Characterizing the Dimensions of Clinical Practice
Guideline Evolution

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Overview

1. Guideline and CDSS update issues
2. Method & Material
   - Characterization of KB evolution
   - KB versions of 2 Bladder cancer CPG revisions
3. Results
4. Discussion and conclusion
Guideline update issues

- Clinical practice guidelines
  - Promotion of “best practices”
  - State of the art: a relative and evolving notion
  - CPG life-cycle

- Guideline-based clinical decision support systems
  - Low impact of textual dissemination
  - Computerized model of CPG content
  - Provide patient-specific recommendations
  - Effective in improving clinician compliance with CPGs

- Building and maintaining CDSS knowledge bases
  - CDSSs need to be updated as their knowledge sources evolve
  - CDSS life cycle
Updating guideline-based CDSSs

- Knowledge acquisition for guideline-based CDSSs
  - From text to a computerized format
  - Guideline knowledge representation formalisms
    - a step towards executable representations
  - Knowledge-centric approaches
  - Document-centric approaches

- Guideline-based CDSS update
  - "From scratch" approaches
    - Considered time consuming
    - Limited reuse
  - Incremental approaches
    - Differential approach
    - Adapted to document-centric approaches
    - The concept of "living guidelines"
Problem statement

- Let $v$ and $v + 1$ the versions of 2 consecutive CPG revisions.
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The KB model: a set of atomic recommendations $\{R_i\}$
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- Compare $\{R_i\}_i^v$ vs. $\{R_j\}_j^{v+1}$
  - Set intersection
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\[ \begin{align*}
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- Compare \( \{ R_i \}^v \) vs. \( \{ R_j \}^{v+1} \).
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Diagram:

- \( R_i \) in version \( v \).
- \( R_j \) in version \( v + 1 \).
- Commonality between recommendations.

Subsumption relationships.

Assumption: \( R_j \) is an evolution of \( R_i \) if it shares "commonality" with \( R_i \).

Characterize commonality between recommendations.

Bouaud & Séroussi – AP-HP & Univ Paris 6
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Need for constraint relaxation on identity

Assumption:

\( R_j \) is an evolution of \( R_i \) if it shares “commonality” with \( R_i \)

- Characterize commonality between recommendations
- Subsumption relationships
Objectives

### Aims

- To characterize formally CPG evolution from a knowledge perspective
- To evaluate the model in a case study
Objectives

Aims

- To characterize formally CPG evolution from a knowledge perspective
- To evaluate the model in a case study

Principles

- Comparison of 2 knowledge bases modelling a CPG and its updated version
  - Identification of evolution patterns
- Quantification of evolution patterns
Knowledge base model and notations

- KB = \{R_i\}
  - A rule-based KB model
  - \(R_i = (S_i, P_i) / S_i \Rightarrow P_i\)

- Knowledge components
  - Decision criteria: \(\{c_n\}\)
    - Tumor grade 1, chemotherapy contra-indicated...
  - Clinical situation: a set of criteria \(S_i = \{c_{i,n}\}_n\)
    - \{Tumor grade 1, prior cystectomy, no recurrence\}
  - Medical actions: \(\{a_n\}\)
    - Transurethral resection (TUR), cystectomy, early post-surgical endovesical instillation (EPSEI)...
  - Action plan: an ordered sequence of actions \(P_i = \{a_{i,m}\}_m\)
    - \{chemotherapy, invasion surveillance\}

- Recommendation identity (\(=\))
  \(R_i = R_j \iff S_i = S_j \land P_i = P_j\)
Definitions

- “Ontological” abstraction ($abst$)
  - A mapping between basic elements and their abstract classes
  - On criteria
    \[ abst(\text{prior cystectomy}) = \text{prior surgery} \]
  - On actions
    \[ abst(\text{gemcitabin}) = \text{chemotherapy} \]

- Structural subsumption of clinical situations ($subsum$)
  - Implemented by set inclusion
    \[ subsum(S_i, S_j) = (S_i \subseteq S_j) \]
    \[ subsum((a, b), (a, c, b)) = t \]

- Action plan similarity ($sim$)
  - Implemented as set identity (no order)
    \[ sim(P_i, P_j) = (P_i \subseteq P_j) \land (P_j \subseteq P_i) \]
    \[ sim((x, y, z), (z, x, y)) = t \]
Definitions (cont’d)

- Enhanced subsumption (Subsum)
  - Combining subsum and abst
    \[ \text{Subsum}(S_i, S_j) = \text{subsum}(\text{abst}(S_i), \text{abst}(S_j)) \]
    \[ \text{Subsum}((a', b), (a'', c, b)) = \text{subsum}((A, B), (A, C, B)) = t \]
    with abst(a') = abst(a'') = A ; abst(b) = B ; abst(c) = C

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Recommendation evolution patterns

- Let $R_i \in \{R\}^v$ and $R_j \in \{R\}^{v+1}$
- Can $R_j$ be derived from $R_i$?
- Proposition of 7 evolution patterns
  - No change
  - Action plan refinement
  - New action plan
  - Condition refinement
  - Recommendation refinement
  - New practice
  - Unmatched recommendations
Evolution categorization from $R_i$ to $R_j$

1. if $S_i = S_j$
2. then if $P_i = P_j$
3. then No change
4. else if $\text{Sim}(P_i, P_j)$
5. then Action plan refinement
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Comparison of recommendation sets

- Compare $\{R\}^v$ vs. $\{R\}^{v+1}$
- Each $R_j^{v+1}$ is categorized, by comparison with every $R_i^v$
Comparison of recommendation sets

- Compare $\{R\}^v$ vs. $\{R\}^{v+1}$
- Each $R_j^{v+1}$ is categorized, by comparison with every $R_i^v$
- Remarks
  - Every *unmatched recommendation* in $\{R\}^{v+1}$ is a new recommendation
  - Every *unmatched recommendation* in $\{R\}^v$ is an obsolete recommendation
Bladder cancer CPGs and KBs

- Bladder cancer management guidelines
  - > 10,000 cases/year – 5th cancer – 3% cancer deaths
  - French Association for Urology

- Two knowledge bases for 2 CDSSs
  - UroDoc-2002 and UroDoc-2004
  - KBs are decision trees (categorization)
  - KBs built independently, with the same methodology

- Decision trees expanded as rule sets
  - A tree path is a rule
Criteria and action comparisons

### Shared and specific concepts

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- Obsolescence: *diffuse CIS* ; *chemotherapy*
- Emergence: *sex* ; *neo-adjuvant chemotherapy*

- 577 2002-recommendations
- 1071 2004-recommendations

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Discussion

- Increase of the number of recommendations
  - Consistent with document size (from 13 to 40 pages)
  - Same target of CPGs
  - More detailed (axillary invasion)

- Importance of differences
  - Many new 2004 recommendations
    - New notions
  - Many obsolete 2002 recommendations
    - Abandoned notions
    - New contexts

- Limitations of the method
  - Could be extended (relevance?)
  - Only subsumption-based derivations
  - Based on exclusive recommendation set
Conclusion

- A requirement for up-to-date guideline-based CDSSs
- Characterization of evolution patterns
  - Derived recommendations
  - Use in knowledge-centric modelling
  - Why not “Living KBs”?
- Some (open) questions
  - What about CPG updates in other domains, from other authors?
  - Impact of “ontological” evolutions?
  - Reusability: incremental vs. “from scratch” approach?
Thank you
Textual CPG comparison

- Same target, same authors (80%)

### CPG structure and volume

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