

1. Module identification code.	
Name of the institution:	Universidad Autónoma de Nuevo León
Name of the school:	School of Medicine
Name of the degree program:	Clinical Chemistry
Name of the course (learning unit):	Hematology
Total number of class hours-theory and practice:	80
Class hours per week:	4 hours
Independent study:	10
Course modality:	Face-to-face instruction
Module level:	Fifth semester
Core/elective module:	Core
Curriculum area:	ACFP-F
UANL credit points:	3
Create date:	August 28 th , 2017
Date of last amendment made:	July 29 th , 2022
Person(s) responsible for the design and amendment of the module:	Dr. E. Diana Guadalupe Robles Espino, Clinical Chemist Maydé Sánchez Villarreal

2. Presentation:

The Hematology module (learning unit) consists of four phases, which integrate and provide the student with the basis that would let him perform adequately in a hematology laboratory.

During phase 1: Blood collection. The student will learn how to select the corresponding supplies and equipment based on the patient's condition and the kind of required tests. Besides that, he will apply the safety protocols related to blood collection and current regulations for dangerous waste disposal.

Later on, in phase 2: Lab tests, useful in the diagnosis of anemias. The student will analyze the pathophysiological foundations of the tests, useful in the diagnosis of anemias, and the analytical methodologies that apply in such cases. At the same time, he will be able to handle traditional manual methods used in the Hematology laboratory. Also, within the competences of this phase, the student will be able to interpret the tests, useful in the diagnosis of anemias and correlate them to the most common diagnosis.

In phase 3: Lab tests, useful in the diagnosis of leukocyte alterations, the student will also analyze the pathophysiological foundations of the tests, useful in the diagnosis of leukocyte alterations and the analytical methodologies that apply in such cases. At the same time, he will be able to handle traditional manual methods in the Hematology laboratory. In this phase, the student will also be able to interpret leukocyte alterations in the hematic biometry and the peripheral blood smear, and finally correlate them to different clinical diagnosis.

Finally, in phase 4: Laboratory tests, useful in the diagnosis of hemostatic disorders. The student will analyze the pathophysiological foundations of the tests, useful in the diagnosis of hemostatic disorders. Also, the student will analyze the methodological foundations of the most common tests in the coagulation laboratory. Within its learning process, the student will be able to interpret the tests, useful in the diagnosis of hemostatic disorders, and correlate them to the most frequent clinical diagnosis.

In order for the student to achieve these goals, he will carry out activities that will promote meaningful learning, and also accomplish tasks that show evidence of the competences being acquired. This will let the student make the course integrative project/product that consists of solving a case study about hematic biometry in a practical way, including its subsequent interpretation and clinical correlation.

3. Purpose:

Develop the necessary skills to perform clinical analysis in the hematology laboratory on blood samples, from the informed selection of tests, collection, preparation, conservation and analysis of samples, to the interpretation and reporting of results to collaborate in the prevention, diagnosis, control and treatment of diseases. This learning unit contributes to achieving three general competencies of the UANL; it encourages students to master their mother tongue orally and in writing through the discussion of cases where they demonstrate their ability to use the appropriate medical terms for the identified findings, and also uses appropriate visual or audiovisual resources during their oral presentations; it promotes an attitude of respect and commitment by integrating into work teams in the classroom and laboratory to solve the activities proposed by their teachers, in an environment of peaceful coexistence; He/she shows his/her leadership during the resolution of cases as a team in the classroom and in the laboratory by contributing ideas for the solution of the same, motivating his/her colleagues to meet the objectives of the activities.

He/she collaborates to achieve three specific competencies of the graduate profile, executes the obtaining, handling, storage and analysis of blood samples to contribute to a diagnosis of different hematological diseases, handles chemical substances and hazardous waste in his/her laboratory practice following current regulations, interprets clinical analysis results from the hematology laboratory based on established criteria that allow the making of timely and pertinent decisions in the clinical diagnosis.

Hematology is taught in the fifth semester of the degree and is related to Medical physiology that provides knowledge of the function of organs and systems of the human body, with Biochemistry that provides the bases of human metabolism, and with Pathology that provides the concepts of disease.

Within the learning units of more advanced semesters, there is a relationship with the Blood bank by providing the diagnostic criteria for hematological diseases that require follow-up by Transfusion Medicine, with Clinical Pathology, General exit examination course and Professional practice, providing them with the knowledge required for the interpretation of hematological tests.

4. Competences of the graduate profile

General competences to which this module (learning unit) contributes:

Instrumental skills:

4. To master their mother tongue orally and in writing with correctness, relevance, timeliness and ethics, adapting their message to the situation or context, for the transmission of ideas and scientific findings.

Personal and social interaction skills:

9. To maintain an attitude of commitment and respect towards the diversity of social and cultural practices that reaffirm the principle of integration in the local, national and international context in order to promote environments of peaceful coexistence.

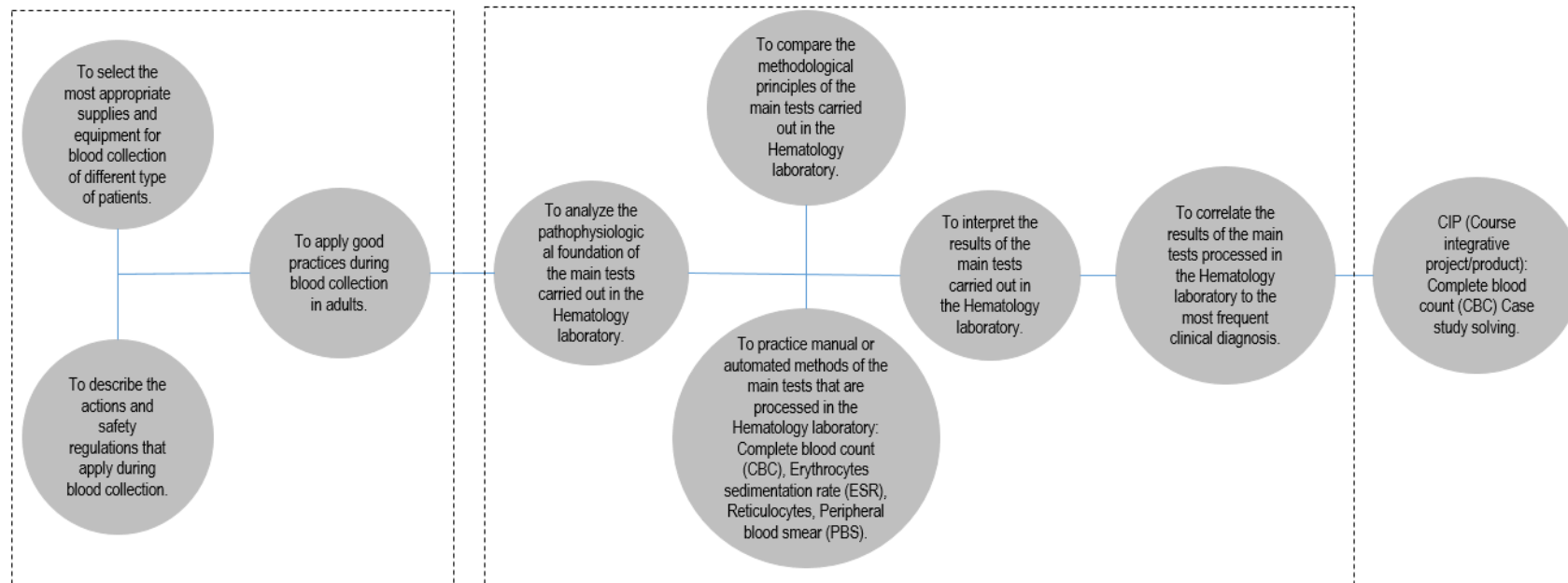
Integrative skills:

13. To assume leadership roles committed to social and professional needs in order to promote relevant social change.

Specific competences of the graduate profile to which this module (learning unit) contributes:

2. To execute physical, chemical and/or biological procedures in the collection, handling, storage and analysis of samples to contribute to a reliable clinical, toxicological, chemical, food, forensic and environmental diagnosis.
3. To handle chemical and biological materials following official Mexican and/or international standards that guarantee their correct use and disposal to preserve health and the environment.
6. To interpret the results of analyses based on established criteria that allow timely and pertinent decision-making in clinical, toxicological, chemical, food, forensic, and environmental diagnosis.

5. Course roadmap:



Phase 1: Blood collection.

Phase 2: Laboratory tests, useful in the diagnosis of anemias

Phase 3: Laboratory tests, useful in the diagnosis of leukocyte alterations

Phase 4: Laboratory tests, useful in the diagnosis of hemostatic disorders

6. Structuring into stages or phases:

Stage 1: Blood collection

Component(s) of the competence:

To select the right technique and supplies for blood collection by considering the corresponding safety regulations in order to obtain an adequate blood sample for its analysis in the laboratory.

Evidence of student learning	Performance criteria	Learning activities	Content	Resources
1. Original video about blood collection procedure.	<p>It is made in teams which are previously distributed by the professor.</p> <p>It is handed in CD or DVD a week after it is assigned by the professor.</p> <p>It is presented in video format. It lasts 4-6 minutes. It shows the process that is followed during blood collection.</p> <p>He or she selects exclusively the supplies for blood collection that are adequate for the patient and the tests to be carried out.</p> <p>He or she considers adequate safety protocols for the patient and the staff.</p>	<p>The professor presents course overview.</p> <p>The professor presents basic concepts by using PowerPoint slides and examples of the topics related to supplies for blood collection, techniques for blood collection and safety regulations applied during blood collection.</p> <p>The professor asks students questions as he presents the topic about blood collection.</p> <p>In teams, students carry out a role play about the different techniques used for blood collection.</p> <p>The student carries out the following lab practice and turns in its corresponding written report.</p>	<p>1.1 Supplies and equipment for blood collection.</p> <p>1.2 Blood collection: Order of draw</p> <p>1.3 Blood collection techniques: Venous and capillary</p> <p>1.4 Safety protocols used during blood collection</p> <p>1.5 Waste disposal regulations related to blood collection</p>	<p>Auditorium equipped with A/V capabilities: a projector, computer, audio system. (large screen, built in seats, whiteboard and carpeted flooring)</p> <p>Teaching laboratory for hematology lab practice.</p> <p>Supplies for blood collection.</p> <p>University Hospital Clinical Laboratory.</p>

		<p>1. Collection of blood by using a syringe. (Accredited learning activity 1.1)</p> <p>Vacuum blood collection system. (Accredited learning activity 1.2)</p> <p>The written report that corresponds to this practice consists of making a trifold brochure about the process of blood collection.</p>		
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Stage 2: Laboratory tests, useful in the diagnosis of anemias.

Component(s) of the competence:

To interpret the results of useful tests in the diagnosis of anemias by considering the patient's clinical situation and the analytical methodologies used to correlate lab findings to the most probable clinical diagnosis.

Evidence of student learning	Performance criteria	Learning activities	Content	Resources
2. Written report: Case study about the interpretation of hematic biometries and other useful tests in the diagnosis of anemias.	<p>It is elaborated individually in the classroom at the time specified by the professor.</p> <p>It is elaborated in the Case Format given by the professor.</p> <p>It includes handwritten answers only and it follows the criteria established in the Case format:</p> <p>Diagnosis and classification of anemias, CBC and PBS findings, clinical correlation, and analytical methodologies should be considered.</p>	<p>The professor gives a lecture on the topics described in the content by using PowerPoint slides.</p> <p>The professor designs case studies in the problems that may arise during the process of hematic biometry.</p> <p>The professor designs case studies in anemias.</p> <p>The student makes a three-column table in which he compares manual methods and automated methods of Complete Blood Count (CBC) parameters.</p> <p>The student takes a tour to the area of Hematology of the Central Laboratory, guided by the professor.</p>	<p>2.1 Metabolic mechanisms that the erythrocyte carries out.</p> <p>2.2 Catabolism of the erythrocyte.</p> <p>2.3 Synthesis, function and catabolism of hemoglobin.</p> <p>2.4 Erythrocyte parameters and indices of Hematic Biometry</p> <p>2.5 Manual methods to determine HB.</p> <p>2.6 Automated method to determine Hematic Biometry.</p> <p>2.7 Basic concepts of anemia, anisocytosis, poikilocytosis and hypochromia.</p>	<p>Auditorium equipped with A/V capabilities: a projector, computer, audio system. (large screen, built in seats, whiteboard and carpeted flooring)</p> <p>Teaching laboratory for lab practice.</p> <p>University Hospital Clinical Laboratory.</p> <p>Reading assignment: Fundamentals of HB parameters from the Cell-dyn Ruby System Operations Manual.</p>

		<p>The student reads about CBC parameters from the Cell-dyn equipment and from the ones generated by warnings. He makes questions about it in written form.</p> <p>The student carries out the following lab practice and turns in its corresponding written report.</p> <p>1. Dosage of hemoglobin (Accredited learning activity 2.1)</p> <p>2. Determination of hematocrit and medium concentration of corpuscular hemoglobin (Accredited learning activity 2.1)</p> <p>3. Erythrocyte sedimentation ratio (ESR) (Accredited learning activity 2.3).</p> <p>4. Reticulocyte count (Accredited learning activity 2.4).</p> <p>The student works on practical case study about “red series” in the practice laboratory. (Accredited learning activity 2.5)</p> <p>The student takes phase 2 exam. (Accredited learning activity 2.6).</p>	<p>2.8 Classification of anemias.</p> <p>2.9 Anemia due to iron deficiency.</p> <p>2.10 Megaloblastic anemia</p> <p>2.11 Hemolytic anemias (hereditary and acquired)</p> <p>2.12 Aplastic anemia</p> <p>2.13 Causes, symptoms, differential diagnosis, treatment, evolution and prognosis of each of the anemias</p>	
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Stage 3. Laboratory tests, useful in the diagnosis of leukocyte alterations.

Component(s) of the competence:

To interpret the results of useful tests in the diagnosis of leukocyte alterations by considering the patient's clinical condition and the analytical methodologies used to correlate lab findings to the most probable clinical diagnosis.

Evidence of student learning	Performance criteria	Learning activities	Content	Resources
3. Written report: Case study about the interpretation of hematic biometries and other useful tests in the diagnosis of leukocyte alterations.	<p>It is elaborated individually in the classroom at the time specified by the professor.</p> <p>It is elaborated in the Case Format given by the professor.</p> <p>It includes handwritten answers only and it follows the criteria established in the Case Format:</p> <p>Assessment of leukocyte alterations, CBC and PBS findings, clinical correlation, and analytical methodologies should be considered.</p>	<p>The professor gives a lecture about the topics described in the content by using PowerPoint slides.</p> <p>The professor designs case studies in the problems that may arise during the process of hematic biometry related to the determination of leukocytes.</p> <p>The professor designs case studies related to the topic: Alterations of leukocytes. The student makes a three-column table in which he compares formed elements of normal peripheral blood.</p> <p>The student makes a three-column chart of</p>	<p>3.1 Origin and functions of leukocytes.</p> <p>3.2 Classification of leukocytes according to their morphological characteristics (Monocytes, lymphocytes, neutrophils, eosinophils and basophils)</p> <p>3.3 Manual count of leukocytes and Differential white blood cell count.</p> <p>3.4 Description and foundation of the automated method for leukocyte count.</p> <p>3.5 Basic concepts of leukocytosis, leukopenia, and leukemia.</p>	<p>Auditorium equipped with A/V capabilities: a projector, computer, audio system. (large screen, built in seats, whiteboard and carpeted flooring)</p> <p>Teaching laboratory for lab practice.</p> <p>University Hospital Clinical Laboratory.</p> <p>Readings: Fundamentals of CBC parameters and of warnings from the Cell-dyn Ruby System Operations Manual.</p> <p>Reports of HB results.</p> <p>Collection of PBS presenting leukocyte alterations and tinted with Wright.</p>

		<p>the morphological alterations of leukocytes.</p> <p>The student carries out the following lab practice and turns in its corresponding written report.</p> <ol style="list-style-type: none"> 1. White blood cell count A (Accredited learning activity 3.1). 2. White blood cell count B (Accredited learning activity 3.2). 3. Extension and coloration. (Accredited learning activity 3.3). 4. Differential white blood cell count. (Accredited learning activity 3.4) <p>The student carries out practical case studies: White blood cell count, differential white blood cell manual count and Complete blood count (CBC). (Accredited learning activity 3.5, 3.6 and 3.7).</p> <p>The student takes phase 3 exam. (Accredited learning activity 3.8).</p>	<p>3.6 Morphological alterations of leukocytes. Classification and causes of leukemia.</p> <p>3.7 Warnings in the functioning and of I parameters of leucocytes</p> <p>3.8 Acute leukemia's.</p> <p>3.9 Chronic leukemia's.</p>	
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Stage 4. Laboratory tests, useful in the diagnosis of hemostatic disorders.

Component(s) of the competence:

To interpret the results of useful tests in the diagnosis of hemostatic disorders by considering the patient's clinical condition and the analytical methodologies used to correlate lab findings to the most probable clinical diagnosis.

Evidence of student learning	Performance criteria	Learning activities	Content	Resources
4. Oral presentation: Case study about the interpretation of tests results that assess disorders of the hemostatic mechanism.	<p>It is presented in teams in the classroom at the time specified by the professor.</p> <p>It includes a fifteen-minute oral presentation.</p> <p>The team elaborates a 10-slide PowerPoint presentation which should be turned in a class session prior to the oral presentation. It includes:</p> <ul style="list-style-type: none"> -Pathophysiology of illness. -Useful tests for the diagnosis. -Interpretation of lab tests. -Clinical correlation. 	<p>The professor lectures about the topics described in the content by using PowerPoint slides.</p> <p>The professor designs case studies about hemostatic disorders and useful tests for their diagnosis.</p> <p>The student makes a summary of the article "Quality control in the coagulation laboratory."</p> <p>The student solves case studies about coagulation disorders and useful tests for their diagnosis.</p>	<p>4.1 Hemostasis.</p> <p>4.2 Vascular phase.</p> <p>4.3 Platelet phase: functions of the platelets, factors that are produced and their role in hemostasis.</p> <p>4.4 Plasma assay of the coagulation cascade: coagulation cascade, its pathways, specific and common factors.</p> <p>4.5 Fibrinolytic phase: fibrinolysis, its components and purpose of this system.</p> <p>4.6 Laboratory tests to assess hemostasis.</p>	<p>Auditorium equipped with A/V capabilities: a projector, computer, audio system. (large screen, built in seats, whiteboard and carpeted flooring)</p> <p>Teaching laboratory for lab practice.</p> <p>University Hospital Clinical Laboratory.</p> <p>Readings: McKenzie. S.B 1998. Hematología Clínica. Tercera edición. Manual Moderno. (Chapter 22)</p> <p>Ruiz-Argüelles. G.J. 2003. Fundamentos de Hematología. Tercera</p>

	-Differential diagnosis. -References.	The student takes a guided tour to the coagulation area of the central laboratory. The student takes phase 3 exam (Accredited learning activity 4.1).	4.7 Vascular system syndromes (hereditary and acquired). 4.8 Disorders related to platelets. 4.9 Disorders related to secondary hemostasis.	edición. Editorial Médica Panamericana. (Chapter 19 – 21) El control de la calidad en el laboratorio de coagulación. Rev Med Inst Mex Seguro Soc 2008; 46(3): 339-348. Moderno. (Chapter 22) Ruiz-Argüelles. G.J. 2003. Fundamentos de Hematología. Tercera edición. Editorial Médica Panamericana. (Chapter 19 – 21) El control de la calidad en el laboratorio de coagulación. Rev Med Inst Mex Seguro Soc 2008; 46(3): 339-348.
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7. Summative evaluation:

Stage	Evidence and weighted activities	Weighting
Stage 1 9 %	Evidence 1: Original video about blood collection procedure.	5 %
	Accredited learning 1.1 Practice Report: Introduction to Clinical Laboratory and Blood Draw	2 %
	Accredited learning 1.2 Trifold brochure about the process of blood collection.	2 %
Stage 2 25.5%	Evidence 2: Written report: Case study about the interpretation of Complete Blood Count and other useful tests in the diagnosis of anemias.	5 %
	Accredited learning 2.1 Lab practice report: Dosage of hemoglobin	2 %
	Accredited learning 2.2 Lab practice report: Determination of hematocrit and medium concentration of corpuscular hemoglobin	2 %
	Accredited learning 2.3 Lab practice report: Erythrocyte sedimentation ratio (ESR)	2 %

	Accredited learning 2.4 Lab practice report: Reticulocyte count	2 %
	Accredited learning 2.5 Practical case studies: Red blood cell count	2.5 %
	Accredited learning 2.6 Knowledge test of the content of stage 1 and 2	10 %
Stage 3 30.5 %	Evidence 3: Written report: Case study about the interpretation of Complete Blood Count and other useful tests in the diagnosis of leukocyte alterations.	5 %
	Accredited learning 3.1 Lab practice report: White blood cell count A	2 %
	Accredited learning 3.2 Lab practice report: White blood cell count B	2 %
	Accredited learning 3.3 Lab practice report: Extension and coloration	2 %
	Accredited learning 3.4 Lab practice report: Differential white blood cell count.	2 %
	Accredited learning 3.5 Practical case studies: White blood cell count.	2.5 %
	Accredited learning 3.6 Practical case studies:Differential white blood cell count.	2.5 %
	Accredited learning 3.7 Practical case: Complete blood count (CBC)	2.5 %
Stage 4 15 %	Accredited learning 3.8: Knowledge test of the content of stage 3	10 %
	Evidence 4: Oral presentation: Case study about the interpretation of tests results that assess disorders of the hemostatic mechanism.	5 %
CIP 20%	Accredited learning 4.1: Knowledge test of the content of stage 4	10 %
	Oral presentation of a Complete Blood Count (CBC) case study.	20 %
	Total	100 %

8. Course integrative project/product:

Oral presentation of a Complete Blood Count (CBC) case study using PowerPoint slides. The student should include a sample being processed in the laboratory and later on, it is interpreted and correlated to a clinical diagnosis, based on solid argumentation. This presentation will be given in front of the professors that are in charge of the course. See appendix.

9. References:

Abbott Laboratories. (2009). *Manual de Operaciones del Sistema Cell-dyn Rubí*. España

Henry, J.B. (2007). *El laboratorio en el diagnóstico clínico*. España: editorial Marbán.

Robles, D. y Sánchez, M. (2022). *Manual de prácticas de hematología*. México: Facultad de Medicina, UANL.

Rodak, B. F. (2014). *Hematología fundamentos y aplicaciones clínicas*. México: editorial Médica Panamericana.

Ruiz, G.J. (2003). *Fundamentos de hematología*. México: editorial Médica Panamericana.

Web resources for free use

BD. Guía práctica para la extracción de sangre. Recuperado en:
<http://www.enfermeriaaps.com/portal/download/LABORATORIO-TOMA%20DE%20MUESTRAS/Guia%20practica%20para%20la%20extraccion%20sanguinea%20BD%20Diagnostics%20-%20Diagnostic%20Systems.pdf> (20/07/2020).

Fink, N. (2005). *Automatización en Hematología*. *Hematología*, Vol. 9, pp.4-16. Recuperado en:
<http://www.sah.org.ar/revista/numeros/vol9.n1.4.16.pdf> (20/07/2020)

Gómez, V. [Maestro Víctor] 2018, diciembre 29. *Extendido de sangre periférica*. Recuperado en:
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NOM-087-ECOL-SSA1-2002. *Protección ambiental - Salud ambiental - Residuos peligrosos biológico-infecciosos - Clasificación y especificaciones de manejo*. Recuperado en: <http://www.salud.gob.mx/unidades/cdi/nom/087ecolssa.html> (20/07/2020).

Ochoa, A.A. (2008). *El control de calidad en el laboratorio de coagulación*. *Revista Médica del Instituto Mexicano del Seguro Social*, 339-348. Recuperado en: <https://www.mediagraphic.com/pdfs/imss/im-2008/im083p.pdf> (20/07/2020)

World Health Organization (2010). *Guidelines on drawing blood: best practices in phlebotomy*. Recuperado en: https://www.who.int/infection-prevention/tools/injections/drawing_blood_best/en/ (20/07/2020)