The many uses of enriched thesauri and ontologies in the ATOD field

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Outline

• Review of thesaurus / ontology functions (or KOS functions
  KOS = Knowledge Organization Systems)

• Examples
  • From the AOD Thesaurus
  • Examples of data added for an enriched thesaurus
Functions of a thesaurus /ontology

• Provide a semantic road map to the multi-disciplinary field
• Improve communication generally. Support learning and assimilating information.
• Provide the conceptual basis for the design of good research and implementation.
• Provide classification for action. Classification for social and political purposes
• Support information retrieval and analysis. Organizing and keeping track of goods and services for commerce (esp. ecommerce) and inventory
• Support meaningful, well-structured display of information.
Functions of a thesaurus /ontology 2

- Ontology for data element definition. Data element dictionary.
- Conceptual basis for knowledge-based systems.
- Dictionary/knowledge base for automated language processing
- Do all this across multiple languages
- Mono-, bi-, or multilingual dictionary for human use.
Semantic road map

- Provide a semantic road map and common language across all disciplines in the AOD field
- Map out a concept space. Map concepts across fields and across cultures
- Relate concepts to terms. Relate terminology across disciplines, languages, and cultures
- Clarify concepts by putting them in the context of a classification / typology. Provide a system of definitions
- Provide orientation and serve as a reference tool
  - For example, make medical concepts clear to social science researchers and vice versa
Improve communication, esp. learning

- Support learning through conceptual frameworks. Conceptual framework to help the learner ask the right questions.
- Assist readers in understanding text by giving the meaning of terms.
- Support the development of instructional materials through conceptual frameworks and suggestions for good didactic arrangement.
- Assist writers in producing understandable text by suggesting good terms appropriate for the intended audience.
- Support foreign language learning.
Design of research and practice

• Assist researchers and practitioners with problem clarification. Includes help with

• exploring the conceptual context of a research or practical problem — a study, policy, plan, or implementation project;

• structuring the problem and providing a conceptual framework for asking the right questions and devising good query formulations for retrieval.
Examples of specific functions:

- Present the issues in a field or application area in a coherent framework.
- Assist in problem-solving:
  - Assist in the exploration of the dimensions of a problem and aspects to be considered in its solution;
  - provide a classification of approaches to solving a specific problem (for example, a classification of approaches to drug abuse prevention as a help in designing drug abuse prevention projects).
Design of research and practice 3

More specific functions:

• Provide classification and consistent definition of
  • variables for research
  • evaluation criteria for practical problems,
• This will
  • enhance the comparability of research and evaluation results
  • make research more cumulative.
Compilation and use of statistics

This is a very important function. Use a thesaurus to unify the definitions used in the various ATOD use and related surveys (such as NHANES)

• **Support data collection**
  • The concepts in a classification used for statistics not only make the collected data retrievable, they define the very nature of the data.

• **Support data aggregation**
  • For example, aggregate use numbers for all substances found in household products.

• **Support retrieval of specific numbers**
  (also part of information retrieval)

• **Support data tabulation and analysis**
  (Need to have proper variables available)
Provide classification for action

- a classification of diseases for diagnosis,
- classification of medical procedures for insurance billing,
- A classification of treatments and treatment components for patient-treatment matching
- a classification of medical outcomes to assist with treatment evaluation,
- a classification of commodities for customs,
- a classification of educational objectives for instructional development,
- a classification of crimes for determining sentences
Classification for social and political purposes

- Establishing that a profession has its own knowledge base, thereby enhancing the recognition of the profession (for example, the Nursing Intervention Classification)

- Establishing a persons condition or behavior as *normal*, or as a *disease*, or as a *moral failing* or otherwise deviant. Different groups may want the same condition or behavior classified in different ways to further their agenda
  - Examples:
    - Should *homosexuality* be classified as a disease?
    - Is *alcoholism or other drug abuse* a disease or a moral failing?
    - Is *mental illness* a disease on a par with physical illness, and thus covered by health insurance the same way?
    - Is some levy to be classified as a *tax* or as a *user fee*
Support information retrieval and analysis

• Provide a tool for searching, particularly knowledge-based support for end-user searching
  • Elicitation of user needs through facet-based questions. Support for conceptual question analysis
  Browsing a hierarchy to find search concepts
  • Mapping from users’ terms to descriptors or free-text terms
  Behind-the-scenes query term expansion: hierarchic and synonym expansion
  • Especially important for free-text searching

• Provide a tool for indexing, esp. user-oriented indexing

• Facilitate unified access to multiple databases

• Support document processing after retrieval.
Meaningful, well-structured display

- Meaningful arrangement of units (document records, paragraphs, property data on a given substance assembled from several databases, prevention projects)
  Includes meaningful structure for Web sites and subject directories

- This supports exploration of large retrieved sets and, by extension, exploration of the content of an entire collection or subcollection.

- Meaningful arrangement of information within a unit (for example meaningful ordering of descriptors within a bibliographic record, such as arranging descriptors in an ETOH record in the order of the AOD Thesaurus).
Conceptual basis for knowledge-based systems

Expert systems for assistance with
- Diagnosis based on observed or elicited symptoms
- Patient-treatment matching
- Community-prevention approach matching

Thesaurus must be expanded to include facts
Rich ontology
- A richer set of relationships
- Acquire facts from various sources
- Integrate with conceptual and terminological information
Exploit the possibilities of the new medium

• Data structures of adequate complexity for rich content
• Searchability and selectivity
• Flexibility of display. Create and store graphical displays with live link to the database
• Processing power and inference
• Linkage
Example

Prevention concepts in AOD 3
prevention

. prevention goals

. prevention of disorder

. prevention of disorder consequences

basic prevention categories

. prevention by timing of the intervention
  SN: Primary, secondary, tertiary prevention

. prevention by scope of recipient group
  SN: Universal versus targeted prevention

prevention model

prevention strategy, program, or service

prevention by sponsor or setting

prevention approach
JB4 prevention goals

JB4.2 intermediate prevention goals

JB4.4 prevention of disorder

JB4.4.2 prevention of new cases of disorder

JB4.4.2.2 prevention of first incidence of a disorder

JB4.4.2.2.2 prevent the start of etiologic sequence

JB4.4.2.2.4 halt the progression of an etiologic sequence

JB4.4.2.4 prevention of later incidences of a disorder

JB4.4.2.6 delay the onset of disorder

JB4.4.4 reduce existing cases of disorder

JB4.4.6 reduce duration or severity of disorder

JB4.4.6.2 reduce the duration of disorder

JB4.4.6.4 reduce the severity of disorder

JB4.4.8 comorbidity prevention

JB4.6 prevention of disorder consequences

JB4.6.2 harm reduction
<table>
<thead>
<tr>
<th>JC</th>
<th>basic prevention categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>JC2</td>
<td>prevention by timing of the intervention</td>
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<tr>
<td>JC2.2</td>
<td>primary prevention</td>
</tr>
<tr>
<td>JC2.4</td>
<td>secondary prevention</td>
</tr>
<tr>
<td>JC2.6</td>
<td>tertiary prevention</td>
</tr>
<tr>
<td>JC4</td>
<td>prevention by scope of recipient group</td>
</tr>
<tr>
<td>JC4.2</td>
<td>universal prevention</td>
</tr>
<tr>
<td>JC4.4</td>
<td>targeted prevention</td>
</tr>
<tr>
<td>JC4.4.2</td>
<td>selective prevention</td>
</tr>
<tr>
<td>JC4.4.4</td>
<td>indicated prevention</td>
</tr>
<tr>
<td>JC4.6</td>
<td>prevention directed at groups</td>
</tr>
</tbody>
</table>
universal prevention

SN Directed at the general public or a population group that has not been identified on the basis of individual risk. The intervention is desirable for everyone in that group.

targeted prevention

SN Targeted at subgroups of the population or at individuals who are at high or very high risk. There are two subordinate categories which are distinguished by the specificity of targeting (the precision of selection into the recipient group), the degree of risk, and the warranted cost per recipient
selective prevention

A measure that is desirable only when the individual is a member of a subgroup of the population whose risk of developing the disorder is above average. The subgroups may be distinguished by age, gender, occupation, family history, place of residence or travel, or other evident characteristics (as opposed to characteristics whose determination requires individual examination), but many individuals within the subgroup upon personal examination are found perfectly well. Because of increased risk of illness, the balance of benefits against risk and cost can be justified.

Many selective preventive interventions can be delivered without identifying individuals, for example, by distributing focused messages through media whose audience consists in large proportion of members of the at-risk target group.
indicated prevention

SN Targeted to high-risk individuals who are identified, through individual examination, as (1) having biological markers indicating predisposition for a disorder or (2) having minimal but detectable signs or symptoms foreshadowing a disorder whose symptoms are still early and are not sufficiently severe to merit a diagnosis of the disorder. (Note that condition (2) deviates from Gordon's original definition and introduces an element also present in the definition of secondary prevention.) An example of an indicated preventive intervention is a parent-child interaction program for children who have been identified by their parents as having behavioral problems. An indicated intervention may be reasonable even if its cost is high and even if it entails some risks. Indicated preventive intervention is often referred to by clinicians as early intervention.
**prevention approach**

- prevention approach by locus of change
- individual-level prevention
- environmental-level prevention
- multi-level prevention
individual-level prevention

SN Aims to affect individuals' AOD use decisions by effecting change in individuals and their proximal environments, especially their families.

environmental-level prevention

SN Prevention measures aimed at changing the physical and social milieus that regulate exposure to AOD, influencing individuals' AOD related behavior or mediating the risks that AOD use poses to an individual.
Enriching a thesaurus for use as a knowledge base

Examples
Risk and protective factors

Condition  <influences> (Process, Disorder, for/against)

cost of AOD  <influences> (onset, AOD use disorder, unspec.)

high cost of AOD  <influences> (onset, AOD use disorder, against)

parent attention  <influences> (onset, AOD use disorder, against)

weak peer resistance skills  
  <influences> (onset, AOD use disorder, for)

genetics  <influences> (onset, AOD use disorder, unspec.)

Link to graphical representation
Drill-down link to literature
Link to terms in their hierarchical context (with definition)
ENVIRONMENTAL INFLUENCES

- cost of alcohol and other drugs
- marketing of alcohol

INTERPERSONAL AND SOCIETAL INFLUENCES

- federal laws concerning alcohol and illegal drugs
- minimum purchase age for alcohol
- school policy

INDIVIDUAL INFLUENCES

- local law enforcement
- portrayal of alcohol, tobacco, and other drugs on T.V. and in movies

the individual

- attitudes and beliefs
- interpersonal and peer resistance skills
- personality traits
- community

parents

personal situations

genetics

community
Inferences for display

Condition \(<is\ type\>\) (Influence factor, Disorder) IF
  Condition \(<influences\>\) (onset, Disorder, unspecified)

Condition \(<is\ type\>\) (risk factor, Disorder) IF
  Condition \(<influences\>\) (onset, Disorder, for)

Condition \(<is\ type\>\) (protective factor, Disorder) IF
  Condition \(<influences\>\) (onset, Disorder, against)
The hypothalamic-pituitary-adrenal axis

- **stress** influences harmful effects group H
- **stress** influences (hypothalamus, secretion, CRF, for)
- **CRF** influences (anterior pituitary, secretion, ACTH, for)
- **ACTH** influences (adrenal glands, secretion, cortisol, for)
- **cortisol** influences (metabolic effects group M, for)
- **metabolic effects group M** influences (harmful effects group H, against)
- **cortisol** influences (adrenal glands, secretion, cortisol, against)
- **cortisol** influences (hypothalamus, secretion, CRF, against)
In response to almost any type of stress, either physical or emotional, there is an activation of the hypothalamic-pituitary-adrenal (HPA) axis. Stress stimulates the hypothalamus to secrete corticotropin-releasing factor (CRF), which in turn stimulates the anterior pituitary gland to produce adrenocorticotropic hormone (ACTH). ACTH then stimulates the adrenal glands to produce cortisol. Cortisol has metabolic effects and also negatively feedback to inhibit the hypothalamus and anterior pituitary from overproducing CRF and ACTH, respectively.
Thesaurus entries

CRT
  FT corticotropin-releasing factor

ACTH
  FT adrenocortotropic hormone

anterior pituitary gland
  AB anterior pituitary
AOD use related problems

(AOD use, Drug) <contributing factor> (Condition, Percent of cases)

(AOD use, all) <contributing factor> (traffic fatalities, 50%)
(AOD use, all) <contributing factor> (drownings, 69%)
(AOD use, all) <contributing factor> (child abuse, 38%)
(AOD use, all) <contributing factor> (rapes, 52%)
Alcohol and other drugs are associated with:

- Up to 50% Spousal Abuse*
- 20-35% Suicides
- 50% Traffic Fatalities
- 62% Assaults
- 52% Rapes
- 49% Murders
- 68% Manslaughter Charges
- 38% Child Abuse
- 69% Drownings
# ATOD abuse consequences

<table>
<thead>
<tr>
<th>Disorder</th>
<th>&lt;causes&gt; (Change, Condition, good/bad)</th>
<th>ATOD abuse</th>
<th>&lt;causes&gt; (increase, criminal behavior, bad)</th>
<th>ATOD abuse</th>
<th>&lt;causes&gt; (decrease, family functioning, bad)</th>
<th>ATOD abuse</th>
<th>&lt;causes&gt; (decrease, employability, bad)</th>
<th>ATOD abuse</th>
<th>&lt;causes&gt; (decrease, work productivity, bad)</th>
<th>alcohol abuse</th>
<th>&lt;causes&gt; (increase, liver cirrhosis, bad)</th>
</tr>
</thead>
</table>
## Treatment participation factors

<table>
<thead>
<tr>
<th>Condition</th>
<th>&lt;influences&gt; (Treatment participation, for/against)</th>
<th>&lt;influences&gt; (treatment stay, for)</th>
</tr>
</thead>
<tbody>
<tr>
<td>motivation to change drug use</td>
<td></td>
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<tr>
<td>support from family</td>
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<td>support from friends</td>
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<td>pressure from employer</td>
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<td>pressure from school</td>
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<tr>
<td>pressure from family</td>
<td></td>
<td></td>
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<tr>
<td>pressure from criminal justice system</td>
<td></td>
<td></td>
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<tr>
<td>pressure from child protective services</td>
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</tr>
</tbody>
</table>
## Patient-treatment matching

<table>
<thead>
<tr>
<th>Condition</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>recent detoxification</td>
<td>&lt;indicates&gt; naltrexone treatment</td>
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<tr>
<td>high motivation</td>
<td>&lt;indicates&gt; naltrexone treatment</td>
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<tr>
<td>total abstinence goal</td>
<td>&lt;indicates&gt; naltrexone treatment</td>
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<tr>
<td>impaired professional parolee</td>
<td>&lt;indicates&gt; naltrexone treatment</td>
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<td>on probation</td>
<td>&lt;indicates&gt; naltrexone treatment</td>
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<tr>
<td>prisoner on work release program</td>
<td>&lt;indicates&gt; naltrexone treatment</td>
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<tr>
<td>presently employed</td>
<td>&lt;indicates&gt; outpatient drug-free treatment</td>
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<tr>
<td>extensive social support</td>
<td>&lt;indicates&gt; outpatient drug-free treatment</td>
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<td>severe case</td>
<td>&lt;indicates&gt; therapeutic community treatment</td>
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<td>dual diagnosis</td>
<td>&lt;indicates&gt; therapeutic community treatment</td>
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<tr>
<td>criminal involvement</td>
<td>&lt;indicates&gt; therapeutic community treatment</td>
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</table>
Relationship types

Condition <indicates> Action [for example, a treatment]
Condition <influences> (Process, Disorder, for/against)
Disorder <causes> (Change, Condition, good/bad)
Condition <influences> (Treatment participation, for/against)
(AOD use, Drug) <contributing factor> (Condition, Percent of cases)
Some inferences

(Disorder, Treatment) <has outcome measure> (Change, Condition) IF
Disorder <causes> (Change, X, good/bad)

Condition <can be used as> (prevention handle, Disorder) IF
Condition <influences> (onset, Disorder, for/against)

Condition <influences> (patient motivation, for) IF
Disorder <causes> (Change, Condition, good/bad) AND
Patient <values> (Change, Condition, good/bad)
Take-home message

• Enriched thesauri can integrate much information in a format that is actionable by the user or by the system drawing inferences
• A suitable set of relationships needs to worked out
• Much work to enter data
• Integrate biomedical data with social science data
• Needs consensus panel review
• Comparable to the publication of standard reference data for materials by NIST
• Could have enormous benefits
Components of Comprehensive Drug Abuse Treatment

The best treatment programs provide a combination of therapies and other services to meet the needs of the individual patient.
Most dopamine-containing neurons are located within the midbrain, extending to the striatum as well as to various sites in the forebrain. Dopamine modulates such varied functions as emotion, aggression, cognition, the coordination of movement, and aspects of the development of addiction.

Source: Adapted from Heimer 1995.
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