

Implementing Venous Leg Ulcer Education and Clinical Decision Support: A Quality Improvement Project

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ABSTRACT

BACKGROUND: Venous leg ulcers (VLU) require early identification and treatment to prevent further harm. Health care providers often fail to initiate evidenced-based VLU treatment promptly because of a lack of knowledge of VLU guidelines. **PURPOSE:** To improve early treatment for patients with VLUs presenting to outpatient clinic settings. **METHODS:** Plan-Do-Study-Act cycles were used for this quality improvement project. Virtual education and a comprehensive clinical decision support (CDS) order set were implemented. Outcome metrics included the rate of ankle-brachial index (ABI) testing, mechanical compression therapy, and home health service referrals for patients with VLUs. The frequency with which the CDS order set was used was also measured. **RESULTS:** Forty health care providers attended the virtual education sessions among 3 outpatient clinics. There was an increase in ankle-brachial index testing from pre (n = 7; 15.9%) to post (n = 10; 18.2%) (P = .796), but there was a decline in mechanical compression therapy from pre (n = 15; 34.1%) to post (n = 4; 7.3%) (P = .002) and home health service referrals from pre (n = 11; 25%) to post (n = 9; 16.4%) (P = .322). The CDS order set was used 9 times over 13 weeks. **CONCLUSION:** Future Plan-Do-Study-Act cycles will include completing in-person education and reducing the VLU CDS order set length. Future projects should consider these approaches when implementing evidence-based VLU guidelines.

KEY WORDS: venous leg ulcer, quality improvement, ambulatory setting, patient education

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Venous leg ulcers (VLUs) are a chronic problem in the United States, with an overall prevalence of 1%; this increases to 3% for those older than 65.¹ Venous stasis and chronic venous insufficiency are associated with several disorders including varicose veins, chronic venous hypertension, postphlebotic syndrome, and lymph insufficiency, all of which can lead to VLU formation.² These diagnoses of mixed chronic venous and lymphatic insufficiency—also known as phlebolymphe-
edema—can cause weakness, diminished

joint flexibility and mobility, pain, discomfort, and recurrent infections.³

To prevent further harm, early identification and treatment of VLUs are imperative.^{4,5} Even when treatment is initiated promptly, VLUs commonly take 3 or more months to heal completely.⁶ When identification and treatment of VLUs are not initiated promptly, delayed wound healing can occur, impacting patients' psychological, emotional, and physical well-being.⁷ It has been found that delayed wound healing can

lead to pain, depression, fatigue, and sleep disturbance.⁸ Furthermore, VLUs contribute additional costs to the health care system because of frequent wound care dressings, the skilled nursing staff required to care for these specialized wounds, and hospitalization due to complications from poor VLU management.⁴ The cost of VLUs, while less than diabetes-related amputations, is staff time-intensive and lies predominantly in the home health, outpatient, and primary care arenas.⁹

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The gold standard of treatment for VLUs is compression of the lower limb, which is typically completed in the outpatient setting.^{5,6,10-13} Ideally, compression is initiated as soon as the VLU is identified; however, health care providers often fail to initiate this treatment promptly because of a lack of knowledge and confidence in treating VLUs.⁵ At a large academic health system in the southeastern United States, there was an identified need to improve VLU wound care, as many patients were not receiving timely VLU compression therapy. Additionally, a knowledge deficit was identified through informal interviews with several clinicians, with many stating they did not feel comfortable providing wound care for patients with VLUs. Thus, a quality improvement (QI) project was initiated to improve care for patients with VLUs.

LITERATURE REVIEW

Education to health care providers. A thorough assessment of patients with VLUs must rule out other potential causes—such as arterial, neuropathic, autoimmune, and malignancy etiologies—and identify the best treatment options. Treatment of VLUs is highly specialized, and many health care providers do not receive formal education on this topic.¹⁴ Therefore, many providers lack the knowledge of how to treat VLUs appropriately. Educating providers on the importance of prompt diagnosis, ankle-brachial index (ABI) testing, mechanical compression therapy, home health service referrals, and transitioning care to a wound care specialist can help improve patient outcomes.⁵ Educational meetings, which aid in presenting new knowledge to encourage best practices, have been noted to be an effective strategy to improve providers' knowledge and patient outcomes.¹⁵

Clinical decision support. The use of clinical decision support (CDS) systems can assist with the implementation of clinical practice guidelines for management of VLUs and allows specialists and primary care providers to collaborate.¹⁶ CDS systems can help health care providers deliver safe, evidence-based

practices that improve patient outcomes. Additionally, CDS systems can control costs and allow for more complete documentation and streamlined workflow.¹⁷ Order sets are a common type of CDS.^{18,19} A comprehensive VLU order set can guide providers in: appropriately documenting diagnoses codes; ordering labs, dressings, and compression devices; and providing documentation and wound assessment templates for more accurate documentation.

Ankle-brachial index testing. An ABI is a noninvasive ultrasound procedure that identifies the presence and degree of peripheral arterial disease of the lower leg. Several clinical practice guidelines recommend this assessment for the management of VLUs.^{11,20,21} The ABI test provides VLU treatment guidance for providers; some guidelines found that mechanical compression therapy is contraindicated for patients with an ABI of less than 0.5, as compression of a limb with poor arterial flow may lead to ischemia.^{11,21} It is helpful for providers to order this test for patients with VLUs.

Mechanical compression therapy. Mechanical compression therapy includes any technique, garment, or pump that applies compressive forces to the lower leg. The most effective treatment of VLUs is mechanical compression therapy, which aids venous and lymph return.^{22,23} Gravity pulls bodily fluids to dependent extremities where the volume return structures are deficient. Physiologically, the calf muscle pump aids in the upward movement of venous and lymph return.^{24,25} When the calf muscle pump is nonfunctional, fluid is unable to move out of the interstitial tissues. The most common method of forcing static fluid out of the interstitial tissue is with mechanical compression therapy, elastic compression stockings, or inelastic multilayer compression wraps and crossover Velcro garments, or pneumatic compression devices.^{6,8,22} Rajhathy et al⁶ found that compression reduces the wound surface area of VLUs by 30%. Mechanical compression is typically initiated in the outpatient clinic setting and is continued even after the VLU

has healed, often remaining throughout the patient's life to control swelling.^{9,26} Early diagnosis, intervention, and basic wound care for patients presenting with a VLU can facilitate effective wound healing.⁸ In addition, prompt referral to an advanced wound care service with specialized knowledge in treating VLUs expedites wound healing.⁵

Home health service referral. Referring patients with VLUs to a home health agency for skilled wound care services can also improve patient care and outcomes.^{26,27} Skilled nursing care is therapy performed by trained individuals to treat, manage, and evaluate patient care safely and effectively.^{28,29} Home health nurses are in an ideal role to provide this type of specialized skilled wound care to patients with VLUs. Therefore, it is beneficial for health care providers who may not be well-versed in VLU wound management to refer patients to a home health agency for skilled wound care services.

Purpose. The purpose of this QI project was to implement and evaluate the impact of provider education and CDS on the treatment of patients with VLUs presenting to outpatient clinic settings. The project was implemented among 3 clinics that care for patients with VLUs within the health system. The project's specific aims were to increase the rate of 1) ABI test completion, 2) initiation of mechanical compression therapy, and 3) home health service referrals. We also evaluated the number of health care providers who attended the educational meetings and how often the CDS order set was used.

METHODS

Plan-Do-Study-Act (PDSA) cycles were used for this QI project.^{30,31} Baseline data were collected for 14 weeks before the PDSA cycles began. Data were collected over 13 weeks after the PDSA cycles were initiated. All patients with a VLU diagnosed by the wound care nurse practitioner (NP) at the consult visit to the wound clinic were included in the data collection. This project was deemed a QI project from the university's institutional review board, not human subjects' research.

Educational program. An educational presentation was developed, including a review and definition of VLUs, provider assessment details highlighting safe practices, and the need to obtain an ABI and begin mechanical compression therapy early. The benefits of ordering home health service referrals were also reviewed. Additionally, the education provided a summary of the various types of compression and wound dressing goals and an overview of how to take VLU images and upload them to the electronic health record (EHR). An introduction to the newly developed VLU CDS order set was reviewed in detail. Following the education, attendees were encouraged to ask questions. Contact information for the wound care NPs and a copy of the educational program was provided to each participant.

The QI project leader, an experienced wound care NP, delivered 4 educational sessions through virtual meetings, each lasting approximately 30 minutes. All providers from each clinic were invited to attend. Attendance for physicians, NPs, and physician assistants was recorded for each session. For the providers unable to attend the educational meeting, a 12-minute narrated e-learning module containing the same information was sent via email. Those who completed the e-learning module were asked to self-report completion by emailing the QI project leader.

Clinical decision support. A comprehensive EHR order set was developed from evidence-based VLU practice guidelines, including diagnosis codes, imaging, laboratory tests, equipment and dressing applications, medications, and referrals (Table 1).¹¹ All necessary orders were prepopulated in the order set with detail for ease and efficiency of use. Smart phrases—shortcuts used in the EHR to incorporate different information into a progress note—were developed to assist with complete documentation of an encounter with a patient who had a VLU. The order set and smart phrases were also reviewed during the education. Reminders regarding the education and the CDS

Table 1. Comprehensive Venous Leg Ulcer Order Set Components

Diagnosis codes

Venous stasis ulcer of left lower leg with edema of left lower leg (CMS-HCC) [I83.029, I83.892, L97.929, R60.9]

Venous stasis ulcer of right lower leg with edema of right lower leg (CMS-HCC) [I83.019, I83.891, L97.919, R60.9]

Chronic venous hypertension with inflammation of both legs [I87.303]

Post-phlebotic syndrome [I87.009]

Acquired (or secondary) lymphedema [I89.0]

Hereditary (or primary) lymphedema [Q82.0]

Imaging

Ultrasound ankle-brachial index bilateral

Laboratory tests

Complete blood count

Comprehensive metabolic panel

Magnesium

C-reactive protein, inflammatory

Hemoglobin A1C

Prealbumin

Vitamin D, 1,25-Dihydroxy

Equipment and dressing applications

Dressing

Compression stockings

Multi-layer compression wrap

Lymphedema pump

Referral

Ambulatory referral to wound management

Ambulatory referral to physical therapy

Ambulatory referral to vascular surgery

Ambulatory referral to home health

Venous leg ulcer documentation

Venous leg ulcer progress note

Prescription medications and supplies

Sodium chlor-hypochlorous acid 0.033% irrigation solution

Foam bandage 4 x 4

Triamcinolone 0.1% ointment

Gauze bandage — elastic bandage topical combo pack

Elastic bandage 4 x 5" — yard bandage

Pentoxifylline 400 mg CR tablet

Diosmin complex no. 1 — 630 mg tablet

Table 2. Results of Variables

Variables	Pre, n (%) ^a	Post, n (%) ^b	P value
ABI testing completion	7 (15.9%)	10 (18.2%)	.796
Mechanical compression	15 (34.1%)	4 (7.3%)	.002
Home health skilled nursing services	11 (25%)	9 (16.4)	.322

Abbreviations: ABI, ankle-brachial index
^aN = 44.
^bN = 55.

tools were sent out to providers routinely after implementation.

Data collection and analysis. Descriptive statistics were used to describe the sample characteristics and project outcomes. The number (n) and percent (%) were used to describe the categorical outcomes of the project (Table 2). Chart reviews were conducted to measure outcomes. Data were collected on the number of new patients that presented to the wound care clinic with and without ABI testing initiated prior to arriving, mechanical compression, and home health service referrals. Fisher’s exact tests were performed to test for differences in proportions of patients who received ABI testing, mechanical compression therapy, and home health service referrals in the pre-intervention and post-intervention periods. Non-directional statistical tests were performed with a level of significance of .05. Data were analyzed using SPSS software version 28 (IBM).

Additionally, per QI methodologies, we monitored the rates of these outcomes using run charts to evaluate changes over time. The run chart mean was frozen and extended after the intervention began to identify signals of improvement.³² Data on how often the VLU order sets were used by health care providers was measured by a report pulled from the EHR and are reported with descriptive statistics (%).

RESULTS

The majority of participants were physicians (n = 34; 85%), followed by NPs (n = 5; 12.5%) and physician assistants

(n = 1; 2.5%). After implementation, the CDS with the VLU order set was used 9 times. A total of 99 patients were included in the data analysis (44 preintervention and 55 postintervention). There was an increase in ABI testing from pre (n = 7; 15.9%) to post (n = 10; 18.2%), although it was not statistically significant (P = .796). There was a significant decline in initiation of mechanical compression therapy from pre (n = 15; 34.1%) to post (n = 4; 7.3%) (P = .002). A decline in home health service referrals was found from pre (n = 11; 25%) to post (n = 9; 16.4%) (P = .322); however, this was not significant (Table 2). Run charts for each of the 3 outcomes were also developed to show changes over time and when interventions were implemented (Figures 1, 2, and 3). There

were no signals of improvement per QI run chart rules.³² Education took place between August 2021 and November 2021 and was presented to 40 health care providers.

DISCUSSION

The current project sought to improve early treatment of patients with VLUs by providing education and CDS tools to providers. There was an increase in the number of patients who received ABI testing; however, we did not find significant improvements in our outcomes after the intervention. As noted previously, results from ABI testing can inform treatment recommendations, as mechanical compression may be contraindicated among patients with an ABI of less than 0.5.^{11,21} The increase in ABI testing may have impacted the decrease in mechanical compression therapy, as patients may have received more appropriate care. Our overall findings differ from Dowsett and Taylor,³³ who found improvements in use of ABI testing and mechanical compression therapy for patients with VLUs after a QI project was initiated. Other QI projects have sought to improve treatment and care of patients with VLUs; however, many looked at different outcome measures, such as cost or wound healing time, which we did not evaluate.^{34,35}

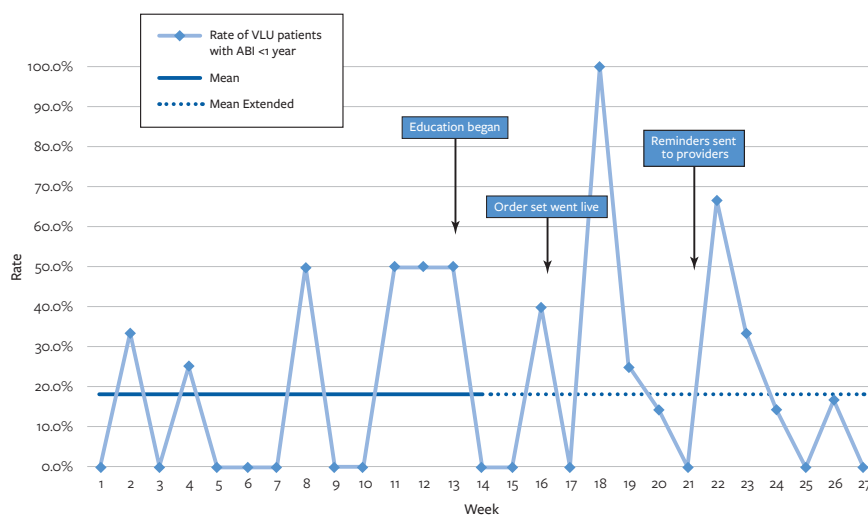


Figure 1. Rate at which ankle-brachial index (ABI) testing was completed on patients with venous leg ulcers (VLUs) in the past year.

Due to the ongoing COVID-19 pandemic, our interventions were modified. The pandemic required us to provide education through a virtual platform rather than in-person educational outreach visits, which are more effective implementation strategies.³⁶ The inability to offer tailored education in person to providers may have impacted our results. In addition, learning during the chaotic time of the pandemic may have been altered. Vogel and Schwabe³⁷ reported on the decreased ability of students to retrieve memories while under acute and chronic stress. Future projects may seek to use in-person interventions instead of virtual education. These may lead to improved engagement and adherence with evidence-based practices by health care providers and may help the participants feel less overwhelmed. In our next PDSA cycle, we will consider using in-person educational outreach visits to deliver education.

Despite the dissemination of clinical practice guidelines, several barriers to their use have been noted in this project and in the literature.^{12,38} Previous research has identified the following barriers to implementing VLU guidelines: 1) perceptions that the guidelines take too long for primary care visits or are not appropriate for the environment, 2) excessive workloads preventing thorough implementation, 3) lack of knowledge of how to perform the ABI test and/or compression interventions, and 4) no access to the supplies and equipment needed to implement guidelines.^{12,38-40} During our educational sessions, providers anecdotally noted several barriers to implementing the guidelines, including comments that the VLU order set was intimidating and overwhelming because of its length and that there was a lack of education on differentiating wound etiology. A health system information technology expert noted that other CDS order sets are also not consistently used, even though literature supports their use to implement evidence-based practices.¹¹ In future PDSA cycles, the QI project team leader will consider developing an abridged version of the CDS order set to reduce

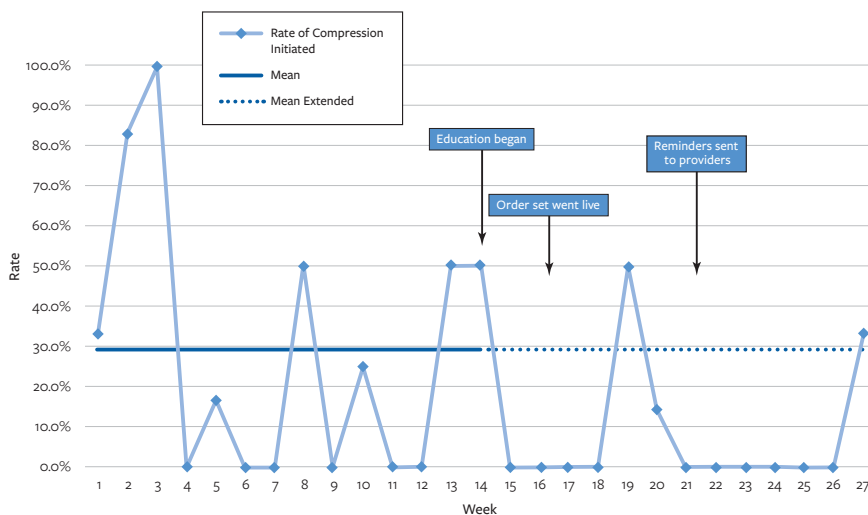


Figure 2. Rate at which mechanical compression therapy was initiated on patients with venous leg ulcers.

its length, including the need to denote wound etiology. In addition, Weller et al⁴¹ recently identified that patients are not likely to follow instructions for self-care if they do not feel the provider has knowledge or understanding of managing their leg ulcer, which could also contribute to poor patient outcomes.

In 2016, the European Wound Management Association document produced a comprehensive review, including how to facilitate implementation of VLU practice guidelines.⁴⁰ They recommended that 1) health care systems must support the use of the guideline and CDS tools, 2) there must be a link in performance incentives to following clinical practice guidelines, 3) collaborations between the nurses and providers is paramount and both must understand the guidelines, and 4) technology must be used to promote ease and efficiency of using the guidelines.⁴⁰ Health care systems should seek to understand the barriers to using VLU guidelines and consider the recommendations put forth by the European Wound Management Association.

LIMITATIONS

Although we did find improvements in ABI testing through our QI project, there are several limitations. First, the

small sample size of the project limits generalizability. This project had only 13 weeks of post-data collection; monitoring trends over a longer period may have yielded different results. The QI project leader intended to complete education via in-person outreach visits; however, education was completed virtually because of social distancing requirements due to the COVID-19 pandemic. This may have impacted providers' engagement and adherence with the evidence-based VLU guidelines.

CONCLUSION

This QI project sought to improve the provision of care to patients with VLUs. Although we did see an increase in the rate of ABI tests ordered, we did not find any statistically significant improvements. We found no increase in use of mechanical compression or initiation of home health services. The education presentation was converted to a virtual format from an in-person format and may have lost impact and inspired enthusiasm, and the CDS tool was used only 9 times. Future PDSA cycles of this project will include completing in-person education, which is noted to be a more effective implementation strategy, and reducing the length of the VLU CDS

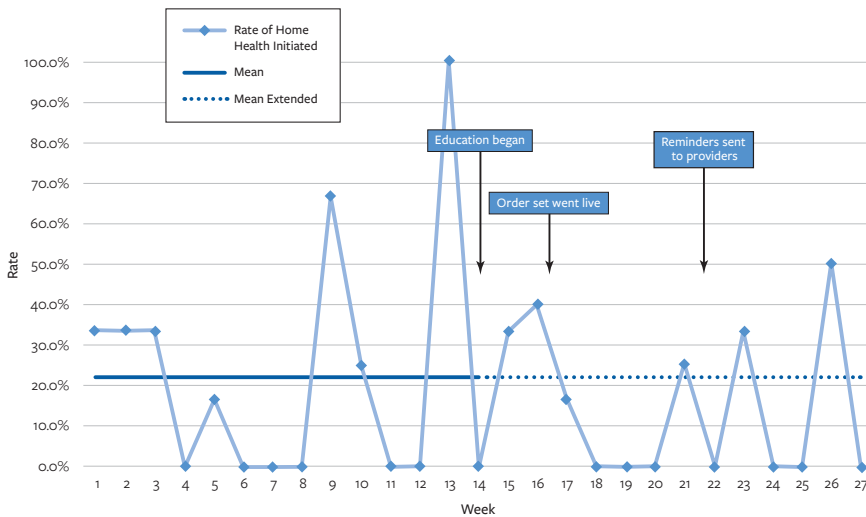


Figure 3. Rate at which home health service referrals were ordered for patients with venous leg ulcers.

order set. Future projects should consider these approaches when implementing evidence-based VLU guidelines.

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REFERENCES

- Xie T, Ye J, Rerkasem K, Mani R. The venous ulcer continues to be a clinical challenge: an update. *Burns Trauma*. 2018;6:18. doi:10.1186/s41038-018-0119-y
- Youn YJ, Lee J. Chronic venous insufficiency and varicose veins of the lower extremities. *Korean J Intern Med*. 2019;34(2):269-283. doi:10.3904/kjim.2018.230
- Fife CE, Farrow W, Hebert AA, et al. Skin and wound care in lymphedema patients: a taxonomy, primer, and literature review. *Adv Skin Wound Care*. 2017;30(7):305-318. doi:10.1097/01.ASW.0000520501.23702.82
- Epstein DM, Gohel MS, Heatley F, et al. Cost-effectiveness analysis of a randomized clinical trial of early versus deferred endovenous ablation of superficial venous reflux in patients with venous ulceration. *Br J Surg*. 2019;106(5):555-562. doi:10.1002/bjs.11082
- Pernot CCEG, Zwiers I, Ten Cate-Hoek AJ, Wittens CHA. The need for a timely diagnostic workup for patients with venous leg ulcers. *J Wound Care*. 2018;27(11):758-763. doi:10.12968/jowc.2018.27.11.758
- Rajhathy EM, Murray HD, Roberge VA, Woo KY. Healing rates of venous leg ulcers managed with compression therapy: a secondary analysis of data. *J Wound Ostomy Continence Nurs*. 2020;47(5):477-483. doi:10.1097/WON.0000000000000693
- Chitambira F. Patient perspectives: explaining low rates of compliance to compression therapy. *Wound Pract Res*. 2019;27(4):168-174. doi:10.33235/wpr.27.4.168-174
- Finlayson KJ, Edwards HE, Courtney MD. Venous leg ulcer recurrence: deciphering long-term patient adherence to preventive treatments and activities. *Wound Pract Res*. 2014;22(2):91-97.
- Olsson M, Järbrink K, Divakar U, et al. The humanistic and economic burden of chronic wounds: A systematic review. *Wound Repair Regen*. 2019;27(1):114-125. doi:10.1111/wrr.12683
- O'Donnell TF Jr, Izhakoff J, Gaebler JA, Niecko T, Iafrati MD. Correlation of disease comorbidity with prescribed treatment among insured U.S. lymphedema patients. *J Vasc Surg Venous Lymphat Disord*. 2021;9(2):461-470. doi:10.1016/j.jvsv.2020.04.030
- Ratliff CR, Yates S, McNichol L, Gray M. Compression for primary prevention, treatment, and prevention of recurrence of venous leg ulcers: an evidence- and consensus-based algorithm for care across the continuum. *J Wound Ostomy Continence Nurs*. 2016;43(4):347-364. doi:10.1097/WON.0000000000000242
- Weller CD, Richards C, Turnour L, Team V. Understanding factors influencing venous leg ulcer guideline implementation in Australian primary care. *Int Wound J*. 2020;17(3):804-818. doi:10.1111/iwj.13334
- O'Meara S, Cullum N, Nelson EA, Dumville JC. Compression for venous leg ulcers. *Cochrane Database Syst Rev*. 2012;11(11):CD000265. doi:10.1002/14651858.CD000265.pub3
- Ennis WJ. Wound care specialization: the current status and future plans to move wound care into the medical community. *Adv Wound Care (New Rochelle)*. 2012;1(5):184-188. doi:10.1089/wound.2011.0346
- Forsetlund L, O'Brien MA, Forsén L, et al. Continuing education meetings and workshops: effects on healthcare professionals' practice and on patients' health. *Cochrane Database Syst Rev*. 2021;9(9):CD003030. doi:10.1002/14651858.CD003030.pub3
- Institute for Healthcare Improvement. Decision Support for People with Chronic Conditions. Institute for Healthcare Improvement. 2021. Accessed July 30, 2021. <http://www.ihf.org/resources/Pages/Changes/DecisionSupport.aspx>
- Sutton RT, Pincock D, Baumgart DC, Sadowski DC, Fedorak RN, Kroeker KI. An overview of clinical decision support systems: benefits, risks, and strategies for success. *NPJ Digit Med*. 2020;3:17. doi:10.1038/s41746-020-0221-y
- Krive J, Shoolin JS, Zink SD. Effectiveness of evidence-based congestive heart failure (CHF) CPOE order sets measured by health outcomes. *AMIA Annu Symp Proc*. 2014;2014:815-824. Accessed April 6, 2022. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4419927/>
- Hulse NC, Lee J, Benuzillo J. Exploring different approaches in measuring EHR-based adherence to best practice - a case study with order sets and associated outcomes. *AMIA Annu Symp Proc*. 2019;2019:477-486.
- Weller CD, Team V, Ivory JD, Crawford K, Gethin G. ABPI reporting and compression

- recommendations in global clinical practice guidelines on venous leg ulcer management: A scoping review [published correction appears in *Int Wound J*. 2019 Aug;16(4):1074]. *Int Wound J*. 2019;16(2):406-419. doi:10.1111/iwj.13048
21. O'Donnell TF Jr, Passman MA, Marston WA, et al. Management of venous leg ulcers: clinical practice guidelines of the Society for Vascular Surgery® and the American Venous Forum. *J Vasc Surg*. 2014;60(suppl 2):3S-59S. doi:10.1016/j.jvs.2014.04.049
 22. Lerman M, Gaebler JA, Hoy S, et al. Health and economic benefits of advanced pneumatic compression devices in patients with phlebolympheoedema. *J Vasc Surg*. 2019;69(2):571-580. doi:10.1016/j.jvs.2018.04.028
 23. Mutlak O, Aslam M, Standfield N. The influence of exercise on ulcer healing in patients with chronic venous insufficiency. *Int Angiol*. 2018;37(2):160-168. doi:10.23736/S0392-9590.18.03950-0
 24. O'Brien JA, Edwards HE, Finlayson KJ, Kerr GK. Understanding the relationships between the calf muscle pump, ankle range of motion and healing for adults with venous leg ulcers: a review of the literature. *Wound Pract Res*. 2012;20(2):80-85.
 25. Madhavan G, Cole JP, Pierce CS, McLeod KJ. Reversal of lower limb venous and lymphatic pooling by passive non-invasive calf muscle pump stimulation. *Conf Proc IEEE Eng Med Biol Soc*. 2006;2006:2875-2877. doi:10.1109/IEMBS.2006.260364
 26. Ylönen M, Viljamaa J, Isoaho H, Junttila K, Leino-Kilpi H, Suhonen R. Internet-based learning programme to increase nurses' knowledge level about venous leg ulcer care in home health care. *J Clin Nurs*. 2017;26(21-22):3646-3657. doi:10.1111/jocn.13736
 27. Batas R. Community nursing care for chronic wounds: a case study of optimal home treatment of a venous leg ulcer. *Gastrointest Nurs*. 2019;17(Sup5):S32-S39. doi:10.12968/gasn.2019.17.Sup5.S32
 28. Sollitto M. What's the difference between skilled nursing care and a nursing home? *Ageing Care*. Accessed June 5, 2022. <https://www.ageingcare.com/articles/difference-skilled-nursing-and-nursing-home-153035.htm>
 29. Centers for Medicare and Medicaid Services. Medicare and Home Health Care. April 2003. Accessed June 5, 2022. <https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HomeHealthQualityInits/Downloads/HHQIHHBenefits.pdf>
 30. Plan-Do-Study-Act (PDSA) Worksheet. Institute for Healthcare Improvement. Accessed March 4, 2022. <http://www.ihl.org:80/resources/Pages/Tools/PlanDoStudyActWorksheet.aspx>
 31. Science of Improvement: Testing Changes. Institute for Healthcare Improvement. 2022. Accessed June 5, 2022. <https://www.ihl.org/resources/Pages/HowtoImprove/ScienceofImprovementTestingChanges.aspx>
 32. Provost LP, Murray SK. *The Health Care Data Guide: Learning from Data for Improvement*. Jossey-Bass; 2011. Accessed March 12, 2022. <https://www.wiley.com/en-us/The+Health+Care+Data+Guide%3A+Learning+from+Data+for+Improvement-p-9780470902585>
 33. Dowsett C, Taylor C. Reducing variation in leg ulcer assessment and management using quality improvement methods. *Wounds UK*. 2018;14(4):46-51.
 34. Atkin L, Schofield A, Kilroy-Findley A. Updated leg ulcer pathway: improving healing times and reducing costs. *Br J Nurs*. 2019;28(20):S21-S26. doi:10.12968/bjon.2019.28.20.S21
 35. Mahoney K, Simmonds W. Using a health improvement methodology to standardise leg ulcer management. *Br J Community Nurs*. 2020;25(Sup9):S20-S25. doi:10.12968/bjcn.2020.25.Sup9.S20
 36. Chan WV, Pearson TA, Bennett GC, et al. ACC/AHA special report: clinical practice guideline implementation strategies: a summary of systematic reviews by the NHLBI Implementation Science Work Group: a report of the American College of Cardiology/American Heart Association Task Force on clinical practice guidelines. *J Am Coll Cardiol*. 2017;69(8):1076-1092. doi:10.1016/j.jacc.2016.11.004
 37. Vogel S, Schwabe L. Learning and memory under stress: implications for the classroom. *NPJ Sci Learn*. 2016;1:16011. doi:10.1038/npjscilearn.2016.11
 38. Friman A, Wiegleb Edström D, Ebbeskog B, Edelbring S. General practitioners' knowledge of leg ulcer treatment in primary healthcare: an interview study. *Prim Health Care Res Dev*. 2020;21:e34. doi:10.1017/S1463423620000274
 39. Weller CD, Richards C, Turnour L, Patey AM, Russell G, Team V. Barriers and enablers to the use of venous leg ulcer clinical practice guidelines in Australian primary care: A qualitative study using the theoretical domains framework. *Int J Nurs Stud*. 2020;103:103503. doi:10.1016/j.ijnurstu.2019.103503
 40. Franks PJ, Barker J, Collier M, et al. Management of patients with venous leg ulcers: challenges and current best practice. *J Wound Care*. 2016;25 Suppl 6:S1-S67. doi:10.12968/jowc.2016.25.Sup6.S1
 41. Weller CD, Richards C, Turnour L, Team V. Patient explanation of adherence and non-adherence to venous leg ulcer treatment: a qualitative study. *Front Pharmacol*. 2021;12:663570. doi:10.3389/fphar.2021.663570