



# Designing an Agent to Support the Retrieval of Medical Evidence to Support Emergency Physician Decision Making at the Point of Care

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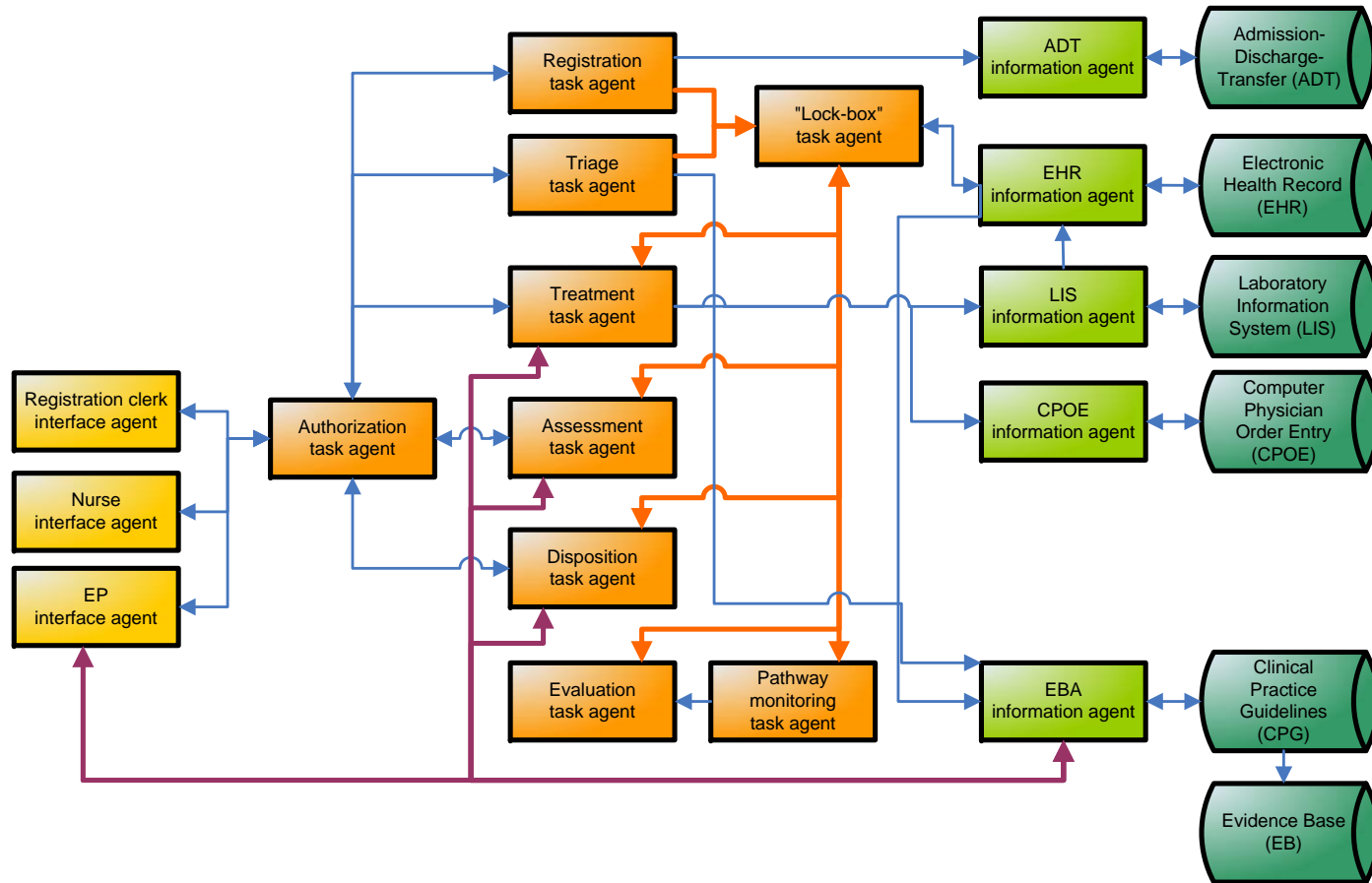


# MET (Mobile Emergency Triage)

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- Multi-purpose Clinical Decision Support System
- Current implementation is pediatric asthma
  - Provides Early Assessment for Asthma Severity
  - Supports Patient Management and Clinical Workflow
  - Multi-agent architecture to support complex care pathway
    - Clinical personnel, patient management tasks, hospital information systems
  - Point of care support

# MET Multi-Agent Design





# Issues and Challenges in Supporting Evidence-based Medicine

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## □ Issue

- How to provide the most relevant evidence in a concise manner at the point of care

## □ Challenges

- Natural language processing/semantic understanding difficult for **highly specialized medical corpuses**
- Difficult to locate “most relevant” documents due to **low precision** of text-based search methodologies
- Ranked **presentation style** favored by many search engines not suitable for point of care support



# Requirement and Solution

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## □ Requirement:

- Access to evidence must be **integrated with existing clinical workflow**
- Evidence must be **contextually relevant** for the current patient-physician encounter
- Evidence should be available at the **point of care**

## □ Solution:

- Employ a **logical concept-based query**, where concepts relate to specific disease and patient state
- Combine concept-based query for document retrieval with **cluster-based approach** for document presentation

# Use Case for Designing Evidence-based Agent (EBA)

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**1(a) Physician evaluates child's state (including asthma exacerbation severity)**

1(b) MET displays in a structured manner all available patient data (history and recorded assessments) together with verified prediction

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**2(a) Physician prescribes treatment**

2(b) MET captures treatment (using structured format)

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**3(a) Physician requests evidence for prescribed treatment and child's state**

3(b) MET looks for evidence by creating a query, consulting clinical practice guidelines, mining the Cochrane Library and clustering results. MET presents clusters to the physician

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**4(a) Physician reads and reviews provided evidence**

4(b) --

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**5(a) Physician decides whether to check another treatment or to continue with the currently prescribed one**

5(b) MET allows the physician to go back to step 2 or to continue with the prescribed treatment

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**6(a) --**

6(b) MET stores the prescribed treatment

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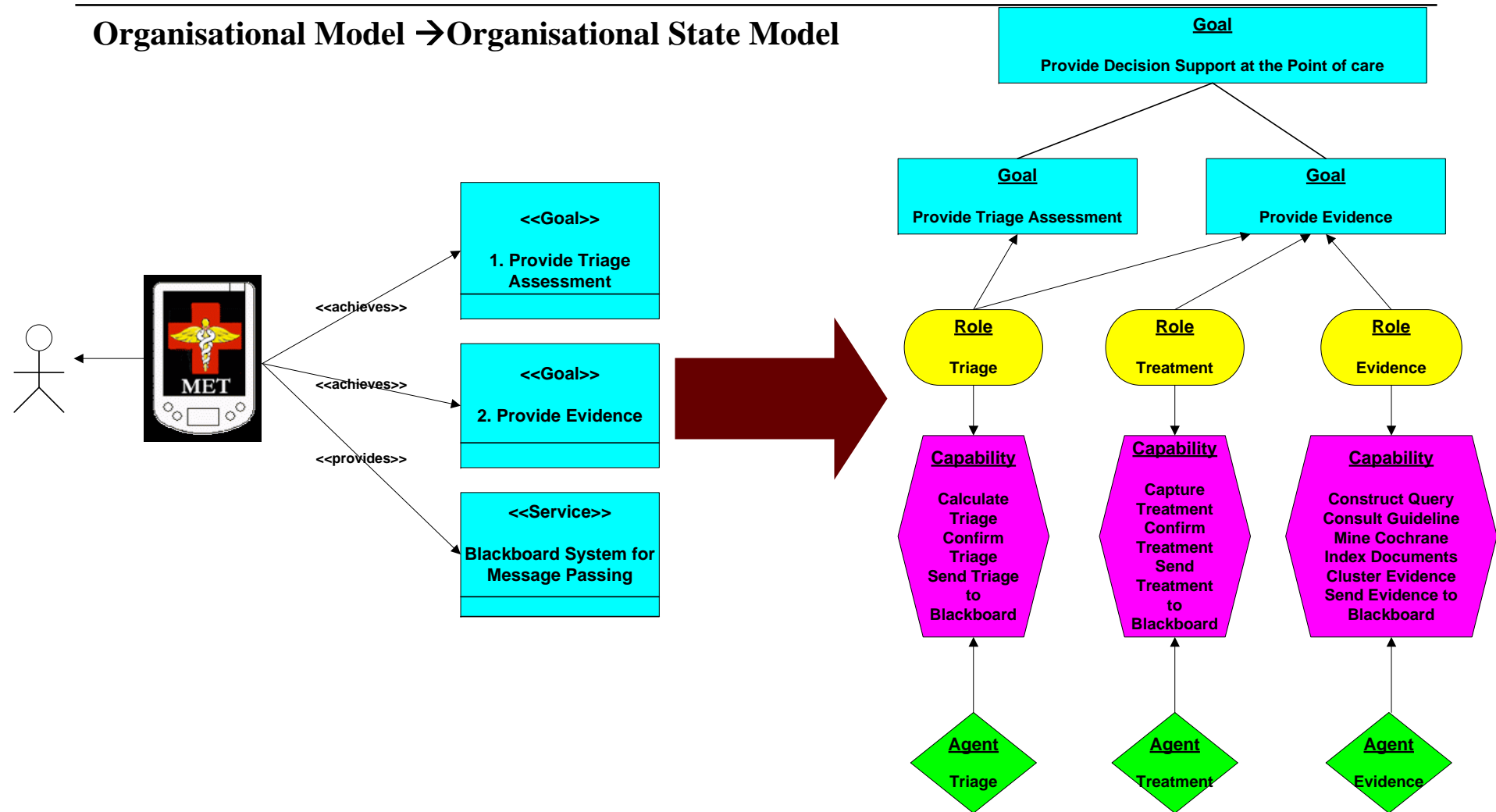
# O-MaSE

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- Methodology for modeling agents in a multi-agent system (MAS)
- Allows for integration of sub-teams of cooperating agents
- MAS defined in terms of Organizational, Goal, Role, and Agent Models
- MET architecture is simplified – One organization and each agent has fixed capabilities

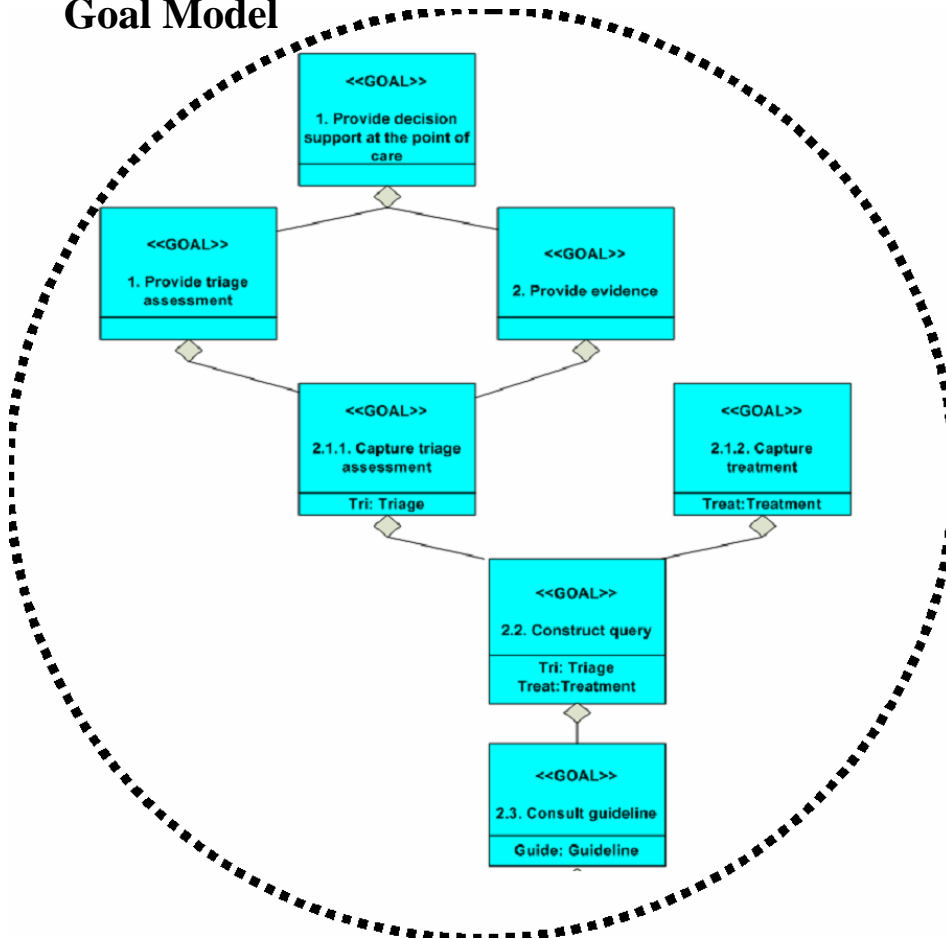
# MET EBA and O-MaSE

Organisational Model → Organisational State Model



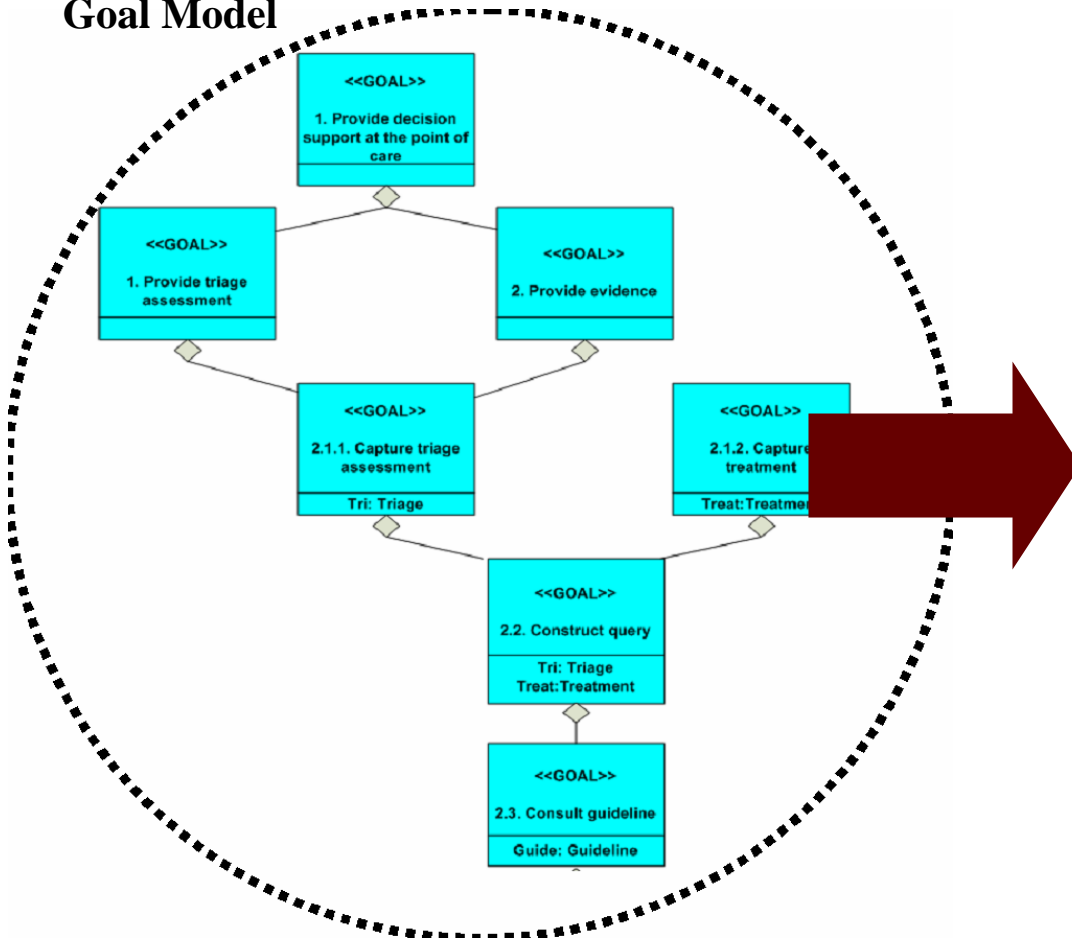
# MET EBA and O-MaSE

## Goal Model



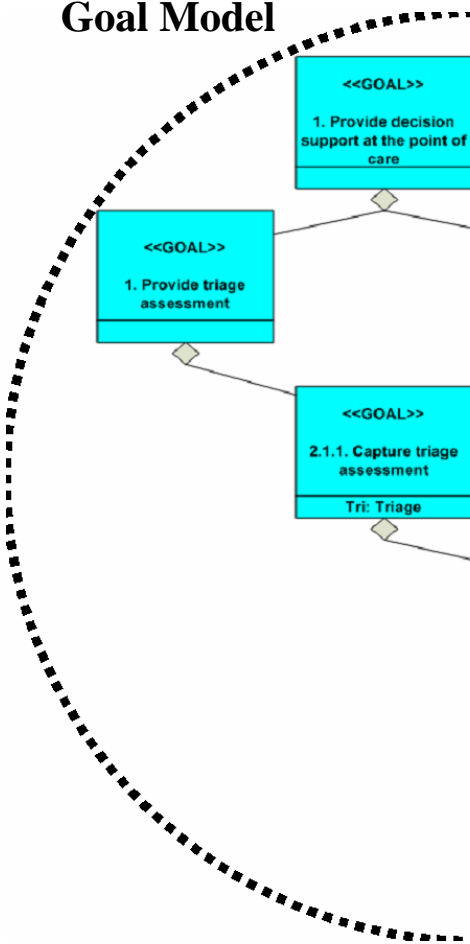
# MET EBA and O-MaSE

## Goal Model

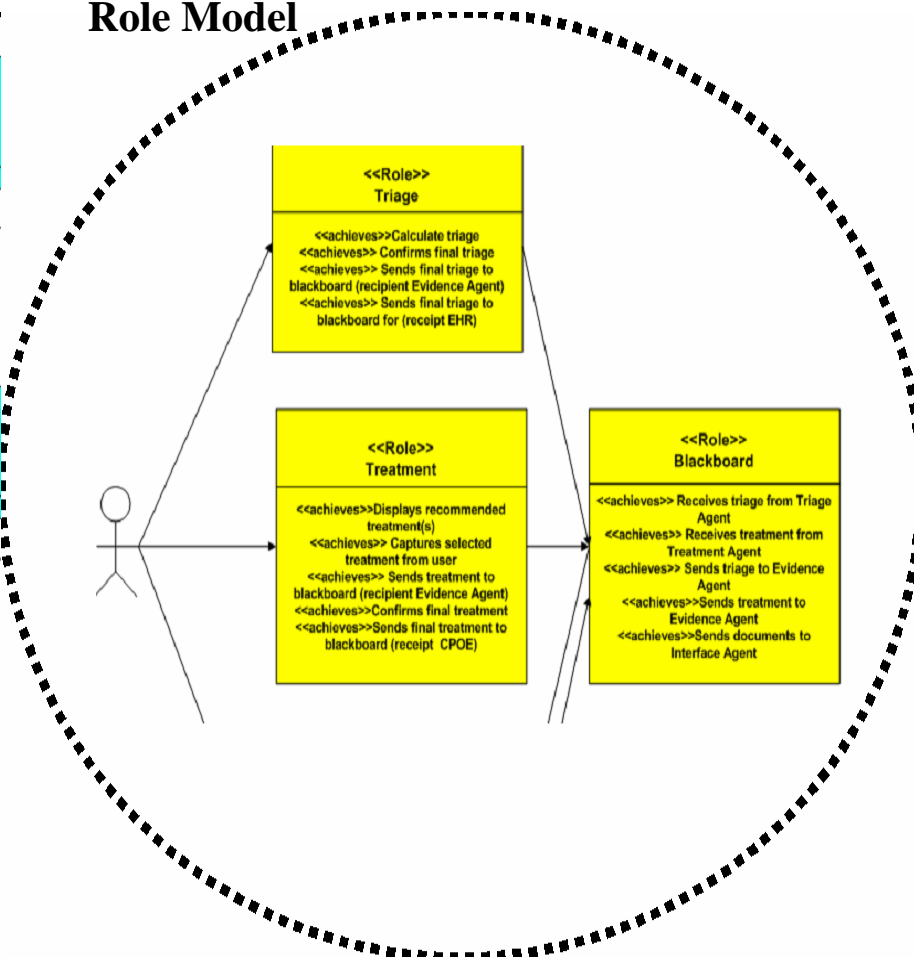


# MET EBA and O-MaSE

Goal Model

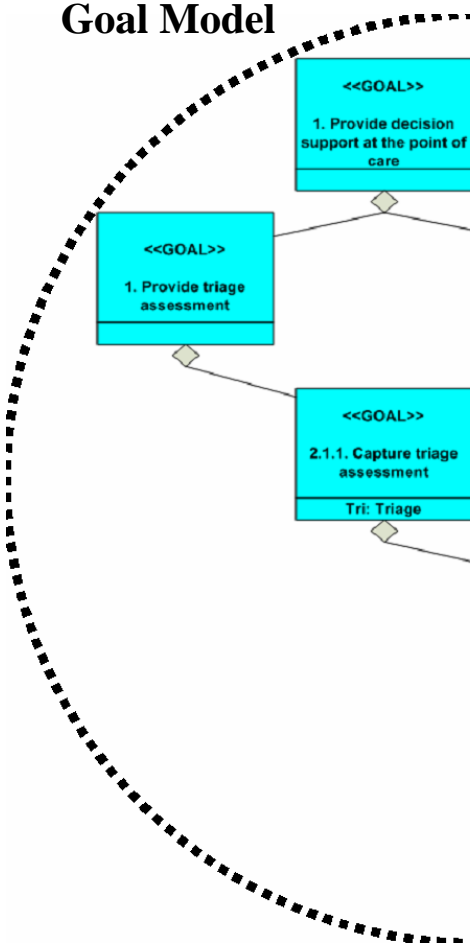


Role Model

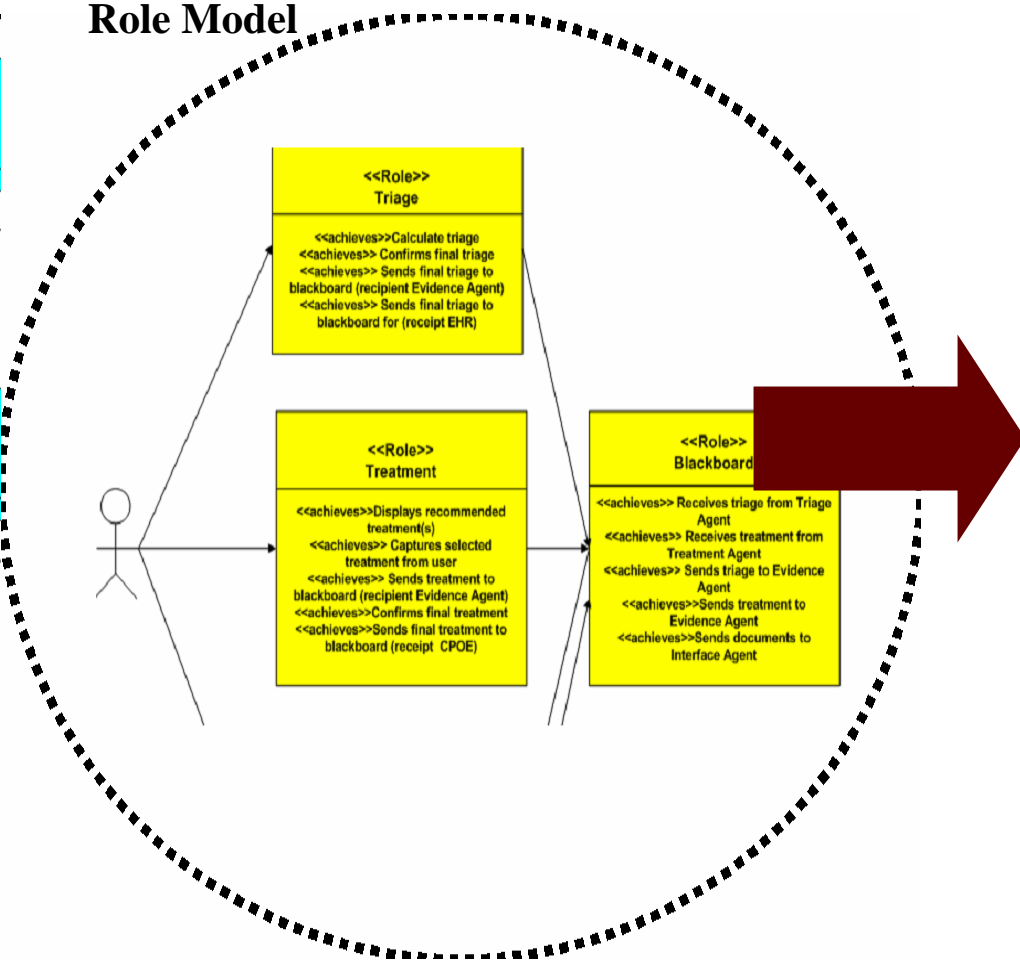


# MET EBA and O-MaSE

Goal Model

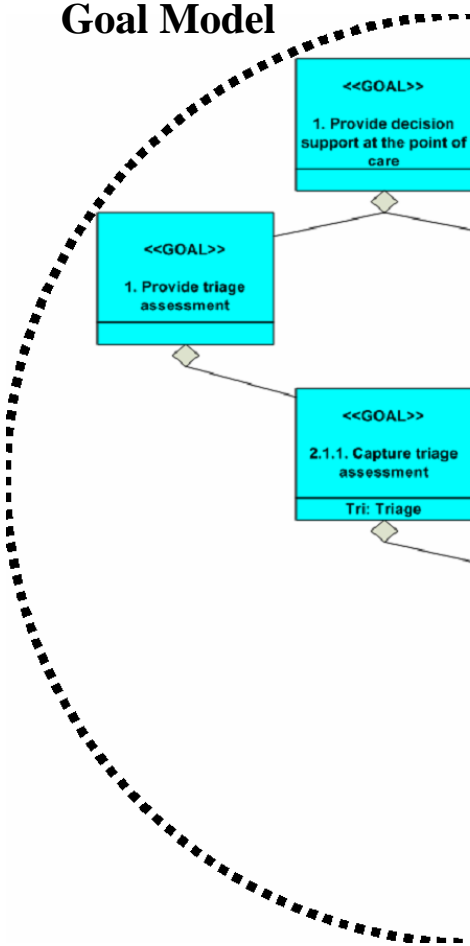


Role Model

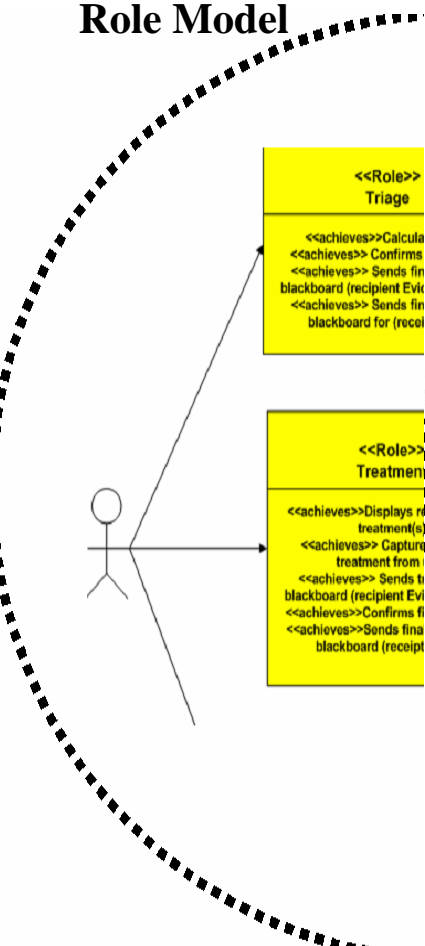


# MET EBA and O-MaSE

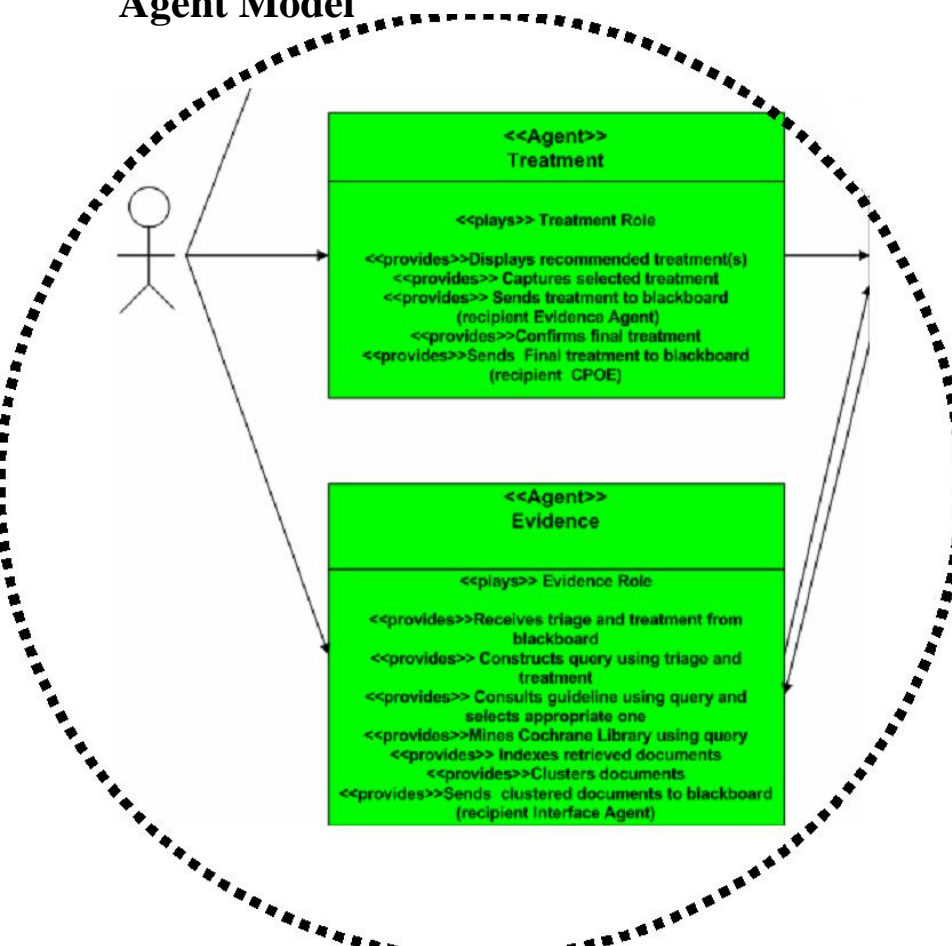
Goal Model



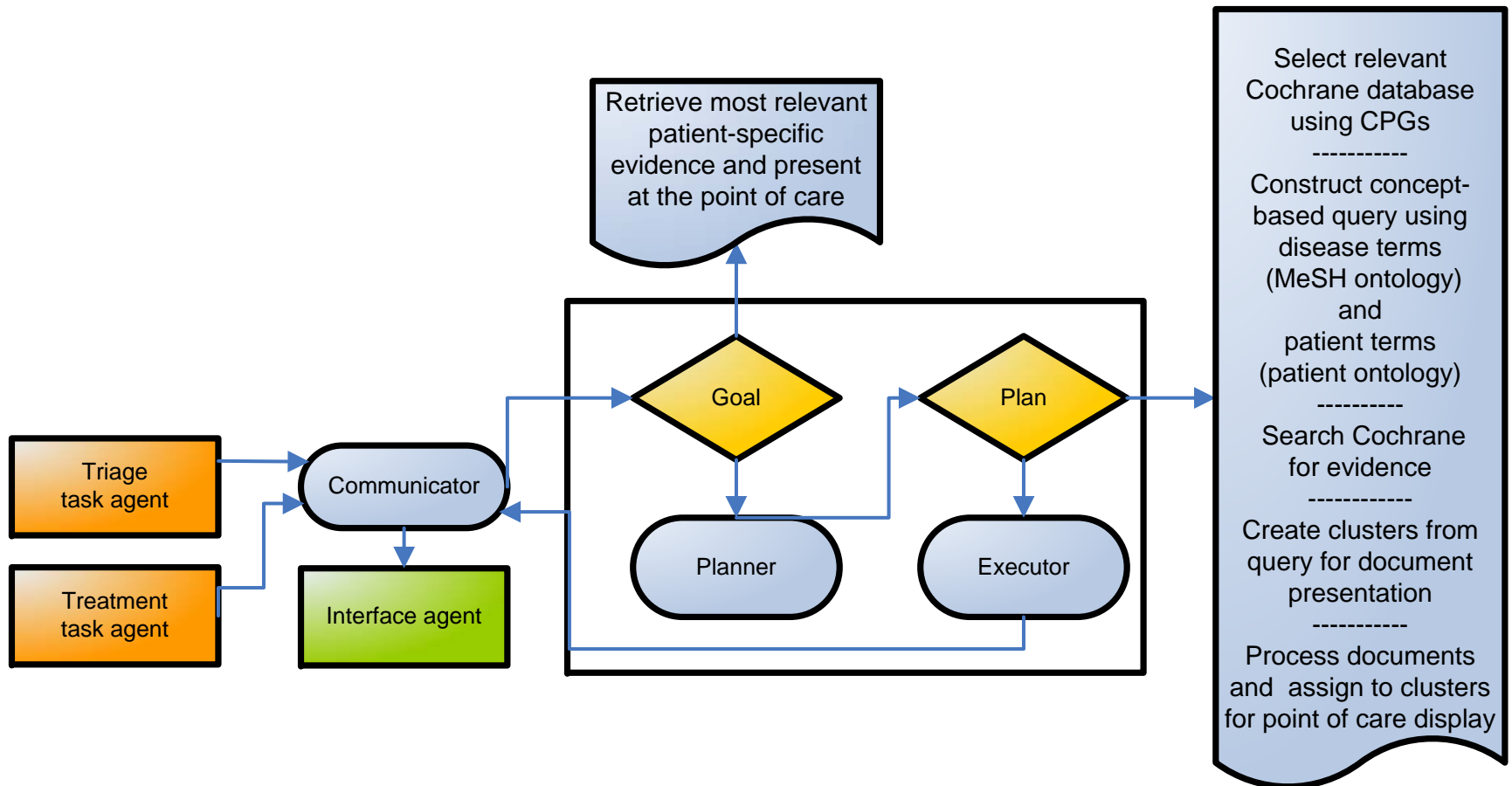
Role Model



Agent Model



# Design of the EBA



# Planning an Evidence-Based Search

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## □ Formulate Concept-Based Search

- Instantiate disease and patient concepts with instances from MeSH ontology and underlying patient ontology respectively
- Combine disease and patient concepts into text-based search using Boolean operators and specify Cochrane index to be searched

*“asthma [MeSH]” AND “child [MeSH]” AND  
“moderate [full text]” AND “β-agonists [full text]”*

## □ Create Clusters for Retrieved Documents

- Formulate labeled clusters by automatically extracting instances of the patient ontology used in the concept-based query

*“treatment”, “severity and treatment”*

## □ Assign Retrieved Documents to Correct Clusters

- Formulate queries by extracting attribute names and values from instances of patient ontology used in the concept-based search

*“treatment, β-agonists”, “severity, moderate, treatment, β-agonists”*

- Pass queries to local text search engine and assign documents to relevant clusters based on discovery of queries in documents



# Conclusions and Future Work

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- Concept-based framework for retrieving evidence
  - Integrated with asthma management workflow
  - Contextualizes evidence for current patient presentation
  - Clustering enhances precision and provides better presentation of information at the point of care
  
- Implementation and integration of the prototype EBA underway using JADE environment
  
- Integrating of EBA with Computerized Clinical Practice Guidelines
  
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