an event or circumstance that could have resulted, or did result, in unnecessary harm to a patient.
Conceptual Framework: lessons

- A construct depicting many dimensions or concepts, each corresponding not necessarily to the same classification
- A knowledge domain organizer / an information model
- The basis:
  - for many reporting systems in countries
  - other information systems
  - ICD 11 revisions (area of quality and safety)
  - research
Next step: Minimal Information Model for Patient Safety

Goal:

• The minimal concepts & relationships from a report to elicit minimal learning & favor commonality across reporting systems
  • Aiming to harmonize reporting
  • And to be able to aggregate, compare and learn at institutional, national, international levels

The Minimal Information Model is the core common elements of any reporting system, which can later be expanded to suit the specific needs of any user.
CF
2009
Conceptual Framework

CS
2010
Categorial Structure

Draft MIMPS
2012-2013

- Top-Down analysis mapping R&L systems
  - University St Etienne
- Bottom-Up analysis NLP unformatted reports
  - University of Tokyo
- Expert External Review & consultations
  - Agencies Denmark, Belgium, Canada, Australia

Testing & validation

MIMPS
2014-2015

- Intergovernmental Agencies, National Agencies, Academia, Experts
WHO invites the scientific community to join this effort and provide input to the development of the Minimal Information Model for Patient Safety Incident Reporting.

Please, contact Dr Itziar Larizgoitia

larizgoitiai@who.int or patientsafety@who.int
Some key points to raise at the workshop

- Highlight next steps: what is the direction of travel from WHO, EC-DG SANCO and others (ie Japan)
- Consider the needs of three different groups of R&L system users

- What other steps would be needed to advance international harmonization and facilitate global learning?
Jean-Marie Rodrigues

WHO Collaborative Center of the Family of International Classifications in French Language, INSERM UMR 872 eq 20, Saint Etienne, Paris France
In 2009, the WHO published reports for an International Classification for Patient Safety (ICPS). Its development includes:
• a list of terms and ‘key concepts’
• a conceptual framework

But… this CF is not suitable for computer modeling.
ICPS Issues

- Schulz et al. (2009) made an appraisal of ICPS
  - [ICPS] “is neither a classification nor a taxonomy” [but] “presents properties for modeling […] an ontology”

- Ceusters et al. (2011) wrote:
  - “some ambiguous definitions” within ICPS such as “class” or “semantic relationship”
  - “additional efforts must be provided, using an ontological methodology”
PS-CAST

- PS-CAST (Patient Safety CAtegorical Structure) aims to propose a categorial structure for modeling Patient Safety information
- Alignment of PS-CAST with existing reporting systems
- Minimum Information Model for Patient Safety
- Intermediate and Full model
- Incident reporting guide
- Minimum template
PS-CAST

- PS-CAST (Patient Safety CAtegorial Structure) aims to propose a categorial structure for modeling Patient Safety information
  - Review of the definitions of key concepts
  - Semantic dissection of the conceptual framework: selection of the relevant key concepts
  - Expert validation
 Ontology development

- Top-down approach
- Iterative development from the model proposed in the conceptual framework
  - add one by one all the key concepts
  - adapt the hierarchical and associated relationships according to concepts added previously
  - add additional concepts to improve consistency and interoperability (with existing ontologies for example)
- Test the coherence of semantic relationships using the ontology representation and a reasoner
PS-CAST - Overview

- 160 concepts
- 46 semantic properties
- Protégé representation (OWL file)
Alignment of PS-CAST with Existing Reporting Systems
### Japanese incident declaration form

- **105 items**

### English translation (coordinated by Prof. Akiyama’s team)

### Free text

<table>
<thead>
<tr>
<th>Axes</th>
<th>Example of subdivision</th>
<th>Example of value set</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Place</strong></td>
<td>Place of occurrence, Outpatient clinics, Wards, …</td>
<td>operation room, training room, radiology room, …</td>
</tr>
<tr>
<td><strong>Patients and staff</strong></td>
<td>Sex of patients, Age of patients, Job category of the staff, Years of experience, …</td>
<td>Nurse, assistant nurse, doctor, Pharmacist, …</td>
</tr>
<tr>
<td><strong>Incident</strong></td>
<td>Detail information about the incident, Coping for the incident and patient’s status</td>
<td>Free text</td>
</tr>
<tr>
<td><strong>Cause of incident</strong></td>
<td>About staff, System, environment, circumstances, Medical machines, equipment, devices, facilities, Education and training, …</td>
<td>not enough knowledge, wrong technical skill, defect of reporting/communicating defect of computer system, bad equipment setup, … Free text</td>
</tr>
</tbody>
</table>
Mapping Process

Incident Declaration Form

Patient & Staff
- Patient
  - Age, Sex, etc.
- Staff
  - Experience, etc.
  - ...

Causes
- Cause of Incident
- Clinical Examination
- Operation
  - ...

Incident
- Date/Time
- Location
- Category of Incident
  - ...

Patient Safety

Action
- Diagnostic Action
- Therapeutic Action
- Managing Action

Circumstances
- Contributing Factors
- Human Deficiency

Role
- Patient
- Staff

Outcome
- Harm
- Organisational Outcome

Organisation
- Harm
- Organisational Outcome

Incident Management
- Intervention Incident
- Management Incident
- Map existing concepts
- Add new concepts (if necessary)
- Adapt the hierarchy (if necessary)
- Improve consistency
<table>
<thead>
<tr>
<th>Item</th>
<th>Categorial Structure Definition Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place of occurrence</td>
<td>Incident hasLocation some Care_Setting</td>
</tr>
<tr>
<td>Patient</td>
<td>Incident hasPeopleInvolved some Person</td>
</tr>
<tr>
<td></td>
<td>Person hasRole some Patient</td>
</tr>
<tr>
<td>Sex of patients</td>
<td>Person hasGender some Gender</td>
</tr>
<tr>
<td>Who found this incident?</td>
<td>Incident hasDetection some Detection</td>
</tr>
<tr>
<td></td>
<td>Detection hasPeopleInvolved some Person</td>
</tr>
<tr>
<td>Years of experience</td>
<td>Staff hasWorkExperience some DurationDescription</td>
</tr>
<tr>
<td>Level of damage</td>
<td>Incident hasConsequence some Outcome</td>
</tr>
<tr>
<td></td>
<td>Outcome hasSeverity some Severity</td>
</tr>
<tr>
<td>Clinical examination</td>
<td>Incident hasSituation some Action</td>
</tr>
<tr>
<td></td>
<td>Diagnostic_Action is a Action</td>
</tr>
<tr>
<td>Cause of incident &gt; system</td>
<td>Incident HasCause some Circumstance</td>
</tr>
<tr>
<td></td>
<td>System_Deficiency is a Circumstance</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
Information Model for Patient Safety
Minimum information model

- Incident identification
  - Patient
  - Time
  - Location
  - Agent(s) involved
- Incident type
- Incident outcomes
- Resulting actions
- Reporter
INCIDENT IDENTIFICATION aims to describe an incident specifically.

The PATIENT is the person who is a recipient of healthcare and involved directly or indirectly in the patient safety incident.

TIME refers to date and time of day when the incident occurred.

LOCATION refers to the physical environment in which a patient safety incident occurs.

AGENT INVOLVED refers to product, device, person or any element involved in the incident with the potential to influence it.

INCIDENT TYPE is a descriptive term for a category made up of incidents of a common nature, grouped because of shared, agreed features.

INCIDENT OUTCOMES refer to all impacts upon a patient or an organization wholly or partially attributable to an incident.

RESULTING ACTIONS refers to all actions resulting of an incident.

REPORTER refers to the person who collects and writes information about the incident.
Intermediate model

- Incident identification
  - Patient
  - Time
  - Location

- Incident circumstances
  - Agent(s) involved
  - Leading actions
  - Ongoing actions
  - (Causes)*
  - (Contributing factors)*

- Incident type
- Incident outcomes
- Resulting actions
- Reporter
  - Role in the incident
Full model

- Incident identification
  - Patient
    - Initial condition
  - Time
  - Location

- Incident detection
  - Time
  - Location
  - Person

- Incident circumstances
  - Agent(s) involved
  - Process involved
  - Leading actions
  - Ongoing actions
  - (Causes)
  - ( Contributing factors)

- Incident type

- Incident outcomes

- Resulting actions

- Report
  - Time
  - Reporter
    - Role in the incident
Incident Reporting Guide

- User guide
  - Definition
  - Rationale
  - Examples of value set
Category value sets

- Every category requires value sets. These correspond to the range of permissible values for any given category. The suggested value sets for the elements for the Minimum Information Model have been identified based on standard terminologies and ontologies, in order to facilitate interoperability. BUT these values are not definitive and will need a consensus.

- Nevertheless free text and NLP tools are possible for some categories as
  - incident types
  - Incident outcome
  - Resulting actions
Template for Incident Reporting

- Minimum Template Available
Goals using NLP data

- Bottom-Up population of the Categorial Structure
  - Adding value sets for each categories
  - Replace ‘other’ with a finite list of values
- Update the Categorial Structure
  - Minor modifications (rename classes, etc.)
  - Find new classes (if necessary)
Clustering Results

G1: Operation
G2: Medicine Management
G3: Patient Management
G4: Examination
G5: Infusion
G6: Oral Medicine
G7: Children Treatment
Labelling

<table>
<thead>
<tr>
<th>Description</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>complication in treatment or examination</td>
<td></td>
</tr>
<tr>
<td>clinical examination</td>
<td></td>
</tr>
<tr>
<td>procedure of treatment</td>
<td></td>
</tr>
<tr>
<td>operation</td>
<td></td>
</tr>
<tr>
<td>anesthesia</td>
<td></td>
</tr>
<tr>
<td>direction of medication</td>
<td></td>
</tr>
<tr>
<td>management of dispensing and storage of pharmaceuticals</td>
<td></td>
</tr>
<tr>
<td>preparation and administration of medicine</td>
<td></td>
</tr>
<tr>
<td>blood transfusion</td>
<td></td>
</tr>
<tr>
<td>direction of food supply and nutrition control</td>
<td></td>
</tr>
<tr>
<td>management of medical equipments</td>
<td></td>
</tr>
<tr>
<td>medical examination/BS check, measuring urine volume, physical measurement and others.</td>
<td></td>
</tr>
<tr>
<td>medical examination/indwelling samples</td>
<td></td>
</tr>
<tr>
<td>medical examination/laboratory test</td>
<td></td>
</tr>
<tr>
<td>medical examination/physiological function testing, ultra-sonography</td>
<td></td>
</tr>
<tr>
<td>medical examination/clinical imaging</td>
<td></td>
</tr>
<tr>
<td>medical examination/endoscopic examination</td>
<td></td>
</tr>
<tr>
<td>usage and management of tubes, lines, drains</td>
<td></td>
</tr>
<tr>
<td>Taking care of patients/fall</td>
<td></td>
</tr>
<tr>
<td>Taking care of patients/food supply</td>
<td></td>
</tr>
<tr>
<td>Taking care of patients/others</td>
<td></td>
</tr>
<tr>
<td>rehabilitation</td>
<td></td>
</tr>
<tr>
<td>dialysis</td>
<td></td>
</tr>
<tr>
<td>tray service</td>
<td></td>
</tr>
<tr>
<td>management of radiation</td>
<td></td>
</tr>
<tr>
<td>Medical record and its management</td>
<td></td>
</tr>
<tr>
<td>explanation to patient and families</td>
<td></td>
</tr>
<tr>
<td>clerical work</td>
<td></td>
</tr>
<tr>
<td>facilities, equipments and relationship of staff</td>
<td></td>
</tr>
</tbody>
</table>
Hierarchies are universal organising principles
Two hierarchical representations of a segment of the PS domain

What is the difference?
What do they represent?
• Structuring of Information
• Hierarchy represents the composition of informational entities
• Hierarchy encompasses the information items to be recorded for a given purpose
• Structuring of **Information**
• Hierarchy represents the **composition** of informational entities
• Hierarchy encompasses the information items to be recorded for a given purpose

• Structuring of entities in a domain
• Nodes represent classes and subclasses
• Links represent subclass hierarchies
• Structuring of Information
• Hierarchy represents the composition of informational entities
• Hierarchy encompasses the information items to be recorded for a given purpose

• Structuring of entities in a domain
• Nodes represent classes and subclasses
• Links represent subclass hierarchies
Problems

- Popularity of ontology languages and tools (OWL, Protégé)
- Ontology: strict taxonomic (is-a) hierarchies
  A is-a B: all instances of A are instances of B
- Intuitive hierarchies non-ontological
- Information models are compositional, not taxonomic
- Earlier mistake of ICPS ("International Classification of Patient Safety"): interpreting an information model in terms of an ontology / classification

```plaintext
country is_a incident

care setting is_a discovery of incident
```
Information models aggregate information items in a hierarchic structure.

Ontologies provide classes / categories, which are hierarchically nested.

Fundamentally different, but easy to be mixed up. Result: inadequate representations, wrong entailments when using formal reasoning.

Test: semantics of is_a relation.
YOUR OPINION AND INTEREST

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THANK YOU!

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