Wanting what we don’t want to want

Representing addiction in interoperable bio-ontologies

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Substance addiction
Substance addiction in DSM-IV

When an individual *persists in use* of alcohol or other drugs *despite problems* related to use of the substance, *substance dependence* may be diagnosed.

Compulsive and repetitive use may result in *tolerance* to the effect of the drug and *withdrawal symptoms* when use is reduced or stopped.
Term Search
Search for a term in multiple ontologies

addiction
advanced options

Addiction - SNOMED Clinical Terms
details - visualize - 32 more from this ontology

Addiction - MedDRA
details - visualize - 15 more from this ontology

Addiction - NCI Thesaurus
details - visualize - 5 more from this ontology

ADDITION - COSTART
details - visualize

addiction - Mammalian phenotype
strong dependence on an addictive compound such as alcohol or narcotics that results in uncontrollable cravings for such compounds
details - visualize

Addiction - Galen
details - visualize

addiction - PHARE
details - visualize

addiction - Suggested Ontology for Pharmacogenomics
What do we know about addiction?

- Behaviour of addicted persons
- Psychiatric treatment
- Neural pathways
- Brain activation
- Metabolism and excretion of substances
- Biochemical pathways
- Properties of the addictive substances
- Toxicity
- Genetic susceptibility

... actually, rather a lot
How do we find data about addiction?

PSYCHOLOGY, OBSERVATION, CLINICAL QUESTIONNAIRES
- Behaviour of addicted persons

FUNCTIONAL IMAGING
- Biochemical pathways

MODELS
- Genetic susceptibility

GENES
- Properties of the addictive substances
- Psychiatric treatment

MEDICAL RECORDS
- Toxicity

NEUROBIOLOGY MODELS
- Neural pathways
- Metabolism and excretion of substances

BIOACTIVITY
- Chemistry

... many, many databases
Query: addiction [all]
The search returned 1 model.

1 Non-curated models returned:

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<th>BioModels ID</th>
<th>Name</th>
<th>Publication ID</th>
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The same applies to many types of data.
Describing mechanism of action

When a portion of heroin is consumed, the molecule heroin (CHEBI:27808) participates in a binding process (GO:0031628) to mu-opioid receptors (PR:000001612).

Similarly, when a portion of tobacco is smoked, the molecule nicotine (CHEBI:27808) participates in a binding process (GO:0033130) to nicotinic acetylcholine receptors (GO:0005892).

Those receptors are present on the dopaminergic neurons (NeuroLex – nlx:144018), of the nucleus accumbens, described in BIRNlex (birnlex:727).
What is missing?

GLUE

DOMAIN-SPECIFIC ONTOLOGIES

Medical

Psychological research into canonical human functioning

Neuroscientific knowledge & data: neurons, neurochemistry, brain structure & function

Biological knowledge & data: mechanisms, genetic variants etc.
Mental Functioning Ontology and Mental Disease Ontology

- **BFO**: Domain-neutral ontological upper level
- **OGMS**: Ontology for General Medical Science
- **MF**: Mental Functioning Ontology
- **MFO-EM**: Emotion Ontology
- **MD**: Mental Disease Ontology (Current focus on **affective disorders** and **addiction**)

**Diagram:**
- BFO connects to OGMS and MF
- OGMS connects to MD
- MF connects to MFO-EM
- MFO-EM connects to MD
Substance addictions can be characterised by the substances that they are addictions to.

- MF:0000071 cocaine addiction
- MF:0010071 cocaine addiction disease course
- S:00100100 portion of cocaine
- MF:0020071 use of cocaine
- CHEBI:27958 cocaine

Chemical and metabolic data
Addiction in the Mental Disease Ontology

- MF:00000046 addiction
  - MF:0000053 process addiction
    - MF:0000054 gambling addiction
    - MF:0000055 sex addiction
    - MF:0000064 internet addiction
  - MF:0000053 substance addiction
    - MF:0000066 benzodiazepine addiction
      - MF:0000065 opiate addiction
    - MF:0000067 diazepam addiction
      - MF:0000059 heroin addiction
    - MF:0000068 morphine addiction
Canonical research can be related to non-canonical symptoms in the disease course.

- **MF:0001002** non-canonical (impaired) thinking process
- **MF:0001012** preoccupation with substance use
- **MF:0001011** failed attempts to stop substance use
- **MF:0001001** non-canonical (impaired) planning process
- **MF:0001053** substance addiction
- **MF:0001053** realized in substance addiction disease course
- **MF:0000053** has part
Bridging to underlying mechanisms

Addictions hijack neurotransmitter receptors and pathways

- Molecular entity (CHEBI:25375)
- Subtype
- Dopamine (CHEBI:25375)
- Has role
- Neurotransmitter (CHEBI:25512)
- Realized in
- Neurotransmitter receptor activity (GO:0030594)
- Molecular function (GO:0003674)
http://code.google.com/p/mental-functioning-ontology/
Acknowledgements

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