



Semantic Search for Personalized Medicine

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- **Personalised medicine:**
 - advances in genome sequencing and molecular characterisation of patients
 - medical practices, medical interventions, disease management, prevention, medical products tailored to the individual patient
 - based on their predicted response to therapy or risk of disease
- **Major driver of biomarker research**
 - Focus on "classical" biomarkers like molecular biomarkers, imaging biomarkers etc.: well-defined
 - Not to forget: biomarkers in a broader sense

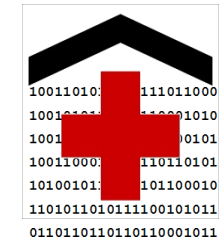
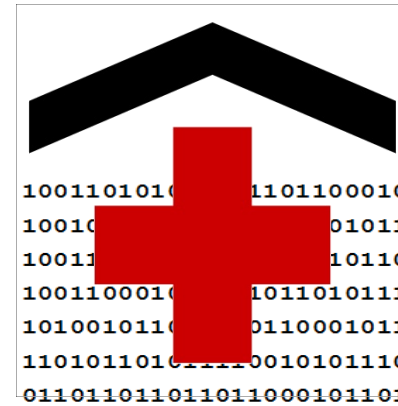
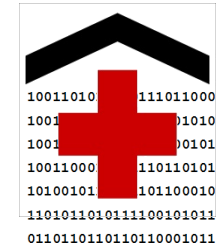
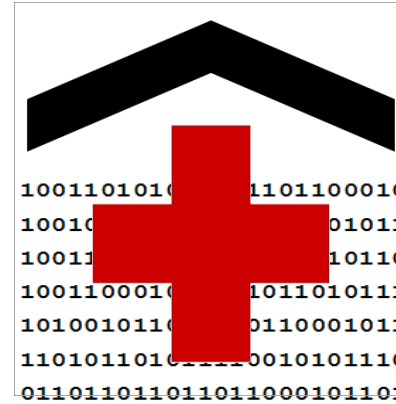
- **Features that are useful for patient profiling across a patient's medical history – together with classical biomarkers**
 - Family history
 - Past diseases
 - Therapies, complications
 - Past response to drugs
 - Clinical trajectory patterns
 - Patterns of lab values or other clinical observables
 - Correlations between different features

- **Data !**

What do they have in common?







St.p. TE eines exulc.
sek.knot.SSM (C43.5) li US
dors. 5/11 Level IV, 2,41mm
Tumordurchm. Sentinell LK
ing. li. tumorfr.

BSA

bovine serum albumin	benzene sulphonic acid	behavior setting assessment	bell-shaped antigen
biomolecular sequence analysis	bismuth sulfite agar	body surface area	background spike activity

Synonyms, spelling variants

Colon-Ca	Kolon-Ca	Kolon- karzinom	Colon- carcinom
Colon- Karzinom	Kolonkrebs	Dickdarm- krebs	Dickdarm-Ca
Malignom des Kolon	Dickdarm- karzinom	Dickdarm-Ca	Bösartige Neubildung am Dickdarm
Bösartiger Dickdarm- tumor	maligne Neoplasie des Dickdarms	Karzinom des Dickdarms	malignes NPL des Colon

Misspellings

**Atorvastatin Atorvastartin Atarvastatin Atavastatin Atorvastin Atorvaststin
Atrovastation**

**Cal-D-Vita CalDVita Caldvita Cal-de-Vita Caldevita CalDeVita KalDvita Kal-D-Vita
Kal-D-vita**

**Euthyrox Euhyrox Eythyrox Eutrhyrox Eutyhrox Eutyrox Euythrox Euthyrex
Euthyox Euthyorx Euthryrox Euthryox Euthrox Euthorox Eurthyrox**

**Finasterid Fenasterid Finastared Finastarid Finasakrid Finastrid Finesterid
Fenastred Finestret Finsaterid Finasteril Fianasterid**

**Lisinopril Lisinipril Lisimopril Lisinoprol Lisinoril Lisionopril Lisionpril Lisniopril
Lisonopril**

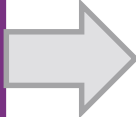
**Pantoprazol Pantopazol Pantobrazol Pantopranzol Panzoprazol Pantazol
Pantbrazol Bantoprazol**

**Simvastatin Simvastat Sinvastatin Simvastastin Simvastain Simvastad
Simbastatin Simavstatin Simavastatin Simastatin Symvastatin Simvastation
Simvaststin Simvatatin Simvatin Simvatstain Simvstatin**

From language to structure

Code (e.g. SNOMED CT)	Value	Context
254730000 Superficial spreading malignant melanoma of skin		392521001 History of
301889008 Excision of malignant skin tumor		392521001 History of
47224004 Skin of posterior surface of lower leg 7771000 Left		
81827009 Diameter 258673006 millimeter	2.41	
258403002 Lymph node level IV		
94339008 Secondary malignant neoplasm of inguinal lymph nodes		15240007 Current 2667000 Absent

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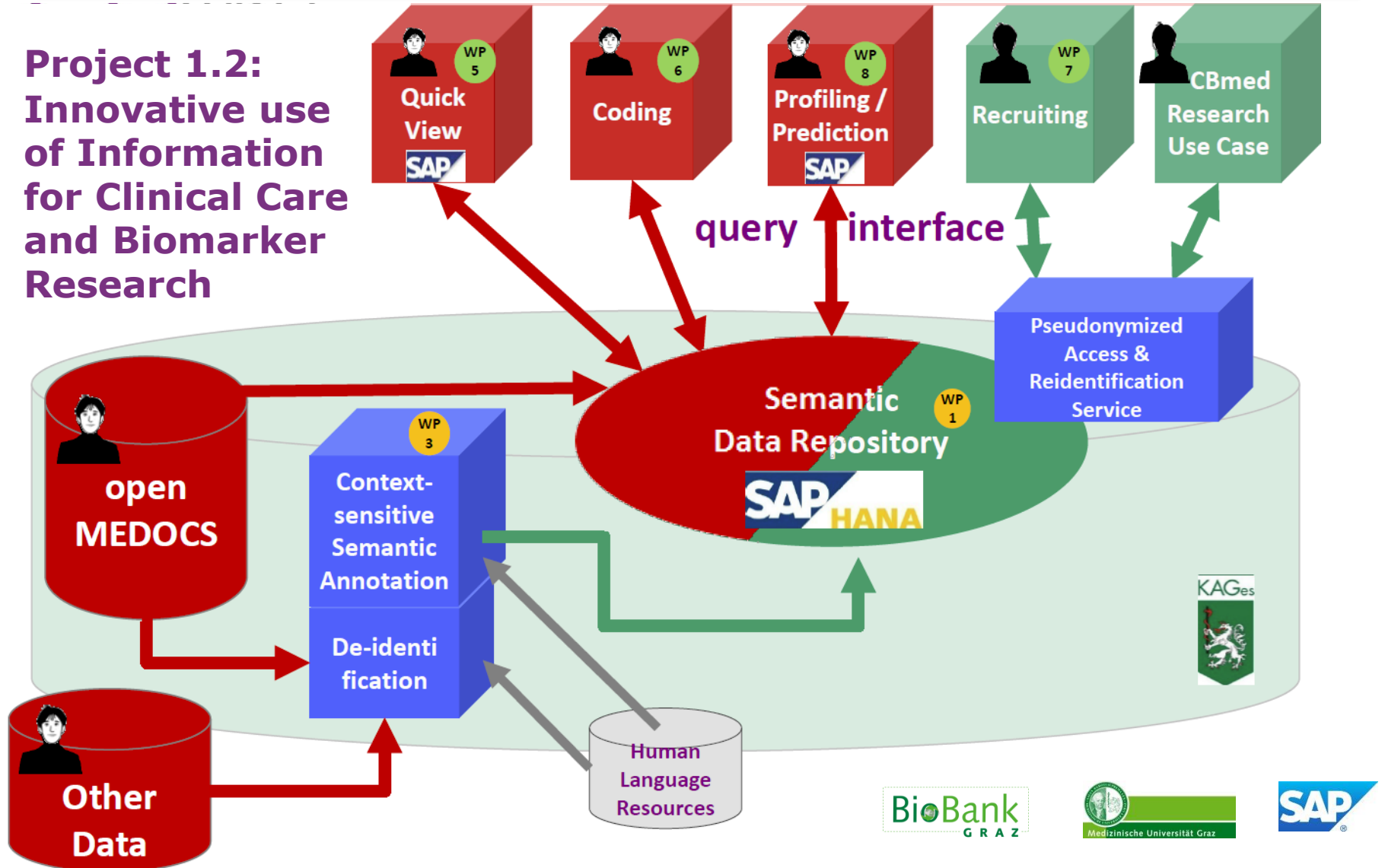


Semantic Search in Cbmed



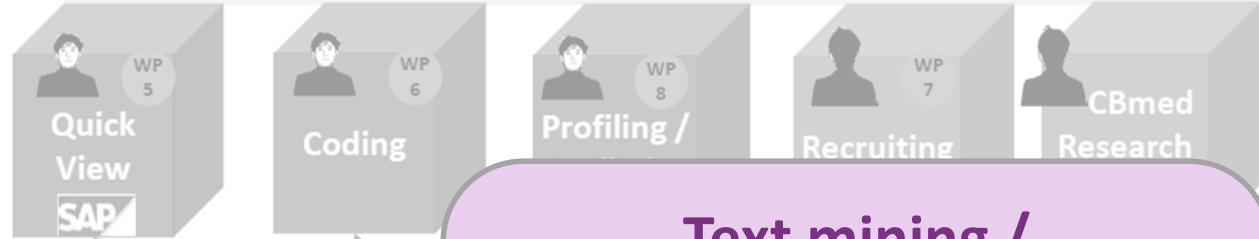
Semantic Search in Cbmed

**Project 1.2:
Innovative use
of Information
for Clinical Care
and Biomarker
Research**

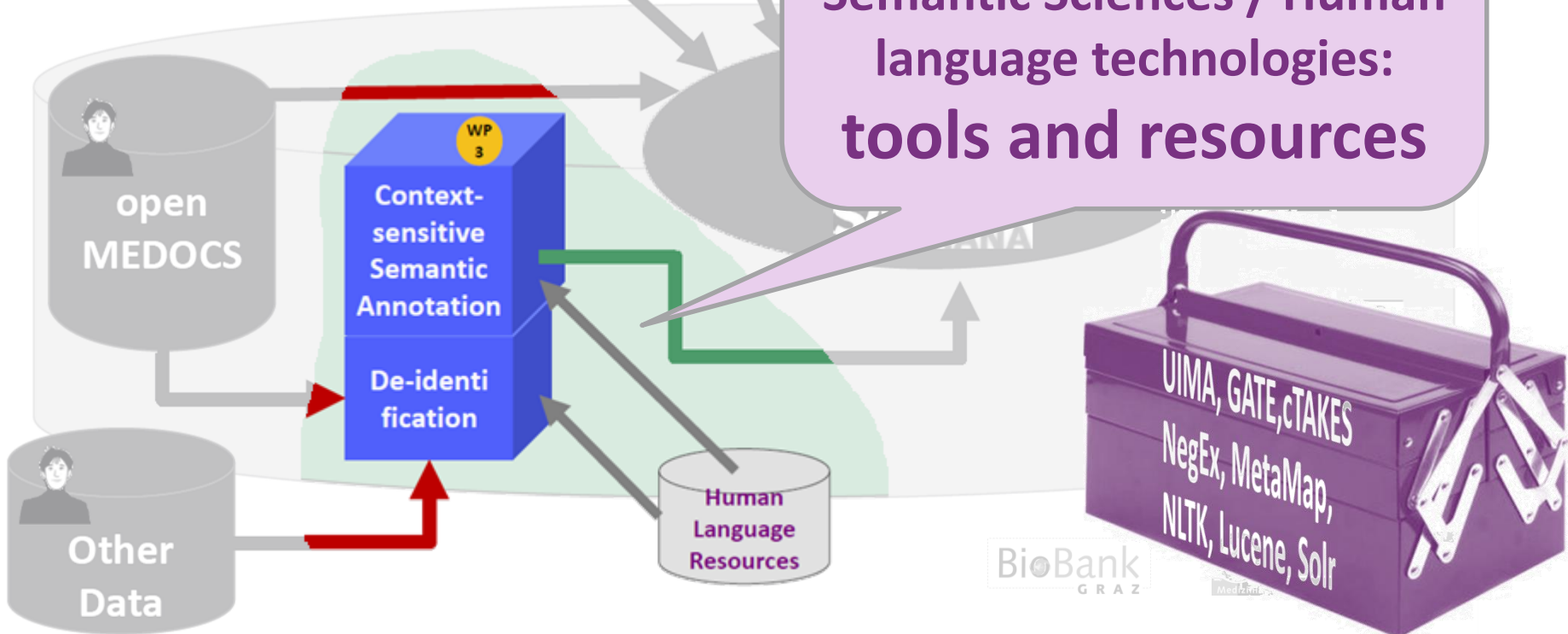


Semantic Search in Cbmed

**Project 1.2:
Innovative use
of Information
for Clinical Care
and Biomarker
Research**



**Text mining /
Computational linguistics /
Semantic Sciences / Human
language technologies:
tools and resources**



- **Terminologies / Lexicons**
 - Domain terms and their relations, e.g. synonyms:
"SSMM" = "Superficially spreading malignant melanoma"
- **Ontologies**
 - Axiomatic descriptions of entities of a domain, e.g.
lower leg part of lower extremity
- **Grammar / Rules**
 - e.g. which word endings are indicative for a certain content, e.g. "-itis" for inflammation, "-ectomy" for surgical removal
- **Corpora**
 - Clinical texts, scientific publications, the Web
 - Annotated: e.g. words by grammatical categories, text passages by context (e.g. diagnosis, family history, lab, medication)
 - Not annotated: which words are collocated, which ones are frequent, which not
 - used for training probabilistic models

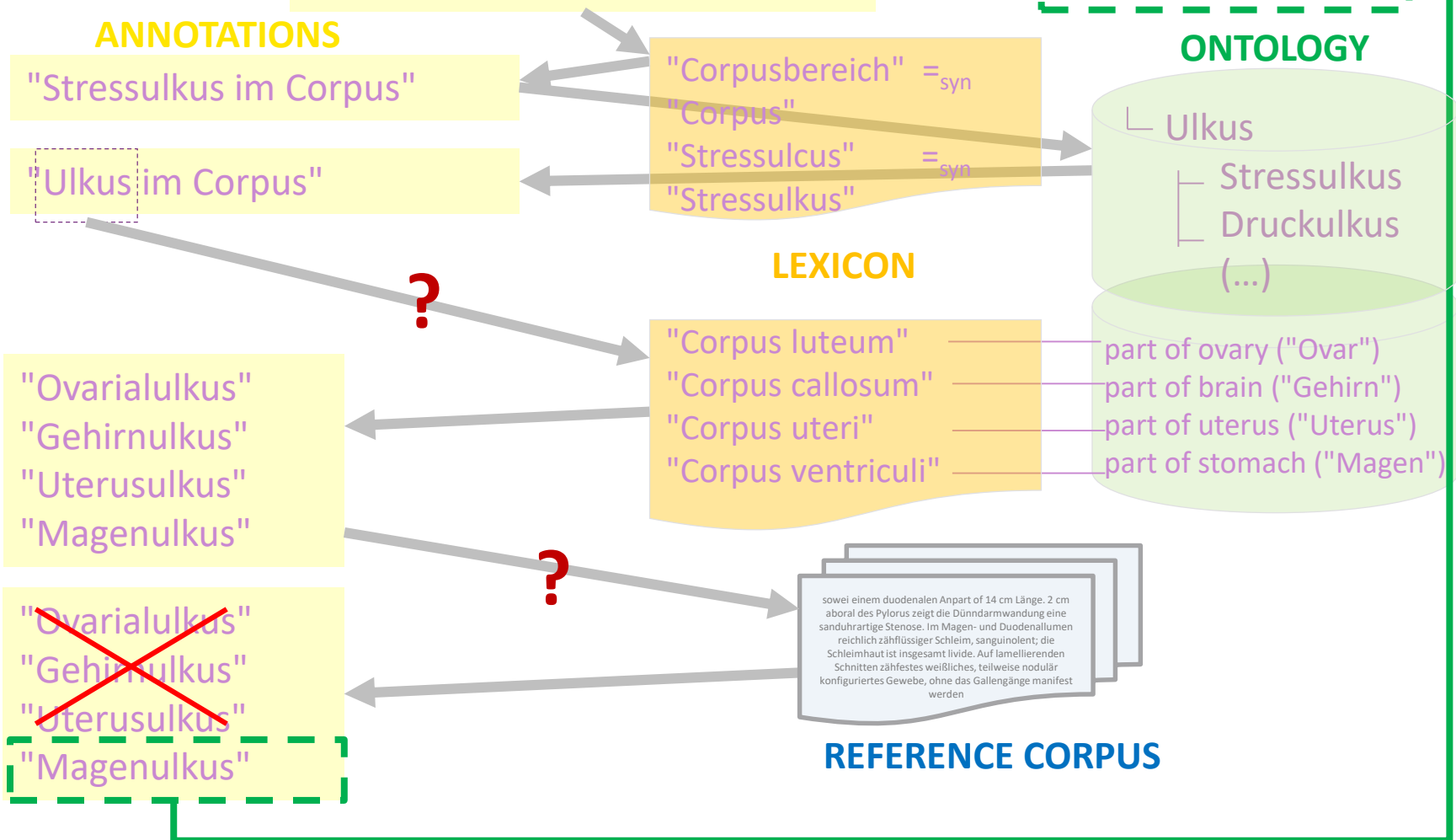
English language well supported by resources, German language isn't

Simple example for semantic search



Simple example for semantic search

In document: "Stressulcus im Corpusbereich" Query: "Magenulcus"



Conclusion

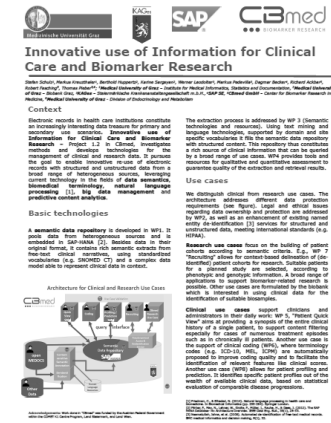
- Unstructured **textual information** in electronic health records constitutes a "**gold mine**" that may provide important information for personalized medicine and biomarker research via **semantic search**
- The mining of appropriate content requires sophisticated tools and resources
- Resources are scarce for languages other than English and need to be built or enhanced
- CBmed addresses this challenge in Project 1.2 "**Innovative use of Information for Clinical Care and Biomarker Research**"



Interested in more information?

- Contact me:
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- Visit our poster:
Schulz, Kreuzthaler, Huppertz,
Sargsyan, Leodolter, Pedevilla,
Becker, Ackbar, Fasching, Pieber:
**"Innovative use of
Information for Clinical Care
and Biomarker Research"**



Innovative use of Information for Clinical Care and Biomarker Research

Context

Electronic records in health care institutions contain an increasingly increasing data volume for primary and secondary care activities. Increasing use of information for Clinical Care and Biomarker Research - Project 1.2 in Clinical, diagnostic methods and analysis technologies, for the management of clinical and research data. It includes records with structured and unstructured data from a broad range of heterogeneous sources. Integrated data handling in the form of data integration, metadata harmonization, natural language processing, (1) Big Data management and predictive content analysis.

Basic technologies

A semantic data repository is developed in W3C standards. Data integration, storage and original format, is carried out. Semantic extracts from the main clinical data are generated. The repository is able to integrate data from other data sources.

Architecture for Clinical and Research Use Cases

Clinical use cases support diagnosis and treatment in real time with the "real-time" data history of a single patient, to support content filtering especially for cases of patient treatment records with the support of clinical coding (SNOMED, where terminology codes (e.g. ICD-10, ICD-9, ICD-9-CM) are automatically mapped to the SNOMED codes). In addition, the distribution of network-based data (clinical notes, laboratory data) is supported. The system is able to identify specific patient profiles out of the records of multiple clinical data, based on statistical analysis.

CONTACT

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Terminology resources

sup spr mel










Stated

10 matches found in 0.255 seconds.

 Superficial spreading melanoma	Superficial spreading melanoma (morphologic abnormality)
 SSM - Superficial spreading melanoma	Superficial spreading melanoma (morphologic abnormality)
 SSMM - Superficial spreading melanoma	Superficial spreading melanoma (morphologic abnormality)
 Superficial spreading melanoma of skin	Superficial spreading malignant melanoma of skin (disorder)
 SMM - Superficial spreading melanoma of skin	Superficial spreading malignant melanoma of skin (disorder)
 Superficial spreading malignant melanoma of skin	Superficial spreading malignant melanoma of skin (disorder)

Parents

-   Malignant melanoma of skin (disorder)
-   Primary malignant neoplasm of skin (disorder)

 Superficial spreading malignant melanoma of skin (disorder)  

SCTID: 254730000

254730000 | Superficial spreading malignant melanoma of skin (disorder) |

Superficial spreading malignant melanoma of skin

Superficial spreading melanoma of skin

SSMM - Superficial spreading malignant melanoma of skin

SMM - Superficial spreading melanoma of skin

Superficial spreading malignant melanoma of skin

Finding site → Skin structure
 Associated morphology → Superficial spreading melanoma

Internal R&D Projects

Area 1: Data & Technologies

- 1.1 Clinical information system
- 1.2 Semantic data management
- 1.3 Knowledge discovery
- 1.4 Next generation sequencing

- 1.5 Metabolomics
- 1.6 Immunology
- 1.7 Health technology assessment
- 1.8 Digital Pathology
- 1.9 Clinical MALDI applications

Area 2: Cancer

- 2.1 CTCs for disease monitoring
- 2.2 Tracking the trace
- 2.3 Blood-based cancer diagnostics

- 2.4 Minimal residual disease and CAR T-cells
- 2.5 Eukaryotic initiation factors
- 2.7 ADX models

Area 3: Metabolism & Inflammation

- 3.1 Diabetesity
- 3.2 Cardiovascular disease
- 3.3 Biosensors
- 3.4 Bone metabolism
- 3.5 Fertility
- 3.6 Liver function

- 3.7 Inflammation and fibrosis
- 3.8 NAFLD
- 3.9 Microbiome-gut-brain
- 3.10 Sepsis
- 3.11 Fungal infections
- 3.12 Electrochemical biomarker detection