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# Antithrombotics in concept maps: an innovative approach to Pharmacology education in Dentistry

Gustavo Lucas Ribeiro Batista[1]
0000-0002-1841-9809

Rafael Lara Brasil[1]
0000-0002-5118-4829

Erica Negrini Lia[1]
0000-0001-5691-415X

[1]Departamento de Odontologia, Faculdade de Ciências da Saúde, Universidade de Brasília (UnB), Brasília, Distrito Federal, Brasil.

Correspondence:
Gustavo Lucas Ribeiro Batista
E-mail: gustavolrb2008@gmail.com

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**Abstract** This study aimed to develop concept maps (CMs) on antithrombotic drugs for undergraduate dentistry teaching with information based on updated scientific evidence. Initially, consulting the scientific literature carried out a list of the fundamental concepts. Next, information on antithrombotic drugs was organized, and the focal questions were defined. The concepts were then inserted into the CMs, and the conceptual relationships were established. Then, searches were carried out in the PubMed, Scopus, and Embase databases for systematic reviews published in the last ten years using the terms "antithrombotics", "antiplatelet", "anticoagulants", "antithrombotic therapy", "dentistry" and "dental surgery". In total, 23 articles were found, 12 were excluded, and 11 articles were included in the study. Subsequently, the CMs layouts were organized using the CmapTools software (v. 6.04). Eight CMs were developed on the hemostatic process, blood coagulation cascade, mechanism of action of anticoagulants and antiplatelet agents, and drug and food interactions. The CMs produced contain essential information for the training of Dentistry students on a topic of great importance, especially for surgical cases. Future studies will be conducted to test the effectiveness of these CMs on learning.
**Descriptors:** Education, Dental. Anticoagulants. Platelet Aggregation Inhibitors. Hemostasis.

**Antitrombóticos en mapas conceptuales: un enfoque innovador para la enseñanza de Farmacología en Odontología**
**Resumen** El objetivo de este estudio fue desarrollar mapas conceptuales (MCs) sobre fármacos antitrombóticos dirigidos a la enseñanza de la Odontología con información basada en evidencia científica actualizada. Inicialmente se identificaron los conceptos fundamentales consultando la literatura científica. A continuación, se organizó la información relacionada con los fármacos antitrombóticos y se definieron las preguntas focales. Los conceptos se insertaron en los MCs y se establecieron relaciones conceptuales. Para mejorar los conceptos se realizaron búsquedas en las bases de datos PubMed, Scopus y Embase de revisiones sistemáticas publicadas en los últimos diez años utilizando los términos *antithrombotics*, *antiplatelet*, *anticoagulants*, *antithrombotic therapy*, *dentistry* y *dental surgery*. En total se encontraron 23 artículos, 12 fueron excluidos y por tanto se incluyeron 11 artículos. Posteriormente se organizaron los diseños de MCs mediante la aplicación CmapTools (versión 6.04). Se desarrollaron ocho MCs sobre el proceso hemostático, la cascada de coagulación sanguínea, el mecanismo de acción de los anticoagulantes y antiplaquetarios y las interacciones entre medicamentos y alimentos. Los MCs producidos contienen información esencial para la formación de los estudiantes de Odontología en un tema de gran importancia, especialmente para los casos quirúrgicos. Se realizarán estudios futuros para probar la eficacia de los MCs en el aprendizaje.
**Descriptores:** Educación en Odontología. Anticoagulantes. Inhibidores de la Agregación Plaquetaria. Hemostasia.

**Antitrombóticos em mapas conceituais: uma abordagem inovadora para o ensino de Farmacologia em Odontologia**
**Resumo** O objetivo desse estudo foi desenvolver mapas conceituais (MCs) sobre fármacos antitrombóticos direcionados ao ensino de Odontologia com informações baseadas em evidências científicas atualizadas. Inicialmente os conceitos

fundamentais foram identificados por meio de consulta à literatura científica. Em seguida, informações relacionadas aos fármacos antitrombóticos foram organizadas e as perguntas focais definidas. Os conceitos foram inseridos nos MCs e estabelecidas as relações conceituais. Para aprimorar os conceitos foram realizadas buscas nas bases de dados PubMed, Scopus e Embase por revisões sistemáticas publicadas nos últimos dez anos utilizando os termos *antithrombotics, antiplatelet, anticoagulants, antithrombotic therapy, dentistry* e *dental surgery*. Ao total foram encontrados 23 artigos, 12 foram excluídos e, portanto, 11 artigos foram incluídos. Subsequentemente, os *layouts* dos MCs foram organizados por meio do aplicativo CmapTools (versão 6.04). Foram desenvolvidos oito MCs sobre processo hemostático, cascata da coagulação sanguínea, mecanismo de ação dos anticoagulantes e antiagregantes plaquetários, interação medicamentosa e alimentar. Os MCs produzidos contém informações essenciais para a formação do aluno de Odontologia acerca de um tema de grande importância, em especial para casos cirúrgicos. Estudos futuros serão conduzidos para testar a eficácia dos MCs sobre o aprendizado.

**Descritores:** Educação em Odontologia. Anticoagulantes. Inibidores da Agregação Plaquetária. Hemostasia.

## INTRODUCTION

There are topics of great interest in Dentistry, such as anticoagulants and antiplatelet agents, considering the increasing prescription for patients who have had or are at risk of thromboembolic events[1]. However, a considerable portion of dentists still do not understand the mechanism of action of these drugs and fear uncontrollable bleeding during and after dental surgical procedures, thus avoiding immediate patient care[1].

Given their complexity and difficulty of understanding, concept maps (CMs) can be used as a strategy for their teaching[2–4]. CMs are graphic organizers representing knowledge through propositions, composed of three essentials elements: the initial and final concepts, and the linking term (LT)[2]. The use of CMs has significantly benefited the health sciences field due to their ability to make connections between concepts which increases critical thinking, reflection, and the student's ability to fully practice metalearning, which means "learning to learn"[4].

There are few studies on using CMs in teaching Pharmacology, especially for dental students. Given the above, this study aimed to develop CMs on antithrombotic drugs at undergraduate Dentistry education, with information based on updated scientific evidence.

## METHODS

Concept maps (CMs) were developed on the pharmacodynamics of drugs involving anticoagulant and antiplatelet therapies, drug and food interactions, and their implications in dental practice.

To this end, a list of fundamental concepts regarding the basic and clinical Pharmacology of anticoagulants and antiplatelet agents was initially compiled using book chapters[5,6]. Next, the focal questions (FQs) were defined, concepts were inserted into the map, and conceptual relationships were established. Finally, the ideas were reviewed, and the concepts were refined through literature searches in the PubMed, Scopus, and Embase databases for systematic reviews published in the last ten years (Table 1). A total of 23 articles were found, with 12 excluded (five duplicates, four unrelated to the topic, and three narrative reviews). In total, 11 articles were included in the study[7-17] (Figure 1). Subsequently, the Propositional Clarity Table (PCT)[2] was used, and the map layout was organized.

**Table 1.** Search strategies used for PubMed, Scopus, and Embase databases.

| Database | Search on 01/11/2022 |
|---|---|
| PubMed | *(((((antithrombotics) OR (antithrombotic therapy)) OR (antiplatelet)) OR (anticoagulants)) AND (dentistry)) AND (dental surgery)*<br>Filters: ten last years and systematic revisions |
| Scopus | (TITLE-ABS-KEY (antithrombotic OR "antithrombotic therapy" OR antiplatelet OR anticoagulants AND dentistry AND "dental surgery") AND TITLE-ABS-KEY ("systematic review")) AND PUBYEAR > 2012 AND PUBYEAR > 2012 |
| Embase | (antithrombotics OR 'antithrombotic therapy' OR antiplatelet OR anticoagulants) AND dentistry AND 'dental surgery' AND (2013:py OR 2014:py OR 2016:py OR 2017:py OR 2018:py OR 2019:py OR 2020:py OR 2021:py) AND 'systematic review'/de |

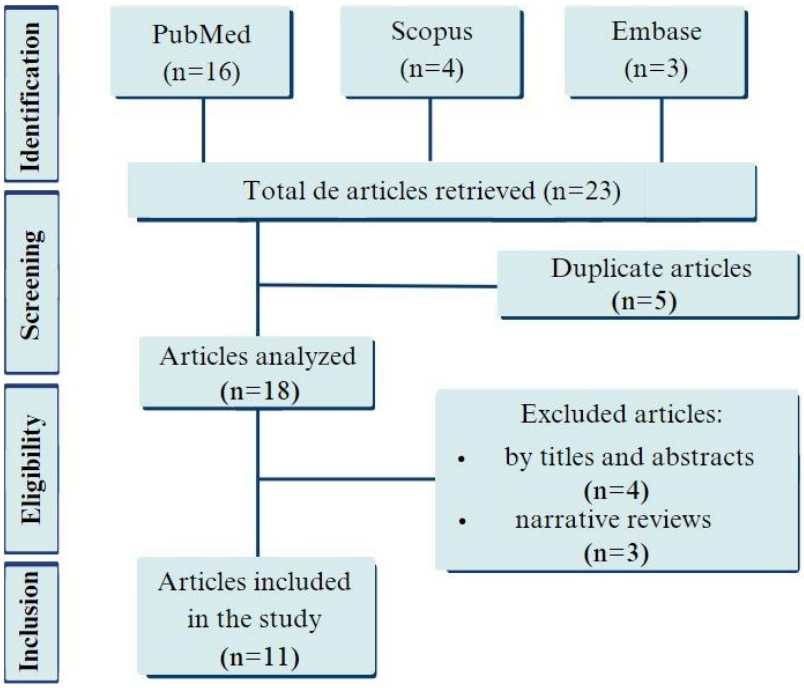


**Figure 1.** Study selection flowchart.

## RESULTS

The first FQ generated the first CM (Figure 2), which reviews the coagulation cascade's main points. The second FQ generated the second CM, which addresses the mechanisms of action of different anticoagulants (Figure 3). The third FQ supported the construction of the third CM on the hemostatic process (Figure 4). The fourth FQ generated the fourth CM on the mechanisms of action of different antiplatelet agents (Figure 5). The drug and food interactions of direct oral anticoagulants (DOACs), antiplatelet agents, Vitamin K antagonists, and heparins were presented in the remaining CMs (Figures 5, 6, 7, and 8, respectively).

The CMs should be read starting from the proposition formed by two concepts (initial and final) connected by an arrow, with a linking term (LT) in the middle, indicating the direction of the reading. It allows for defining the initial concept, the conceptual relationship, and the final concept of the proposition. Example: COAGULATION CASCADE-----is divided into----->INTRINSIC PATHWAY.

The first CM (Figure 2) presents the blood coagulation cascade, showing all the steps of the three pathways: intrinsic (in green), extrinsic (in blue), and common (in yellow). The extrinsic pathway is responsible for most of the coagulation in vivo, while the intrinsic pathway is mainly *in vitro*, and both converge at the activation point of factor X. Factor Xa and Thrombin (IIa) are the linking points to the second CM (Figure 3).

The second concept map (CM) (Figure 3) shows the mechanisms of action of the principal anticoagulants and their

sites of action, Thrombin (IIa), Antithrombin III, Factor Xa, and Vitamin K, in the coagulation cascade. The linking points between the first and second CMs are Factor Xa and Thrombin (IIa).

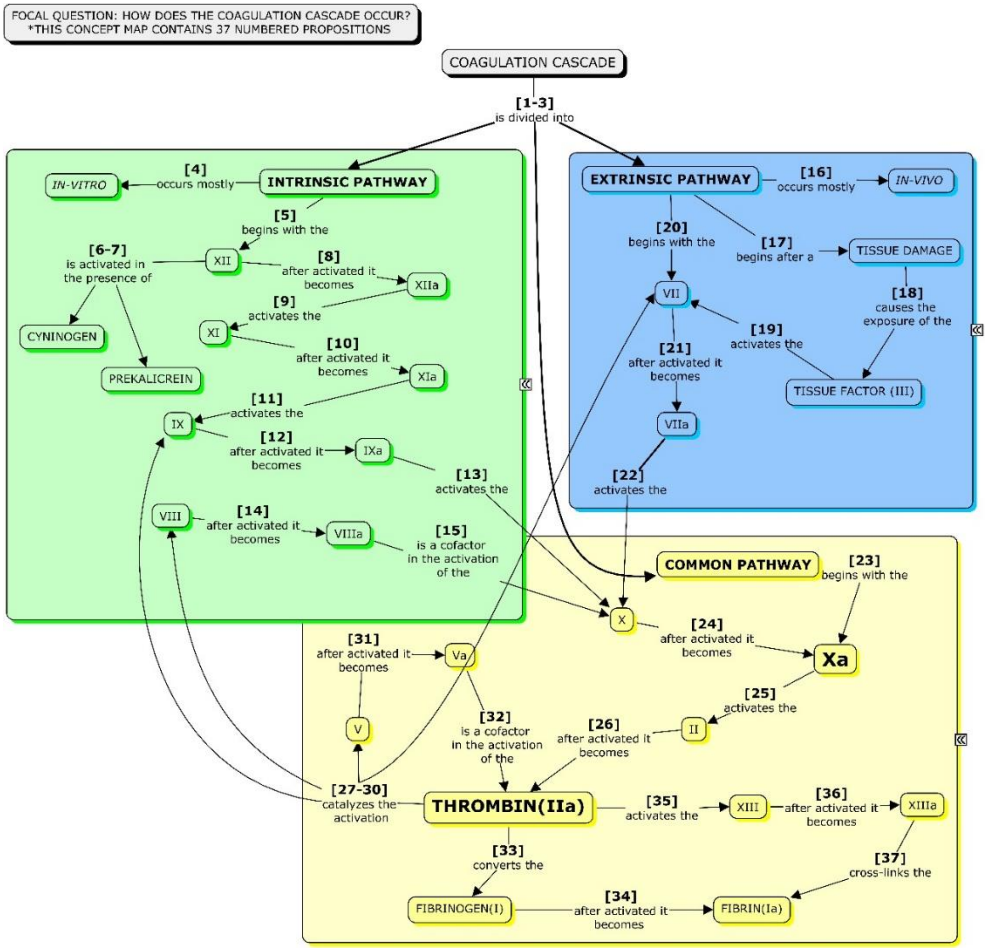


**Figure 2.** Concept Map of the Blood Coagulation Cascade. The concepts refer to blood coagulation factors, with the term "factor" omitted (e.g., factor X). The term "a" following the factors means activated (e.g., factor Xa, read as activated factor X).

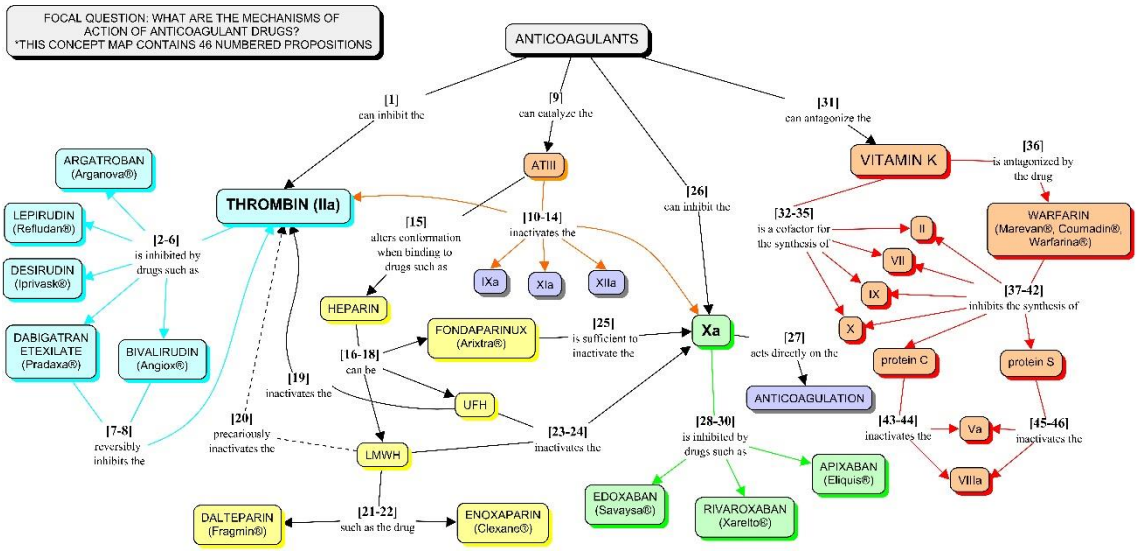


**Figure 3.** Concept Map of the mechanisms of action of Anticoagulants. Thrombin (IIa) inhibitors are in blue; Heparins in yellow; Factor Xa inhibitors in green; Vitamin K antagonists in red; Antithrombin III (ATIII) inhibitors in orange; and other factors and the concept of anticoagulation in purple. LMWH (Low Molecular Weight Heparin), UFH (Unfractionated Heparin).

The third CM (Figure 4) structures the hemostatic process divided into four phases: vasoconstriction (in red), primary hemostasis (in yellow), secondary hemostasis (in blue), and tertiary hemostasis (in green). This division is merely didactic, as these phases can occur simultaneously. The concepts ADP, TxA2, and Platelet Aggregation link points to the fourth CM (Figure 5).

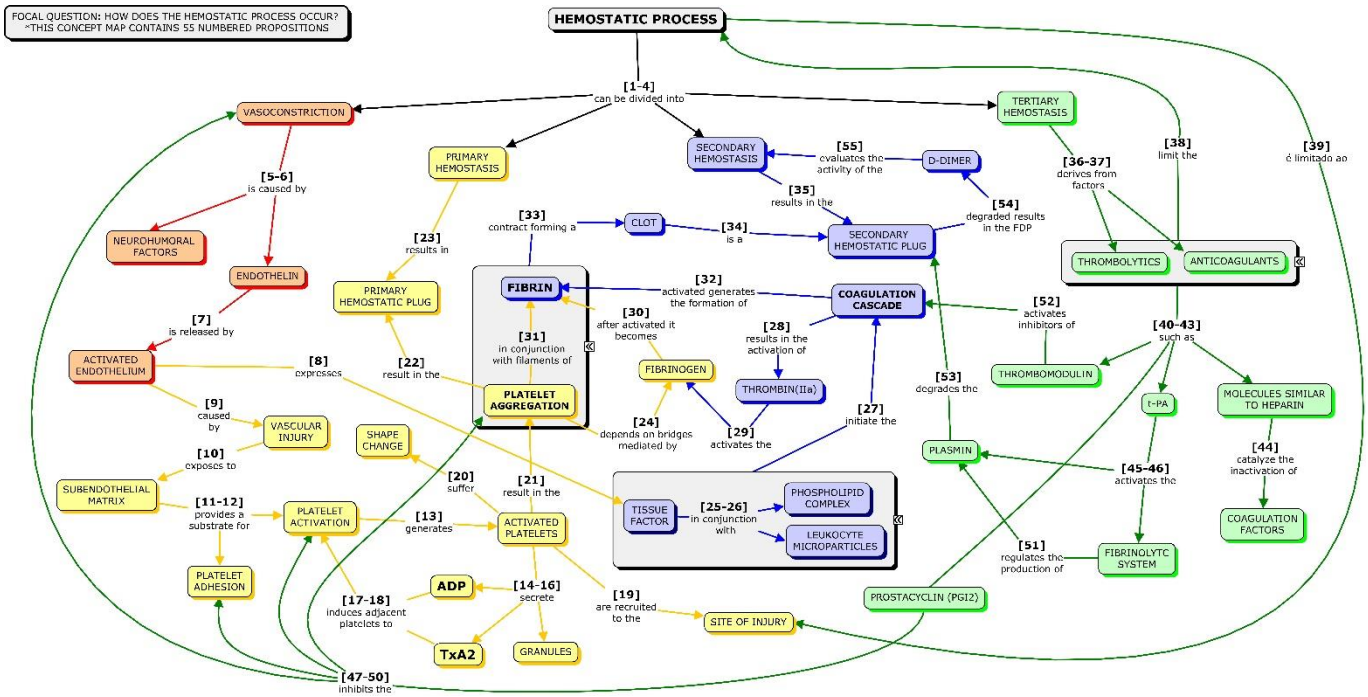


**Figure 4.** Concept Map of the Hemostatic Process Scheme. ADP (Adenosine Diphosphate), TxA2 (Thromboxane A2), t-PA (tissue plasminogen activator), and FDP (Fibrin Degradation Product).

The fourth concept map (CM) (Figure 5) illustrates the mechanisms of action of the main antiplatelet agents and their sites of action, such as COX1, TxA2; GPIIb/IIIa receptors, platelet aggregation via fibrinogen bridges; and ADP receptors (P2Y12), platelet activation. The fourth CM links to the third CM (Figure 4) through the COX1, ADP receptors, and GPIIb/IIIa receptors (concepts).

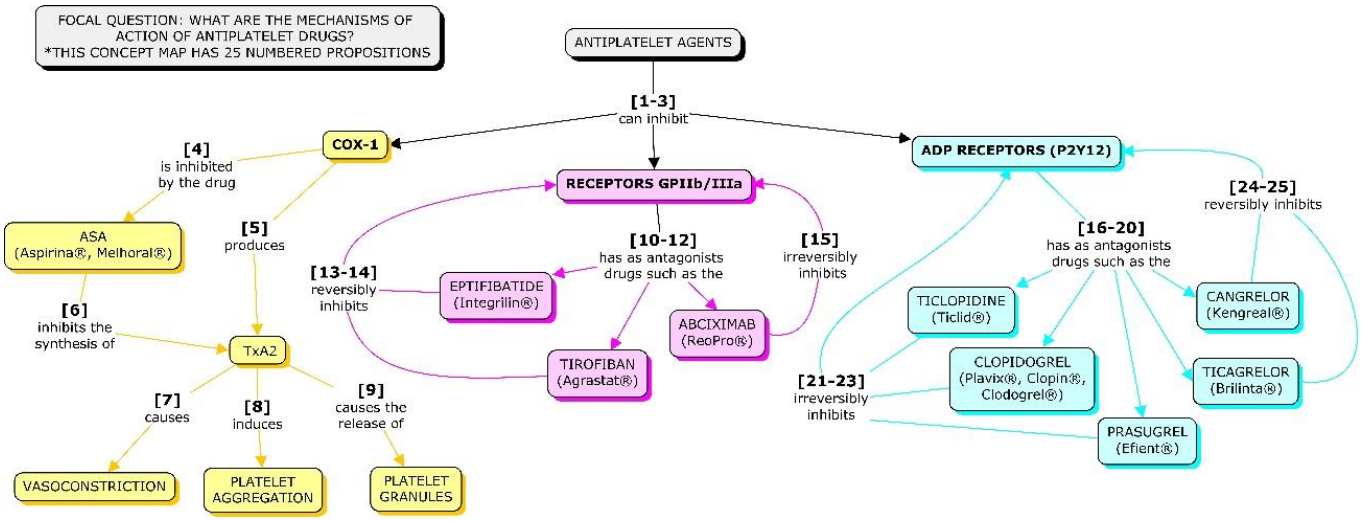


**Figure 5.** Concept Map of the mechanisms of action of Antiplatelet Agents. COX-1 (cyclooxygenase-1), ASA (acetylsalicylic acid) and TxA2 (thromboxane A2), ADP (Adenosine Diphosphate), GPIIb/IIIa Receptors (Glycoprotein IIb/IIIa Receptors), ADP Receptors – P2Y12 (Adenosine Diphosphate Receptors - P2Y12). Colors were used to sectorize the key points of the CM, which are the concepts COX1 (in yellow), GPIIb/IIIa Receptors (in pink), and ADP Receptors – P2Y12 (in blue).

CMs numbered 5 to 8 (Figures 6 to 9) highlight the principal drug and food interactions of anticoagulants and antiplatelet agents such as antibiotics, azole antifungals, analgesics, macrolides, anticonvulsants, nonsteroidal anti-inflammatory drugs (NSAIDs), barbiturates, foods rich in vitamin K, and alcohol. Additionally, in these CMs, the intensity of the interaction is presented by colors, such as lower, moderate, or higher. The intensity of the interaction was established using the academic license database of DrugBank, provided free of charge by the University of Alberta[18]. The concepts in CMs numbered 5 to 8 were not numbered as they only present examples of drugs, making a reading sequence unnecessary. The color intensity indicates the degree of interaction intensity. In shades of yellow (lower), orange (moderate), and dark orange (higher), drugs and foods that increase the effect of the drugs in each CM and increase the risk of bleeding are presented; in shades of light green (lower), green (moderate), and dark green (higher), drugs and foods that decrease the effect of the drugs in each CM are presented.

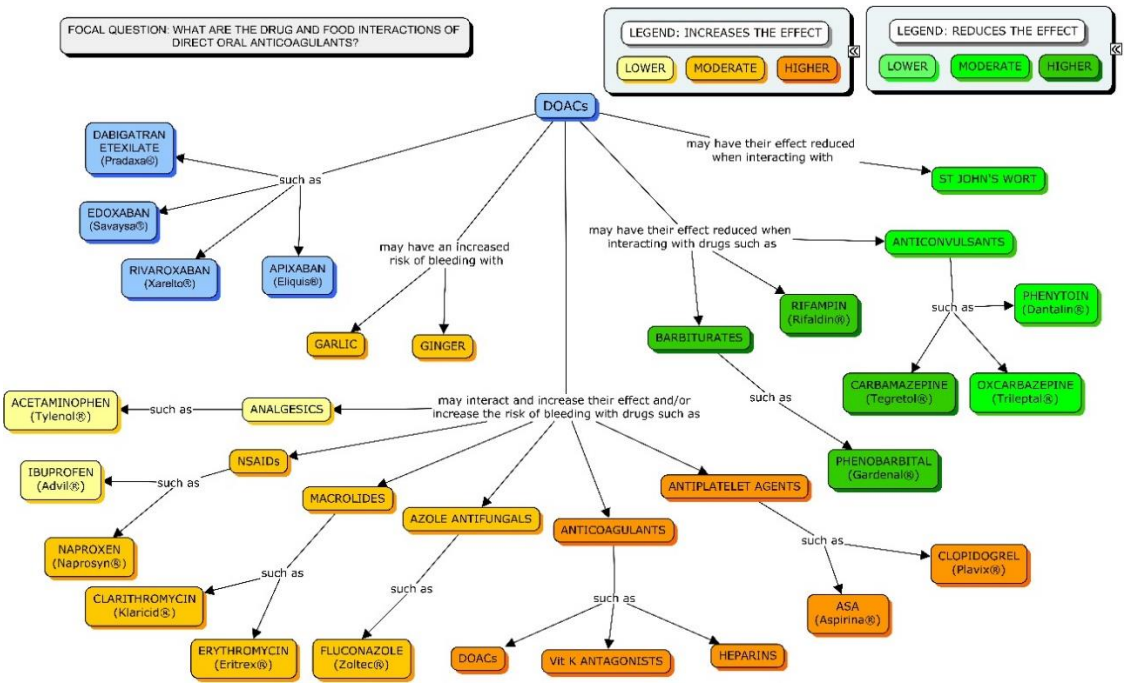


**Figure 6.** Concept Map of drug and food interactions of DOACs (Direct Oral Anticoagulants), NSAIDs (Nonsteroidal Anti-inflammatory Drugs). Examples of DOACs are highlighted in blue.

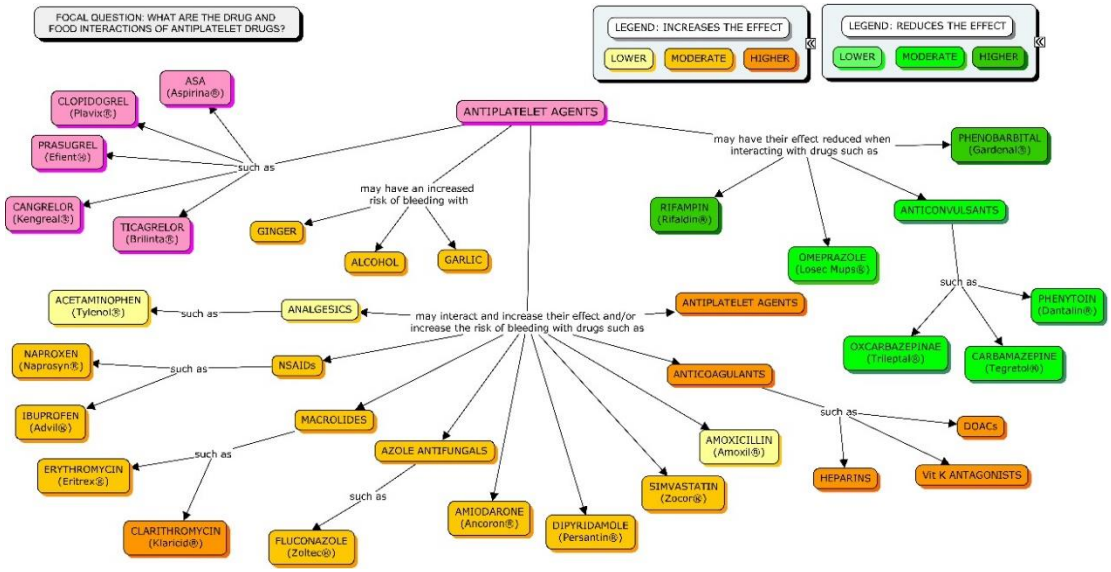


**Figure 7.** Concept Map of drug and food interactions of Antiplatelet Agents. ASA (Acetylsalicylic Acid), DOACs (Direct Oral Anticoagulants), NSAIDs (Nonsteroidal Anti-inflammatory Drugs). Examples of Antiplatelet Agents are highlighted in pink.

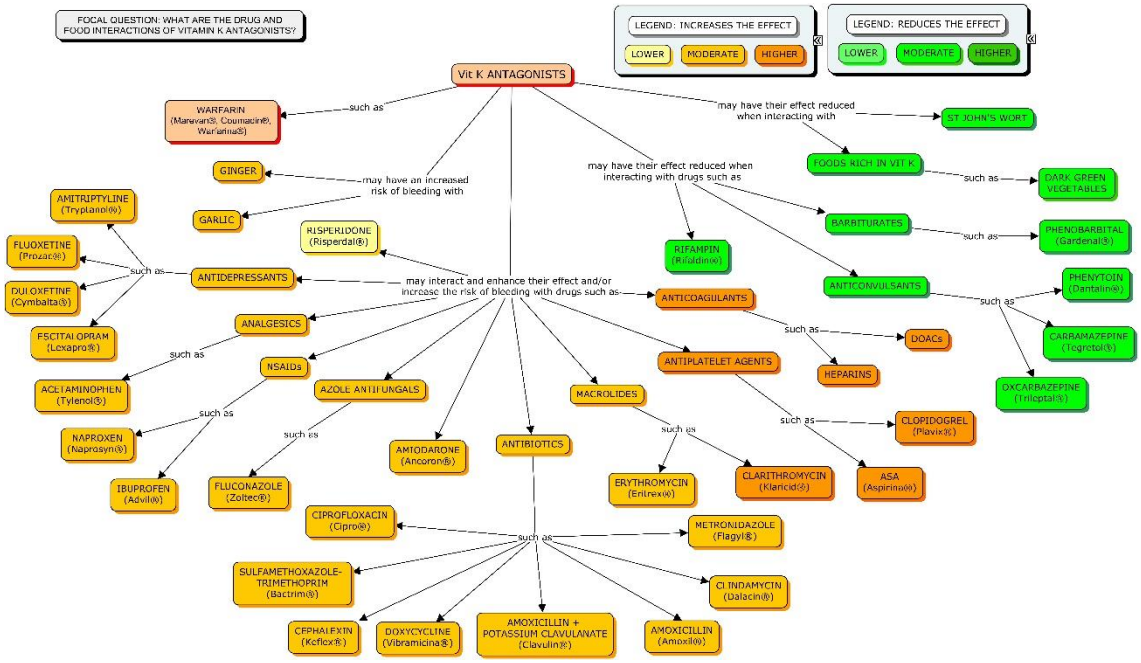


**Figure 8.** Concept Map of drug and food interactions of Vitamin K Antagonists. ASA (Acetylsalicylic Acid), DOACs (Direct Oral Anticoagulants), NSAIDs (Nonsteroidal Anti-inflammatory Drugs), Vit K Antagonists (Vitamin K Antagonists). Examples of Vitamin K Antagonists are highlighted in red.

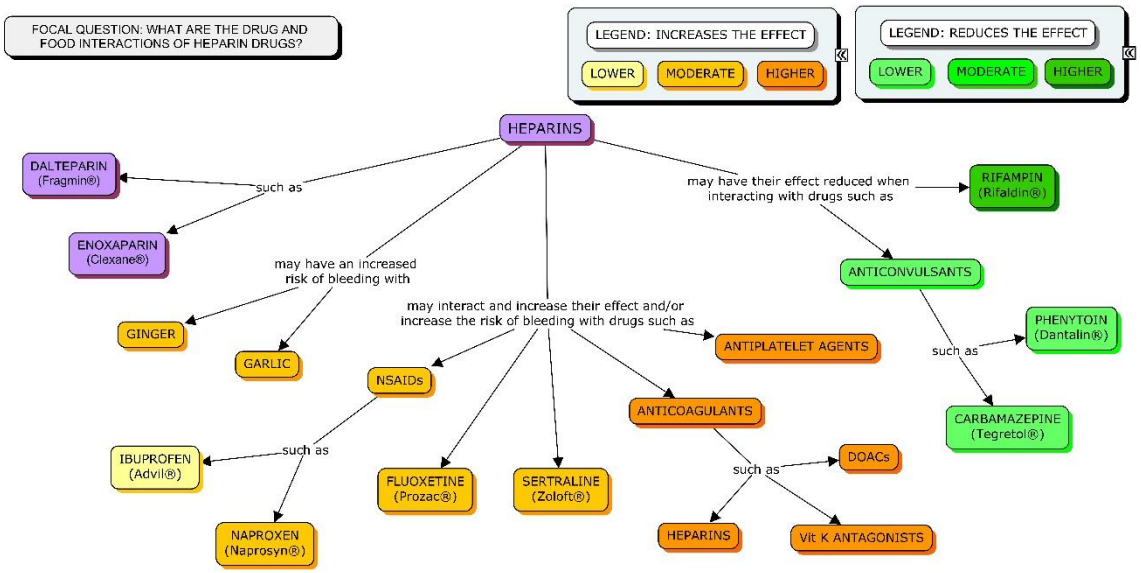


**Figure 9.** Concept Map of drug and food interactions of Heparins. DOACs (Direct Oral Anticoagulants), NSAIDs (Nonsteroidal Anti-inflammatory Drugs), Vit K Antagonists (Vitamin K Antagonists). Examples of Heparins are highlighted in purple.

## DISCUSSION

In this study, CMs were constructed on anticoagulants and antiplatelet agents, a topic that raises many questions for students and clinicians regarding dental procedures that cause bleeding. The produced CMs are graphical representations that gather information about the pharmacodynamics of anticoagulants and antiplatelet agents. Therefore, they serve as support material for dynamic study and review of the topic. As such, they assist students and professionals during the care of patients who have an increased risk of bleeding due to the use of antithrombotics. Thus, the content present in this material is a valuable tool for meaningful learning[3,19,20] about the mapped topic, bringing the student closer to the specialized knowledge of professor[2]. Additionally, the CMs constructed in this study can help identify and understand

possible drug and food interactions with anticoagulants and antiplatelet agents. This information is essential for dental practice, as it allows for safe and informed decision-making when dealing with patients who use these medications.

It is important to emphasize that concept maps differ from mind maps, because they include concepts (initial and final) and LTs. The concept consists of one or more words that define regularities perceived in objects and events[2]. The LT explains the conceptual relationship between the initial and final concepts, ideally using a conjugated verb to define the relationship [2]. However, specifically regarding the CMs constructed in the study, it was decided to insert examples of drugs at the end of the propositions, which justifies the absence of verbs in these LTs.

The use of CMs as a teaching tool has been widely studied, given its effectiveness in promoting meaningful learning[3,20]. By visualizing the relationships between concepts, students can better understand the organization and structure of knowledge [20], identify gaps in their understanding, and integrate new information more efficiently [2].

The CMs present hierarchically distributed concepts, with more general concepts at the beginning (top) and more specific ones at the end (bottom)[2,21]. It is necessary to define a FQ[2,21] to delimit the subject to be addressed by the CM, which will help evaluate whether all concepts fit the theme to limit the scope of the CM, thus avoiding overly extensive CMs. The FQ can be compared to the title of an essay. In a didactic manner, and as a guide for the reader, the propositions were numbered, and colors were inserted to sectorize groups of concepts that integrate different categories.

Considering the educational objectives of knowledge organization, study, and review, the produced Concept Maps (CMs) were based on the most recurrent applications of CMs in the literature, such as inserting new content or themes, organizing information hierarchically, describing complex processes, reviewing content from the most important concepts, synthesizing extensive content, addressing doubts and providing timely feedback[2]. Therefore, Therefore, the student can use the already constructed CM as support material during their studies and reviews. It is important to emphasize that CMs are configured as instructional materials, as they are produced through systematic consultations in specialized literature. In our study, the construction of CMs will allow them to be available to students and professionals to stimulate initial learning. Once students receive the ready CM, they will perform its dynamic reading and, thus, can dedicate their cognitive resources to the studied topic. At the same time, while the CM creator focuses on the concept mapping technique[22]. This technique avoids the cognitive overload that could be generated by requiring the student to learn to produce the CM while learning a new content to be mapped, facilitating the teaching-learning process[23]. The CMs produced in our study were reviewed to ensure there was no saturation of information and the inclusion of unnecessary or confusing visual information, avoiding cognitive overload [23].

After the Concept Maps (CMs) production, a propositional clarity table was used to correct the CMs semantically. This step allowed for the analysis of each proposition individually to verify its clarity and precision[2]. Thus, conceptual errors were corrected. Through the establishment of the Focus Question (FQ), hierarchical organization of concepts, semantic clarity of propositions, and continuous revisions, the necessary parameters for the proper production of CMs were followed[21]. Consequently, the main quality indicators of a CM were considered, such as its structure and content, which refer to the graphical organization and the set of propositions, respectively[23].

The CMs developed in this study were constructed through systematic searches in the scientific literature, which increases their reliability. However, it is important to recognize that CMs can be improved and refined over time as new scientific evidence emerges.

An integrative literature review gathered studies that showed the advantages of using CMs as a learning resource that allows for the organization of knowledge, the hierarchy of concepts, the development of students' autonomy, and critical thinking[20]. Studies showed more meaningful learning, with more significant cognitive gain and integration between theory and practice, through CMs compared to traditional teaching methods, such as discussion based on questions and answers[24], for students in health-related courses[25,26]. However, learning the concept mapping technique and putting it into practice can initially seem difficult[27], in addition to being a task that requires practice and time[28]. Thus, students may initially have difficulties adhering to concept maps (CMs). However, with the inclusion of a facilitator whose role is to discuss the peculiarities of CMs and explain how to use the tool, these difficulties are gradually overcome[27]. Therefore, it is suggested that CMs be integrated into the educational process, as they are highly effective in improving students'

academic performance[28]. With this strategy in mind, our study opted to develop CMs to provide them ready-made to students.

As limitations of this study, it was observed that the number of studies on CMs in Dentistry, especially in clinical pharmacology, is still tiny. Few have compared the effectiveness of using CMs with traditional pedagogical techniques in Dentistry students. Furthermore, there are not many clinical studies, both observational and experimental, on the impact of using antithrombotics in Dentistry, whose methodological quality is not always adequate. This fact explains the low number of systematic reviews produced on the subject, the quality of the evidence generated, and the low degree of recommendation of practices. Unlike the medical field, expert opinions are used to guide the management of patients using antithrombotics in dentistry. However, it is important to highlight that there are several particularities in dental procedures and, in most cases, medical studies cannot be used as a parameter for dental practice. Finally, although it was not the scope of this study, the need for the development of clinical research on the impact of the use of antithrombotics in Dentistry was observed, considering the bleeding risks associated with various types of procedures, hemostasis management, and the risk of drug interactions.

The study in question is preliminary and focused on constructing CMs based on scientific evidence. Future studies will be conducted to test the effectiveness of the developed CMs and compare them with other pedagogical strategies involving the addressed topic.

## CONCLUSION

The produced CMs contain essential information for the training of Dentistry students on a topic of great importance, especially for surgical cases. Future studies will be conducted to test the effectiveness of this teaching strategy.

## REFERENCES


1. Felix J, Chaban P, Ouanounou A. Dental management of patients undergoing antithrombotic therapy. Em J Can Dent Assoc [Internet]. 2020 [cited 2022 Nov 22];86:k17. Available from: https://jcda.ca/k17
2. Correia PRM, Aguiar JG, Viana AD, Cabral GCP. Por que vale a pena usar mapas conceituais no ensino superior? Em Rev Grad USP [Internet]. 2016 [cited 2022 Feb 27];1(1):41-45. Available from: https://www.revistas.usp.br/gradmais/article/view/117724
3. Porto RP, Haas SE. Utilização de mapas conceituais em farmacologia: uma estratégia para a promoção da aprendizagem significativa. SIEPE [Internet]. 2020 [cited 2022 Nov 22];9(1). Available from: https://periodicos.unipampa.edu.br/index.php/SIEPE/article/view/85482
4. Gomes AP, Dias-Coelho UC, Cavalheiro P O, Siqueira-Batista R. O papel dos mapas conceituais na educação médica. Em Rev Bras Educ Méd [Internet]. 2011;35(2):275–82. doi: https://doi.org/10.1590/S0100-55022011000200018
5. Armstrong AW, Golan DE. Farmacologia da hemostasia e trombose. In Golan ED, Tashjian JR AH, Armstrong EJ, Armstrong AW. Princípios de farmacologia: a base fisiopatológica da farmacologia. 3 ed. Rio de Janeiro: Editora Guanabara Koogan; 2014. p. 375-399.
6. Hogg K, Weitz JI. Coagulação sanguínea e fármacos anticoagulantes, fibrinolíticos e antiplaquetários. In Brunton LL, Hilal-Dandan R, Knollmann, B. As bases farmacológicas da terapêutica de Goodman e Gilman. 13 ed. Porto Alegre: AMG; 2019. p. 723-747.
7. Saez-Alcaide L, Sola-Martin C, Molinero-Mourelle P, Paredes-Rodriguez V, Zarrias-Caballero C, Hernandez-Vallejo G. Dental management in patients with antiplatelet therapy: a systematic review. Em J Clin Exp Dent [Internet]. 2017;9(8):e1044-e1050. doi: https://doi.org/10.4317/jced.54079
8. Dawoud BES, Kent S, Tabbenor O, George P, Dhanda J. Dental implants and risk of bleeding in patients on oral anticoagulants: a systematic review and meta-analysis. Em Int J Implant Dent [Internet]. 2021;7(1):82. doi: https://doi.org/10.1186/s40729-021-00364-5
9. Ockerman A, Bornstein MM, Leung YY, Li SKY, Politis C, Jacobs R. Incidence of bleeding after minor oral surgery in patients on dual antiplatelet therapy: a systematic review and meta-analysis. Em Int J Oral Maxillofac Surg [Internet]. 2020;49(1):90-98. doi: https://doi.org/10.1016/j.ijom.2019.06.002

10. Calcia TBB, Oballe HJR, Silva AMO, Friedrich SA, Muniz FWMG. Is alteration in single drug anticoagulant/antiplatelet regimen necessary in patients who need minor oral surgery? A systematic review with meta-analysis. Em Clin Oral Investig [Internet]. 2021;25(6):369-338. doi: https://doi.org/10.1007/s00784-021-03882-z
11. Andrade NK, Motta RHL, Bergamaschi CDC, Oliveira LB, Guimarães CC, Araújo JDO, et al. Bleeding risk in patients using oral anticoagulants undergoing surgical procedures in dentistry: a systematic review and meta-Analysis. Front Pharmacol [Internet]. 2019;10:866. doi: https://doi.org/10.3389/fphar.2019.00866
12. Cetira Filho EL, Franco JMPL, Ribeiro TR, Silva PGB, Costa FWG. Does platelet-rich fibrin prevent hemorrhagic complications after dental extractions in patients using oral anticoagulant therapy? J Oral Maxillofac Surg [Internet]. 2021;79(11):2215-2226. doi: https://doi.org/10.1016/j.joms.2021.07.003
13. Muñoz-Corcuera M, Ramírez-Martínez-Acitores L, López-Pintor RM, Casañas-Gil E, Hernández-Vallejo G. Dabigatran: A new oral anticoagulant. Guidelines to follow in oral surgery procedures. A systematic review of the literature. Em Med Oral Patol Oral Cir Bucal [Internet]. 2016;21(6):e679-e688. doi: https://doi.org/10.4317/medoral.21202
14. Ockerman A, Miclotte I, Vanhaverbeke M, Verhamme P, Poortmans LL, Vanassche T, et al. Local haemostatic measures after tooth removal in patients on antithrombotic therapy: a systematic review. Em Clin Oral Investig [Internet]. 2019;23(4):1695-1708. doi: https://doi.org/10.1007/s00784-018-2576-x
15. Manfredi M, Dave B, Percudani D, Christoforou J, Karasneh J, Diz Dios P, et al. World workshop on oral medicine VII: Direct anticoagulant agents management for invasive oral procedures: A systematic review and meta-analysis. Oral Dis [Internet]. 2019;25(Suppl1):157-173. doi: https://doi.org/10.1111/odi.13086
16. Comoretto RI, Rea F, Lucenteforte E, Mugelli A, Trifirò G, Cascini S, et al. Bleeding events attributable to concurrent use of warfarin and other medications in high-risk elderly: meta-analysis and Italian population-based investigation. Eur J Clin Pharmacol [Internet]. 2018;74(8):1061-1070. doi: https://doi.org/10.1007/s00228-018-2467-8
17. Weltman JN, Al-Attar Y, Cheung J, Duncan DPB, Katchky A, Azarpazhooh A, et al. Management of dental extractions in patients taking warfarin as anticoagulant treatment: A systematic review. Em J Can Dent Assoc [Internet]. 2015 [cited 2022 Nov 22];81:20; Available from: https://jcda.ca/article/f20
18. Wishart DS, Feunang YD, Guo AC, Lo EJ, Marcu A, Grant JR, et al. DrugBank 5.0: A major update to the DrugBank database for 2018. Nucleic Acids Res [Internet]. 2018;4(46):1074-1082 [cited 2023 Feb 15]. Available from: https://go.drugbank.com/
19. Daley BJ, Durning SJ, Torre DM. Using concept maps to create meaningful learning in medical education. MedEdPublish [Internet]. 2016,5:19. doi: https://doi.org/10.15694/mep.2016.000019
20. Medeiros JO, Ribeiro RC, Sousa MNA. Mapa conceitual como ferramenta de aprendizagem: revisão integrativa da literatura. SANARE [Internet]. 2021 [cited 2024 Apr 14];19(2):1477. Available from: https://sanare.emnuvens.com.br/sanare/article/view/1477
21. Aguiar JG, Correia PRM. Como fazer bons mapas conceituais? Estabelecendo parâmetros de referências e propondo atividades de treinamento. RBPEC [Internet]. 2013 [cited 2022 Apr 27];13(2):141-157. Available from: https://periodicos.ufmg.br/index.php/rbpec/article/view/4265
22. Correia PRM, Cabral GCP, Aguiar JG. Cmaps with errors: why not? Comparing two Cmap-based assessment tasks to evaluate conceptual understanding. Innov Conc Map [Internet]. 2016 [cited 2022 Apr 27];635:1-15. Available from: http://link.springer.com/10.1007/978-3-319-45501-3_1
23. Silva KS, Fonseca LS, Correia PRM. Abordagem neurocognitiva de processos atencionais envolvidos na aprendizagem mediada por mapas conceituais. Rev Bras En Ciên Tec [Internet]. 2020 [cited 2022 Jul 10];13(2):247-268. doi: http://dx.doi.org/10.3895/rbect.v13n2.9421
24. Sorte SR, Sande S, Rathod SB, Vij VA, Gumashta J, Muthiyan G, et al. Concept mapping a potential pedagogical strategy to foster meaningful learning in physiology students. J Educ Health Promot [Internet]. 2024;13(1):2. doi: https://doi.org/10.4103/jehp.jehp_728_23
25. Carvalho DPSRP, Vitor AF, Barichello E, Villar RLA, Pereira-Santos VE, Ferreira-Junior MA. Aplicação do mapa conceitual: resultados com diferentes métodos de ensino-aprendizagem. Aquichan [Internet]. 2016;16(3):382-391. doi: https://doi.org/10.5294/aqui.2016.16.3.9
26. Bressington DT, Wong WK, Lam KKC, Chien WT. Concept mapping to promote meaningful learning, help relate theory to practice and improve learning self-efficacy in asian mental health nursing students: a mixed-methods pilot

study. Nurse Educ Today [Internet]. 2018;60:47-55. doi: https://doi.org/10.1016/j.nedt.2017.09.019

27. Melo LA, Bezerra MVM, Melo LA, Martins CMA, Correia MS, Albuquerque RS. Diálogo sobre a construção de um mapa conceitual como recurso para aprendizagem: relato de experiência. Rev Iberoam Educ Invest Enferm [Internet]. 2015 [cited 2024 Apr 14];5(4):50-58. Available from: https://www.enfermeria21.com/revistas/aladefe/articulo/184/dialogo-sobre-a-construcao-de-um-mapa-conceitual-como-recurso-para-aprendizagem-relato-de-experiencia/
28. Izci E, Akkoc EA. The impact of concept maps on academic achievement: A meta-analysis. Heliyon [Internet]. 2023;10(1):E23290. doi: https://doi.org/10.1016/j.heliyon.2023.e23290

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