



Nursing in mechanical prevention of venous thromboembolism in surgical patients

Enfermagem na prevenção mecânica de tromboembolismo venoso em pacientes cirúrgicos

La enfermería en la prevención mecánica del tromboembolismo venoso en pacientes quirúrgicos

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ABSTRACT

Objective: This theoretical study aims to discuss the role of nurses in the mechanical prevention of venous thromboembolism in surgical patients. **Method:** The study considered the updated versions of the main international guidelines and reviews on the topic. Non-pharmacological measures to prevent venous thromboembolism in surgical patients and the role of nurses are discussed. **Results:** It is important that surgical nurses include in their activities risk of assessments for venous thromboembolism and non-pharmacological prophylactic measures, based on scientific evidence and well-designed institutional protocols. **Conclusion:** Among the mechanical measures, the use of graduated compression stockings and intermittent pneumatic compression should be ensured by nurses.

DESCRIPTORS

Thromboembolism; Venous Thromboembolism; Patient Safety; Surgical Procedures, Operative; Operating Room Nursing.

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INTRODUCTION

Venous thromboembolism (VT), characterized mainly by deep vein thrombosis (DVT) and pulmonary embolism (PE), represents a serious health complication for hospitalized clinical and surgical patients, high associated costs and longer hospital stay⁽¹⁾. VT is the most frequent cause of preventable death in these patients, in addition to being the third cause of death of cardiovascular origin, after coronary disease and cerebrovascular accident⁽¹⁻³⁾.

Currently, it is recognized that clinical patients are at risk for VT as much as those undergoing surgical procedures. However, some studies indicate that surgical patients receive less proper prophylaxis measures than clinical ones⁽¹⁻²⁾.

In the pathophysiology of VT, one or more of the following factors are present: hypercoagulability, stasis and endothelial injury. The stasis generated by immobilization of the lower limbs or by resting for more than 3 days, common in the perioperative period, increases the risk for VT. The same is observed in severe trauma, spinal trauma and congestive heart failure (CHF)⁽³⁻⁵⁾.

The frequency of thromboembolic complications, as well as its adverse consequences and economic impact justify the priority of thromboprophylaxis for the safety of the surgical patient, being a significant factor to reduce morbidity and mortality in the short and long term. However, there are still doubts about this type of intervention and about the ideal form of delivery, although it has been more than five decades since it was demonstrated that specific prophylaxis could reduce VT and almost three decades after the first guideline based on evidence to guide the practices of the prophylaxis of this disease⁽³⁻⁵⁾.

Despite the guidelines to guide VT prophylaxis, adherence to these guidelines is still not ideal, increasing the number of cases of high-risk patients who could have prevented this event if they had received proper care. It is estimated that mechanical prophylaxis is even less prescribed and used properly⁽⁶⁾.

This theoretical study aims to discuss the role of nurses in mechanical prevention of VT in surgical patients, considering the main international guidelines and reviews on the topic^(2,4-5,7-8).

The guidelines that were considered are classic references in the area that have been updated in recent years^(2,4-5,7-8). Guidelines that were only about pharmacological prophylaxis were excluded. The role of nurses is discussed in a session with reference to the NIC - Nursing Interventions Classification taxonomy and a guideline from the North American Association of periOperative Registered Nurses (AORN), considering that there are no national guidelines⁽⁹⁾.

MECHANICAL PROPHYLAXIS FOR VENOUS THROMBOEMBOLISM

The main non-pharmacological methods of prophylaxis for VT include the use of graduated compression elastic stockings (GCES), intermittent pneumatic compression

(IPC) and venous pumps for feet, the passive and active movement of the lower limbs, in addition to early ambulation⁽³⁻⁴⁾. Although these methods do not increase the risk of bleeding, research on these practices is scarce, according to a wide literature review⁽³⁾. Currently, evidence indicates its use for patients at a high risk of bleeding or combined with pharmacological prophylaxis to try to increase its effectiveness⁽³⁾.

The American College of Chest Physicians (ACCP) guideline and the European guideline on perioperative prophylaxis for VT still consider mechanical prophylaxis as a controversial topic^(3,7). The guideline recognizes that there are few studies on GCES and IPC, however, it registers that there is clinical significance recognized in the practice of associating these methods with pharmacological strategies, which is the most adopted practice in surgery services today⁽⁵⁾.

There are few studies on the effectiveness of using GCES in most surgical specialties in preventing VT, but there is evidence that its use has significant results in some scenarios, such as plastic, orthopedic, cardiac and neurological surgeries^(3,10-11). A systematic review concluded that it was not possible to evidence its benefit in protecting against pulmonary embolism, but the preventive effect on DVT was demonstrated⁽⁸⁾.

The GCES must have a pressure gradient, with the distal pressure being higher, close to the foot, and lower near the thigh, usually with a minimum compression of 20 mmHg⁽¹²⁾. Stockings above the knee cause greater discomfort and are difficult to handle to perform daily care. At the knee and thigh, they are usually better tolerated and effective in preventing DVT⁽¹²⁻¹⁴⁾. GCES can be classified as mild (< 15 mmHg), for rest and prevention of varicose veins; medium compression (20 to 30 mmHg) or therapeutic elastics, to prevent DVT; and high compression or antithrombus (30 to 40 mmHg), for post-thrombotic syndrome and severe chronic venous insufficiency⁽¹⁵⁾.

Controversies in the use of GCES are related to its isolated use and the possibility of increasing skin lesions⁽⁵⁾. It is recommended not to use GCES without pharmacological measures, in addition to observing a safe protocol for permanent assessment of the skin, peripheral pulses and the coloring of the extremities during their use⁽⁵⁾. The heat generated by the use of GCES can weaken the skin and favor injuries and infections. Nurses must have this evaluation routine while the patient is using GCES and IPC, especially observing regions of bony prominences. In patients with decreased sensitivity in the limbs, the presence of pale skin, loss of integrity, markings due to excessive compression, reports of pain or discomfort should be checked^(12,15-16).

Like elastic stockings, IPC also seems to be more effective in preventing DVT in relation to the PE, also in the postoperative period^(3,17-19). When compared to stockings, IPC has been shown to have better results^(7,11,20-21). IPC decreases stasis by repeatedly compressing the limb, with periodic intervals, at an inflation pressure of 35-40 mmHg and an increase in flow speed from 180% to 240%⁽¹⁵⁾.

European guidelines contraindicate the use of isolated GCES for patients of intermediate and high risk and advise that, for patients who cannot receive pharmacological prophylaxis, the use of IPC is more indicated than elastic stockings⁽⁵⁾. Routine GCES and IPC are also contraindicated in patients using pharmacoprophylaxis, except for those considered to be at high risk for VT⁽⁵⁾. IPC combined with pharmacological agents can decrease the risk of VT, but increase the risk of bleeding when compared only with the use of IPC alone, and can decrease the risk of PE, compared to pharmacological prophylaxis alone^(7,11,21). The contraindications to the use of IPC are: acute lung edema, DVT of the lower limbs, severe peripheral arterial disease in the lower limbs, bypass surgery of the aorta and arteries of the lower limbs, severe dermatitis, skin ulcers, recent skin graft, peripheral neuropathy and severe edema or presence of deformity of the lower limbs or surgeries that prevent the use of the resource⁽¹²⁻¹³⁾.

INSTITUTIONAL PROTOCOLS FOR THE USE OF MECHANICAL PROPHYLAXIS FOR VENOUS THROMBOEMBOLISM IN SURGICAL PATIENTS

The ACCP has published guidelines for the treatment and prevention of VT that have been used for the elaboration of institutional protocols worldwide, having been reinforced by European guidelines^(5,11). In this guideline, it is clear that hospitals should have their protocols for VT prophylaxis instituted and disseminated among the surgical team, considering the association between pharmacological measures or not, highlighting the use of mechanical prevention, especially for patients who have contraindicated anticoagulation⁽⁵⁾.

Considering the evidence and guidelines, institutional protocols should start by recommending the risk stratification of each patient for VT, which should guide non-pharmacological actions and measures⁽³⁾. The number of low-risk patients for VT who receive unnecessary interventions is significant, as well as the number of high and extremely high-risk patients who do not receive them⁽²⁾.

Health institutions must know the profile of patients according to the risk strata, in order to adopt measures for the correct prophylaxis and even allocate resources according to the best evidence⁽⁶⁾. Although the use of GCES and IPC can decrease costs considering the value of the treatment of preventable VT, introducing these measures causes cost to health services. In the public health system, the costs are related to the cost of stockings for high and very high-risk patients, as well as compression devices that have disposable compressors and disposable boots.

The worldwide study ENDORSE, carried out in 32 countries, evaluated the prevalence of inpatients at risk for VT and the proportion of those who received the correct prophylaxis in a total of 358 hospitals, concluding that VT prophylaxis is underutilized worldwide, since only approximately half of these patients received the prophylaxis recommended by the ACCP guidelines⁽²²⁻²³⁾.

Although this study was carried out more than a decade ago, more recent studies have shown that the situation has not changed as it should^(1,3,6).

The Caprini model is the most widespread for risk stratification⁽⁶⁾. In this model, the assessment is individualized, consisting of risk factors that correspond to a score of 1 to 5 points, plus a specific score for women of 1 point when they use contraceptives or hormone replacement therapy, pregnancy or postpartum, prematurity with toxemia or restricted development^(6,24). According to the score achieved by the patient in the evaluation, this is classified as: Low, from 0 to 1 point; Moderate, 2 points; High, 3 and 4 points; and Very High risk, with 5 or more points^(6,24). The ACCP guideline recommends mechanical prophylaxis for patients of moderate and high risk when pharmacological prophylaxis is contraindicated⁽⁷⁾.

In Brazil, the simplified classification of VT risk assessment for surgical patients has been widely used^(2,25), described below.

- Low risk: Operations in patients under 40 years old, without other risk factors; minor operations (less than 30 minutes and without the need for prolonged rest) in patients over 40 years old with no risk other than age; minor trauma;
- Moderate risk: Major surgery (general, urological or gynecological) in patients aged 40 to 60 years old without additional risk factors or in patients under 40 taking estrogens;
- High risk: General surgery in patients over 60 years old or in patients aged 40 to 60 years old with additional risk factors; major surgery in patients with a history of previous DVT or PE or thrombophilia; major amputations; major orthopedic surgeries; major surgeries in patients with malignant neoplasms; major surgeries in patients with other states of hypercoagulability; multiple trauma with fractures of the pelvis, hip or lower limbs.

The Johns Hopkins Hospital in Baltimore, in the United States, started in 2005 a collaborative team for the prevention of VT⁽²⁶⁾. The multidisciplinary team reviewed the protocols and permanently updated them, developed education strategies for hospital professionals and carried out active search and audit actions to assess the improvement of processes and results. The adequate prescription of thromboprophylaxis increased from 26% to 80% of cases⁽²⁶⁾. The development of a computerized decision support tool and the inclusion of professionals from several areas involved ensured the success of the strategy in the hospital⁽²⁶⁾.

A review study pointed to the fact that in addition to alerts in electronic medical records, human alerts by pharmacists and nurses, in a double or triple check strategy, ensure a better prescription⁽²⁷⁾. The involvement of more actors in training and the development and implementation of protocols improves the quality of the prophylaxis prescription, and nursing must be involved in the whole process⁽²⁷⁻²⁹⁾.

NURSING ACTIONS IN THE PREVENTION OF THROMBOEMBOLISM

The nursing evaluation must start in the preoperative period and be continuous until the postoperative period. The Systematization of Perioperative Nursing Care must include the continuous assessment of the risk for VT, as well as the registration of related Nursing Diagnoses and Interventions. Patient counseling should begin in an out-patient pre-operative nursing consultation or during hospitalization, including the indication of the use of stockings, when applicable. In the admission to the operating room, the nurse must plan the application of IPC according to the availability of compressors, the number of surgeries and the indication for risk. Finally, in the postoperative period, the maintenance of these resources must be ensured until spontaneous walking.

In a broad review of the literature on the role of nursing in the prevention of VT, studies were identified that showed actions concerning: the assessment and stratification of the risk of VT (28.5%), compression therapy (14.3%), electrostimulation (14.3%), the position of the lower limbs (14.3%), range of motion exercises (14.3%) and the knowledge of individuals about VT and thromboprophylaxis (14.3%)⁽¹⁶⁾.

The assessment of VT risk by nurses is still not routine in most services^(16,28). However, with the development of institutional protocols and training, nursing must appropriate these tools and include them in their routine^(16,28).

The International Classification of Nursing Interventions presents a set of interventions Precaution against embolism, applicable to the nursing diagnosis Ineffective Peripheral Tissue Perfusion (and the Risk correspondent)⁽³⁰⁾. In this set of Nursing Interventions, activities are divided between caring for patients on pharmacological and mechanical prophylaxis, with the following being those that have a direct relationship with mechanical prophylaxis⁽³⁰⁾:

- Start the appropriate VT regimen in patients at risk immediately in accordance with the organizational policy and protocol;
- Raise any limb that is thought to be affected 20° or more above the level of the heart to increase venous return;
- Apply GCES to reduce the risk of DVT or to prevent its recurrence, according to the policy and the organizational protocol;
- Keep GCES to prevent the development of post-thrombotic syndrome, which is caused by long-standing clots on the affected extremity and reduced venous flow;
- Apply IPC device, according to the policy and the organizational protocol;
- Remove GCES and intermittent pneumatic compression device for 15 to 20 minutes every 8 hours or according to the policy and the organizational protocol;
- Assist the patient with the range of passive or active movement, as appropriate;
- Encourage the patient to flex and extend the foot and legs at least 10 times every hour;

- Change the patient's position every 2 hours, encourage movement or early walking according to what the patient tolerates;
- Avoid massaging or compressing the muscles of the affected limbs;
- Advise patients that they cannot cross their legs and that they should avoid sitting for long periods with their legs hanging down.

Nursing Interventions are submitted to a validation process to compose the NIC catalog. However, the guidelines only indicate or contraindicate interventions and, in this case, do not describe the use of stockings or IPC devices, except for an older guideline from The National Institute of Health and Clinical Excellence (NICE)⁽⁸⁾ and a document from the Joanna Briggs Institute published in 2018⁽³¹⁾. It is a document that guides the use of compression stockings, with a summary of evidence on the topic to be consulted by nurses to implement evidence-based best practices⁽³¹⁾. Based on these last two references, it is worth mentioning in relation to the use of stockings and IPC devices^(8,31):

- Compression stockings should not be offered to patients: with suspicion of peripheral arterial disease, peripheral arterial bypass, peripheral neuropathy or other cause of sensory impairment, dermatitis or skin lesions or weaknesses of the lower limbs, allergy to the material, congestive heart failure, deformities in the lower limbs;
- In edema formation, the limb must be measured again and the stocking adjusted;
- Encourage patients to wear stockings day and night until they no longer have significantly reduced mobility;
- Remove stockings daily for hygiene purposes and inspect the condition of the skin;
- Discontinue the use of stockings, if there is marking, blistering or discoloration of the skin, particularly on the heels and bony prominences, or if the patient feels pain or discomfort;
- Show patients how to properly use the stockings and ensure that they understand that this will reduce their risk of developing VT;
- Monitor the use of compression stockings and offer assistance if they are not being used correctly.

Patients must be evaluated by nursing as a routine, guided by institutional protocols and preventive measures must be implemented. As for pharmacological measures, it is up to the nurse to double check. The non-pharmacological measures are competence of nurses, and must be implemented with initiative, based on evidence, supported by protocols, without waiting for the prescription of another professional. In the operating room, for example, on immediate preoperative admission, the nurse must assess the risk for VT and ensure intraoperative preventive measures.

The AORN guideline advises that nurses in the operating room are in a position to ensure that patients are evaluated

for the risk of VT, that they must initiate preventive measures upon patient admission, participate in the discussion of needs and the selection of prophylactic measures appropriate in each case, collaborating with other members of the surgical team and ensuring the correct indication of the use of non-pharmacological measures⁽³¹⁾.

FINAL CONSIDERATIONS

Venous thromboembolism is an event that deserves attention and care for its prevention. The assessment for

risk stratification must be performed for all surgical patients and mechanical prophylaxis must be instituted for patients in specific conditions, associated with pharmacological prophylaxis.

Surgical nurses must include risk assessments in their activities and institute non-pharmacological measures, based on scientific evidence and well-designed institutional protocols. The use of graduated compression stockings and intermittent pneumatic compression, with evidence-based indications, must be ensured by nurses.

RESUMO

Objetivo: O estudo teórico apresentado tem por objetivo discorrer sobre o papel do enfermeiro na prevenção mecânica do tromboembolismo venoso em pacientes cirúrgicos. **Método:** O estudo considerou as versões atualizadas dos principais *guidelines* internacionais e revisões acerca do tema. Além de serem discutidas as medidas não farmacológicas de prevenção de tromboembolismo venoso em pacientes cirúrgicos e o papel do enfermeiro. **Resultados:** É importante que o enfermeiro cirúrgico inclua, em suas atividades, as avaliações de risco do tromboembolismo venoso e as medidas profiláticas não farmacológicas, baseadas em evidências científicas e protocolos institucionais bem delineados. **Conclusão:** Dentre as medidas mecânicas, o uso de meias elásticas de compressão graduada e a compressão pneumática intermitente devem ser asseguradas pelos enfermeiros.

DESCRITORES

Tromboembolia; Tromboembolia Venosa; Segurança do Paciente; Procedimentos Cirúrgicos Operatórios; Enfermagem de Centro Cirúrgico.

RESUMEN

Objetivo: El estudio teórico presentado tiene como objetivo discurrir sobre el papel del enfermero en la prevención mecánica del tromboembolismo venoso de pacientes quirúrgicos. **Método:** El estudio tuvo en cuenta las versiones actualizadas de las principales directrices y revisiones internacionales sobre el tema, además de discutir las medidas no farmacológicas para la prevención del tromboembolismo venoso en pacientes quirúrgicos y el papel del enfermero. **Resultados:** Es importante que el enfermero quirúrgico incluya, en sus actividades, evaluaciones de riesgo de tromboembolismo venoso y medidas profiláticas no farmacológicas, basadas en la evidencia científica y en protocolos institucionales bien diseñados. **Conclusión:** Entre las medidas mecânicas, los enfermeros deben garantizar el uso de medias elásticas de compresión graduada y la compresión neumática intermitente.

DESCRIPTORES

Tromboembolia; Tromboembolia Venosa; Seguridad del Paciente; Procedimientos Quirúrgicos Operativos; Enfermería de Quirófano.

REFERENCES

- Grosse SD, Nelson RE, Nyarko KA, Richardson LC, Raskob GE. The economic burden of incident venous thromboembolism in the United States: A review of estimated attributable healthcare costs. *Thromb Res.* 2016;137:3-10. <https://doi.org/10.1016/j.thromres.2015.11.033>
- Qaseem A, Chou R, Humphrey LL, Starkey M, Shekelle P; Clinical Guidelines Committee of the American College of Physicians. Venous thromboembolism prophylaxis in hospitalized patients: a clinical practice guideline from the American College of Physicians. *Ann Intern Med.* 2011;155(9):625-32. <https://doi.org/10.7326/0003-4819-155-9-201111010-00011>
- Raymundo SR, Lobo SM, Hussain KM, Hussein KG, Secches IT. What has changed in venous thromboembolism prophylaxis for hospitalized patients over recent decades: review article. *J Vasc Bras.* 2019;18:e20180021. <https://doi.org/10.1590/1677-5449.002118>
- Afshari A, Fenger-Eriksen C, Monreal M, Verhamme P; ESA VTE Guidelines Task Force. European guidelines on perioperative venous thromboembolism prophylaxis: mechanical prophylaxis. *Eur J Anaesthesiol.* 2018;35(2):112-5. <https://doi.org/10.1097/EJA.0000000000000726>
- Samama CM, Afshari A; ESA VTE Guidelines Task Force. European guidelines on perioperative venous thromboembolism prophylaxis. *Eur J Anaesthesiol.* 2018;35(2):73-6. <https://doi.org/10.1097/EJA.0000000000000702>
- Farhat FC, Gregório HC, Carvalho RD. Evaluation of deep vein thrombosis prophylaxis in a general hospital. *J Vasc Bras.* 2018;17(3):184-92. [<https://doi.org/10.1590/1677-5449.007017>]
- Gould MK, Garcia DA, Wren SM, Karanicolas PJ, Arcelus JJ, Heit JA, et al. Prevention of VTE in nonorthopedic surgical patients: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest.* 2012;141(2 Suppl):e227S-77S. <https://doi.org/10.1378/chest.11-2297>
- Hill J, Treasure T; Guideline Development Group. Reducing the risk of venous thromboembolism (deep vein thrombosis and pulmonary embolism) in patients admitted to hospital: summary of the NICE guideline. *Heart.* 2010;96(11):879-82. <https://doi.org/10.1136/hrt.2010.198275>
- Link T. Guideline implementation: prevention of venous thromboembolism: 1.6 www.aornjournal.org/content/cme. *AORN J.* 2018;107(6):737-48. <https://doi.org/10.1002/aorn.12146>
- Sachdeva A, Dalton M, Amaragiri SV, Lees T. Graduated compression stockings for prevention of deep vein thrombosis. *Cochrane Database Syst Rev.* 2014;(12):CD001484 <https://doi.org/10.1002/14651858.CD001484.pub3>

11. Pavon JM, Adam SS, Razouki ZA, McDuffie JR, Lachiewicz PF, Kosinski AS, et al. Effectiveness of intermittent pneumatic compression devices for venous thromboembolism prophylaxis in high-risk surgical patients: a systematic review. *J Arthroplasty*. 2016;31(2):524-32. <https://doi.org/10.1016/j.arth.2015.09.043>
12. Ayhan H, Iyigun E, Ince S, Can MF, Hatipoglu S, Saglam M. A randomised clinical trial comparing the patient comfort and efficacy of three different graduated compression stockings in the prevention of postoperative deep vein thrombosis. *J Clin Nurs*. 2015;24(15-16):2247-57. <https://doi.org/10.1111/jocn.12866>
13. National Institute for Health and Clinical Excellence. Venous thromboembolism: reducing the risk of venous thromboembolism (deep vein thrombosis and pulmonary embolism) in patients admitted to hospital. London: Royal College of Physicians; 2010 [cited 22 May 2020]. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/23346611>
14. Sajid MS, Desai M, Morris RW, Hamilton G. Knee length versus thigh length graduated compression stockings for prevention of deep vein thrombosis in postoperative surgical patients. *Cochrane Database Syst Rev*. 2012;5(5):CD007162. <https://doi.org/10.1002/14651858.CD007162.pub2>
15. Vitor SK, Daou JP, Góis AF. Prevenção de tromboembolismo (trombose venosa profunda e embolia pulmonar) em pacientes clínicos e cirúrgicos. *Diagn tratamento [Internet]*. 2016 [cited 22 May 2020];21(2):59-64. Available from: <http://files.bvs.br/upload/S/1413-9979/2016/v21n2/a5583.pdf>
16. Barp M, Carneiro VSM, Amaral KVA, Pagotto V, Malaquias SG. Nursing care in the prevention of venous thromboembolism: an integrative review. *Rev Eletr Enf*. 2018;20:v20a14. <https://doi.org/10.5216/ree.v20.48735>
17. Urbankova J, Quiroz R, Kucher N, Goldhaber SZ. Intermittent pneumatic compression and deep vein thrombosis prevention: a meta-analysis in postoperative patients. *Thromb Haemost*. 2005;94(6):1181-5. <https://doi.org/10.1160/TH05-04-0222>
18. Zareba P, Wu C, Agzarian J, Rodriguez D, Kearon C. Meta-analysis of randomized trials comparing combined compression and anticoagulation with either modality alone for prevention of venous thromboembolism after surgery. *Br J Surg*. 2014;101(9):1053-62. <https://doi.org/10.1002/bjs.9527> PMID:24916118
19. Morris RJ, Woodcock JP. Intermittent pneumatic compression or graduated compression stockings for deep vein thrombosis prophylaxis? A systematic review of direct clinical comparisons. *Ann Surg*. 2010;251(3):393-6. <https://doi.org/10.1097/SLA.0b013e3181b5d61c>
20. Arabi YM, Khedr M, Dara SI, Dhar GS, Bhat SA, Tamim HM, et al. Use of intermittent pneumatic compression and not graduated compression stockings is associated with lower incident VTE in critically ill patients: a multiple propensity scores adjusted analysis. *Chest*. 2013;144(1):152-9. <https://doi.org/10.1378/chest.12-2028>
21. Kakkos SK, Caprini JA, Geroulakos G, Nicolaides AN, Stansby G, Reddy DJ, et al. Combined intermittent pneumatic leg compression and pharmacological prophylaxis for prevention of venous thromboembolism. *Cochrane Database Syst Rev*. 2016;9(9):CD005258. <https://doi.org/10.1002/14651858.CD005258.pub3>
22. Cohen AT, Tapson VF, Bergmann JF, Goldhaber SZ, Kakkar AK, Deslandes B, et al.; ENDORSE Investigators. Venous thromboembolism risk and prophylaxis in the acute hospital care setting (ENDORSE study): a multinational cross-sectional study. *Lancet*. 2008;371(9610):387-94. [https://doi.org/10.1016/S0140-6736\(08\)60202-0](https://doi.org/10.1016/S0140-6736(08)60202-0)
23. Lopes BA, Teixeira IP, Souza TD, Tafarel JR. Do we know how to prescribe venous thromboembolism prophylaxis to hospitalized patients?. *J Vasc Bras*. 2017;16(3):199-204. <https://doi.org/10.1590/1677-5449.008516>
24. Caprini JA. Risk assessment as a guide for the prevention of the many faces of venous thromboembolism. *Am J Surg*. 2010;199(1, Supl):S3-10. <https://doi.org/10.1016/j.amjsurg.2009.10.006>
25. Maffei FH, Caiafa JS, Ramacciotti E, Castro AA. Normas de orientação clínica para prevenção, diagnóstico e tratamento da trombose venosa profunda. *J Vasc Bras [Internet]*. 2005 [cited 2020 May 22];4(Supl 3):S205-20. Available from: http://www.saudedireta.com.br/docsupload/1334451524Arquivo_4.pdf
26. Streiff MB, Carolan HT, Hobson DB, Kraus PS, Holzmüller CG, Demski R, et al. Lessons from the Johns Hopkins Multi-Disciplinary Venous Thromboembolism (VTE) Prevention Collaborative. *BMJ*. 2012;344 jun19 6:e3935. <https://doi.org/10.1136/bmj.e3935>
27. Kahn SR, Morrison DR, Diendéré G, Piché A, Filion KB, Klil-Drori AJ, et al. Interventions for implementation of thromboprophylaxis in hospitalized patients at risk for venous thromboembolism. *Cochrane Database Syst Rev*. 2018;4:CD008201. [<https://doi.org/10.1002/14651858.CD008201.pub3>
28. Brewer CF, Ip D, Drasar E, Aghakhani P. Reducing inappropriately suspended VTE prophylaxis through a multidisciplinary shared learning programme and electronic prompting. *BMJ Open Qual*. 2019;8(1):e000474. <https://doi.org/10.1136/bmjopen-2018-000474>
29. Duff J, Walker K, Omari A. Translating venous thromboembolism (VTE) prevention evidence into practice: a multidisciplinary evidence implementation project. *Worldviews Evid Based Nurs*. 2011;8(1):30-9. [<https://doi.org/10.1111/j.1741-6787.2010.00209.x>
30. McCloskey JC, Bulechek GM. *Classificação das Intervenções de enfermagem*. 6 ed. Porto Alegre: Artmed; 2016.
31. Long Khanh-Dao Le. Evidence summary. Graduated compression stockings: clinician information. The Joanna Briggs Institute EBP Database, JBI@Ovid. 2018; JBI179.