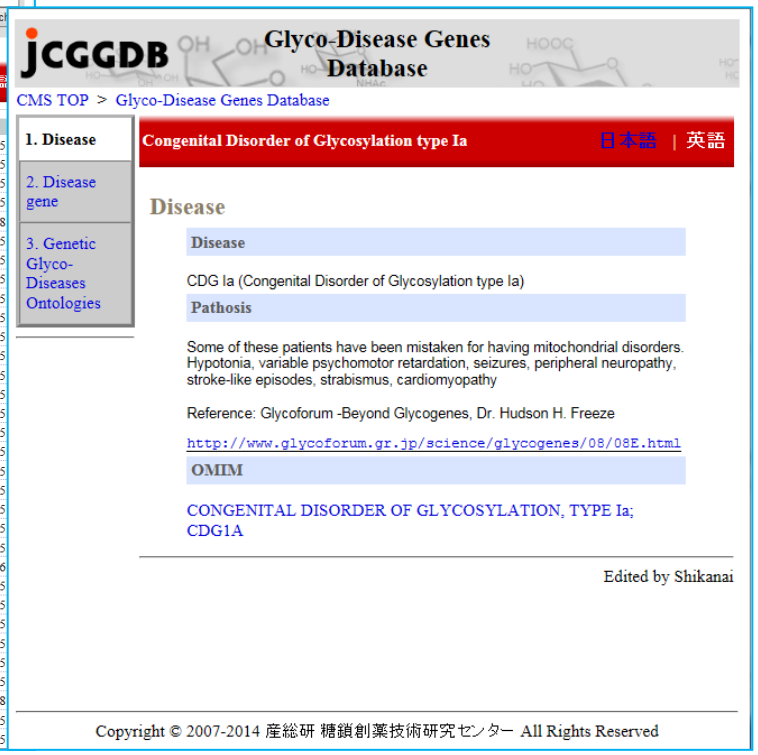
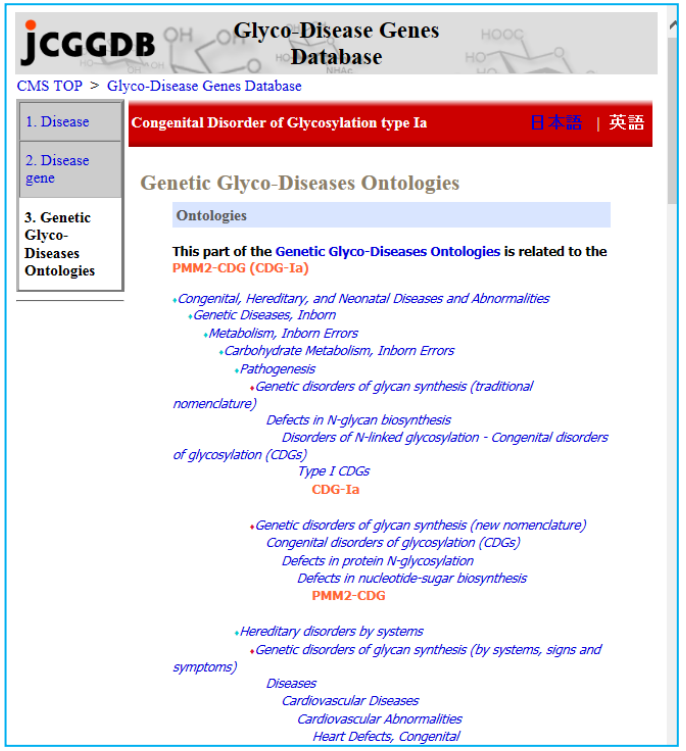
GDGDB - Glyco-Disease Genes Database

The complexity of glycan metabolic pathways and the large numbers of genetic defects in these pathways make it difficult to deal with the broad range of diseases that are caused by mutations in glycan-related genes. The Glyco-Disease Genes Database (GDGDB) was created by Research Center for Glycoscience (RCMG) and released in April 2010. This database is supported by Ministry of Education, Culture, Sports, Science and Technology (MEXT) as part of Life Science Integrated Database project. At present time GDGDB provides information on about 80 genetic diseases of both glycan synthesis and degradation, and information on mutant genes that cause these diseases. In addition, we designed and created the "Pathway" and "Phenotype" ontologies for both types of these genetic diseases (Congenital Disorders of Glycosylation (CDG) and Lysosomal Storage Diseases (LSD)) and included them in the GDGDB.

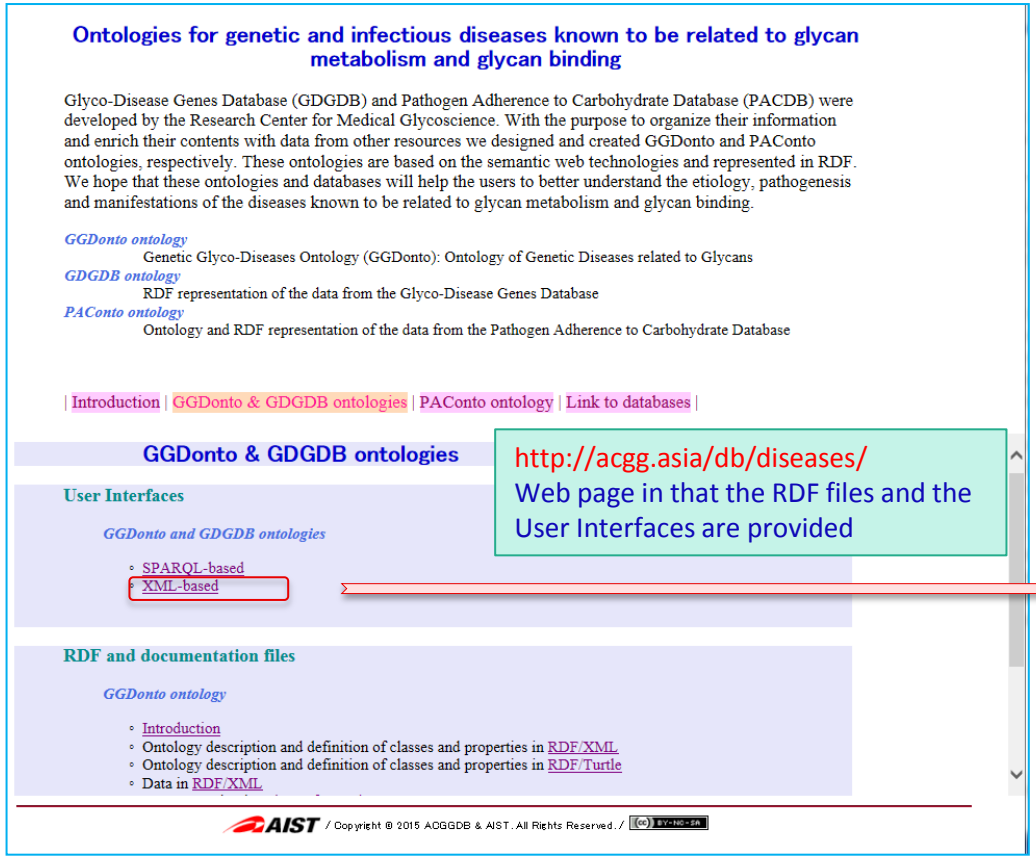
The Web-based user interface was created and released and now available at http://jcggdb.jp/doc/ProjectTop.action?langType=1&projectId=2.

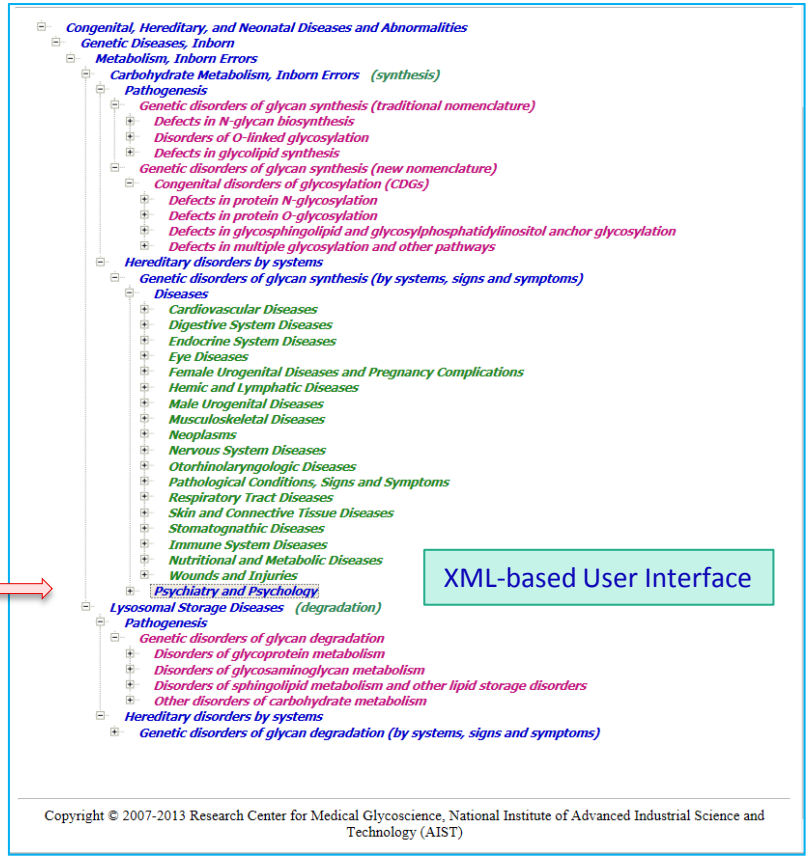




GDGDB & GGDonto ontologies - RDF representation of the GDGDB data and Ontology for Genetic Diseases known to be related to Glycan Metabolism

Glyco-Disease Genes Database (GDGDB) was developed by the Research Center for Medical Glycoscience (RCMG) and released in April 2010. Being the members of the "Life-Science Database Integration Project" of National Bioscience Database Center (NBDC) of Japan Science and Technology Agency (JST), we decided to organize GDGDB information and enrich its content by integration with other biomedical resources. We designed and developed the ontologies, called GDGDB ontology and GGDonto. In addition to these ontologies, we developed a system with the user interfaces, using which the users can retrieve and search information from GDGDB and GGDonto. These XML-based and SPARQL-based user interfaces and RDF files for GDGDB ontology and GGDonto are available at http://acgg.asia/db/diseases/. We hope that these GDGDB & GGDonto ontologies with GDGDB database will help the users to better understand the etiology, pathogenesis and manifestations of the genetic diseases known to be related to glycan metabolism.





JCGGDB

GDGDB & GGDonto ontologies

Internal and external sources of information

RDF representation of the GDGDB data

Database provided by the AIST: Glyco-Disease Genes Database

GDGDB

GDGDB provides information on about 80 genetic diseases of both glycan synthesis and degradation, and information on mutant genes that cause these diseases.

We designed and developed the ontologies, called GDGDB & GGDonto ontologies . These ontologies are based on the Semantic Web Technologies and represented in Resource Description Framework (RDF) format. Using Semantic Web Approach with Web Ontology Language (OWL), Simple Knowledge Organization System (SKOS) and RDF standards, we described semantics of GDGDB data, enriched this data with additional various classifications, and linked GDGDB data with related biomedical resources.

RDF

GDGDB & GGDonto ontologies

Link information to internal and external information resources

Database provided by the AIST: GDGDB provides information about genetic diseases of glycan synthesis and degradation

Glyco-Disease Genes Database (GDGDB)

RDF

Database provided by the AIST: GlycoGene includes genes associated with glycan synthesis

GlycoGene Database (GGDB)

External information resources used to create the classifications

Information resources about diseases and causative genes that are used to create the classifications

NCBI Databases

Scientific literature that are used to create the classifications of diseases by pathogenic aspects (“pathway” classifications)

Scientific literature

RDF

Information that were obtained from related information resources and included in GGDonto

We used the information of the proteins that are product of glyco-genes

UniProtKB_Proteins

Classifications

Information resources that are used to create the classification of Diseases by “symptoms, signs and abnormal clinical and laboratory findings” (“phenotype” classifications)

MeSH

UMLS

UMLS - Unified Medical Language System

MeSH - Medical Subject Headings vocabulary

We used the information about diseases and causative genes

NCBI Databases

We used the information of the enzymes that are involved in the metabolism of glycans

UniProtKB_Enzymes

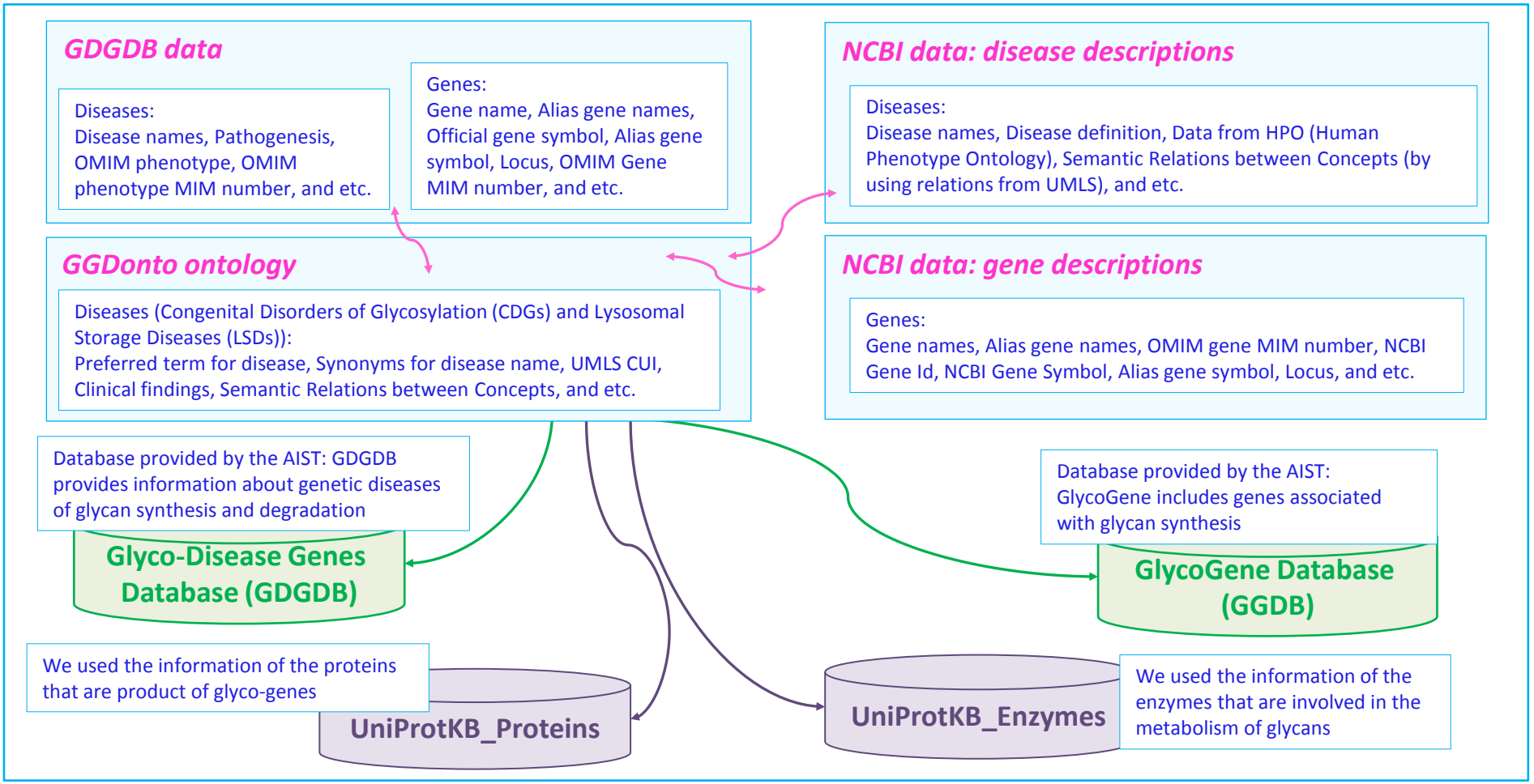
We used the information from Unified Medical Language System such as disease name, UMLS CUI, disease classification, and etc.

UMLS

Structure of the GDGDB & GGDonto ontologies

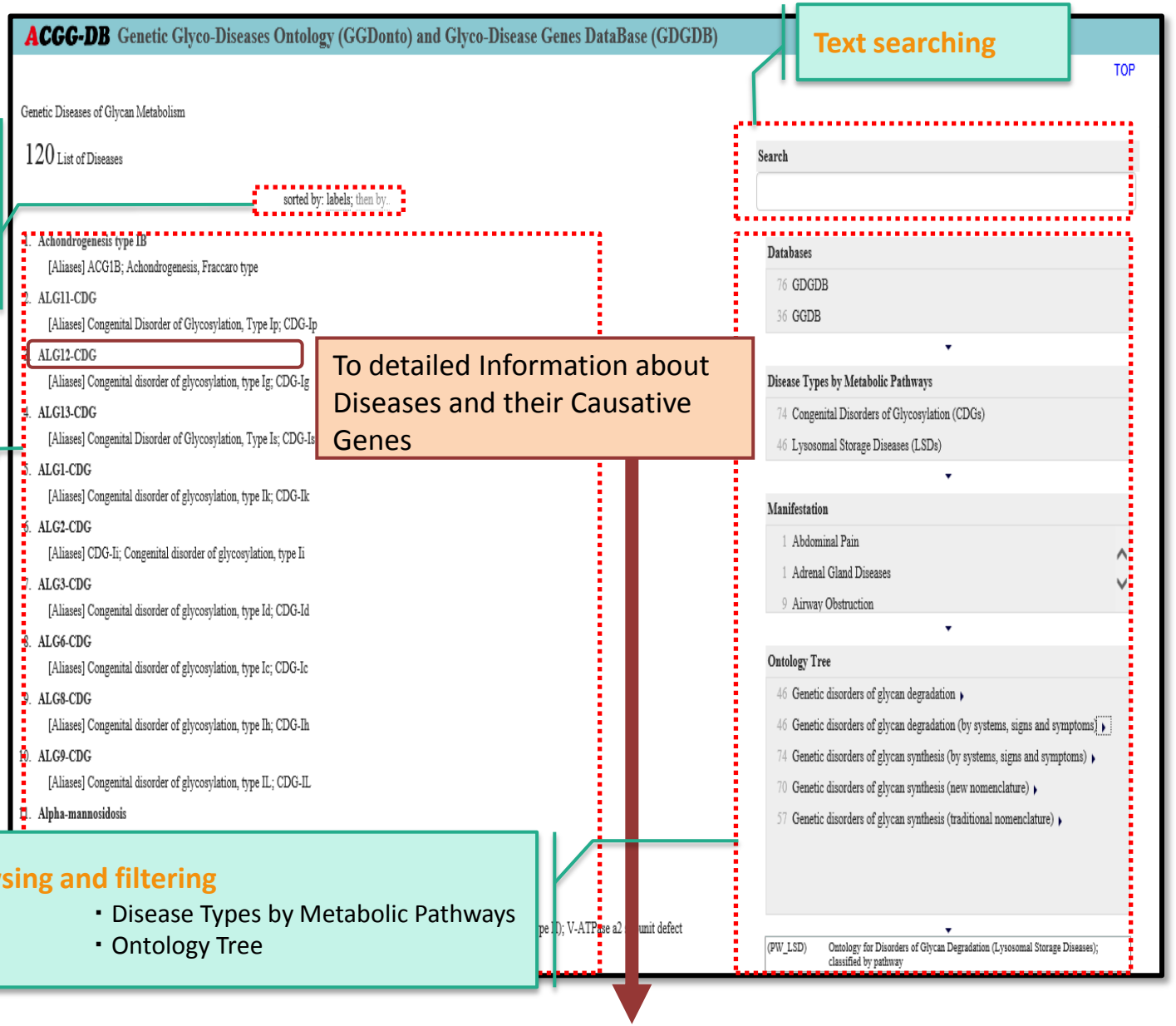
Features of this ontology

- The proposed ontology has the advantage of representing comprehensible knowledge related to genetic defects in glycan metabolism, because it integrates the pathogenic aspects with the clinical features associated with each of these genetic disorders.
- The objects of these database and ontology are genetic disorders which are caused by inherent defects in single gene (single-gene disorders). Since the information about these diseases and they causative genes have been published in a variety of medical-related information resources, the relations between this ontology and external information resources are diverse.



Top Page of SPARQL-based user interface

http://acgg.asia/db/diseases/gdgdb



Text searching

Changing the Layout of the list of Diseases
Menu for changing the layout of the list

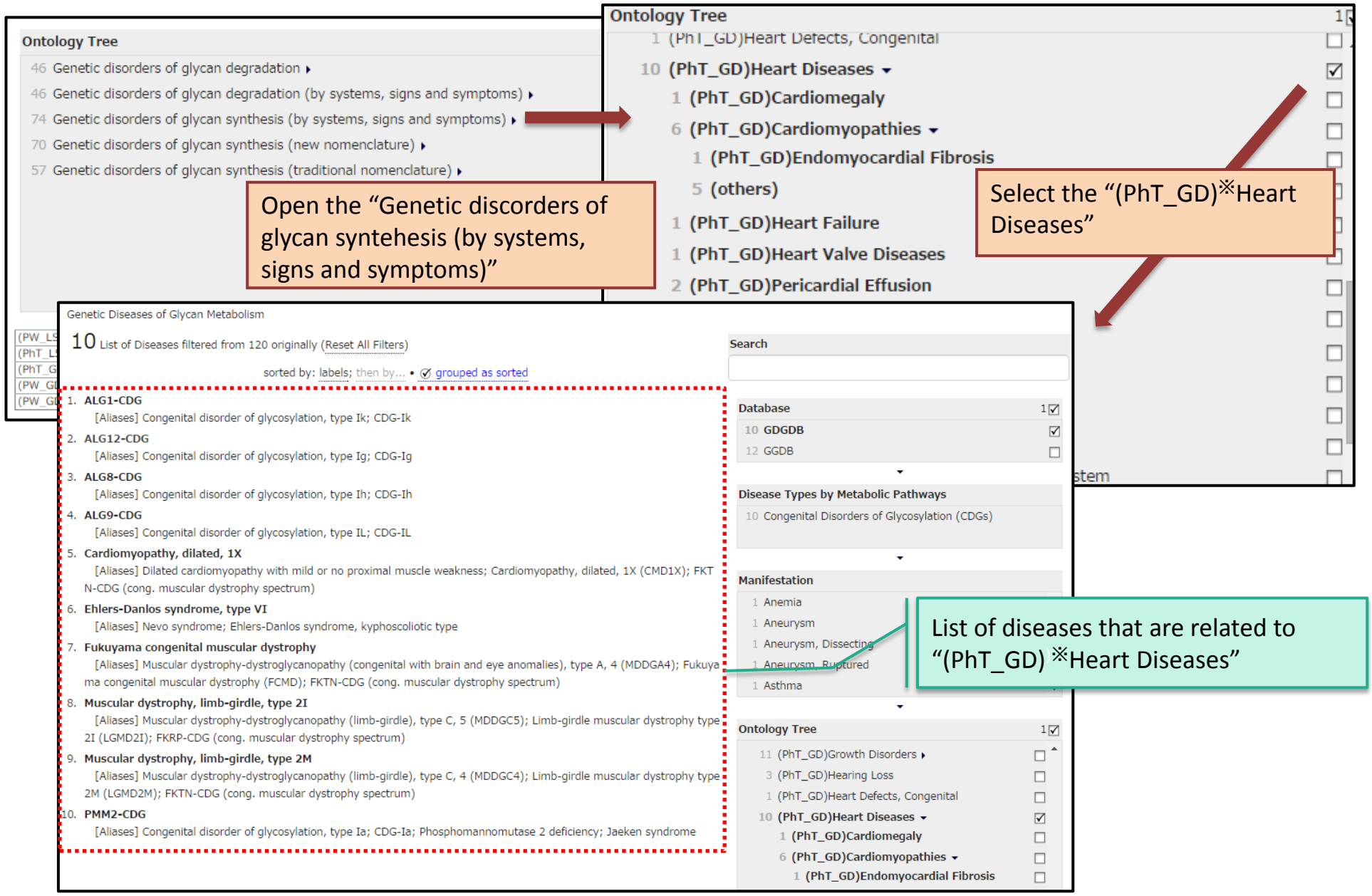
To detailed Information about Diseases and their Causative Genes

List of Diseases

Facets sets: Faceted browsing and filtering

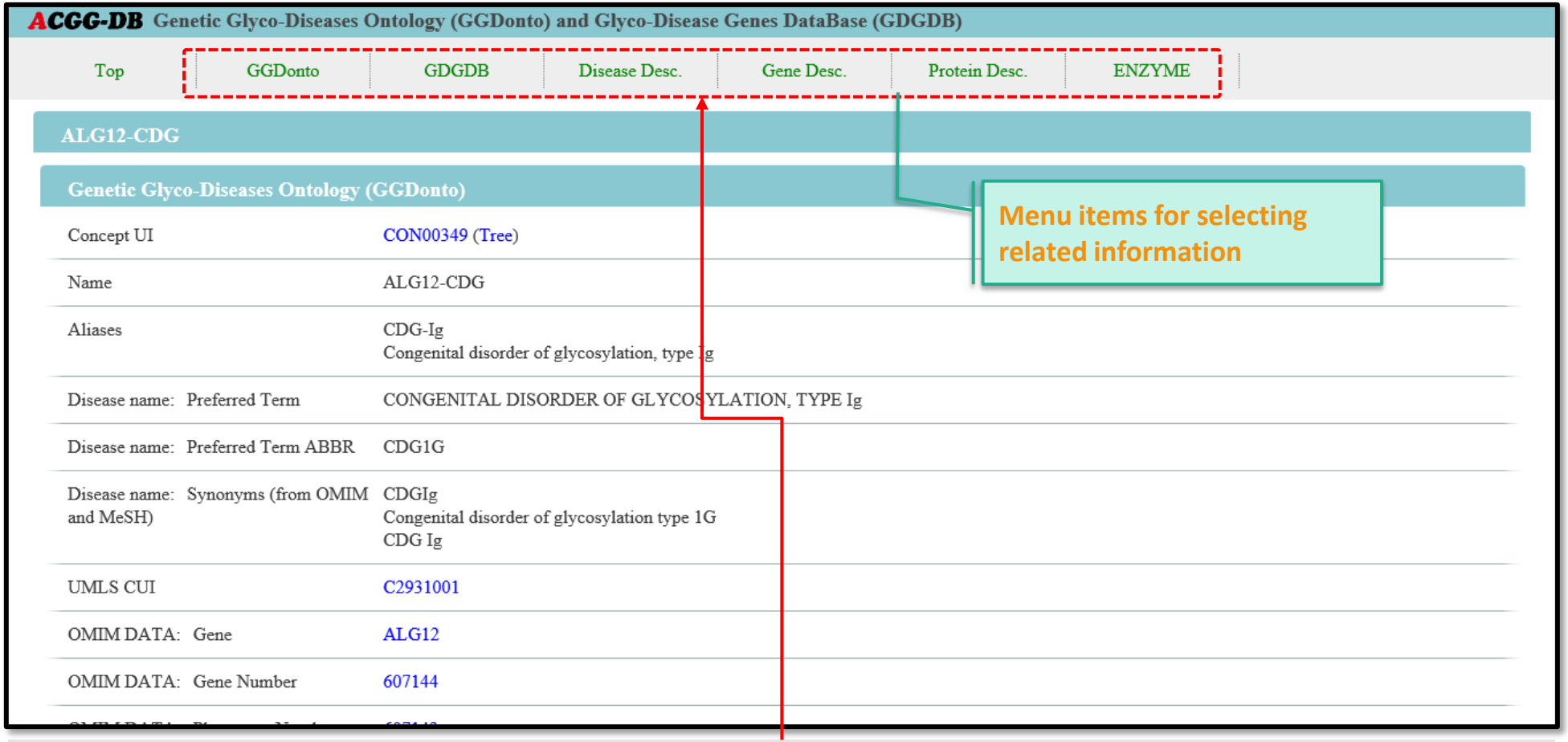
- Database
- Manifestation
- Disease Types by Metabolic Pathways
- Ontology Tree

Narrow down the subset of diseases by using the Ontology Tree



※(PhT_GD) : Ontology for Disorders of Glycosylation; classified by phenotype

Detailed Information about Diseases and their Causative Genes



Stanza:

**GGDonto: **
**GDGDB: **
**Disease(NCBI): **
**Gene(NCBI): **
**Protein(UniprotKB): **
**ENZYME(Swiss-Prot): **

※Stanza: TogoStanza (http://www.togostanza.org/) is a generic Web framework which enables the development of reusable Web components that are embeddable into any Web applications.

JCGGDB

Stanza provided by GGDonto

Genetic Glyco-Diseases Ontology (GGDonto)

GGDonto

Concept UI	CON00349 (Tree)
Name	ALG12-CDG
Aliases	CDG-Ig Congenital disorder of glycosylation, type Ig
Disease name: Preferred Term	CONGENITAL DISORDER OF GLYCOSYLATION, TYPE Ig
Disease name: Preferred Term ABBR	CDG1G
Disease name: Synonyms (from OMIM and MeSH)	CDGIg Congenital disorder of glycosylation type 1G CDG Ig
UMLS CUI	C2931001
OMIM DATA: Gene	ALG12
OMIM DATA: Gene Number	607144
OMIM DATA: Phenotype Number	607143
Symptoms, signs and abnormal clinical and laboratory findings	Blindness (Vision loss) Bone Diseases, Developmental Developmental Disabilities Psychomotor Disorders
References	• H.H. Freeze and H. Schachter. Genetic Disorders of Glycosylation. 2009;585-600. Table 42.1 Genetic defects of glycan synthesis in humans • H.H. Freeze. Genetic defects in the human glycome. Nat Rev Genet. 2006;7(7):537-51. Table 2. Human diseases caused by genetic defects in N-glycosylation pathways • T. Hennet. Diseases of glycosylation beyond classical congenital disorders of glycosylation. Review. Biochim Biophys Acta. 2012;1820(9):1306-17. Table 1. Diseases of glycosylation
GDGDB (ID) Link to the Glyco-Disease Genes Database	41
GGDB (Gene Symbol) Link to the GlycoGene Database	ALG12

Glyco-Diseases Gene Database (GDGDB)

GDGDB

GDGDB ID	41
Disease names	CDG Ig (Congenital Disorder of Glycosylation type Ig)
Pathogenesis	Hypotonia, severe psychomotor retardation, seizures, feeding difficulties, facial dysmorphy, coagulopathy Glycoforum -Beyond Glycogenes, Dr. Hudson H. Freeze http://www.glycoforum.gr.jp/science/glycogenes/08/08E.html
OMIM phenotype	CONGENITAL DISORDER OF GLYCOSYLATION, TYPE Ig; CDG1G
OMIM phenotype mim number	607143
Gene names	asparagine-linked glycosylation 12, alpha-1,6-mannosyltransferase homolog (S. cerevisiae)
Official gene symbol	ALG12
Alias gene symbol	ECM39; hALG12; MGC3136; PP14673; MGC111358
Locus	22q13.33
Link	NCBI Gene : http://www.ncbi.nlm.nih.gov/gene/79087 GGDB : http://jcggdb.jp/rcmg/ggdb/Homolog?cat=symbol&symbol=ALG12

Disease Description from NCBI

Information about Disease from NCBI

OMIM phenotype MIM number	607143
OMIM disease name	CONGENITAL DISORDER OF GLYCOSYLATION, TYPE Ig
Disease name (from UMLS sources)	Congenital disorder of glycosylation type 1G (MSH)
Symptoms, signs and abnormal clinical and laboratory findings (from MedGen sources)	Abnormality of immune system physiology (HPO) link Cognitive impairment (HPO) link Muscular hypotonia (HPO) link Genital abnormalities (OMIM) link

Gene Description from NCBI

Information about Gene from NCBI

OMIM Gene MIM number	607144
Gene name	ALG12, alpha-1,6-mannosyltransferase
Gine Symbol	ALG12
Alais Gene Name	asparagine-linked glycosylation 12 homolog (S. cerevisiae, alpha-1,6-mannosyltransferase); asparagine-linked glycosylation 12 homolog (yeast, alpha-1,6-mannosyltransferase); asparagine-linked glycosylation 12, alpha-1,6-mannosyltransferase homolog; asparagine-linked glycosylation protein 12 homolog; dol-P-Man dependent alpha-1,6-mannosyltransferase; dol-P-Man:Man(7)GlcNAc(2)-PP-Dol alpha-1,6-mannosyltransferase; dolichyl-P-Man:Man(7)GlcNAc(2)-PP-dolichol alpha-1,6-mannosyltransferase; dolichyl-P-Man:Man(7)GlcNAc(2)-PP-dolichyl-alpha-1,6-mannosyltransferase; dolichyl-P-mannose:Man-7-GlcNAc-2-PP-dolichyl-alpha-6-mannosyltransferase; mannosyltransferase ALG12 homolog; membrane protein SB87
Alias Gene Symbol	CDG1G; ECM39; PP14673; hALG12
Locus	22q13.33
Gene Id	79087

Protein Description from UniProtKB

Information about Protein from UniProtKB

UniProt Accession number	Q9BV10
UniProt Entry name	ALG12_HUMAN
Protein Recommended Name	Dol-P-Man:Man(7)GlcNAc(2)-PP-Dol alpha-1,6-mannosyltransferase
Protein Function	Adds the eighth mannose residue in an alpha-1,6 linkage onto the dolichol-PP-oligosaccharide precursor (dolichol-PP-Man(7)GlcNAc(2)) required for protein glycosylation.
Catalytic Activity	Dolichyl beta-D-mannosyl phosphate + D-Man-alpha-(1->2)-D-Man-alpha-(1->2)-D-Man-alpha-(1->3)-(D-Man-alpha-(1->2)-D-Man-alpha-(1->3)-D-Man-alpha-(1->6))-D-Man-beta-(1->4)-D-GlcNAc-beta-(1->4)-D-GlcNAc-diphosphodolichol = D-Man-alpha-(1->2)-D-Man-alpha-(1->2)-D-Man-alpha-(1->3)-(D-Man-alpha-(1->2)-D-Man-alpha-(1->3)-(D-Man-alpha-(1->6))-D-Man-alpha-(1->6))-D-Man-beta-(1->4)-D-GlcNAc-beta-(1->4)-D-GlcNAc-diphosphodolichol + dolichyl phosphate.

Enzyme Description from Swiss-Prot/ENZYME

Information about Enzyme from Swiss-Prot

EC Number	2.4.1.260
Accepted Name	Dolichyl-P-Man
Reaction catalysed	Dolichyl beta-D-mannosyl phosphate + D-Man-alpha-(1->2)-D-Man-alpha-(1->2)-D-Man-alpha-(1->3)-(D-Man-alpha-(1->2)-D-Man-alpha-(1->2)-D-Man-alpha-(1->3)-(D-Man-alpha-(1->2)-D-Man-alpha-(1->3)-(D-Man-alpha-(1->6))-D-Man-alpha-(1->6))-D-Man-beta-(1->4)-D-GlcNAc-beta-(1->4)-D-GlcNAc-diphosphodolichol = D-Man-alpha-(1->2)-D-Man-alpha-(1->2)-D-Man-alpha-(1->3)-(D-Man-alpha-(1->2)-D-Man-alpha-(1->3)-(D-Man-alpha-(1->6))-D-Man-alpha-(1->6))-D-Man-beta-(1->4)-D-GlcNAc-beta-(1->4)-D-GlcNAc-diphosphodolichol + dolichyl phosphate.