Semantic MEDLINE: A Proof of Concept
Online information

- Wealth of textual resources
- Access provided by document retrieval systems
  - Google
  - PubMed for biomedical information
- Technology: Manipulate text tokens
  - Frequency of occurrence
  - Distribution patterns
  - No access to meaning
Emerging applications

- Text mining
  - Task-driven extraction of facts
  - Observe trends
- Connect text and structured data
- Question answering
- Literature-based discovery
  - Research assistance
Emerging applications

- Text mining
  - Task-driven extraction of facts
  - Observe trends
- Connect text and structured data
- Question answering
- Literature-based discovery
  - Research assistance
- Require more effective language processing
Automatic semantic interpretation

- Augment document retrieval systems
- Manipulate information
  - Not just documents
- Bridge the gap between
  - Language (text)
  - Meaning
- Summarize and visualize information
  - In the biomedical domain
Automatic semantic interpretation

- Augment document retrieval systems
- Manipulate information
  - Not just documents
- Bridge the gap between
  - Language (text)
  - Meaning
- Summarize and visualize information
  - In the biomedical domain
  - Semantic MEDLINE
Semantic MEDLINE

- PubMed
- MEDLINE citations
- Natural language processing
- Semantic relationships
- Automatic summarization
- Graphical summary

Enhanced access to biomedical research literature
Exemestane after non-steroidal aromatase inhibitors for post-menopausal women with advanced breast cancer.
... Exemestane after non-steroidal aromatase inhibitor for post-menopausal women with advanced breast cancer
Unified Medical Language System

- Developed by National Library of Medicine
- SPECIALIST Lexicon
  - Linguistic information
- Metathesaurus
  - Biomedical concepts
- Semantic Network
  - Relationships between concepts
Components of the UMLS

- **SPECIALIST Lexicon**
  - More than 432,822 entries (general and medical)
  - Syntactic information (e.g. verb inflection)

- **Metathesaurus**
  - 2,181,676 concepts and synonyms
  - One or more semantic types (or categories)

- **Semantic Network**
  - 135 semantic types
  - 54 relationships
Metathesaurus concept

- **Concept name**
  - Arthroplasty

- **Synonyms**
  - Reconstruction of joint
  - Repair of joint ...

- **Semantic type**
  - Therapeutic or Preventive Procedure
Semantic Network relationships

Pharmacologic Substance TREATS Disease or Syndrome
Therapeutic or Preventive Procedure USES Medical Device
Body Location or Region LOCATION_OF Biologic Function
Disease or Syndrome OCCURS_IN Population Group
Disease or Syndrome PROCESS_OF Organism
cancer patients who commenced exemestane 25mg/d orally following previous treatment with Tamoxifen and a non-steroidal third-generation aromatase inhibitor (AI). Patients were seen 3 monthly until clinical or radiological disease progression. Median age was 64 years (range 34-90yrs). The average number of recurrences before the first hormone challenge was one (range 1-6). There were two complete responses (CR), four partial responses (PR), 12 with stable disease and 11 with disease progression. The overall clinical benefit rate (CR+PR+SD) was 51% (95% CI 42% - 60%). All clinical benefit was accompanied by the anti-tumour activity of exemestane 25mg daily alone. Or exemestane is associated with an altered orientation of the E2R-ER alpha to tamoxifen is associated with an altered orientation of the E2R-ER alpha to tamoxifen, which results in resistance to tamoxifen. Now, we demonstrate that phosphorylation of serine 305 (S305) of ERalpha by PKA leads to an altered orientation between ERalpha and its coactivator SRC-1, which renders the transcription complex active in the presence of tamoxifen. This altered orientation involves the C-terminus of ERalpha and SRC-1, which requires a prolonged AF-1 mediated interaction. This interaction is orientation as a result of PKA-mediated phosphorylation of ERalpha and tamoxifen. This approach provides a unique model for resistance in the anticancer drug tamoxifen. Tamoxifen can be combined with a peptide that reduces uterine hyperplasia and increases the antitumour effect of tamoxifen. AB = Tamoxifen.

Aromatase Inhibitors

Malignant neoplasms of breast

Tamoxifen

Malignant neoplasms of breast

CDKN1A gene

Malignant neoplasms of breast

BARD1 gene
Domain coverage

- Initially developed for clinical medicine
- Extended to
  - Genetic etiology and substance interactions
  - Pharmacogenomics
  - Influenza epidemic preparedness
- Currently working on
  - Public health
  - Climate and health
- Prospects for extending beyond biomedicine
  - Biomedical informatics
Several evaluations

- Focused on biomedical subdomains, e.g.
  - Clinical treatment
  - Genetic etiology of disease
  - Pharmacogenomics

- Overall
  - Precision is around 75% (lower for molecular biology)
  - Recall is around 60%
Semantic database

- **MEDLINE (National Library of Medicine)**
  - Bibliographic database of the biomedical research literature
  - More than 18 million citations (1940s to present)

- **Automatic semantic processing**
  - Extracted 24.9 million semantic relationships
  - From 7.2 million citations (01/01/99 – 08/31/10)

- **Made available to the research community**
  - SQL database
  - RDF triples
Exploiting the technology

- Manipulate online information
  - Summarize
  - Visualize
  - Connect text to structured data
- Facilitate literature-based discovery for:
  - Research assistance
  - Observing trends
  - Support for decision making
    - Portfolio analysis
Tamoxifen TREATS Malignant neoplasm of breast

Malignant neoplasm of breast ASSOCIATED_WITH CDKN1A gene

CDKN1A gene STIMULATES BARD1 gene

BARD1 gene

Aromatase Inhibitors TREATS Malignant neoplasm of breast
Tamoxifen TREATS Malignant neoplasm of breast
Tamoxifen TREATS Malignant neoplasm of breast
An alpha-fetoprotein-derived peptide reduces the uterine hyperplasia and increases the antitumour effect of tamoxifen.

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Tamoxifen (Tam) is effective for the treatment and prevention of breast cancer. However, it has toxic drawbacks and has limited-duration utility because, over time, human tumours become refractory to Tam. Recently, a new nontoxic peptide, alpha-fetoprotein-derived peptide (AF Pep) has been proposed for the treatment and prevention of breast cancer. The purpose of this paper is to determine whether combining AF Pep with Tam would increase efficacy and reduce toxicity in experimental models of breast cancer. Low doses of AF Pep and Tam were more effective in combination than either agent alone against breast cancer growth in cell culture, in tumour-xenografted mice, and in carcinogen-exposed rats. Alpha-Fetoprotein-derived peptide interfered with Tam-induced uterine hyperplasia in immature mice, and showed no
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