Modelling clinical goals
A corpus of examples and a tentative ontology

John Fox 1, Alyssa Alabassi1,2, Elizabeth Black1, Chris Hurt1, Tony Rose1

1Advanced Computation Laboratory, Cancer Research UK
2Guy’s Hospital Breast Unit, London
Modelling clinical goals

- Models of goals: why and how
- Goals in PROforma
- Armchair ontology of goals
- Some proposals for goal models
- A corpus of examples (breast cancer)
- Revised ontology & goal model
- Conclusions
CREDO core service model

Detection
- Primary care
- Screening
- Genetics & Risk assessment

Work-up
- Triple assessment
- Diagnosis
- Pathology

Treatment
- Therapy planning
- Surgery
- Radiotherapy
- Systemic Therapy
- Multi-disciplinary patient reviews

Follow-up
- Palliative care
- Primary Care
- Follow up Clinics

Patient journey

- Patient portal
- Professional portal
- Current awareness
- Research Services/Clinical Trials
- External/Data base
- RED box (safety/audit)
“A simple, flexible model”
(with apologies to Gunther Schadow)
Why are goals important?

• Understanding the clinical process
  – Rationale of clinical tasks (Shahar)
  – Critiquing, quality assessment (Advani)

• Management of clinical workflow
  – Recovery from task failure
  – Tasks become irrelevant/inappropriate

• Defractalisation of acts
Goals and tasks in PROforma

See www.openclinical.org and Sutton and Fox, JAMIA 2003
“A simple, flexible model”
(with apologies to Gunther Schadow)
Goal ontology (version 1)

- **Knowledge goals**
  Decide between alternative hypotheses about world
  - Detect \( e.g: \) presence/absence an abnormality
  - Classify \( e.g: \) which of \( N \) possible conditions is present
  - Stratify \( e.g: \) level of risk
  - Predict: \( e.g: \) diagnosis, prognosis

- **Action goals**
  Achieve
  - Eradicate \( e.g: \) eradicate an infectious organism
  - Create \( e.g: \) create a sterile site

  Control
  - Prevent \( e.g: \) prevent side-effect of a treatment
  - Limit \( e.g: \) maintain physiological parameter within limits

  Communicate
  - Enquire \( e.g: \) request an appointment
  - Inform \( e.g: \) tell colleague results of test
Properties of goals

Shahar (1998)

– Whether the intention is to achieve, maintain or avoid a situation;
– Whether the intention refers to a clinical state or action;
– Whether the intention holds during care (intermediate) or after it has been completed (overall)
Properties of goals


– *Context* in which goal is relevant
– *Target* e.g. state of disease or disorder
– *Verb* that specifies whether the target is to be achieved, avoided, etc
– *Temporal constraints.*
– *Priority* of the goal
“Formal” properties of goals

Winikoff et al (2002)

- Known, goals must be explicit
- Consistent, goals must not conflict
- Persistent, while success conditions not satisfied
- Unachieved, drop as soon as satisfied
- Possible, abandon if impossible
Improving the ontology

- A large corpus of examples would help to identify the range of functions supported by goals
- Systematic classification of the examples would help to understand the main goal types and semantics
- CREDO provides one domain for developing such a corpus
CREDO model of cancer care

Detection

Primary care

Screening

Genetics & Risk assessment

Work-up

Triple assessment

Diagnosis

Staging

Pathology

Radiology

Psycho-social

Therapy planning

Treatment

Surgery

Radiotherapy

Systemic Therapy

Multi-disciplinary patient reviews

Follow-up

Palliative care

Primary Care

Follow up Clinics

Patient journey

Patient portal

Professional portal

Current awareness

Research Services/Clinical Trials

External/Data base

RED box (safety/audit)
CREDO service description: triple assessment

• Clinical services
  – Decision support (investigations, follow up, genetic risk)
  – Tracking results and investigations.
  – Management of follow up or discharge

• Patient services
  – Personalised schedules

• Communication services
  – Notifying physician of results, management, discharge plan
  – Notifying patient of results and management plan.
  – Inviting patients for follow up and investigations.
Review of CREDO corpus against Shahar model

<table>
<thead>
<tr>
<th>State</th>
<th>Achieve</th>
<th>Intermediate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action</td>
<td>67</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>155</td>
<td>Overall</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>175</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avoid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
Review of CREDO corpus against Hashmi, Boxwala model

<table>
<thead>
<tr>
<th>Context</th>
<th>Verb</th>
<th>Target</th>
<th>Temporal</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>222</td>
<td>222</td>
<td>48</td>
<td>47</td>
<td>0</td>
</tr>
</tbody>
</table>
Revised ontology

Knowledge goals
  o Acquire knowledge about specific setting \([15 \text{ instances}]\)
     § ...
  o Decide between alternative hypotheses about the world \([52 \text{ instances}]\)
     § Detect
     § Classify
     ...
     § Predict
     ...

Action goals
  o Achieve some state of world \([65 \text{ instances}]\)
     § Limit changes to current state
     § Bring about required future state
     ...
     § Decide between alternative interventions
     ...
  o Enact tasks \([90 \text{ instances}]\)
     § Arrange service
     § Investigate
     § Communicate
Consensus model?

<Situation>
   - Context (Hashmi)
   - Scenarios (e.g. Prodigy)
   - Triggers and preconditions (e.g. PROforma)

<Verb phrase><Noun phrase>
   - Task, Focus (Huang et al)
   - Verb, Object (Fox et al)
   - Verb, Target (Hashmi et al)
   - Verb phrase, Noun phrase (Kelly, safety goals)
   - Performative, message (KQML, FIPA)

<Constraints>
   - Temporal (Shahar, Hashmi)
   - Scheduling (Peleg et al)
   - Cost and other resources?
   - Other requirements?

<Control>
   - Priority (Hashmi)
   - Urgency, importance, deontic
Example

“If a patient presents with symptoms of possible breast cancer then it is obligatory that the patient is referred to see a specialist oncologist within two weeks”
Example

<Situation> if patient presents with symptoms of possible breast cancer

<Verb phrase> refer patient

<Noun phrase> specialist oncologist

<Constraints> within two weeks

<Priority> obligatory
Conclusions

• Guideline enactment systems should explicitly support clinical goals and intentions
• Several existing attempts to model goals have yielded proposals for possible structures and semantics
• Analysis of a corpus of examples in the domain of breast cancer suggests further refinements
• Analysis of other typical corpora would yield further refinements