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English for specific purposes in the medical sciences to strengthen the professional profile of the higher education medicine student: a knowledge representation using SuperHyperSoft Sets

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Abstract. The English language is an important added value for the professional profile of students in all higher education courses due to the demands of the current century, in which mastering more than one language is undoubtedly one of the preponderant skills to access better and more opportunities within the workplace, especially in careers such as medicine. Therefore, the curricular design and the implementation of a program focused on the development of the linguistic skills of the future health professional is pertinent and necessary to strengthen their professional profile; not only in the discourse at the level of talks, congresses, training, and international participation where English is the official communicative language; but also at the level of research as one of the fundamental pillars of this career because most of the high-impact medical bibliography is developed and available in English. The present study proposes the strengthening of English for specific purposes in medical students through the implementation of a lexicographic material that provides them with the definition and pronunciation in English of the most prevalent medical vocabulary in this field, as well as its translation into Spanish, which would significantly increase the professional skills of future doctors. The present research proposal is also justified by the fact that many medical students did not have advanced preparation in the English language at school, which is why the proposed lexicographic material would represent an added complementary value to the curricular programming of this subject, which would help to make the learning of English viable in a much more specific and contextualized way in this branch of science, an important aspect given the substantial need to be able to communicate both locally and internationally. This paper proposes a model where medical terms are organized in English and Spanish using the theory of SuperHyperSoft Sets. The importance of the model is that it allows this knowledge to be automated so that students can access it easily. Additionally, it deals with ambiguity in medical definitions, as well.

Keywords: English for specific purposes, lexicographic material, medical lexicon, SuperHyperSoft Sets.

1 Introduction

English is the language par excellence that should be required of all medical science professionals. Virtually all the most relevant literature on the subject is written in English. Scientific articles with the most important discoveries and experiments are written in English for greater scientific dissemination. On the other hand, doctoral, master, or undergraduate theses are recommended to have an English version for dissemination. The exchange of knowledge is easier when communicating in English while two specialists cannot communicate in one of their mother tongues. Generally, English is the language that should be mastered by both of them and in this way, communication is possible [1, 2].

For all these reasons, effective teaching of technical English in medical terms is a challenge. To do so, some key concepts used for teaching English in this branch of knowledge must be established.

In particular, we will focus on Spanish-speaking specialists from Latin America.

The first important term is "English for Specific Purposes," which differentiates English from "English for General Purposes." English for Specific Purposes is subdivided into "English for Academic Purposes" (EAP) and "English for Vocational Purposes" (EVP).

"English for academic purposes" is further subdivided into "English for general academic purposes" and "English for specific academic purposes". Within medicine, the term "English for medical purposes" (EMP) is used. EMP is usually subdivided into EVP, which is related to professionals working in the health sector, and English for specific academic purposes, which is mainly related to university studies.

Within the field of medicine, there are some particular characteristics of the teaching of this science; it is students of this specialty who, for the most part, end up being doctors, which is why it is very clear what needs to be taught to students of the specialty. This does not happen with students of other careers, such as engineering, where future engineers do not know what jobs they will be placed in once they graduate. The distinction between English for General Academic Purposes (EGAP) and ESAP is that the former involves the development of skills for the study of academic subjects in English, while the latter is studied to meet the specific needs of students, based on their immediate and real needs.

Physicians must communicate with patients in more or less colloquial language. Meanwhile, they must use the medical language in their presentations with other professionals in academic and scientific contexts, which are highly technical. For this reason, physicians and health science professionals, such as nurses, laboratory technicians, etc., must be able to master both technical terms in Spanish and English.

The aim of this article is to formalize English terms and their definitions, translation, pronunciation, and relationship with other terms. This will allow for easier automation of the terms and will therefore serve as support for the learning of this language by professionals who are studying it. In addition, it will personalize knowledge through better structuring.

To achieve this goal, we have selected the theory of SuperHyperSoft Sets [3-6]. This theory, introduced by F. Smarandache, allows us to represent complex situations typical of the real world. This theory further extends Professor Molodtsov's Soft Set theories where a function is defined on the values of a single parameter [7-13]. HyperSoft Sets contain a function on the Cartesian product of several sets, each containing the possible values of several parameters [14-18]. SuperHyperSoft Sets are defined as the previous one on the Cartesian product but in this case on power sets. Fuzzy-extended SuperHyperSoft Sets have as their destination set the fuzzy set or some of its extensions of the universe set. Where "fuzzy-extended" means fuzzy, intuitionistic fuzzy, interval-valued fuzzy, Pythagorean, Fermatean, neutrosophic, plithogenic, etc. [3, 19]

We use this tool as a model to represent medical terms translated from English to Spanish because in some cases these terms cannot be clearly defined. For example, blood vessels, including veins and arteries, are part of the circulatory system and also the cardiovascular system. On the other hand, fever is a "sign or symptom" that is part of several infectious diseases, each of them of different origin. The proposed model can serve as a basis for automated learning of English terms by medical students.

This article is divided into a Materials and Methods section, where the main concepts of SuperHyperSoft Sets are recalled. The following section contains the details of the proposed model. The article finishes with the conclusions.

2 Materials and Methods

Definition 1 ([7])**.** Given U is the initial universe set and E is the set of parameters. A pair (F, E) is called a *soft set* (over U) if and only if F is a mapping of E into the set of all subsets of U.

That is to say, having a set E of parameters and fixing a parameter $\varepsilon \in E$, then $F(\varepsilon) \in \mathcal{P}(U)$, where

$\mathcal{P}(U)$ denotes the power set of U and $F(\varepsilon)$ is considered the set of ε-elements of the Soft Set (F, E) or the set of ε-approximate elements of the Soft Set.

It is not difficult to realize that fuzzy sets are soft sets, this is a consequence of the α-levels definition of a membership function μ_A where we have the following:

$F(\alpha) = \{x \in U \mid \mu_A(x) \geq \alpha\}$, $\alpha \in [0,1]$. Thus, if we know the family F, then we can reconstruct the function μ_A by using the following formula:

$$\mu_A(x) = \sup_{\substack{\alpha \in [0,1] \\ x \in F(\alpha)}} \alpha$$

Thus, a fuzzy set is a $(F, [0,1])$ soft set.

Given a binary operation * for subsets of the set U, where (F, A) and (G, B) are soft sets over U. Then, the operation * for soft sets is defined as follows:

$(F, A) * (G, B) = (J, A \times B)$, where $J(\alpha, \beta) = F(\alpha) * G(\beta)$; $\alpha \in A$, $\beta \in B$, and $A \times B$ is the Cartesian product of the sets A and B.

Definition 2 ([14])**.** Let U be a universe set, $\mathcal{P}(U)$ the power set of U. Let $a_1, a_2, \ldots, a_n$, for $n \geq 1$, be n distinct attributes, whose corresponding attribute values are respectively the sets $A_1, A_2, \ldots, A_n$, with $A_i \cap A_j = \emptyset$, for $i \neq j$, and $i, j \in \{1, 2, \ldots, n\}$. Then the pair $(F, A_1 \times A_2 \times \ldots \times A_n)$, where: $F: A_1 \times A_2 \times \ldots \times A_n \to \mathcal{P}(U)$ is called a *HyperSoft Set* over U.

Definition 3 ([3])**.** Let U be a universe set, $\mathcal{P}(U)$ the power set of U. Let $a_1, a_2, \ldots, a_n$, for $n \geq 1$, be n distinct attributes, whose corresponding attribute values are respectively the sets $A_1, A_2, \ldots, A_n$, with $A_i \cap A_j = \emptyset$, for $i \neq j$, and $i, j \in \{1, 2, \ldots, n\}$. Then the pair $(F, \mathcal{P}(A_1) \times \mathcal{P}(A_2) \times \ldots \times \mathcal{P}(A_n))$, where:

$F: \mathcal{P}(A_1) \times \mathcal{P}(A_2) \times \ldots \times \mathcal{P}(A_n) \to \mathcal{P}(U)$ is called a *SuperHyperSoft Set* over U.

Definition 4 ([3, 19])**.** Let U be a universe set, $\mathcal{P}(U)$ the power set of U. Let $a_1, a_2, \ldots, a_n$, for $n \geq 1$, be n distinct attributes, whose corresponding attribute values are respectively the sets $A_1, A_2, \ldots, A_n$, with $A_i \cap A_j = \emptyset$, for $i \neq j$, and $i, j \in \{1, 2, \ldots, n\}$. Then the pair $(F, \mathcal{P}(A_1) \times \mathcal{P}(A_2) \times \ldots \times \mathcal{P}(A_n))$, where:

$F: \mathcal{P}(A_1) \times \mathcal{P}(A_2) \times \ldots \times \mathcal{P}(A_n) \to \mathcal{P}\left(U\left(x(d^0)\right)\right)$ is called a *Fuzzy-Extension-SuperHyperSoft Set* over U.

Where $x(d^0)$ is the fuzzy or any fuzzy extension degree of appurtenance of the element x to the set U. Fuzzy extension means Fuzzy Set or Intuitionistic Fuzzy Set, Pythagorean Fuzzy Set, Fermatean Fuzzy Set, Neutrosophic Fuzzy Set, Plithogenic Fuzzy Set, and so on.

3 The linguistic Model

The model we propose in this article organizes the different terms that a doctor must know in English. SuperHyperSoft Sets are used to deal with the indeterminacy due to ambiguity that exists in the classification of terms. Some terms are classified in at least two different ways because the human body physiologically behaves as a whole and that is why there are diseases that must be treated by two or more different specialists. Let us explain the details below:

1. We have the universe set $U = set\ of\ \{Term\ in\ English, definition, pronunciation, Translation\ into\ Spanish\}$. That is, the universe set contains as a basic component the set of four terms formed by the name of the term in English, the definition in English, the pronunciation, and its translation into Spanish.
2. The parameters to be measured are as follows:
   2.1. a_1: Letter of the alphabet with which the term begins in English $A_1 = \{a, b, c, \cdots, z\}$.
   2.2. a_2: Letter of the alphabet with which the term begins in Spanish $A_2 = \{a, b, c, \cdots, z\}$.
   2.3. a_3: Classification of the term.

A_3 = {{Disease, Signs and Symptoms},
{Design, Organ System, Organ},
{Disease, Bacterial origin},
{Disease, Virus origin},
{Disease, Other},
{Medical Procedures, Examinations},
{Medical Procedures, Hospital Staff},
{Hospital Vocabulary, Treatments},
{Hospital Vocabulary, Hospital Departments},
{Medical Specialty},
}

3. The SuperHyperSoft Set is defined by the pair $(T, \mathcal{P}(A_1) \times \mathcal{P}(A_2) \times \mathcal{P}(A_3))$, where:

$T: \mathcal{P}(A_1) \times \mathcal{P}(A_2) \times \mathcal{P}(A_3) \rightarrow \mathcal{P}(\mathrm{U})$.

Remark

1. {Disease, Organ System, Organ} is a generic way; it is assumed that we have several sets of this type, for example {Disease, Cardiovascular System, Heart}, etc.
2. {Disease, Other} includes a classification that is not part of the previous disease classifications.

Below we demonstrate in general what the model is like based on more specific cases, where we show a small database with medical terms:

MEDICAL HEALTH LEXICOGRAPHICAL MATERIAL

Diseases

• **Fever**

Definition: a very high-temperature condition.
Pronunciation : /ˈ fiːvər /
Translation: Fiebre

• **Cough**

Definition: a sudden expulsion of air from the lungs.
Pronunciation : / kɒf /
Translation: Tos

• **Allergy**

Definition: a response from the immune system (red eyes, runny nose, skin irritation, among others), usually as a reaction to certain food, medicine, material, or smell.
Pronunciation: /ˈ æl.ə.dʒi /
Translation: Alergia

• **Infection**

Definition: invasion and multiplication of microorganisms such as bacteria, viruses, etc.
Pronunciation: /ɪnˈfek.ʃən/
Translation: Infección

• Asthma: a respiratory condition that causes difficulty in breathing.

- Diabetes: a chronic condition that affects the body's ability to use sugar.
- Migraine: a type of severe headache.
- Anxiety: a mental health disorder that causes a lot of fear and worry.
- Depression: a mental health condition characterized by a constant feeling of sadness and disinterest.
- Arthritis: a condition that causes pain and stiffness in the body's joints.
- Fracture: a break or crack in a bone usually requiring medical attention.
- Flu: influenza; an infectious disease caused by a virus.
- Indigestion: discomfort in the stomach, often after eating.
- Hypertension: also known as high blood pressure.

Medical Procedures
Examinations

- Check-up: a routine examination by a doctor or dentist.
- X-ray: a type of imaging test using radiation to view inside the body.
- Blood test: laboratory analysis of a blood sample.
- Biopsy: the removal and examination of body cells, liquid, or tissue to diagnose a condition.
- MRI scan: an imaging test using magnetic fields to create detailed images of the body.
- Ultrasound: a diagnostic tool using sound waves to view internal organs.
- CT scan: a type of X-ray providing cross-sectional images of the body.
- ECG: a test that records heart activity and can detect heart problems.

Treatments

- Surgery: a medical procedure used to repair or remove parts of the body.
- Therapy: treatment to relieve or heal a disorder.
- Medication: a substance used to treat an illness or condition.
- Vaccination: administration of a vaccine to help the body develop immunity to a disease.
- Chemotherapy: a cancer treatment using drugs to kill or slow the growth of cancer cells.
- Radiation therapy: a cancer treatment using high-energy radiation to kill cancer cells.
- Dialysis: a treatment for kidney failure to remove waste products from the blood.
- Insulin therapy: a treatment for diabetes to control blood sugar levels.
- Antibiotics: medications that fight bacterial infections.
- Immunotherapy: a treatment that boosts the immune system often used for cancer patients.
- Transplant: replacing a failing organ with a healthy one from a donor.
- Physical therapy/rehabilitation: a program to restore strength and mobility after injury or surgery.
- Inhaler: a device delivering medication to the lungs, often used for asthma.
- Acupuncture: therapy using needles to stimulate specific points and treat pain.

Hospital Vocabulary
Hospital Staff

- Doctor: a medical professional.
- Nurse: a healthcare provider trained to assist doctors and care for patients.
- Surgeon: a doctor specialized in performing surgeries; operates on patients.
- Pharmacist: a professional who dispenses prescribed medications.
- Therapist: a professional who provides therapy.
- Radiologist: a doctor specialized in imaging.
- Anesthesiologist: a doctor who administers medicines to prevent pain during surgeries and

procedures.

- Pathologist: a doctor who analyzes body tissues and fluids.
- Psychologist: a mental health professional who provides counseling and therapy.
- Paramedic: a healthcare professional who provides emergency medical care outside the hospital.
- Dietitian: creates eating plans for patients.

Hospital Departments

- Emergency Room (ER): part of the hospital providing immediate treatment for urgent conditions.
- Operating Room (OR): a sterile environment where surgical procedures are performed.
- Ward: a hospital unit where patients with similar conditions are treated.
- Maternity ward: a section of the hospital specifically for childbirth and newborn care.
- Pediatric ward: a section of the hospital dedicated to treating children.
- Pharmacy: a place where medications are stored and dispensed.
- Clinic: a healthcare facility providing regular or specialized outpatient care.
- Intensive Care Unit (ICU): a special hospital department for critically ill patients.
- Laboratory: a place where medical tests are conducted.
- Rehabilitation center: a facility that helps patients recover after surgeries or injuries.
- Waiting room: an area where patients and their guests wait before, during, or after appointments or treatments.
- Radiology department: the part of the hospital where imaging tests are performed.
- Outpatient department: where patients receive treatments without being admitted overnight.

Let us take the above terms as a small illustrative medical database. So, we have the following:

Suppose we have a database containing terms such as {$Fever$, "a very high-temperature condition", "/ˈfiːvər/", fiebre}, {Cough, "a sudden expulsion of air from the lungs", "/kɒf/", tos}, among many others. These are the elements of the universe set U.

The model we propose, as it is based on SuperHyperSoft Sets rather than HyperSoft Sets or Soft Sets, allows flexibility in the representation of elements. For example:

$T(\{a, b, c, \cdots, z\}, \{a, b, c, \cdots, z\}, \{\text{Disease, Signs and Symptoms}\})$ part of the image of $T$are the elements $\{Fever, "a\ very\ high\text{-}temperature\ condition",\ "/ˈfiːvər/", fiebre\}$, $\{Cough,$ $"a\ sudden\ expulsion\ of\ air\ from\ the\ lungs", "/kɒf/", tos\}$,

$\{Allergy, "a\ response\ from\ the\ immune\ system\ (red\ eyes, runny\ nose, skin\ irritation, among\ others),$ $usually\ as\ a\ reaction\ to\ certain\ food, medicine, material, or\ smell", "/ˈæl.ə.dʒi/", Alergia\}$, among others.

Note that there are elements of the universe set that begin with any letter in both Spanish and English and that are signs and symptoms of diseases.

If on the other hand, it is taken $T(c, \{a, b, c, \cdots, z\}, \{\text{Disease, Signs and Symptoms}\})$ then neither Fever nor Allergy is included, but it is included $\{Cough,\ "a\ sudden\ expulsion\ of\ air\ from\ the\ lungs", "/kɒf/", tos\}$, because "c" is the first letter of cough.

On the other hand, it can be included $T(c, \{a, b, c, \cdots, z\}, \{\{\text{Disease, Signs and Symptoms}\}, \{\text{Disease, Bacterial origin}\}\})$, where there are signs and symptoms or bacterial diseases that begin with c in English. This includes $\{Cough,$ $"a\ sudden\ expulsion\ of\ air\ from\ the\ lungs", "/kɒf/", tos\}$, and also $\{Cholera,$ $"an\ acute\ diarrhoeal\ disease\ that\ can\ kill\ within\ hours\ if\ left\ untreated", "/ˈkäl(ə)rə/", cólera\}$, among others, see the Venn diagram in Figure 1.

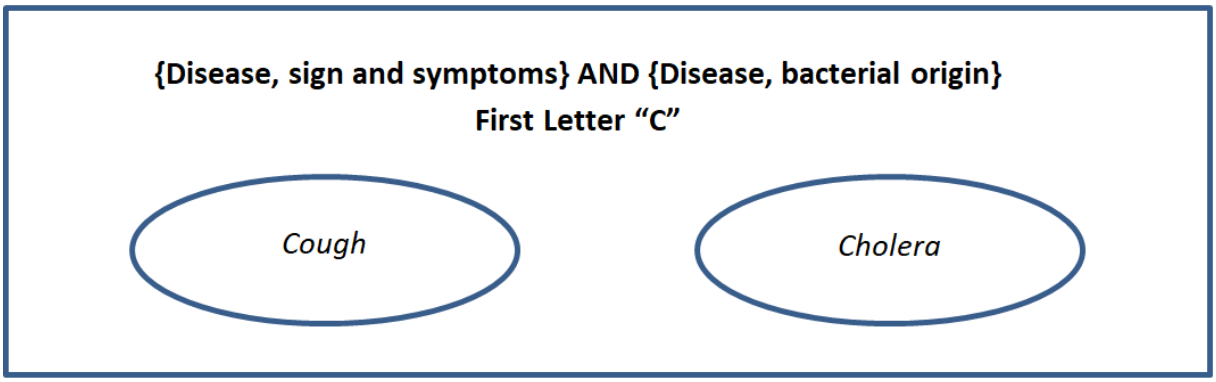

Figure 1: Venn diagram for the example above. *Cough* and *cholera* are a sign and symptom, and a bacterial disease, respectively; both starting by "c".

Another demonstration of the flexibility of the proposed model is the following:

$T(\{a,b,c,\cdots,z\},\{a,b,c,\cdots,z\},\{Disease,\text{Cardiovascular system, Blood vessels}\}) =$ $\{Ictus,$ *"A stroke or seizure", "/ik·tuhs/", ictus*$\}$ but also $T(\{a,b,c,\cdots,z\},\{a,b,c,\cdots,z\},\{Disease,\text{Nervous system, Brain}\}) = \{Ictus,$ *"A stroke or seizure", "/ik·tuhs/", ictus*$\}$.

Since ictus has the ambiguity of being a disease of the cardiovascular system that supplies blood to the brain, it, therefore, has the affectation of blood vessels as a cause and neurological sequelae as a consequence, see Figure 2.

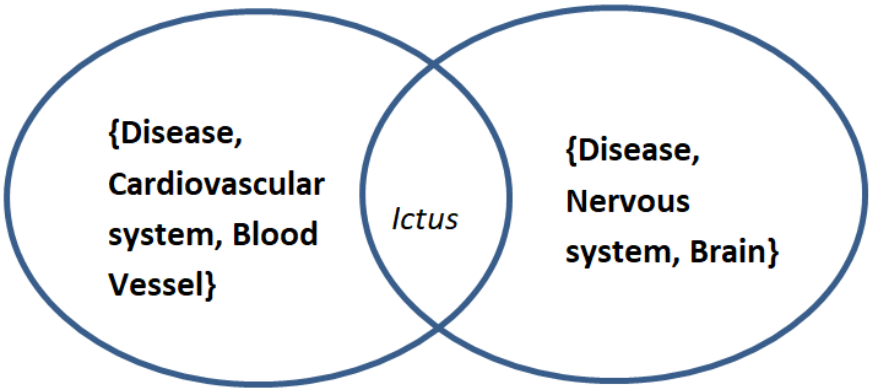

Figure 2: Venn diagram for ictus, demonstrating the ambiguity supported by the model for classification.

4. Conclusion

The study of the English language is essential for any professional today in any branch of science and beyond. Medical personnel are no exception. This paper proposes a way to help organize the knowledge of medical terms in English, and the relationship between each of them, including definition, pronunciation, and translation into Spanish. To do this, we use the theory of SuperHyperSoft Sets that allows combining medical terms in English, and Spanish, their pronunciation and definition, which help to classify the elements being studied. This article takes into account the indeterminacy and uncertainty to accurately classify the medical terms. This fact is due to the interconnection between the biological components of the human organism. So, the model allows to structure of language that is usually un-structured. Also, the model is feasible to be automated very easily since it allows the organization of knowledge in databases. This will contribute to the development of students in a self-taught way.

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