Hemocomponents and Hemoderivatives Ontology (HEMONTO): An Ontology About Blood Components

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Abstract. *Ontologies has been widely used in the formal description of scientific knowledge, as well in the practice of the conceptual modeling. Considering the description of scientific knowledge, several ontologies has been proposed in the biomedical domain. This article describes an ongoing research in the domain of blood transfusion, presenting the construction of a domain ontology about hemocomponents and hemoderivatives. Such ontology, named HEMONTO, has been developed using top-level ontologies, biomedical domain ontologies, among other resources. The ontology is based in a set of philosophical principles that has been identified in the literature under the label "ontological realism"and relies on technologies developed in the scope of Semantic Web. HEMONTO aims to provide both a knowledge repository about blood transfusion and an auxiliary instrument for modeling and evaluation of the information systems. The results presented here refer to the partial content of the ontology, encompassing classes, relations and representation diagrams.*

1. Introduction

The search for the best way to represent reality in information systems has been constrained over the years by the intrinsic limitations of the modeling techniques. The inconsistency of the modeling activity during the first years of the conceptual modeling, may have been the reason for many of the current interoperability problems between systems [Smith and Welty 2001]. This situation becomes more complex when one can see that the practices of information systems conceptual modeling has been oriented to specific modeling cases and performed in an ad-hoc way[Fonseca and Martin 2007].

Ontologies has been proposed as an alternative to relieve this type of problem. Indeed, the use of ontologies represents an evolution in the practices of information systems modeling of [Guarino 1998] [Smith 2003] [Wand and Weber 2004] [Fonseca and Martin 2007]. Ontologies allow to make explicit the acquired knowledge from a domain, promoting the sharing of knowledge and supporting the integration of information between different representation instruments, such as information systems.

This article describes an ongoing research in the domain of hematology and blood transfusion. The research encompasses a case study, which purpose is the construction of an ontology about human blood components (hemocomponents and hemoderivatives), named HEMONTO. We expect that the outcome of our research may be used as a scientific knowledge repository, for example as an annotation instrument [Rubin et al. 2008] and, accordingly, to fill a lack caused by missing of the formal representation geared for blood components and by limited possibilities of information

retrieval in this area as function of the use of general tools. Moreover, we expect that the ontology can facilitate the modeling activities or the information systems evaluation in the blood transfusion domain. This paper presents the partial content of HEMONTO – set of terms, representation diagrams, some semi-formal definitions – which has been developed in the scope of the Blood Project [ALMEIDA et al., 2010]. It is also worth mentioning the project guidelines, which have been used in the development of HEMONTO: it can be categorized as an ontology for information systems [Fonseca 2007] or as an ontology-driven information systems [Guarino 1998]; it relies on philosophical principles, which has sometimes received, in th literature that deals with biomedical ontologies, the label "ontological realism" [Smith and Ceusters, 2010].

The remaining part of the article is organized as follows: section 2 presents the required research background, explaining the basis of domain and high-level ontologies used here; section 3 describes the methodology used for the development of the ontology; the section 4 presents the partial content of HEMONTO, developed so far; and, finally, section 5 presents a brief discussion about the study and possibilities for future works.

2. Background

Ontology is a topic that has been studied for a long time in Philosophy, where it is defined as branch of metaphysics that deal with things existing in world. In Computer Science, ontologies are considered a software engineer artifact. In Information Science, ontology is seen as a type of controlled vocabulary used for information retrieval. In the literature under the topic "ontology", it be found many definitions for the term in different publications, such [Grüber 1993], [Guarino 1998], [Soergel 1997], [Vickery 1997], [Sowa 2000], to mention but a few. The approaches range from the philosophical bias to the context of the information systems.

One of the principles universally accepted in the construction of ontologies is the reuse of terms and relations from other ontologies. In general, a domain ontology is developed using both the hierarchy of a high-level ontology and terms obtainned from other domain ontologies. In the development of HEMONTO, we chose the following ontologies: (i) *Basic Formal Ontology* (BFO); (ii) *Relation Ontology* (RO) e (iii) *Foundational Model of Anatomy* (FMA). These choices wer based in the fact that there are a large number of biomedical ontologies grounded on those generic ontologies[1].

The Basic Formal Ontology (BFO) received influence from Aristoteles' works and from Edmund Husserl's metaphysics and logics. Other ontologies also contributed in the creation of BFO, like the DOLCE [Masolo et al., 2003]; Also, BFO has a philosophical ground based on the so-called ontological realism [Grenon and Smith 2004]. Hence, the desired interpretation for the BFO fundamental entities and relations is that they are real divisions among types of entities existing in the world. In addition, these entities are independent of the human mind [Spear 2006]. Accordingly, categories in the BFO are entities termed universals. The BFO also includes particulars, that is, the instances of those universals.

[1] See, for example, available initiatives in the *OBO Foundry* (http://www.obofoundry.org/) and in the *BioPortal* (http://bioportal.bioontology.org/)

The BFO universals are grouped in two different branches: (i) *continuants:* entities that endure through time while maintaining their identity and that have no temporal parts (examples: a human individual, the human blood, the disposition of an organism to bleed); and (ii) *occurrents*: entities that happen, unfold or develop in time and that have temporal parts (examples: the process of respiration, a whole human life in the 19th century, the functioning of a heart) [Grenon and Smith 2004] [Spear 2006]. The BFO entities are linked together by the ontological relations defined in the RO, which were incorporated in the BFO semantic structure. Indeed, the ontological relations of the RO and BFO are the same.

The RO is result of collaborative work accomplished by groups of research in biomedical ontologies (BFO, Gene Ontology[2], FMA e GALEN), with the purpose of defining a restrict set of relations to be used in biomedical ontologies. These relations are logically well-defined and created in order to fostering interoperability [Smith and Ceusters 2010]. In its first version, in 2005, the RO was published containing 10 formal relations in the biomedical domain and. In the current version[3], it has a total of 160 relations.

In the construction of HEMONTO, we make use of the ontological relations present in RO. These relations establish the basic connections among classes (<class, class>), among instances (<instance, instance>) and among classes and instances (<instance, class>) [Smith et al. 2005]. The term *class* will be used, henceforward, to refer to an entity in the reality equivalent to the terms *universal* and *type*, considering that the main ontology editors do not make this distinction. Similarly, the term *instance* will be used to refer to a particular in reality, which is equivalent to the terms *particular* and *individual*.

Other ontology that is important in our work is the *Foundational Model of Anatomy (FMA)*. It was created as a set of classes necessary for the symbolic representation of phenotypic structure of the human body, specifically, the anatomy. The FMA was developed based both on some fundamental modeling principles (unified context, abstraction level, definition principle, dominant concept) and on aristotelian definitions about the objects of the world [Rosse and Mejino 2003]. As a consequence of this approach, the nodes of the FMA hierarchies are called of *classes* or *types*, bolstering its commitment with entities of the real world, instead of commitment with the meanings of the terms. Currently, the FMA contains about 75.000 classes, which represent entitities like complex macromolecular structures, cell components of the human body, and so forth; about 120.000 terms associated with these classes and 168 types of relationships [FMA 2013].

The content related to "blood" in the FMA includes entities as blood itself (*FMA: blood*) and some of its specifications, such as *FMA: Venous blood* and *FMA: Plasma*. Despite the FMA includes some entities of the blood domain, the convering of this domain is shallow, not including specific components such as hemocomponents and hemoderivatives. Within our study, some FMA terms are used in the ontology HEMONTO as a starting point for the definition of more general terms.

[2] Available in: http://www.geneontology.org/. Access: 07th of May 2013.
[3] Available in: http://code.google.com/p/obo-relations/. Access: 26th of April 2013.

3. Methodology

In this section, we describe the methodological steps performed to conduct this research. Basically, these steps are: (i) a study in the domain of the human blood, using bibliographic resources and reference publications in the hematology field; (ii) a literature review, followed by an exploratory study of the relevant ontologies in the biomedical domain; and (iii) the construction of the ontology *per se*, using other ontologies and principles of top-level ontologies.

For the study of the hematology domain, we selected initially the "ISBT 128 - Standard Terminology for Blood, Cellular Therapy, and Tissue Product Descriptions" [ICCBBA 2010], since it is the reference manual about blood and cellular therapy. This document provides a standard terminology for describing transfusion and transplantation products. It is designed to allow distinction between products where such is required on safety, clinical practice, or inventory management grounds.

Parallel to the study of the blood domain, we performed a literature review about relevant ontologies in the domain of blood. Thus, we selected those ones more suitable for our approach, which includes BFO, RO e FMA. Specifically, the criteria used in the selection of these ontologies were: (i) its scope of coverage; (ii) compatibility with ontological realism, which is adopted in the project; (iii) current applicability of these ontologies; (iv) available content (classes, relations and axioms freely accessable); and (v) underlying principles and logic formalisms.

With regard to the use of classes and relations of other ontologies, we proceeded as follows: (i) the BFO was used for the definition of generic classes; (ii) the relations of the RO were used the basis for the composition of the HEMONTO relations; and (iii) the classes of the FMA were used in the definition of specific classes in the blood domain. For the knowledge representation of the in the blood domain, we constructed taxonomies (using formal relation **is_a**), partonomies (using formal relation **part_of**) and other relevant ontological relations, such as **participates_in, has_agent, produces, has_quality**. The ontology's editor Protege 4.2[4] was used for the construction of the ontology and it enabled the implementation of the ontology in *Ontology Web Language* (OWL). For the creation of the diagrams (taxonomies, partonomies and others) of the ontology proposed, we used the software Diagram Editor[5].

It is worth mentioning the use of a semi-formal syntax for specify the ontological relations, according to the guidelines suggested by ontologies integrated to the repository *Open Biomedical Ontologies (OBO)*. This syntax involves a set of basic conventions of the logic notation described in Smith et al. (2005). Here, this logic notation was used with some adaptations. The basic conventions are:

- The variables C, C1, ... Cn (capital letter) are used for the representation of *continuants universals* and c, c1, ... cn (lower-case letter) are used for the representation of *continuants particulars*;
- The variables P, P1, ... Pn (capital letter) are used for the representation of *occurrents universals* and c, c1, ... cn (lower-case letter) are used to the representation of *occurrents particulars*;

[4] Available in: http://protege.stanford.edu/. Access: 03rd of September 2013.
[5] Available in: https://projects.gnome.org/dia/. Access: 03rd of September 2013.

- The variables t, t1, ... tn are used to represent intervals.
- The relations between two universals (for example: C **is_a** C1), between two particulars (for example: c1 **part_of** c) and between one particular and one universal (for example: c **instance_of** C) are all in bold.

This notational pattern adopted here is especially important in the definition and understanding of the RO ontological relations, used to link terms. Altogether, we used 9 ontological relations to link HEMONTO terms, which were defined according to Smith et al. (2005) as: (see Table 1)

Table 1. Semiformal definitions for the ontological relations included in HEMONTO.

Relation	Semiformal Definition	Examples HEMONTO
C **is_a** C1	∀c, ∀t, if c **instance_of** C at t then c **instance_of** C1 at t, where c **instance_of** C at t is a primitive relation, at which a continuant particular c instance the universal C in the given time t.	Hemocomponent **is_a** Object Aggregate. Platelet concentrate **is_a** Hemocomponent.
P **is_a** P1	∀p, if p **instance_of** P then p **instance_of** P1, where p **instance_of** P is a primitive relation, at which a occurrent particular p instance the universal P.	Process of freeze **is_a** Process. Process of centrifugation at high rotation **is_a** Process of centrifugation.
C **part_of** C1	**∀**c, **∀**t, if c **instance_of** C at t then there is some c1 such that c1 instance of C1 at t and c **part_of** c1 at t, where c **part_of** c1 at t is a primitive relation between two continuant instances and a time at which the one is part of the other.	Plasma **part_of** Whole portion of blood. Fibrinogen **part_of** Cryoprecipitate
C **participates_in** P	∀c, ∀t, if c **instance_of** C at t then there is some p such that p **instance_of** P and p **has_participant** c at t, where p **has_participant** c at t is a primitive relation between a process, a continuant, and a time at which the continuant participates in some way in the process.	Whole portion of blood **participates_in** Process of centrifugation. Plasma **participates_in** Cryoprecipitate extraction.
P **produces** C	**∀**p, if p **instance_of** P then there is some c, t; such that if c **instance_of** C1 at t and p **produces** c at t, where p **produces** c at t is a relation between a process p, a continuant c and a time t, at which p produces c if some process that **occurs_in** p **has_output** c.	Process of centrifugation **produces** Buffy coat. Cryoprecipitate extraction **produces** Cryoprecipitate free plasma.
P **preceded_by** P1	**∀**p, if p **instance_of** P then there is some p1 such that p1 **instance** of P1 and p **preceded_by** p1, where p **preceded_by** p1 = **∀**t, **∀**t1, if p **occurring_at** t and p1 occurring_at t1, then t1 earlier t, where t **earlier** t1 is a primitive relation between two times such that t occurs before of t1 and **p occurring_at t** = for some c, p **has_participant** c at t.	Process of centrifugation at high rotation **preceded_by** Process of centrifugation. Process of collection **preceded_by** Process of centrifugation.
C **contained_in** C1	**∀**c, **∀**t, if c **instance_of** C at t then there is some c1 such that: if c1 **instance_of** C1 at t1 and c **contained_in** c1 at t, where c **contained_in** c1 at t = c **located_in** c1 at t and not c **overlap** c1 at t	Plasma **contained_in** Top and bottom pocket. Erythrocyte **contained_in** Top and bottom pocket.
P **has_agent** C	**∀**p, if p **instance_of** P then there is some c, t; such that if c **instance_of** C1 at t and p **has_agent** c at t, where p **has_agent** c at t is a primitive relation between a process, a continuant and a time at which the continuant is causally active in the process.	Extraction of buffy coat **has_agent** Plasma extractor.
C **has_quality** Q	Relation between an continuant entity C and a quality Q, at which C **has_quality** Q if only if: **∀**c, **∀**t, if c **instance_of** C at t then there is some c1 such that: if c1 **instance_of** C1 and exists **∀**q, **∀**t, if q **instance_of** Q at t then there is some q1 such that: if q1 **instance_of** Q1, such that q	Fresh frozen plasm **has_quality** Time after collection. Plasma of 24 hours **has_quality** Freeze time.

	inheres_in c at t.	
Q **is_quality_measured_as** q	Relation between a continuant universal Q and a continuant particular q, such that both are qualities, and ∀q, ∀t, if q **instance_of** Q at t then there is some q1 such that q1 **instance_of** Q1.	Time after collection **is_quality_measured_as** <= 8 hs. Freeze time **is_quality_measured_as** > 1 h.

4. Results

In this section, we present the partial results obtained so far. We describe the ontology about hemocomponents and hemoderivatives of the human blood, highlighting classes, relations and diagrams used to represent the knowledge. As we mentioned, these results are partials, since the process of construction of ontologies, especially in complex domains, should not be considered finished and must be under constant evaluation [Grüber 1993].

HEMONTO represents knowledge about blood products – hemocomponents and hemoderivatives – encompassing the constituent elements those products, as well as the procedures used to obtain them. In its current version, the ontology has 54 terms, which 45 are classes of the ontology and other 9 are relations. Among the classes, 30 classes are specific of the ontology, 13 classes were imported from the BFO and 2 classes from the FMA. The relations were imported from the RO and adapted to the domain under study.

In the remainder of this section, we present the classes and relations of HEMONTO, as well as the representation structures connecting them. Each ontology class or relation, when referenced in the text, is represented in italic. Similarly, classes and relations imported from other ontologies are spelled in italic and accompanied of an acronym representing the source ontology.

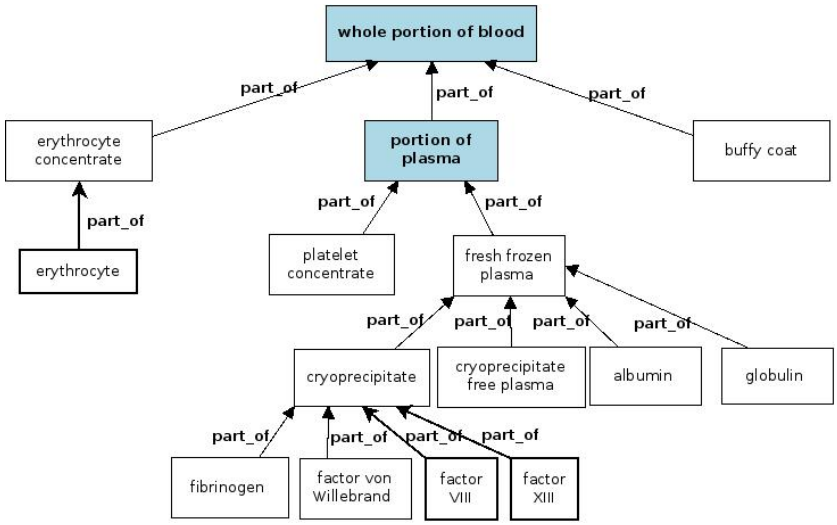

Figure 1. Partonomy of the blood components.

According to the FMA, the *blood (FMA: portion of blood)* is the substance and main fluid of the human body, composed of plasma (*FMA: portion of plasma*) and blood cells. In order to obtain hemocomponents and hemoderivatives is necessary to submit one unity of the *whole blood (FMA: whole portion of blood)* to specific processes, such as centrifugation and freeze. According to the FMA, the *whole portion of blood* is a type of *portion of blood*, such as its components were not separated.

Aiming to understand these processes and the types of hemocomponents and hemoderivatives that can be obtained, we constructed a partonomy of the blood derivate products (see figure 1). In this partonomy, the entities originated from the FMA are represented by shaded rectangles and the other entities, specific of HEMONTO, are represented as rectangles without shading.

The partonomy demonstrates that the *whole portion of blood*, when subjected to the first process of centrifugation, is separated, initially, in three products: (i) *erythrocyte*, whose a portion, when stored in specific conditions of temperature and storage, generates the hemocomponent *erythrocyte concentrate*; (ii) *portion of plasma*, which corresponds to *plasma* in its natural state (gross) yet rich in platelets (synonym term: *platelet rich plasma*); and (iii) *buffy coat*, a portion of blood formed by leucocytes and platelets. Next, after a new centrifugation process applied to a portion of blood performed in high rotation, the *portion of plasma* is separated into two products: (i) the *platelet concentrate* and (ii) the *fresh frozen plasma* (a plasma with low percentage of platelets). On the other hand, the *fresh frozen plasma* can be submit to a extraction process of one of its own components – the *cryoprecipitate* – creating two other hemocomponents: (i) the *cryoprecipitate* and (ii) the *cryoprecipitate-free plasm*. From *fresh frozen plasma,* it is still possible to extract two hemoderivatives – *albumin* and *globulin* – from the plasma subdivision by industrial process. Finally, the hemocomponent *cryoprecipitate* has glycoproteins of high molecular weight (*fibrinogen, factor Von Willdebrand, factor VIII* and *factor XIII*) that fulfill the role of clotting factors in the blood transfusion process. Using a industrial process it is possible both to obtain these proteins and to generate other important hemoderivative named *clotting factors concentrate*, which encompasses these proteins.

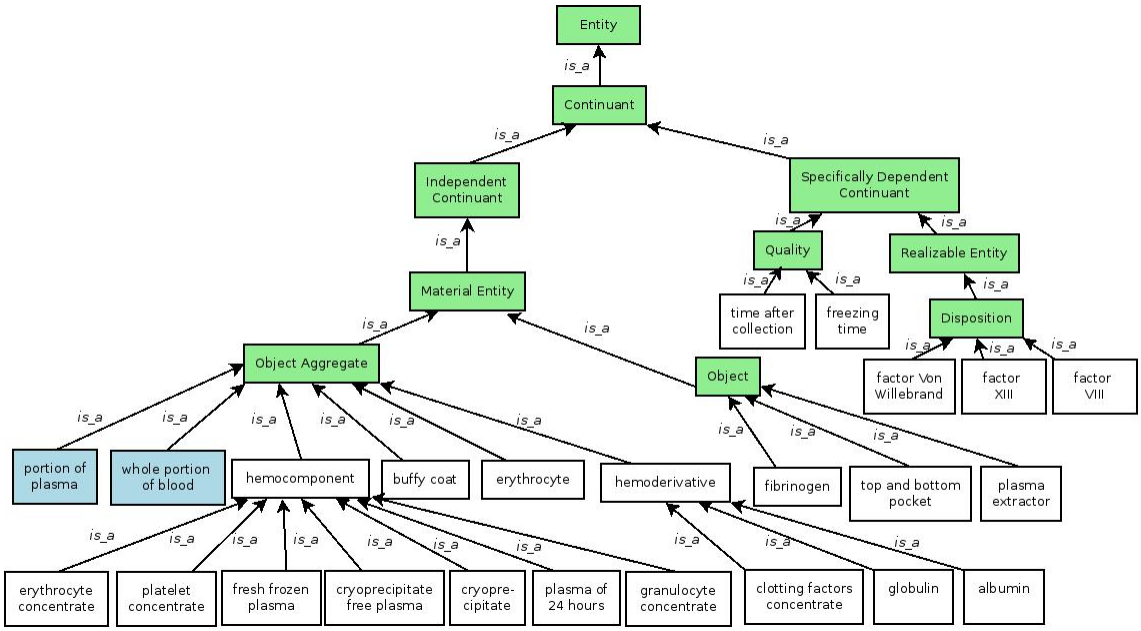

Figure 2: Taxonomy of the continuants entities of HEMONTO.

According to the taxonomic structure of the BFO, we have two large groups of real entities: the *continuants* and the *occurrents*. Following this structure, we created two taxonomies of entities included in HEMONTO, taking as a starting point the fundamental categories of the BFO. The taxonomy of figure 2 represents the set of

continuant entities of HEMONTO, in which the entities imported from BFO and FMA are represented as shaded rectangles and the other entities, specific of HEMONTO, are represented as rectangles without shading.

According to the BFO classification, the entity *FMA:whole portion of blood is_a BFO:object aggregate*, similarly to its components (*FMA:portion of plasma, buffy coat* and *erythrocyte*) obtained in the first process of blood centrifugation. The *hemocomponents* and the *hemoderivatives* of the human blood also are classified as *BFO:object aggregate*, as well as its specific types: (i) *erythrocyte concentrate, platelet concentrate; fresh frozen plasm; cryoprecipitate free plasma, cryoprecipitate, plasma of 24 hours* and *granulocyte concentrate*, which are types of *hemocomponents*; and (ii) *clotting factors concentrate, globulin* and *albumin*, which are types of *hemoderivatives*.

The entities *plasma extractor* and *top and bottom pocket*, used in the production of the hemocomponent *platelet concentrate*, are classified as *BFO:object*, similarly to protein *fibrinogen*, contained in the *cryoprecipitate*. This blood component still contains elements as *factor Von Willebrand, factor VIII* and *factor XIII*, which work as clotting factors and therefore were classified as *BFO:disposition*. The entities *time after collection* and *freezing time* were classified as *BFO:quality*, since these entities are important parameters of the hemocomponents during their process of production.

The other large group of entities of HEMONTO corresponds to *occurrent entities*. This group is represented in the taxonomy depicted in figure 3:

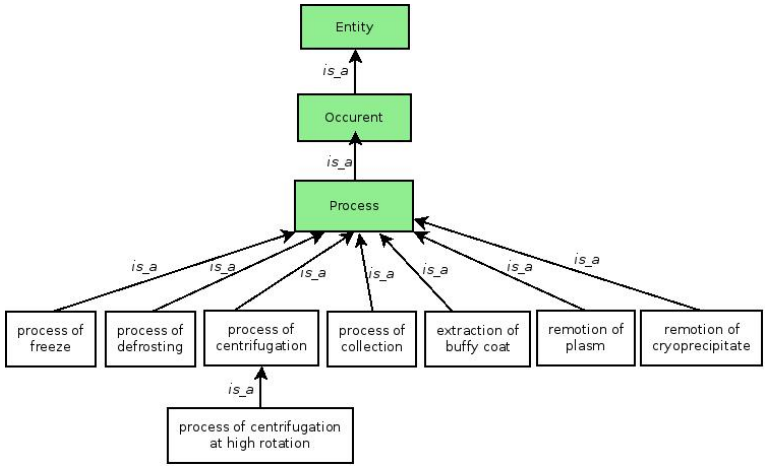

Figure 3: Taxonomy of the occurrents entities of HEMONTO.

Within the taxonomy of *occurrent entities* (figure 3), again, the entities extracted from BFO are represented as shaded rectangles and the entities specific from HEMONTO are represented as rectangles without shading. In this taxonomy, we tried to include all process involved in the production of human blood hemocomponents and hemoderivatives: *process of freeze; process of defrosting; process of centrifugation* and specific types as *process of centrifugation at high rotation*; *process of collection*; *extraction of buffy coat; remotion of plasma* and *remotion of cryoprecipitate*. All these entities were classified as *BFO:process*, since their existence are connected to an event or an occurrence. In addtion, they have their own temporal parts and dependence of one or more material entities, according to Grenon and Smith (2004).

In addition to the partonomy and the taxonomy presented, we needed to create other representation structures involving different ontological relations as a way to

describe the specificities involved in the processes of production of each blood hemocomponents and hemoderivatives. The processes of production of the hemocomponents *erythrocyte concentrate* and *platelet concentrate* are represented in the diagram of figure 4:

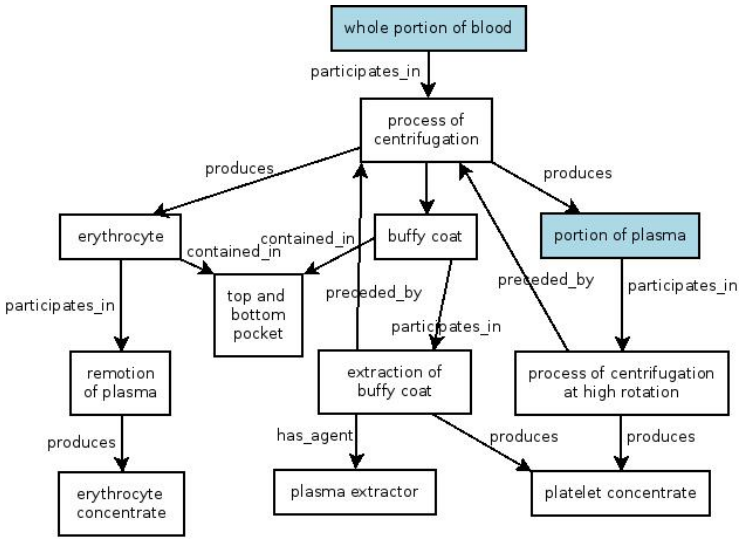

Figure 4: Processes for obtaining of the erythrocytes and platelet concentrate.

The initial procedure to obtain both hemocomponents (figure 4) consists in the *process of centrifugation* of the *whole portion of blood,* which separates the following elements: *portion of plasma, buffy coat* and *erythrocyte*. Therefore, we represented that the *whole portion of blood* **participates_in** the *process of centrifugation,* which, on the other hand, **produces** *portion of plasma, buffy coat* and *erythrocyte*. In order to obtain the *erythrocyte concentrate* (left side of figure 4), plasma, **contained_in** *top and bottom pockets*, is removed of the set of *erythrocytes* that remained after the *process of centrifugation* of the *whole portion of blood*. Thus, we represented the *remotion of plasma* **produces** *erythrocyte concentrate*.

However, in order to obtain the hemocomponent *platelet concentrate* (right side of figure 4), two different methods can be used: (i) obtaining it from *buffy coat*; and (ii) obtaining it from *plasma*. In the first method, the *buffy coat* **contained_in** *top and bottom pockets* after the *process of centrifugation*, is extracted by one the outputs of the *top and bottom pocket* with the use of *plasm extractors*. Therefore, it was represented that the *extraction of buffy coat* **has_agent** *plasm extractors* and that the *extraction of buffy coat* **produces** *platelet concentrate*. In the second method, the *plasma* obtained after the *process of centrifugation* (called light centrifugation) is again centrifuged in high rotation (*process of centrifugation at high rotation*). After this process, it **produces** *platelet concentrate*.

The plasma is one of the most important components of the human blood and, as result of process acomplished on it, one can generates other four blood hemocomponents – (i) the *fresh frozen plasm*, (ii) the *cryoprecipitate free plasm*, (iii) the *plasma of 24 hour*, (iv) the *cryoprecipitate* – and also three blood hemoderivatives – (i) the *albumin*; (ii) the *globulin* and (iii) the *clotting factors concentrate*. The diagram depicted in figure 5 represents the processes required for the achievement of the mentioned hemocomponents and hemoderivatives. The rectangles of the figure 5

represents classes of the ontology and the ellipses represents the properties of these classes.

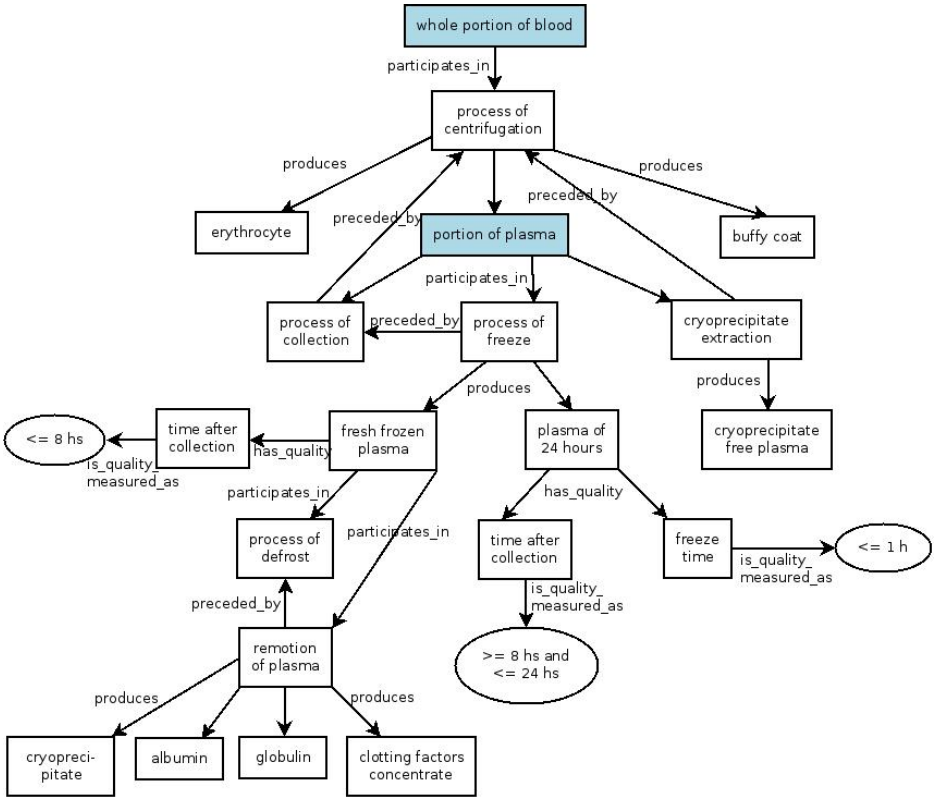

Figure 5: Processes for obtaining of the plasm components.

In order to obtain the hemocomponents *fresh frozen plasma* and *plasma of 24 hours* (left side of figure 5), the initial procedure required is again the *process of centrifugation* of the *whole portion of blood* for separation of *erythrocyte, buffy coat* and *portion of plasma*. The next step consists in the *process of collection* of the obtained *portion of plasma*. The elapsed time after the collection of plasma, here called *time after collection*, is an important parameter in the process as a whole, because it determines the hemocomponent that is going to be generated: (a) when this time is at most 8 hours, the result is the *fresh frozen plasma*, formally, *fresh frozen plasma* **has_quality** *time after collection* **is_quality_measured_as** <= 8 hs; and (b) when the time after collection is between 8 hours and 24 hours the result is the *plasma of 24 hours*, formally, *plasma of 24 hours* **has_quality** *time after collection* **is_quality_measured_as** >= 8 hs and <= 24 hs. In order that both hemocomponents are generated is necessary also that, after the process of collection, the *plasma* be referred to a *process of freeze*. In the case of the *plasma of 24 hours*, the *freeze time* must not exceed 1 hour, formally, *plasma of 24 hours* **has_quality** *freeze time* **is_quality_measured_as** <= 1 h.

The diagram of figure 5 also represents the achievement of the hemocomponents *cryoprecipitate free plasma* and the own *cryoprecipitate*. In spite of the names of these hemocomponents suggest similarities in their respective processes of achievement – extraction of the cryoprecipitate of the plasma and achievement of both -, in practice, this process is performed in a different manner. In order to obtain the *cryoprecipitate free plasma* (right side of figure 5), the initial stage corresponds again to *process of centrifugation* of the *whole portion of blood*, which obtains *portion of plasma, buffy*

coat and *erythrocyte*. The next stage consists in the process of *cryoprecipitate extraction* of the *plasma*. After this extraction, we obtained the hemocomponent *cryoprecipitate free plasma*. On the other hand, the hemocomponent *cryoprecipitate* is obtained from *fresh frozen plasma* (left side of figure 5) with temperature between 1º C and 6º C. This plasma is subjected to *process of defrost* and, then, the supernatant plasma is removed (*remotion of plasma*), leaving in the collection pocket only the precipitate protein and 10-15 ml of this plasma. These products form the hemocomponente *cryoprecipitate*. In this process of *remotion of plasma*, the removed *plasma* **produces** also three hemoderivatives of blood: *albumin*, *globulin* and *clotting factors concentrate*, which are important for blood transfusion.

5. Final considerations and future works

This paper presented a case study in the domain of the human blood describing the construction of an ontology about the human blood hemocomponents and hemoderivatives. We hope that this ontology works as a repository for scientific knowledge about the domain, as well as a instrument to support modeling and evaluation of information systems. In order to achieve this goal, the first stage of the research emcompassed the organization of sets of terms (classes and relations, formally defined) and the creation of representation diagrams (taxonomies, partonomies and other diagrams) to map the knowledge of the studied field.

The next stage of this research will consist in the content evaluation of the ontology by expert professionals. Then, it will be possible the incorporation of new terms and formalisms to ontology. In order to enable the evaluation of the HEMONTO content by experts, we plan to create a web interface to the terms of the ontology with possibilities of searching. This interface will be construct to use the implementation of the ontology in Web Ontology Language (OWL), with use of the ontology editor Protégé. In addition to enable the evaluation of HEMONTO, the search interface will work as a support tool for the biomedical professionals in the learning of specific procedures for blood transfusion.

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