

STRIDE 2 Delphi

Lymphoedema of the upper limb, breast and trunk: Delphi study on the STRIDE algorithm for compression selection

Karen J Bock, Suzie Ehmann, Naomi Dolgoy, Sandi Davis, Brandy McKeown, Justine Whitaker and Elizabeth Anderson

Abstract

Background: Upper-body lymphoedema is treated with compression therapy.

Aims: To update the STRIDE algorithm for compression selection to cover lymphoedema of the upper limb, breast and trunk by achieving consensus on the definitions and importance of its six aspects.

Method: Using a modified Delphi framework, clinical experts in the field ranked agreement and gave open-ended feedback method over two rounds of surveys, with a >70% threshold for agreement.

Results: In the first round, participants representing five continents (n=36). Characteristics that met the threshold consensus of >70% agreement were then applied to the STRIDE algorithm, and the second survey was developed. In the second round (n=22), the definitions of all elements of the STRIDE algorithm had at least 70% agreement or strong agreement. Site, size and shape and issues were the elements most often considered first in compression selection, while refill was least often considered first in selection.

Conclusions: This Delphi study achieved consensus on the description of the elements of the revised STRIDE algorithm for compression applies to the upper limb, breast and trunk lymphoedema. The STRIDE can now be used to make clinical decisions on selecting compression garments for the upper body.

Keywords

lymphoedema, compression therapy, upper extremity, trunk, STRIDE

Introduction

Lymphoedema in the upper limb, breast and trunk can significantly impact a person's overall quality of life.¹ Oedema in these locations can result from lymphatic damage from trauma or cancer treatments,^{2,3} venous insufficiency⁴ and other inflammatory processes, as well as an underlying dysfunction (e.g., primary oedema).² Lymphoedema is commonly treated with compression therapy as a component of complete decongestive therapy (CDT), with garments used to apply pressure to the affected sites to optimise lymphatic drainage and reduce oedema.⁵⁻¹⁴ However, selecting the optimal compression garment and/or device can be challenging due to variations in clinical presentations (both the location and severity of the swelling) and variations in the availability of products in different geographical regions.^{15,16}

The literature regarding compression selection focuses more on the lower limb than the upper body. While evidence for upper-body compression has grown over the past 20 years, there remains a gap in consensus-driven clinical guidelines for garment selection.^{14,17-19} Furthermore, there are notable differences in clinical practice and device availability in the United States (US) and other countries.

Aim

To address the need for a comprehensive evidence-based guidance on compression selection for upper-body lymphoedema, a new international consensus document built on the original STRIDE algorithm for compression selection, which was limited to lower-limb lymphoedema.¹⁵

The updated STRIDE algorithm required face and content validation to achieve two main objectives: to define elements involved in selecting upper-body compression devices and to establish the importance of these elements to compression selection.

Method

Study design

The content of the updated STRIDE algorithm was determined using a modified Delphi method.¹⁹ This structured communication technique is widely used to solicit and synthesise expert opinion to achieve consensus on complex issues.²⁰⁻²² The Delphi process is iterative, involving multiple rounds of surveys.^{23,24} This process was followed for this study. Survey questions and domains were developed from the original STRIDE algorithm. At each round, a series of statements was shared with an expert panel, and participants anonymously indicated their agreement or disagreement on a 5-point Likert scale and have the option to give open-ended feedback. These responses were then summarised and shared with the investigators so that the statements can be collectively revised. The iterative process continued until a consensus was reached.²²

The study protocol was reviewed by the Rockhurst University institutional review board and deemed no more than minimal risk and exempt from ongoing review (exempt review #2425-37). Participants completed informed consent for each round of the survey, conforming to the Declaration of Helsinki guidelines. The survey was developed by the primary, with face validity provided by remaining authors. Content validity was confirmed through previewed surveys and feedback from an international group of lymphoedema therapists and clinicians for cultural and language adaptations for universal understanding.²⁰

Expert panel

Recruitment of content experts prioritised qualified clinicians active in compression selection for upper-body lymphoedema. Content experts had to have at least 2 years of relevant clinical experience,²² as well as meet at least one of the following criteria:

- In the past month, have worked in a setting with a caseload of at least five patients with upper-body lymphoedema
- At any point in their career, have had a caseload where at least 30% of patients had upper-body lymphoedema
- Be currently researching upper-body lymphoedema.

Purposive and snowball sampling was instituted, with primary survey dissemination through research team-recommended colleague experts. Respondents were excluded if for the following reasons:

- Worked part- or full-time in the compression garment industry
- Failed to provide consent
- Completed only part of the survey.

Delphi process

The Delphi survey was created with Survey Monkey (San Mateo, California, US), with statements based on the original STRIDE algorithm and organised into domains.¹⁵

The first round covered participant demographic details and the importance of different factors for compression selection. All identified experts were emailed the first survey, with 6 weeks to complete and three reminder emails. A minimum of 30 responses to the first round was set to account for likely attrition in the second round.²²

The second round covered agreement with definitions of STRIDE elements and the ranked importance of STRIDE elements to compression selection. All respondents to the first round were contacted again, with a 4-week deadline and two reminder emails.

Data analysis

Consensus on a statement was set at 70% agreement.¹⁸ Statements that met this benchmark were included in the second round, with any open-ended feedback analysed from a grounded theory perspective to further develop those statements to better describe the STRIDE algorithm.²⁵ Through iterative analysis by the research team, characteristics and domains were condensed and clustered into the STRIDE algorithm and the second survey aimed for agreement on criteria in each section of the algorithm. Also, in the second survey, participants ranked the use of the algorithm categories in order of importance when selecting compression garments and devices.

Results

The participant demographic details are detailed in *Table 2*. Countries represented included: Australia (n=2), Canada (n=8), Ireland (n=1), Kuwait (n=1), Russia (n=1), Saudi Arabia (n=1), South Africa (n=2), Sweden (n=1), United Kingdom (n=5), United States (n=14).

Regarding the importance of factors for compression selection, all but one factor met the threshold of being considered moderately or highly important by 70% of respondents (*Figure 1*). The exception was hand dominance, which was only 52.1% and did not meet the threshold for consensus. The following were considered highly important by at least 70% of respondents: limb shape, tissue composition, donning/doffing ability, function during wear, patient adherence, lymphoedema distribution, limb size and compression dosage

In the second round, all six definitions of STRIDE elements met the 70% consensus threshold for agreement (*Table 2; Figure 2*). Over 60% of participants strongly agreed with definitions of the first five elements, while only 55% strongly agreed on the definition of etiology. Responses to open-ended questions were analysed and determined to be either agreement, non-agreement or proposing a different approach for each element definition.

When the importance of STRIDE elements to compression selection was ranked, site, size and shape and issues were considered the most important elements, while refill was the least important (*Figure 3*). The trends in the open-ended feedback informed and mirrored the ranking of the level of importance of each element. There were no comments specific enough to trend any malalignment with the importance of the elements.

Table 1. Participant demographics, n=36

Demographic factor		n ¹	%
Continent of practice	Africa	2	6
	Asia	3	9
	Australia	2	6
	Europe	7	19
	North America	22	61
Professional discipline	Occupational therapy	8	22.22

	Medicine	1	2.78
	Nursing	4	11.11
	Physical therapy/physiotherapy	20	55.56
	Research	1	2.78
	Other	3	8.33
Lymphoedema-specific training or certification	Yes	34	97.14
	No	1	2.86
Duration of lymphoedema specialisation	0–5 years	5	14.29
	6–10 years	9	25.71
	11–20 years	12	35.29
	>20 years	9	25.71
Proportion of current or previous practice focused on upper-body lymphoedema	0–20%	5	13.89
	21–40%	12	33.33
	41–60%	10	27.78
	61–80%	5	13.89
	81–100%	4	11.11
Phase of upper-body lymphoedema treated or researched (more than one selection accepted)	Subclinical/surveillance	28	80
	Initial (acute)	33	94.29
	Maintenance (chronic)	34	97.14
Experience recommending specific compression regimens	Yes	35	97.22
	No	1	2.78
Experience measuring and fitting compression devices	Yes	33	97.67
	No	3	8.33
	Other*	2	5.56
Note: ¹ Not all demographic questions were compulsory, so some sections may not add up to 36; ² 'Local durable medical equipment providers', 'All referrals go to orthotist or practicing lymphoedema therapists in South Africa'			

Figure 1. Factors for compression selection ranked as 'high importance', n=36 (%)

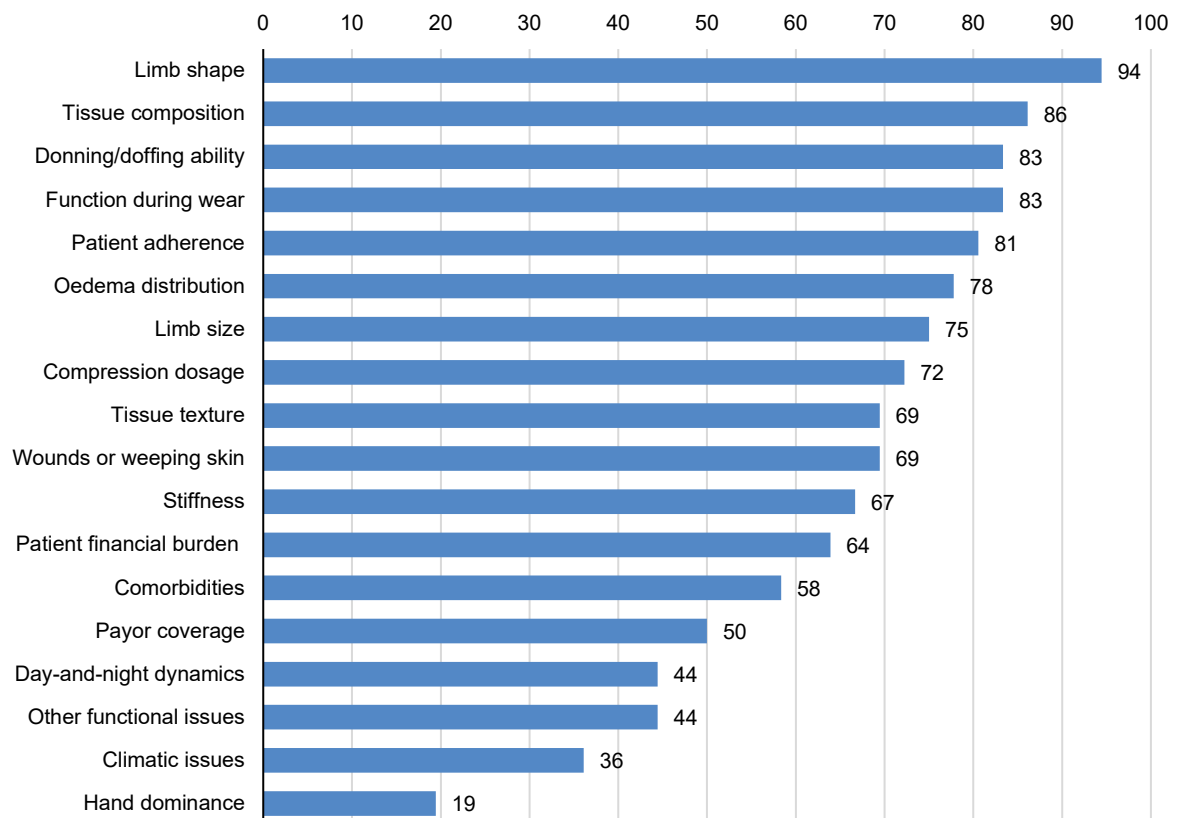


Table 1. Definitions of STRIDE elements

Element	Definition
Size	Site, size and shape of lymphoedematous swelling
Texture	Tissue texture (watery, doughy, woody, fatty or fragile) and textile type (elastic, stiff, textured) used in compression garments
Refill	How lymphoedema volume changes with activity or throughout the day and the night
Issues	Ability to don/doff garments, willingness to participate in compression regimen, function while wearing compression device, cost of device acquisition, physical /dexterity issues, medical issues
Dosage	Optimal resting pressure and stiffness to manage lymphoedema
Etiology	Comorbid diagnoses, stages of lymphoedema and how these affect compression selection

Figure 2. Agreement with definitions of STRIDE elements, second round, n=20 (%)

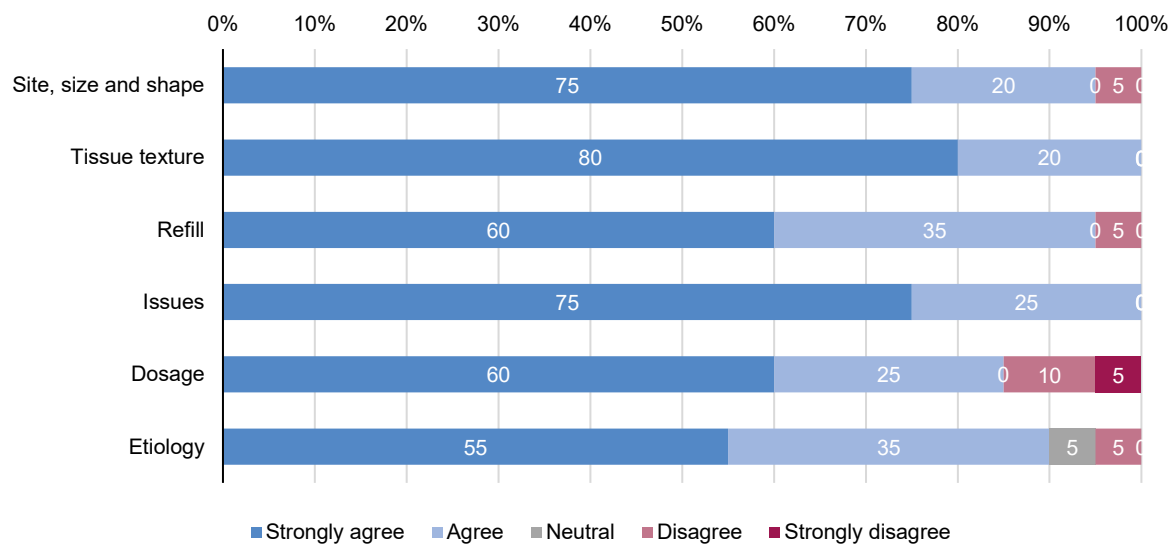
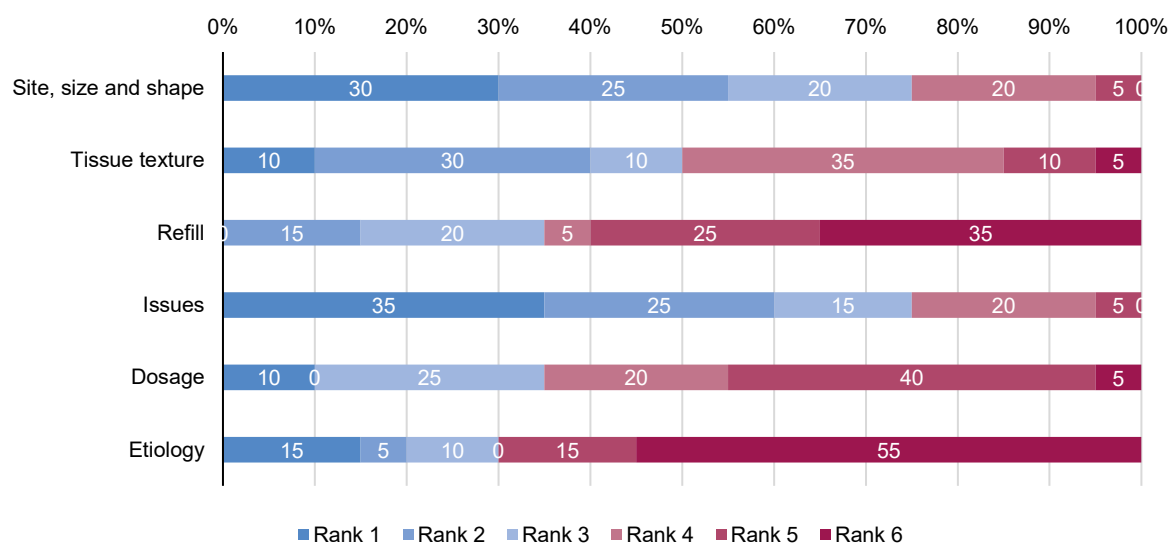


Figure 3. Ranked importance of STRIDE elements in compression selection, where rank 1 is the most and rank 6 the least important, n=20 (%)



Discussion

In two rounds of Delphi surveys, an international panel of clinical experts reached a consensus on the definitions of the six elements of the STRIDE algorithm, as well as on the importance of these elements in compression selection for managing upper-body lymphoedema.

The Delphi study findings informed the development of the new STRIDE algorithm, creating an innovative approach to compression that spans traditional boundaries of dosage and single-method compression selection therapies. This allows best practice to be standardised and shared with other clinicians to improve care for people with lymphoedema and the rest of the medical community.

The goal of developing the STRIDE algorithm for upper-body lymphoedema, to optimise outcomes for individuals living with lymphedema, mirrors the paradigm of a complexity-informed approach to researching health services and systems.²¹ It was vital to explore an international expert consensus on characteristics of compression selection and note how complexity-informed approaches seek to generate insights and wisdom with multiple perspectives on an issue.²⁵ The ranking of importance in *Figure 3* demonstrates that clinicians focus on different key elements to arrive at a regimen for the patients. A complexity-informed approach to research embraces the imperfection of datasets and the need for future research to collect more data to keep up with evolving developments in the field.^{26,27} The generation of the STRIDE algorithm to organise clinical approaches to compression garment selection is the beginning of future research embracing a scientific approach to compression garment selection while emphasising the important roles of the patient–clinician partnership in pragmatic, tailored application.²⁷

Clinical implementation of STRIDE would benefit from formal implementation frameworks and standardised assessment of how the algorithm affects outcomes, as well as local and regional adaptations.^{28,29} Implementation frameworks are designed for assessment of action or practice cycles of knowledge acquisition, use and adjustment to tailor the intervention to the stakeholders, often going back and forth between these steps multiple times.^{30,31} These frameworks are frequently used in physical medicine and rehabilitation.³² In the US, the Knowledge to Action framework is being applied to the physical therapy clinical practice guideline for diagnosing breast cancer-related lymphoedema to monitor and evaluate the use of the guidelines.²⁹ Case series and mixed-method analysis from different countries, geographies/climates, financial models and health care models are needed to explore the complexities of STRIDE in depth. This may generate different versions of STRIDE that are more applicable to specific groups of individuals living with lymphoedema. These versions of STRIDE may identify systemic issues and allow health systems to find political, strategic and financial alignments that improve health quality for their community.²⁷

Although the STRIDE algorithm is the first framework to detail compression selection for the upper limb, breast and trunk, other organisations are bringing lymphoedema into their frameworks for lower-limb compression. The Wound, Ostomy, Continence Nurses (WOCN) Society has recently incorporated lymphoedema into its algorithm for compression therapy in the comprehensive management of lower-limb venous disease and lymphoedema.³³ International lymphology organisations have highlighted the impact of chronic oedema on quality of life,³⁴ and numerous national clinician groups have developed clinical practice guidelines for interventions addressing upper-body lymphoedema.^{3,35,36}

The STRIDE Delphi study had several limitations. While the panel was international, there were no surveys from South America, so the transferability of the outcomes to this continent cannot be assumed. This survey focussed on experts in upper-body lymphoedema, and so generalisability to the lower limb cannot be assumed.¹⁵ Although differences in terminology were controlled through content validity construction, non-native English speakers may have interpreted some questions differently. Inherent bias should also be considered part of the Delphi process in the non-random sampling technique involved in recruiting experts in the field.

Conclusions

This Delphi study reached a consensus on the definitions and importance of all elements of the STRIDE algorithm for selecting compression garments for lymphoedema of the upper limb, breast or trunk. The STRIDE algorithm should help clinicians efficiently and effectively select

appropriate compression garments to increase their patients' quality of life and functional abilities. Application to real-life cases and further research should help refine and develop this structured approach to compression selection.

References

1. Donahue PMC, MacKenzie A, Filipovic A, Koelmeyer L. Advances in the prevention and treatment of breast cancer-related lymphedema. *Breast Cancer Res Treat.* 2023; 200(1):1-14. <https://doi.org/10.1007/s10549-023-06947-7>
2. Anonymous. The diagnosis and treatment of peripheral lymphedema: 2020 Consensus Document of the International Society of Lymphology. *Lymphology.* 2020; 53(1):3-19
3. Davies C, Levenhagen K, Ryans K, Perdomo M, Gilchrist L. Interventions for Breast Cancer–Related Lymphedema: Clinical Practice Guideline From the Academy of Oncologic Physical Therapy of APTA. *Physical Therapy.* 2020; 100(7):1163-1179. <https://doi.org/10.1093/ptj/pzaa087>
4. Hettrick H, Ehmann S, McKeown B, Bender D, Blebea J. Selecting appropriate compression for lymphedema patients: American Vein and Lymphatic Society position statement. *Phlebology.* 2023:2683555221149619. <https://doi.org/10.1177/02683555221149619>
5. Committee E. The diagnosis and treatment of peripheral lymphedema: 2016 consensus document of the International Society of Lymphology. *Lymphology.* 2016; 49(4):170-184
6. Hansdorfer-Korzon R, Teodorczyk J, Gruszecka A, Lass P. Are compression corsets beneficial for the treatment of breast cancer-related lymphedema? New opportunities in physiotherapy treatment - a preliminary report. *Onco Targets Ther.* 2016; 9:2089-2098. <https://doi.org/10.2147/ott.S100120>
7. Karafa M, Karafova A, Szuba A. The effect of different compression pressure in therapy of secondary upper extremity lymphedema in women after breast cancer surgery. *Lymphology.* 2018; 51(1):28-37
8. Johansson K, Jonsson C, Bjork-Eriksson T. Compression Treatment of Breast Edema: A Randomized Controlled Pilot Study. *Lymphat Res Biol.* 2019. <https://doi.org/10.1089/lrb.2018.0064>
9. Mosti G, Cavezzi A. Compression therapy in lymphedema: Between past and recent scientific data. *Phlebology.* 2019; 34(8):515-522. <https://doi.org/10.1177/0268355518824524>
10. Document C. THE DIAGNOSIS AND TREATMENT OF PERIPHERAL LYMPHEDEMA: 2020 CONSENSUS DOCUMENT OF THE INTERNATIONAL SOCIETY OF LYMPHOLOGY. *Lymphology.* 2020; 53(1). <https://doi.org/10.2458/lymph.4649>
11. Gregorowitsch ML, Van den Bongard D, Batenburg MCT et al. Compression Vest Treatment for Symptomatic Breast Edema in Women Treated for Breast Cancer: A Pilot Study. *Lymphat Res Biol.* 2020; 18(1):56-63. <https://doi.org/10.1089/lrb.2018.0067>
12. Bock KJ, Muldoon J. A 24-hour interval compression plan for managing chronic oedema: part 1-the science and theory behind the concept. *J Wound Care.* 2022; 31(Sup2):S4-s9. <https://doi.org/10.12968/jowc.2022.31.Sup2.S4>
13. Brunelle CL, Ag AG. The important role of nighttime compression in breast cancer-related lymphedema treatment. *Cancer.* 2022; 128(3):458-460. <https://doi.org/10.1002/cncr.33942>
14. McNeely ML, Dolgoy ND, Rafn BS et al. Nighttime compression supports improved self-management of breast cancer–related lymphedema: A multicenter randomized controlled trial. *Cancer.* 2022; 128(3):587-596. <https://doi.org/https://doi.org/10.1002/cncr.33943>
15. Bjork R, Ehmann S. S.T.R.I.D.E. Professional Guide to Compression Garment Selection for the Lower Extremity. *J Wound Care.* 2019; 28(Sup6a):1-44. <https://doi.org/10.12968/jowc.2019.28.Sup6a.S1>
16. Hettrick H, Ehmann S, McKeown B, Bender D, Blebea J. Selecting appropriate compression for lymphedema patients: American Vein and Lymphatic Society position statement. *Phlebology.* 2023; 38(2):115-118. <https://doi.org/10.1177/02683555221149619>
17. Abouelazayem M, Elkorety M, Monib S. Breast Lymphedema After Conservative Breast Surgery: An Up-to-date Systematic Review. *Clin Breast Cancer.* 2021; 21(3):156-161. <https://doi.org/https://doi.org/10.1016/j.clbc.2020.11.017>
18. Verbelen H, Tjalma W, Dombrecht D, Gebruers N. Breast edema, from diagnosis to treatment: state of the art. *Archives of physiotherapy.* 2021; 11:1-10
19. Blom KY, Johansson KI, Nilsson-Wikmar LB, Brogårdh CB. Early intervention with compression garments prevents progression in mild breast cancer-related arm lymphedema:

- a randomized controlled trial. *Acta Oncologica*. 2022; 61(7):897-905. <https://doi.org/10.1080/0284186X.2022.2081932>
20. Fernández-Gómez E, Martín-Salvador A, Luque-Vara T, Sánchez-Ojeda MA, Navarro-Prado S, Enrique-Mirón C. Content Validation through Expert Judgement of an Instrument on the Nutritional Knowledge, Beliefs, and Habits of Pregnant Women. *Nutrients*. 2020; 12(4):1136
 21. Pohl J, Held JPO, Verheyden G et al. Consensus-Based Core Set of Outcome Measures for Clinical Motor Rehabilitation After Stroke-A Delphi Study. *Front Neurol*. 2020; 11:875. <https://doi.org/10.3389/fneur.2020.00875>
 22. Shang Z. Use of Delphi in health sciences research: A narrative review. *Medicine*. 2023; 102(7):e32829. <https://doi.org/10.1097/md.00000000000032829>
 23. Murphy JP, Rådestad M, Kurland L, Jirwe M, Djalali A, Rüter A. Emergency department registered nurses' disaster medicine competencies. An exploratory study utilizing a modified Delphi technique. *Int Emerg Nurs*. 2019; 43:84-91. <https://doi.org/10.1016/j.ienj.2018.11.003>
 24. Drumm S, Bradley C, Moriarty F. 'More of an art than a science'? The development, design and mechanics of the Delphi Technique. *Res Social Adm Pharm*. 2022; 18(1):2230-2236. <https://doi.org/10.1016/j.sapharm.2021.06.027>
 25. Conlon C, Timonen V, Elliott-O'Dare C, O'Keeffe S, Foley G. Confused about theoretical sampling? Engaging theoretical sampling in diverse grounded theory studies. *Qualitative Health Research*. 2020; 30(6):947-959
 26. Greenhalgh T, Papoutsi C. Studying complexity in health services research: desperately seeking an overdue paradigm shift. *BMC Medicine*. 2018; 16(1):95. <https://doi.org/10.1186/s12916-018-1089-4>
 27. Reed JE, Howe C, Doyle C, Bell D. Simple rules for evidence translation in complex systems: A qualitative study. *BMC Medicine*. 2018; 16(1):92. <https://doi.org/10.1186/s12916-018-1076-9>
 28. Darzi A, Abou-Jaoude EA, Agarwal A et al. A methodological survey identified eight proposed frameworks for the adaptation of health related guidelines. *Journal of Clinical Epidemiology*. 2017; 86:3-10. <https://doi.org/https://doi.org/10.1016/j.jclinepi.2017.01.016>
 29. Campione E, Wampler M, Newell A. Methodological description of knowledge translation: Implementation of clinical practice guidelines into clinical practice. *Pm r*. 2025. <https://doi.org/10.1002/pmrj.13304>
 30. Graham ID, Logan J, Harrison MB, Straus SE, Tetroe J, Caswell W, Robinson N. Lost in knowledge translation: Time for a map? *Journal of Continuing Education in the Health Professions*. 2006; 26(1):13-24. <https://doi.org/10.1002/chp.47>
 31. Nilsen P. Making sense of implementation theories, models and frameworks. *Implement Sci*. 2015; 10:53. <https://doi.org/10.1186/s13012-015-0242-0>
 32. Moore JL, Mbalilaki JA, Graham ID. Knowledge Translation in Physical Medicine and Rehabilitation: A Citation Analysis of the Knowledge-to-Action Literature. *Arch Phys Med Rehabil*. 2022; 103(7s):S256-s275. <https://doi.org/10.1016/j.apmr.2020.12.031>
 33. Ratliff CR, Yates S, McNichol L, Gray M. Compression for lower extremity venous disease and lymphedema (CLEVDAL): update of the VLU algorithm. *Journal of Wound Ostomy & Continence Nursing*. 2022; 49(4):331-346
 34. Moffatt C, Keeley V, Quéré I. The Concept of Chronic Edema—A Neglected Public Health Issue and an International Response: The LIMPRINT Study. *Lymphat Res Biol*. 2019; 17(2):121-126. <https://doi.org/10.1089/lrb.2018.0085>
 35. Thomas MJ, Morgan K. The development of Lymphoedema Network Wales to improve care. *Br J Nurs*. 2017; 26(13):740-750. <https://doi.org/10.12968/bjon.2017.26.13.740>
 36. Tan M, Salim S, Beshr M, Guni A, Onida S, Lane T, Davies AH. A methodologic assessment of lymphedema clinical practice guidelines. *Journal of Vascular Surgery: Venous and Lymphatic Disorders*. 2020; 8(6):1111-1118.e1113. <https://doi.org/10.1016/j.jvsv.2020.05.004>