

Semantics of Medical Terminology and Fundamentals of Ontological Modeling

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ABSTRACT

This article analyzes the semantic properties of medical terminology and the foundations of ontological modeling. In linguistics, the relevance of studying semantic relations using modern computer technologies and modeling terminological systems based on a conceptual and ontological approach is substantiated. Medical terms are analyzed based on paradigmatic and syntagmatic relations, in particular, semantic connections such as synonymy, antonymy, homonymy, hyper-hyponymy, holonymy, paronymy. In ontological modeling, hierarchical classification, semantic fields, classes and subclasses, and statistics of component terms are considered. As a result of the research, the <https://uzbekontology.uz/> platform was created based on 4626 medical terms, which created the opportunity to systematize and automate medical knowledge. This work serves to study medical terminology at the intersection of linguistics and information technologies.

Keywords: Domain ontology, hierarchical classification, semantic field analysis, ontological modeling, paradigmatic relationship, holonym, paronym, taxonomic relationship

INTRODUCTION

In world linguistics, advanced achievements of applied linguistics are widely used in the analysis of semantic relationships between lexical units. Semantic analysis is being studied using computer technologies and methods. Today, the

issue of expressing the semantic properties of linguistic units in a user-friendly, functional and structured form is relevant. This encourages researchers to develop new approaches to modeling terminological systems. As a result of the use of computer resources in linguistics, dictionary systems based on thesaurus, WordNet and ontological models have been formed. These resources serve as an effective tool for the systematic analysis of lexical units, determining their semantic interrelationships, and elucidating the cognitive essence of terms in linguistic consciousness.

RELATED WORK

In world linguistics, extensive fundamental and practical research has been conducted in the areas of computer linguistics and computer lexicography. In particular, the work of scientists such as T. R. Gruber [8], T. Berners-Lee, N. Noy [14], Gomez-Perez [7], M. Ushold, N. Guarino on the creation of an ontological knowledge base, the formation of theoretical foundations in ontological modeling, the development of methodologies and practical applications is of significant practical importance. Also, in this area, the research of A. Y. Zinovieva [24], A. V. Dobrov [22], O. A. Antonova [18], B. N. Nguyen [28], N. V. Lukashevich [25], L. G. Fedyuchenko [30] in Russia is aimed at theoretically substantiating a model of technical knowledge transfer based on the integration of linguistic ontology and thesaurus principles. In addition, scientists such as K. I. Belousov [20], N. Y. Kazakova, M. G. Zasedateleva [23], A. G. Shabalin [31], A. Aleksandrovich [17], R. Gataullin [6] have conducted research on semantic relations in computer linguistics and applied linguistics.

In Uzbek linguistics, professors A. Pulatov, S. Muhamedova, N. Abdurakhmonova [2], M. Abjalova [3], B. Mengliyev, L. Raupova, G. Toirova, O. Abdullaeva [32], A. Eshmominov, D. Akhmedova, N. Ataboyev have conducted scientific research in this area.

HIERARCHICAL CLASSIFICATION IN TERMINOLOGY

The study of semantic relationships in the terminological system is currently one of the important directions, and the scope of research aimed at analyzing the terminological system of various scientific fields on a semantic basis is expanding. Research in this direction is mainly aimed at the rapid presentation and understanding of knowledge on a certain subject, and also proves the existence of strong connections between the terminological systems of various scientific fields.

In world linguistics, a number of studies have been carried out on the systematization of medical terms and their study from a linguistic aspect. Work aimed at studying medical terminology from various perspectives was carried out in Russia by E. V. Bekisheva [19], E. D. Makarenko [27], L. Besekirskaya, O. G. Borisova [21], S.I . Madzhaeva, V. F. Novodranova, M. N. Chernyavsky, S. M. Velichkova and others.

In Uzbek linguistics, there are also a number of works aimed at studying medical terms from a linguistic point of view. In particular, it is worth noting the studies of Z. Mirzahmedova[10], M. Navruzova [12], F. Abdulkhairova [1], Z. Urunova [16], B. Suyunov [15].

The emergence of a hierarchical relationship in the terminological system is manifested in a unique way. Based on the hierarchical relationship, content groups of lexemes are distinguished [6]. According to the opinions of H. Ne'matov, R. Rasulov, this situation is very common among scientific terms. The implementation of a hierarchical classification of professional terms initially begins with the identification of higher classes.

Units of the medical field also have a certain hierarchy, which forms a hierarchy from top to bottom. The hierarchy from top to bottom begins with finding the largest, main class and determining its internal branches.

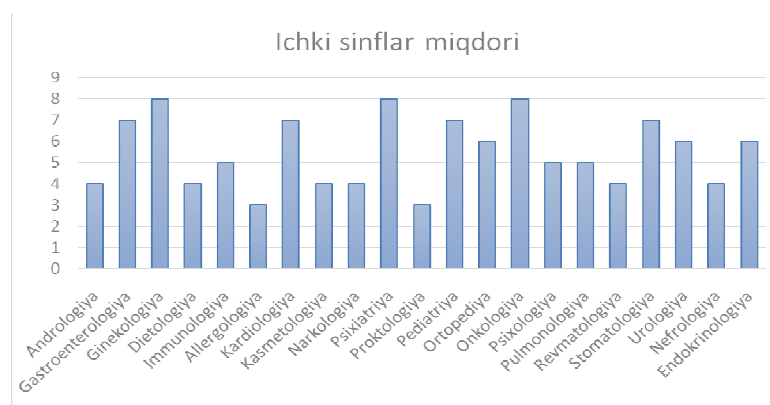


Figure 1. Statistics of classes within the internal medicine disciplines

ANALYSIS OF SEMANTIC FIELDS

The use of field structures is an effective method for deriving the real semantic relations of language units. Semantic fields are important in determining the main concepts in a particular field and the relationships between concepts. In ontology, a semantic field represents how concepts are related to each other.

A semantic field is a set of lexemes whose meaning is interrelated. The introduction of the theory of semantic fields into Uzbek linguistics began in the 1990s. In this regard, the studies of R. Rasulov [28], Sh. M. Iskandarova [9], N. R. Nishonova [13], S. Kh. Muhamedova [11], H. Tojimatov can be noted.

In our study, we used the following semantic fields:

1. **The semantic field of the nouns of persons engaged in medical activities:** *shifokor, hamshira, stomatolog, jarroh, travmatolog, pediatr, kardiolog, nevropatolog, oftalmolog, laborant, sanitar, dorixonachi, patronaj, ortoped ...*
2. **Semantic field of anatomical terms:** *yurak, miya, jigar, oshqozon, ichaklar, o'pka, suyak, mushak, bo'g'im, bosh, bo'yin, ko'krak qafasi, qorin, qo'l, oyoq, og'iz bo'shlig'i, tomoq ...*

3. **Semantic field of disease names:** *gripp, diabet, saraton, astma, infarkt, insult, sil, mioma, qizamiq, pnevmoniya, qabziyat, qandli diabet, shizofreniya, altsgeymer kasalligi ...*
4. **Semantic field of terms related to the treatment process:** *operatsiya, terapiya, emlash, rehabilitatsiya, fizioterapiya, profilaktika, fitoterapiya, diagnostika, tekshiruv, biopsiya, rentgen, UTT tekshiruvi, EKG tekshiruvi, endoskopiya, kompyuter tomografiyasi ...*
5. **Semantic field of medical place names:** *shifoxona, klinika, laboratoriya, reanimatsiya bo'limi, ambulatoriya, tibbiyot markazi, dispanser, sanatoriya, qabul bo'limi, travmatologiya bo'limi, shoshilinch operatsiya xonasi, palata, izolyator, tug'ruq xonasi, bola parvarishi xonasi ...*
6. **Semantic field of pharmacological agents and drug names:** *antibiotik, dori-darmon, tabletk, kapsula, eritma, inyeksiya, tomchi, malham, sirop, vaksina, analgin, paratsetamol, spirt, yod, vodorod peroksidi ...*
7. **Medical equipment semantic field:** *termometr, tonometr, rentgen apparati, UZI apparati, tomograf, endoskop, mikroskop, skalpel, shtativ, qaychi, kislorod baloni, kislorod niqobi, shprist, kateter, nogironlar aravachasi, qo'ltiqtayoq, tibbiy karovat ...*
8. **Semantic field of diagnostics and disease symptoms:** *isitma, yo'tal, og'riq, harorat ko'tarilishi, bosh aylanishi, ko'ngil aynishi, terlash, qaltirash, ko'z qizarishi, sariqlik, shish, holsizlik, qon tahlili, ultratovush tekshiruvi, klinik tekshiruv, qon tahlili, peshob tahlili ...*
9. **Semantic field of physiological and biochemical terms:** *yurak urishi, qon aylanishi, nafas olish, nafas chiqarish, qon bosimi, immunitet, insulin, gormonlar, insulin, adrenalin, DNK, modda almashinuvi, uglevodlar, yog'lar, nuklein kislotalar, vitaminlar, minerallar, refleks etc.*

ANALYSIS OF PARADIGMATIC RELATIONS

The phenomenon of homonymy, which is considered an integral part of the paradigmatic relation, is not considered an active type of relation in the formation of semantic fields. On the contrary, it

determines the affiliation of terms to one or another semantic field. Homonymy between medical terms can be observed between different branches of medicine. In the terminological system, the similarity of forms of terms is a special feature. There are two types of homonymy in the terminological system:

- a. external homonymy;
- b. internal homonymy.

According to I. Irmatov [6], in the issue of external homonymy in the terminological system, one of the similar lexical units belongs to the national language, and the other to the terminological system; in internal homonymy, both lexical units with similar forms belong to the same terminological system. During the formation of the terminological base, we have witnessed the relevance of the analysis of the scientist I. Irmatov. Below is an example of how the term Depressor is used in various fields of medicine and has several meanings. For example, in Anatomy: in the sense of a muscle that moves a body part downward; In Physiology: as a factor that reduces activity; In Pharmacology: as a drug that slows down nerve or heart activity. This example represents the homonymy existing in the internal fields of medicine, while below we observe external homonymy.

In Medicine (in the field of Hematology): Anemia - (anemia) is used in the sense of a disease characterized by a decrease in the number of erythrocytes and hemoglobin in the blood, as well as a change in their quality. In Biology (in the field of Botany): Anemia – is used in the sense of a genus (seed) of perennial spore-bearing plants belonging to the centipede family. In this example, we observe the use of the word anemia in two separate fields of science, such as medicine and botany.

1. Synonymy is a semantic relationship between words that have the same (or almost the same) meaning, but different graphic representations. In other words, we can say that synonymy is semantic equivalence between lexical units. Pairs with this type of semantic relationship are called synonyms. Synonyms are of two types in relation to the concept of meaning.

1) synonyms, in which the meaning relationship of words is based on similarity, that is, absolute synonyms; 2) synonyms, in which the meaning relationship of words is not exactly the same, but differs in the context and manner of use, are semantic synonyms.

In absolute synonyms, the meaning of words is based on similarity and is called absolute synonyms in linguistics. In such synonyms, there is almost no difference in meaning. In fact, this type of synonyms is rare.

Table 1

No.	O'zlashma termin	O'z qatlam leksikasiga oid so'z
1	<i>Avtomatiya</i>	<i>O'z-o'zidan harakatga kelish</i>
2	<i>Agglyutinatsiya</i>	<i>Bir-biriga yopishib qolish</i>
3	<i>Adaptatsiya</i>	<i>Moslashish</i>
4	<i>Anemiya</i>	<i>Kamqonlik</i>
5	<i>Anomaliya</i>	<i>Notekislik</i>
6	<i>Gipergedroz</i>	<i>Ko'p terlash</i>
7	<i>Gipesteziya</i>	<i>Teri sezuvchanligining pasayishi</i>
8	<i>Gipomneziya</i>	<i>Xotiraning pasayishi</i>
9	<i>Orbita</i>	<i>Ko'z kosasi</i>
10	<i>Glossit</i>	<i>Tilning yallig'lanishi</i>

Antonym is a semantic relationship between two or more words with opposite meanings. Antonyms can be called pairs of words with opposite meanings. Antonym pairs usually belong to the same grammatical category, that is, both elements are nouns, both elements are adjectives, or both are verbs. In medical terminology, there are two types of antonymy: 1) lexical antonymy; 2) morphological antonymy. The phenomenon of lexical antonymy arises as a result of the fact that separate independent words have opposite meanings. For example *kasal-sog'lom*, *sog'lik-kasallik*, *kuchli-zaif*, *tirik-o'lgan*.

The phenomenon of morphological antonymy is observed in antonymy that occurs by adding suffixes to the bases. For example, (*giper* – *ortiqcha*, *oshish*; *gipo* – *kam*, *pasayish*) *gipertermiya-gipotermiya*, *gipertoniya-gipotoniya*, *giperplaziya-gipoplaziya*; (*taxi* – *tez*; *bradi* – *sekin*) *taxikardiya-bradikardiya* etc.

RESULT

In medicine, ontology refers to the formal representation of medical knowledge, including concepts, objects, and their relationships, in a specific field. Ontology provides a common vocabulary for medical professionals and researchers, which allows for consistent interpretation and effective use of medical data. In ontology, classes represent groups or sets of objects that combine properties. Classes are the basic building blocks of ontology and are used to define concepts in a specific field. The definition of main classes in the medical terminology system is associated with the need to accurately and consistently represent medical knowledge. The definition of main classes includes domain knowledge and hierarchical relationships. Main classes should represent the most fundamental concepts in the medical field. For example: The concept of diseases is a main class. All diseases existing in the classifier of internal medical fields are divided into certain groups in the classifier of diseases.

Class instances also have a subclass level relative to their content. For example, Eye diseases (class) – *ko'z soqqasi, qovoq, konyuktiv, ko'z yoshi a'zolari and ko'z kosasi kasalliklari, yaqindan and uzoqdan ko'rolmaslik, ko'z astigmatizmi* (subclass) etc. Eye diseases (*ko'z kasalliklari*) *tug' ma va hayotda orttirilgan, yuqumli andyuqmaydigan, o' tkir and surunkali, bitta else ikkala ko'zdauchrovchi* (attribute) is expressed in the form.

Ontological principles help to classify medical terms in a logical and consistent manner. These principles are as follows:

Taxonomic and hierarchical classification: classifying terms from general to specific, top to bottom. It involves systematization according to the following categories: *Tibbiyot > Kasallik > Yurak-qon tomir kasalliklari > Gipertoniya*). In the second chapter of our study, we noted that the top-down approach of hierarchical classification was chosen to create an ontological model of medical terms. The hierarchical relationship combines two relationships: paronymy and holonymy. In the studies of a number of linguists, the paronymy relationship is considered a

phenomenon that realizes the holo-meronymic, that is, whole-part relationship, and it is clearly manifested at the lexical-semantic level of the language, especially in the terminological system. In our study, we found it necessary to distinguish paronymy and holonymy as separate phenomena. The choice of approach in hierarchical classification determines which type of relationship will emerge. Among ontological relationships, the taxonomic relationship is close to the hierarchical relationship and has very similar aspects, however, the taxonomic and hierarchical relationships differ from each other. In taxonomy, the presence of units in the system is important, and in the hierarchy, the level at which medical units are located is important. Types of taxonomic relations: *Is_a*, *part_of*, *has_a*, that is, they realize the relations of holonymy and hyperonymy.

H. Dadabayev emphasizes that hyper-hyponymic relations are present in almost all terminological systems and are characterized by their unique properties, expressing extremely complex relations in nature and society, as follows: central organ of the circulatory system (*qon aylanish sistemasining markaziy a'zosi*) seminalheart (*yurak*) hyperonym *aortal yurak*, *astenik yurak*, *atletikyurak*, *buqoq yurak*... provides examples of the active use of hyponyms such as [4]. Based on H. Dadaboev's hyper-hyponymic classification in terminology, we identified the following examples in our study.

The term "inflammatory process in lung tissue" (*O'pka to'qimalarida kechadigan yallig'lanish jarayoni*) seminal *zotiljam* hyperonym *ichterlama zotiljami*, *surunkali zotiljam*, *surunkali o'pka zotiljami*, *o'lat zotiljami*, *o'pka bo'lagi zotiljami*, *o'tkir zotiljam*, *o'choqli zotiljam*, *qizamiq zotiljami* hyponyms such as were identified.

Table 2

Hyponyms of the hypernym of <i>og'riq</i> according to the state and situation of observation in the human body:	Hyponyms of the hypernym <i>og'riq</i> , depending on which part of the human body it is observed in:
<i>burama og'riq</i> , <i>ikki to'lqinli og'riq</i> ,	<i>belog'riq</i> , <i>boshog'riq</i> ,

<i>zirqiroq og'riq,</i> <i>kechki og'riq,</i> <i>lo'q-lo'q og'riq,</i> <i>mavsumiy og'riq,</i> <i>simillovchi og'riq,</i> <i>o'tkir og'riq,</i> <i>ertaki og'riq,</i> <i>uzatiluvchi og'riq,</i> <i>o'qtin-o'qtin og'riq.</i>	<i>bo'g'im og'riq,</i> <i>ichog'riq,</i> <i>ko'zog'riq,</i> <i>ko'krakog'riq,</i> <i>oyoqog'riq,</i> <i>tomoqog'riq,</i> <i>yurakog'riq,</i> <i>qorinog'riq.</i>
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During the study, a medical terminology database was formed. Of the 4,626 terms in the medical terminology database (Figure 1), 678 synonymous doublets and 264 homonym terms were identified.

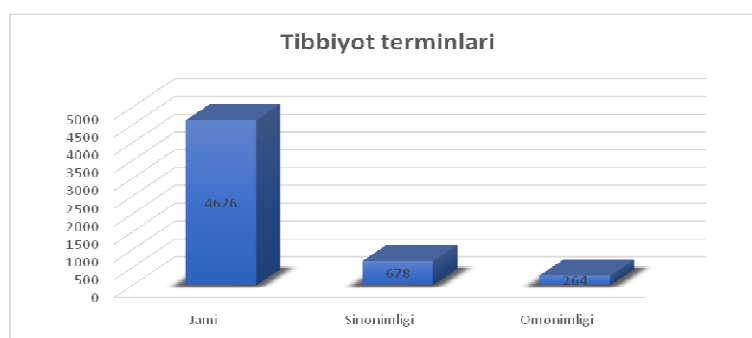


Figure 1. Statistics of paradigmatic relationships of medical terms

One of the practical results of the research work was the creation of an ontological database of medical terms on the platform <https://uzbekontology.uz/>. The platform included a number of areas of medicine as main areas and subareas within the main areas.

BOSH SAHFA Yurakning normal ritmga qoʻshilishi rivojida Yurak mushaklarining fajratilishi oʻrni

Turk tushib qolgan qoʻshilishi qoʻshilishi

SOHALAR

Tibbiyot

Genealogiya

Anatomiya

Bachadon

Bachadon yoki matka (facha — „bola“ -don; lotincha: uterus) — ayollarda va urgʻochi sut emizuvchi hayvonlarda homila oʻstirib rivojlanadigan ichki organ.

Simonim: Matka, Uterus

Omonim: -

Antonim: -

Giperonim: Organ

Giponim: Bachadon agʻdarilishi, Bachadon tushishi, Qorin-bachadon oqmasi, Qovuq-bachadon qin oqmasi, Qovuq-bachadon boʻyni oqmasi, Chala bachadon tushishi, Toʻla bachadon tushishi, Bachadon halqa, Boʻyda boʻlibga qarshi bachadon ichki vositalari, Bachadon nayidagi xomiladorlik, Bachadon boʻynidagi homiladorlik, Bachadondan qon ketishi, Bachadon yorilishi, Bachadon ichki bosimi, Bachadon mayi

Holonim: Bachadon

Meronom: bachadon maylari

Sintagmatik munosahiddagi birlik: Bachadon agʻdarilishi, Bachadon tushishi, Qorin-bachadon oqmasi, Qovuq-bachadon qin oqmasi, Qovuq-bachadon boʻyni oqmasi, Chala bachadon tushishi, Toʻla bachadon tushishi, Bachadon halqa, Boʻyda boʻlibga qarshi bachadon ichki vositalari, Bachadon nayidagi xomiladorlik, Bachadon boʻynidagi homiladorlik, Bachadondan qon ketishi, Bachadon yorilishi, Bachadon ichki bosimi, Bachadon mayi

Figure 2. Search example on the *Uzbekontology.uz* platform

The term uterus is studied in two main areas of medicine: anatomy and gynecology. Anatomy studies the structure, location and relationship of the uterus with other organs, while gynecology analyzes the diseases and functional state of the uterus. Figure 3 shows the ontological classification of the term uterus as follows.

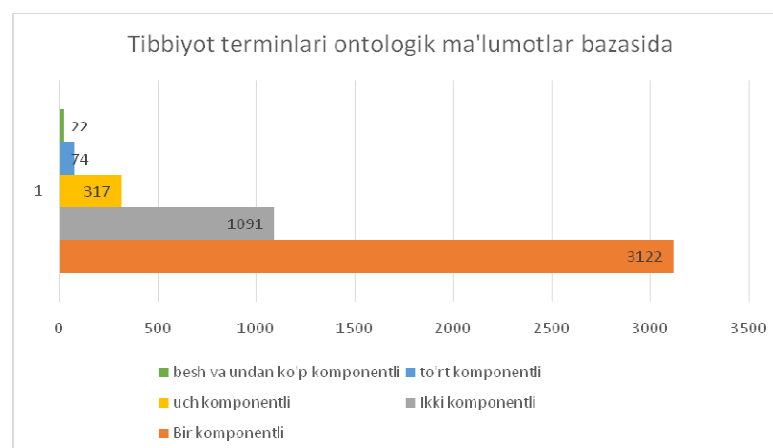


Figure 3. Statistics of terms by the number of components in the ontological database of medical terms

Out of 4626 terms in the medical terminology database (Figure 4), 22 terms with five or more components, 74 with four components, 317 with three components, 1091 with two components, and 3122 with one component were identified.

CONCLUSION

It should be noted that the analysis of medical terms based on ontological principles is of great importance in the systematic study of the field and the classification of terminology. In the context of ontological principles, the functional significance of each type of relationship arises in the approach. While paradigmatic relationships analyze terminology semantically, syntagmatic relationships analyze how terms are used in context. In taxonomy, it is important to divide terms into classifications. In taxonomy, general concepts are divided into smaller, more specific types through hyper-hyponymic relationships, which allows for the systematization of complex terminology, such as in the field of medicine. In hierarchical classification, domain terms are classified into certain classes by determining the level at which they are located. All of the above-mentioned types of relationships are of important practical importance in domain ontological modeling.

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