Panel Session on Decision Support - II

How to Detect and Exploit Non-Adherence to Guidelines?

3.45 -- 5.15 PM

MedInfo2013, August 20-23, 2013, Copenhagen, Denmark
How to Detect and Exploit Non-Adherence to Guidelines?

Vimla L. Patel, PhD, DSc, FRSC

• Senior Research Scientist, The New York Academy of Medicine
• Director, Center for Cognitive Studies in Medicine and Public health
• Adjunct Professor, Biomedical Informatics. Columbia University, NY
• Adjunct Professor, Public Health, Weill Cornell College of Medicine
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• Fellow of the Royal Society of Canada (Academy of Social Sciences)
• Fellow, American College of Medical Informatics
• Associate Editor, Journal of Biomedical Informative (JBI)
• Editorial Boards of Journal of Artificial Intelligence in Medicine (AIM), Advances in Health Science Education (AHSE), Topics in Cognitive Science.

• Past Vice-President (Member services), International Medical Informatics Association (IMIA)
• Past Vice-Chair, AMIA Scientific Program Committee
• Past Editorial Boards: International Journal of Medical Informatics (IJMI), Journal of Medical Decision Making (MDM), Journal of Experimental Psychology
Panel Overview

The panelists will address the following issues:

- How to detect non-adherence to guidelines?
- How to detect structural changes in guideline adherence (with or without decision support) over time?
- Why do patients and providers deviate from guidelines?
- How can deviations inform us about opportunities for guideline improvement and customization?
- How should organizational and social barriers to guideline improvement be managed?
Panelists

Vimla L. Patel- Center for Cognitive Studies in Medicine and Public Health, The New York Academy of Medicine, USA
  • To Adhere or Not?: Role of Deviations from Standard Protocols in Complex Trauma Environments

Ameen Abu-Hanna- Department of Medical Informatics, University of Amsterdam, The Netherlands
  • Guideline Adherence and Implication for Decision Support

Mor Peleg- Department of Information Systems, University of Haifa, Israel
  • Process Mining Methods and the Effects of Guideline Personalization

Silvana Quaglini- Laboratory of Biomedical Informatics, School of Engineering, University of Pavia, Italy
  • “True and False” Non-Compliance and Cultural Bias
Panel Outline

Moderator: Vimla L. Patel, PhD, DSc

- Introduction: 5 minutes
- Panelists: 15 minutes each
- Discussion: 25 minutes
To Adhere or Not?: Role of Deviations from Standard Protocols in Complex Trauma Environments

Vimla L. Patel, PhD, DSc, FRSC
Center for Cognitive Studies in Medicine and Public Health
The New York Academy of Medicine

Paper presented at Medinfo2013
Copenhagen, Denmark August 19-23, 2013
How to Detect and Exploit Non-Adherence to Guidelines?

Following Standards

• Software development regulations
• Standard protocol for military operations
• Guidelines for cockpit negotiations in Airline transportation
• Guidelines for Cardiac Resuscitation
• Standard procedures for Trauma management
How to Detect and Exploit Non-Adherence to Guidelines?

Research Context and Domain

• Complex Adaptive System
  “a collection of individual agents with freedom to act in ways that are not always predictable, and whose actions are interconnected so that one agent's actions, changes the context for other agents”
  – Plesk and Greenhalgh, 2001

• Key Research Challenges
  – Clinicians may need to deviate to adapt to dynamic events
  – Researchers may be limited by the tools used to study these systems

Simulation Training and ACLS
How to Detect and Exploit Non-Adherence to Guidelines?

Trauma Critical Care: Coding Scheme

Characterize extent to which clinical protocols are followed in practice
Develop focused instrument that measures team performance

Team Organization
- Composition
- Role Clarification
- Physical Positioning
- Resource Availability
- Intervention Organization

Communication
- Uncertainty Clarification
- Confirmation
- Request
- Acknowledgment
- Incomplete Sentences
- Seek Suggestions
- Provide Suggestions
- Incorrect Exchange of Information
- Non-task related Statements

Situation Awareness
- Problem Recognition
- Provide Patient Status
- Status Review
- Attempt to Obtain Patient Information
- Conveying Task Plans
- Provide Task Status
- Monitoring

Team Leadership
- Task planning and decision-making
- Response Sequencing
- Establishing Mutual Support

How to Detect and Exploit Non-Adherence to Guidelines?

Video Clips
Undetected Error
How to Detect and Exploit Non-Adherence to Guidelines?

Video Clips
Poor Communication
How to Detect and Exploit Non-Adherence to Guidelines?

Methods (ACLS)

- **Methods**
  - Team and task work coded bad or goos on clinical protocol
  - Coding tested with independent raters or coders

- **Results**
  - Successful and Unsuccessful Teams
  - Adherence to sequence of protocol was not characteristic of a successful team

Frequency of team behaviors in the successful and the unsuccessful teams
Outcome determined by patient survival
A: Good Outcome; B: Bad Outcome

Attempts to Obtain Pat. Information (AO-PI);
Providing Patient Status (PPS);
Provide Task Status (PTS);
Reminders(R);
Clarifications (CL);
Confirmations (CO);
Non-leader Providing Suggestions (NL-PS) for Intervention;
Leader assigning tasks to members of the team (L-AT)

Methods for Data Collection in Real Trauma

• Data Collection
  – Qualitative methods (observations and interviews)
  – Quantitative methods (tags)

• Quantitative methods
  – Radio frequency identification tags used to track encounters
  – Features tracked included tag ID, time, date and received signal strength indication (RSSI) value
  – Proximity information used as a proxy for interaction

Vankipuram et al., “Toward Automated Workflow Analysis and Visualization in Clinical Environments” JBI (2011)
Trauma Critical Care (ATLS protocol)

Key Research Questions
- How often do the clinicians deviate from guidelines?
- What types of deviations are made?
- How do these types of deviations vary with the experience (level and type) of the members of the clinical team?

Deviations were classified as
- Errors: potentially impact patients and their treatment outcome negatively
- Innovations: May positively affect the patient’s outcome
- Proactive: Actions performed ahead of need
- Reactive: Steps in reaction to patient-specific actions

Kahol et al., “Deviations from Protocol in a Complex Trauma Environment: Errors or Innovations?” JBI (2011)
Deviations as Errors

• An error is defined as a deviation from the standard, if,
  – It violated a prescribed order of activities with a negative impact on workflow
  – Resulted (directly or indirectly) in compromising patient care (or)
  – Resulted in an activity being repeated due to failure in execution or a loss of information

• Examples of errors encountered our study,
  – A resident completed the secondary survey prior to ordering chest/abdomen/pelvis x-rays
  – A junior resident attempted to remove the spine board before the patient’s spine was cleared (confirmed not be injured)
An average of 9.1 (± 2.14) deviations in 10 trauma cases observed

- Experts (attending and senoir residents) considered more innovative themes than junior residents
- Novices made more errors compared to any other group

Limitation
- Sample size too small to assess if classification is complete

Proactive and Reactive Deviations

- A proactive deviation occurs when an activity is performed in order to correct or prevent an error.
- Reactive deviations occur when an activity is performed in reaction to an unanticipated event such as change in patient condition, diagnostic process or treatment plan.
Deviations as Innovations

• Innovations are defined as deviations that
  – Potentially benefit the individual, team or patient
  – By bringing a novel perspective to the situation at hand

• Example of a deviation as innovation in our study
When attempting to diagnose the cause for head injuries in a patient, the resident noticed that the head trauma did not look like a typical presentation of a 1-week-old trauma. In addition, the patient had a high GCS, was lucid and conscious, but noticed a wound on the leg and the patient had presented with high temperature. The resident did not do usual head x-ray, instead requested blood cultures for the patient. Problem resolved after blood culture result as acute infection.

Study Extended with Large Sample

- Step 1: Observations of 30 trauma cases, with 15 cases led by PGY 4/5 (senior) residents and 15 cases led by PGY 2/3 (junior) residents was gathered.
- Step 2: A rater compared each observation case to the steps in the ATLS guideline to identify deviations.
- Step 3: Deviations are then classified based on terminology scheme developed.

Typical Workflow Observed in Trauma Management

How to Detect and Exploit Non-Adherence to Guidelines?

Results

- Errors and reactive deviations were found to be greater in cases led by Junior residents when compared to cases led by senior residents.
- The total number of innovations was found to be greater in cases led by a senior resident.
- Trauma leaders with more experience are able to adapt to the dynamic environment will minimizing errors.

Analysis of Type of Deviation
Results (Cont)

- Greater number of deviations occurred in the phases following trauma preparation and primary review.
- Errors occurred throughout the various stages of the trauma, while innovations only after the primary review.
- The primary survey is protocol driven, while the secondary review and definitive care are more flexible.
Conclusions

• Guidelines and standards are important, but deviations are also important in complex, dynamic conditions
  – To detect deviations to standards, need methods that capture dynamic situations
  – Deviations leaning towards innovations produce new knowledge for updating guidelines

• Experts most often deviate from standards in uncertain emergency conditions to innovate or create new knowledge
  – Novice under similar situations generate errors
Thank You

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http://ccsmph.nyam.org
How to Detect and Exploit Non-Adherence to Guidelines?

Ameen Abu-Hanna, PhD

- Full professor of Medical Informatics
- Head of Department of Medical Informatics, Academic Medical Center, University of Amsterdam
- Principle Investigator
- Past vice-chair Educational Board of Medical Informatics
- Associate Editor JBI, board member MIM
- AIME past president
Guideline Adherence and Implication for Decision Support

Ameen Abu-Hanna
Challenge #1

Providing “operational semantics” for non-adherence
Guideline: Mechanical Ventilation in ICU

• Max TV = 6 * Predicted Body Weight (PBW) ml/kg
  
  • For men: 50 + 0.91 * (Height [cm] – 152.4)
  
  • For women: 45.5 + 0.91 * (Height [cm] – 152.4)

- Very simple to compute for any individual measurement
Would you alert physicians based on:

- Each **individual** measurement of non-adherence?
- % measurements in which VT > 6 ml/kg PBW?
- % of time?
- % measurement/time in **last 15/30/60/120 mins**?
- **Area under curve** (includes **distance** from target)
- **Trend**?

Notes

• Many other guidelines require such considerations, especially feedback loop-guidelines such as blood glucose control

• These difficulties arise also when comparing adherence (between e.g. 2 strategies)

Challenge #2

What if we can’t calculate adherence for a patient online?
How to act when information is missing?

- We have a rule when to act on tidal volume non-adherence
- But the system does not know patient’s gender or height
- What now?
Idea: use decision theory

- Nothing
- Ask about gender/height
  - Probability of trouble
  - Probability of irritation
- Show message in **modality1**
- Show message in **modality2**

⇒ Can be done offline or dynamically
Challenge #3

What happens over time?
Adherence is not static

• It can change over time
• A powerful tool to scrutinize adherence over time is Statistical Process Control
• SCP charts integrate:
  – Intuitive graphics
  – Easy statistical inference
### Sample Number

<table>
<thead>
<tr>
<th>Measure of adherence</th>
<th>Upper control limit</th>
<th>Process average</th>
<th>Lower control limit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Out of control</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Upper control limit**
- **Process average**
- **Lower control limit**

**Statistical Process Control**

The chart illustrates the statistical process control for a measure of adherence. The data points are plotted over sample numbers from 1 to 10. The chart highlights a sample (number 9) that is considered out of control, as it exceeds the upper control limit.
Is reminder to write discharge letter effective?

Does ICU adhere to new BGR guideline?

Is CDSS effective in BGR?

Mean Hyperglycemia Index

ICU C

Starting glycemic control

Starting CDSS
Challenge #4

Understanding factors associated with adherence
Global picture

- Clinicians
- Patients
- Guidelines

System and organization

Clinicians

Patients

Guidelines

- Recent medical school graduates
- Women
- Minorities
- Physicians in non-solo practice types

[Sammer et al. Health Serv Res 2008].

System and organization
Clinicians

Patients

Guidelines

- Demands
- Falling under more guidelines (elders)

System and organization
Clinicians

Patients

Guidelines

Evidence
Endorsement by medical opinion leaders
...

System and organization
Clinicians

Patients

Guidelines

System and organization

Availability
Feedback and audit
CDSS
...

...
Gaining insight into factors associated with adherence

1. **Ask** physicians (offline) via surveys
2. **Analyze reasons** for non-adherence given by physicians **during care provision**
3. **Discover** from data
Asking clinicians (offline)

• Reasons for wanting support
  – Sense of responsibility
  – Concerns about forgetting to perform action
  – Belief that failure to perform is harmful

• Reasons for rejecting support:
  – Would not forget to perform action
  – Concerns about interruptions

Analyze reasons

The 2 main reasons given for deliberately deviating from guideline-based advices are:

1. Exclusion criteria not mentioned in guideline
2. Patient preferences

Are these reasons valid?
In most cases yes!

Arts et al [in progress]
Discovering factors

• Instead of testing whether specific characteristics of clinicians, systems, etc correlate with adherence we can discover factors associated with:
  • markedly higher or lower adherence
  • markedly higher or lower benefit
Statistical Machine Learning

• Decision Trees
• Logistic regression
• Subgroup discovery with PRIM

Abu-Hanna A, Nannings B, Dongelmans D, Hasman A. JBI 2010
Subgroup discovery using PRIM

Definition: subgroups deviating from rest

Bad outcome

Definition: subgroups deviating from rest

Mean Body Temperature

Bicarbonate
Results: Example of Rule

IF

• Mean Body Temperature < 35.5 °C last 6h
• Bicarbonate < 14.9 mmol/l in last 6h

THEN Mean Glucose = 12.5 mmol/l

These patients do not seem to benefit from the guideline. Guideline could be improved
Discovering Non-Adherence

Bad adherence

Axes will be factors pertaining to:
1. Patients
2. Clinicians
3. Systems
4. Guidelines

Unaware of such work yet.
Summary of challenges

• Providing operational semantics for non-adherence
• Reasoning about acting when adherence is uncertain
• Monitoring progress over time
• Finding factors associated with adherence by asking, analyzing, and discovering
Thanks!

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How to Detect and Exploit Non-Adherence to Guidelines?

Mor Peleg, PhD

• Associate Professor, University of Haifa, Israel
• Coordinator, MobiGuide FP7 ICT European Commission Project

• Recipient of 2005 AMIA New Investigator Award
• Member, American Medical Informatics Association Awards Committee
• Member of the Israeli Medical Informatics Association
• Editorial Boards of Journal of Biomedical Informative (JBI), Methods of Information in Medicine (MIIM), International Journal of Computers in Healthcare, The Open Medical Informatics Journal

• Co-chair Process Support in Healthcare (ProHealth) Workshop
• Co-chair Knowledge Representation for Healthcare (KR4HC)
• Member American Association of Clinical Endocrinologists Advisory Committee for Electronic Implementation of guidelines
• Member Deontics Scientific Advisory Board

• Past Chair, Dept. of Information Systems, University of Haifa
• Past PC Chair of Artificial Intelligence in Medicine (AIME 2011)
How to detect and exploit non-adherence to guidelines: process mining methods and the effects of GL personalization

Mor Peleg
University of Haifa

Medinfo, August 22, 2013
Outline

- Process mining for GL care process improvement
- The effects of guideline personalization and patient empowerment on process evolution
  - Insights from the MobiGuide project

When are deviations useful?
Case study: what are the important patient groups (contexts) to consider in urinary tract infections?

Can we use machine learning to find the relevant contexts and provide a semantic definition for them?

Can we then recommend for each context group the path that would lead to best outcome?


## Context, process, and outcome data

<table>
<thead>
<tr>
<th>Process instance ID</th>
<th>253467</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>&lt;65&gt;</td>
</tr>
<tr>
<td>Gender</td>
<td>&lt;Male&gt;</td>
</tr>
<tr>
<td>General condition</td>
<td>&lt;Good&gt;</td>
</tr>
<tr>
<td>Medications</td>
<td>&lt;Insulin&gt;</td>
</tr>
<tr>
<td>History</td>
<td>&lt;CAD&gt;</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>&lt;CVD, CRF, UTI&gt;</td>
</tr>
<tr>
<td>Initial Treatment</td>
<td>&lt;Augmentin&gt;</td>
</tr>
<tr>
<td>Urine test results</td>
<td>&lt;…&gt;(1 field for each measure), &lt;ESBL+= Y&gt;</td>
</tr>
<tr>
<td>Blood test results</td>
<td>&lt;…&gt; (1 field for each measure)</td>
</tr>
<tr>
<td>Ultra sound</td>
<td>&lt;OK&gt;</td>
</tr>
<tr>
<td>Modified treatment</td>
<td>&lt;ZINACEF&gt;</td>
</tr>
<tr>
<td>Additional tests</td>
<td>&lt;&lt;CT, OK&gt;, &lt;ESBL, +&gt;</td>
</tr>
<tr>
<td>Final Patient status</td>
<td>&lt;Partially cured - require home care&gt;</td>
</tr>
</tbody>
</table>

Variables: 53 context, 18 path, 12 outcome
The context of the patient affects the right process path for him and the outcome.

Can we work backward to discover the contexts that predict path and outcome?

- Cluster cases with similar process paths and outcomes (two-step clustering of SPSS)
- Find a semantic definition for the contextual data of similar cases (Chi-squared Automatic Interaction Detection [CHAID])
Semantic definitions of clusters

9 relatively clean leaves

e.g., node 23:
55 < age < 65 and
(General_state = Medium or General_state = Good) and
Beta Blockers= Y
Recommending best path

- Build on process path mining and Wf adaptation work of other groups (van der Aalst, Reichert)
- Example: for the context group of
  - Adult female with UTI symptoms and no previous history of uncomplicated UTIs and no itching and no discharge and Urinalysis microscopic dipstick results positive and UTI uncomplicated and no sulfa allergy
- The recommended path is (Path 1):
  - Treat with 3 days Trimethoprim/Sulfa then followup
- The expected outcome is:
  - Symptoms do no persist
Outline

- Process mining for GL care process improvement
- The effects of guideline personalization and patient empowerment on process evolution
  - Insights from the MobiGuide project
Guideline-based DSSs: any time everywhere

PHR

DSS

Personalized

Computer-interpretable guideline (CIG)

BAN

EMR1

EMR2

PHR
Parallel workflows

**Care professional “traditional” plan**

- GDM diagnosis Monitoring
  - AND
    - 1. Blood Pressure
    - 2. Ketonuria
    - 3. Diet compliance
    - 4. Exercise compliance
    - 5. Blood glucose (BG)

**Patient “parallel workflow” plan**

1. Start
   - Check BG every meal intake
   - If target exceeded - Send Alert
2. End

García-Sáez, Rigla, Shalom, Peleg, Caballero, Gómez, Hernando. Medicon 2013
CIG Customization + Personalization

- 4 stages towards better adherence
  - CIG formalization
  - CIG customization
  - Personalization
  - Execution

**K acquisition**

**Patient + Physician**

**Customization (for patient groups):**

- Recommendations address personal context
- EBM Clinical considerations narrow of possible treatment options
  - Personal context narrows them further
Different **declarative** and **procedural (plan)** knowledge depending on **clinical**, **personal**, and **technological** context

<table>
<thead>
<tr>
<th>Context</th>
<th>Entry cond</th>
<th>Affected objects</th>
<th>(Plans and declarative K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine diet or schedule AND NOT Good metabolic control</td>
<td></td>
<td>Fasting BG</td>
<td>70-100 ml/dl</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal BG</td>
<td>70-120 ml/dl</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Threshold</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measurements</td>
<td>3-4 times per day, every day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physical activity</td>
<td>mild to moderate exercise (1-6 MET), 0.5-1 hour each time, 3-4 times a week</td>
</tr>
<tr>
<td>Semi routine diet or schedule AND NOT Good metabolic control</td>
<td></td>
<td>Fasting BG</td>
<td>70-100 ml/dl</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal BG</td>
<td>70-140 ml/dl</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Threshold</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measurements</td>
<td>2-3 times per day, every day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physical activity</td>
<td>mild exercise (1-3 MET), 0.5-1 hour each time, 3-4 times a week</td>
</tr>
</tbody>
</table>
Personalization

• Matching personal events to C3s
  Regular schedule ➔ Routine_diet_or_schedule
  Holiday schedule ➔ Semi-routine_diet_or_schedule

• Dynamic Induction Relations of Context (DIRCs) stored in the PHR

• Patient local preferences (e.g., meal times)
  • Send measurement reminder 30 min before meal time
Process mining can suggest GL care process improvements for specific patient context, based on learning from outcomes of path deviations.

Delivering DSS to patients on mobile apps requires designing parallel workflows.

Guideline customization adds the effect of non-clinical context (e.g., personal context).

Customized GLs can be personalized to specific patient preferences and context.
Questions?

http://www.mobiguide-project.eu/

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How to Detect and Exploit Non-Adherence to Guidelines?

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- Member of the Italian Strokeforum society
- Program Committee AIME (Artificial Intelligence in Medicine)
- Program Committee MIE (Medical Informatics Europe)
- Consultant, CBIM (Consortium of Bioengineering and Medical Informatics)
- Fellow, GNB, National Group of Bioengineering
- Past PC Chair of Artificial Intelligence in Medicine (AIME 2001)
How to detect and exploit non-adherence to guidelines: “true and false” non-compliance and cultural bias

Silvana Quaglini

Dept of Electrical, Computer and Biomedical Engineering
University of Pavia, Italy
Exploiting (false and true) non-compliance detection

• To improve
  ▪ GL formalization
  ▪ GL content
  ▪ GL compliance

• To show hard-to-remove cultural biases
Premise: computer-based detection of non-compliance

A software tool analyzes the actions taken for a patient (stored in the EMR) and discovers possible non-compliance with respect to the theoretical actions that should have been done according to the GL. The software matches a patient’s data with the formalized GL recommendations that patient is eligible for.
There are common mistakes in GLs formalization that result in wrong recommendations and in “false non compliance” detection.
Are we sure that automatically detected non compliances are real non compliances?

Example from stroke GL

*In patients at high risk of deep venous thrombosis (i.e. presenting with plegic limbs, or reduced consciousness, or obesity or previous lower-limb venous diseases) prophylaxis with heparin [...] is recommended starting since hospital admission*

This recommendation was associated with a big number of non compliances.

The explanation came from motivations given by apparently *non-compliant* physicians.
Understanding causes for non-compliance

RoMA - Patient Report

MARIO ROSSI FINAL REPORT

(b) THE PATIENT WAS ELIGIBLE FOR:

R10.5 (A) Aspirin (160-300 mg per day) is recommended in all patients with acute stroke unless anticoagulant therapy or thrombolysis are indicated.

R10.15 (A) In patients with stroke secondary to atherothrombosis of extracranial vessels who were not on antithrombotic therapy, aspirin (160-300 mg per day) is the recommended treatment.

R10.18 (B) In patients at high risk of deep venous thrombosis (DVT) (i.e. presenting with plegic limbs, or reduced consciousness, or obesity or previous lower-limb venous diseases) prophylaxis with subcutaneous low-dose heparin (5000 i.u. twice daily) or low-molecular-weight heparins is recommended starting since hospital admission.

(c) GL NON-COMPLIANCES

R10.18 (B): obese patient (BMI=34.7)
In patients at high risk of deep venous thrombosis (i.e. presenting with plegic limbs, or reduced consciousness, or obesity or previous lower-limb venous diseases) prophylaxis with heparin [...] is recommended starting since hospital admission initially assessed, as from the definition, by evaluating the body mass index, age and gender.

in the context of this recommendation, indeed, the term “obesity” should be formalized more specifically as “obesity causing limited mobility” (i.e. DVT prophylaxis has not to be performed when a patient, while obese, is able to move).
Temporal issues

From GL recommendations:

... the first CT scan should be done as soon as possible ... 
... a second CT scan should be done within 48h, in any case not after 7d

How to judge the fact that the second CT scan has not been performed to a patient who died after 3 days from admission?

a second CT scan could have saved the life of my father

my intention was to perform the CT scan in few hours, as the GL gives me 7 days to do that
Is it a non-compliance?

_Not-to-do_ recommendations

- From GL recommendations:

  24h ECG Holter is indicated **only in patients with TIA or ischemic stroke** when arrhythmias are potential causes of cardioembolism ...

It’s seems you’re over-prescribing ECG holter !

I did it to ensure the best care to my patients ...
Disambiguation of GL recommendation

Results from the first iteration of the computerized GL

<table>
<thead>
<tr>
<th>Non-compliance motivation</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient-related Problems</td>
<td>17%</td>
</tr>
<tr>
<td>Technical Problems</td>
<td>18%</td>
</tr>
<tr>
<td>Different physician’s opinion</td>
<td>24%</td>
</tr>
<tr>
<td>Erroneous Recommendation</td>
<td>41%</td>
</tr>
</tbody>
</table>

Who’s to blame?

- Too many GLs are still poorly written, leading to errors in formalisation, and in turn in non-compliance detection.
- Knowledge engineers try formalizing recommendation without consulting domain experts, so loosing lot of tacit knowledge that is needed for a correct interpretation of the GL.
- Domain experts often are not able to make all that knowledge explicit.

All this calls from closer collaboration!
Detecting non-compliance and asking motivations in real time is in principle valuable, BUT ...

we have to consider how real processes go on (socio-technical approach)

In a real-world healthcare setting, too many variables affect real-time data input in a patient’s EMR and, consequently, a detected non-compliance could be not real, i.e. an action could have been made, but not yet stored in the EMR;

Pretending that physicians justify their behaviour in real time has some drawbacks:

- physician perceives the system not only as a reminder, but as a controller, mainly when the reminder is a false positive;
- if in a hurry, physician may have no time to write down justification.
Exploiting “True” non compliance

Hypothesis: The GL is correctly formalized, data are correctly entered into the EMR. In this case, a detected non compliance is a **true** non compliance

- Non compliance statistics
- Comparison of non compliance among different hospitals to improve compliance “by competition”
- Correlation of non compliance with health outcomes
Simple non compliance statistics

GL
Recommendation:

“Neurological and disability scales must always be measured”

Just to make physicians and administrators aware of the care process pitfalls (often it’s a surprise !)
Comparative statistics for a specific centre
(results from the SUN network for stroke)

% of non compliance according to the recommendation type (overall and for a specific centre)

% of non compliance for all the recommendations implemented by the GL (overall and for a specific centre)
Comparative statistics for a specific centre (results from the SUN network for stroke)

- Your performance is at the same level as the average performance.
- p<0.0001 indicates significant difference.

Number of Non Compliance

Alive at discharge vs. dead at discharge.

The chart shows a significant difference (p<0.0001) in the number of non-compliances between those alive and dead at discharge.
Comparative statistics for the network administrator

For audit purposes

<table>
<thead>
<tr>
<th>Outcome at Discharge for ICH patients</th>
<th>Overall</th>
<th>Best case</th>
<th>Worst case</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIHSS measured at admission (all)</td>
<td>66.8%</td>
<td>98.2%</td>
<td>4.8%</td>
</tr>
<tr>
<td>Statins prescription and adherence at follow-up (ischemic patients only)</td>
<td>39.6%</td>
<td>78.0%</td>
<td>16.0%</td>
</tr>
<tr>
<td>Early rehabilitation</td>
<td>73.0%</td>
<td>80.6%</td>
<td>38.3%</td>
</tr>
<tr>
<td></td>
<td>49.0%</td>
<td>73.5%</td>
<td>20.7%</td>
</tr>
</tbody>
</table>
GL compliance and cultural bias

Step back to clinical trials, that are the major source of clinical evidence on which guidelines are based
Cultural bias in clinical trial


“… Establishing the specific needs of women has been hampered by a strong male bias of study populations in clinical trials resulting in a lack of female-specific data …”

Even if …. The NIH mandated enrollment of women in human clinical trials in 1993!!

Data from Food and Drug Administration (FDA) showed that percentage of women in phase I and II clinical studies in 2000-2002 were only 25%. In 2006-2007 data show a slightly increase but still far from 50%.

Watts G. Why the exclusion of older people from clinical research must stop. BMJ. 2012 May 21;344

“…This problem has stark consequences, according to an expert committee of the European Medicines Agency (EMA). The drugs we are using in older people have not been properly evaluated …


“… Male bias was evident in 8 disciplines and most prominent in neuroscience, with single-sex studies of male animals outnumbering those of females 5.5 to 1”

Just out of curiosity:
How this affect GL compliance

From our data on stroke GL implementation

? We don’t know if

- physicians are aware that recommendations have not been proved effective for elderly
- in general there is less care for elderly people

In any case, it’s worth documenting the phenomenon
Discussion points

Physicians may comply or do not comply with guidelines according to the so-called *defensive medicine*.

Too many guidelines are written in such a way that makes it impossible to detect non-compliance.

There are still cultural biases to be removed for achieving good GL development and adherence.

There is still insufficient collaboration between medical experts and knowledge engineers in the GL implementation design.

*Defensive medicine* is the practice of diagnostic or therapeutic measures conducted primarily not to ensure the health of the patient, but as safeguard against possible malpractice liability.
Thank you for your attention
Physicians may comply or do not comply with guidelines according to the so-called *defensive medicine*.

Too many guidelines are written in such a way that makes it impossible to detect non-compliance.

There are still cultural biases to be removed for achieving good GL development and adherence.

There is still insufficient collaboration between medical experts and knowledge engineers in the GL implementation design.
How to Detect and Exploit Non-Adherence to Guidelines?

Statements for Discussion

1. Standards interfere with innovations

2. Social norms are more powerful than policies in guideline adherence

3. Leaders (experts) are likely to non-adhere to protocols with greater success
Statements (continued)

4. There will usually not be enough detailed information in EHR in order to allow process mining to find useful path and outcome patterns

5. Doctors should not try to deviate from the recommendations that have the highest evidence of being effective in order to address personal patient considerations

6. Patients’ deviations from recommendations should be exploited in order to add contextualized recommendations to clinical guidelines