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Cost impact and outcomes of 50 lymphoedema cases using adjustable compression garments

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Cost impact and outcomes of 50 lymphoedema cases using adjustable compression garments

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Increasing pressures on healthcare resources require constant evaluation of the efficiency and effectiveness of provision, particularly for the rising number of vulnerable, elderly and obese patients. Practices regarding compression are arguably often ingrained due to its historical usage, with evidence from managing chronic venous insufficiency (CVI) underpinning its effectiveness. This evaluation explores the clinical benefit, impact, outcomes and cost-efficiencies of using an adjustable compression wrap system instead of previous care. 'Before-after design' observation of 50 patients captured baseline resource use, costs and outcomes (clinical and patient) at the time of assessment and again at a maximum of six-month follow-up. Data after using the adjustable compression wrap showed significantly improved clinician-reported outcomes: presence of wounds/leg ulceration (from 56% to 21%), incidence of cellulitis (halved), and reduced complexity/severity of lymphoedema. Additionally, patient-reported outcomes, visual analogue scale (VAS) health score and LYMPROM© scores for pain, heaviness, shopping for shoes and clothes, and body image significantly improved. The mean number of community nurse visits per patient reduced from 11.6. to 9.1, but was not statistically significant (p-value 0.09). However, this evaluation found that over six months there was a mean cost reduction of over £383.70 per patient, which included the purchase price of the adjustable compression wrap system.

KEYWORDS:
■ Economic impact ■ Lymphoedema ■ Patient-reported outcome measures ■ Adjustable compression wrap ■ Wounds/leg ulceration

Lymphoedema is a long-term condition affecting hundreds of thousands of people in the UK. An epidemiological study found the crude prevalence of lymphoedema was nearly four per 1,000 of the population, rising to nearly 29 per 1,000 in those aged 85 or above (Moffatt et al, 2017).

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Since the pandemic, the complexity and incidence of oedema cases have increased, causing a rise in venous ulceration, falls, and cellulitis infections within NHS Wales (Humphreys et al, 2023; Lymphoedema Wales Clinical Network, 2023). Obesity, immobility, multimorbidity and lengthened waiting times also seem to have exacerbated complexity factors. Untreated lymphoedema is costly to the National Health Service (NHS), causing pressures on unscheduled care, community nurse contacts, wound care visits, and dressing and compression product utilisation (Thomas et al, 2017; Humphreys et al, 2023). Lymphoedema complications, such as wounds, have a huge economic impact on health system budgets, accounting for over £5 billion per annum (Graves et al, 2021). Reports of increasing falls and repeated cellulitis episodes (Posnett and Franks, 2008; Burian et al, 2021) also add to ongoing financial pressures in the NHS.

Lymphoedema Wales Clinical Network previously identified that 55% of community nurse capacity was spent managing lower limb wounds, leg ulceration and lymphoedema (Thomas et al, 2017). Lack of knowledge in the use of compression therapy, leading to reduced competence and confidence, contributed to delayed healing rates and patients remaining on caseloads unnecessarily. Additionally, use of unsuitable dressings, bandages and sub-optimal compression garments add little value, while contributing to exponential mounting costs (Guest et al, 2015; Humphreys et al, 2017).

From a patient's perspective, the impact of lymphoedema on life causes poorer reported outcome measures and quality of life. Anxiety, depression, increasing isolation, intimacy and desirability, limitations in choices of clothing/shoes and even hobbies, holidays and finances have been documented (Thomas et al, 2020; Gabe-Walters and Thomas, 2021; Chima et al, 2022; Aszkul et al, 2023). Although patient-reported outcome measures (PROMs) are

captured in lymphoedema services, they are not evaluated specifically in relation to changes in compression treatment.

Compression is one of the most important components in lymphoedema management, reducing limb size, improving shape and expediting wound healing (Mosti and Cavezzzi, 2019). Compression methods include pneumatic devices, multilayer bandaging, traditional style graduated compression garments (or stockings), and adjustable wrap garments or devices.

International healthcare literature variously refers to wrap devices as adjustable wrap garments (AWG), adjustable Velcro wraps (AVW), (Velcro-) adjustable compression wraps (VACW/ACW), or by their product name, e.g. ReadyWrap® (L&R). In essence, the adjustable compression device is a garment for a limb, most commonly the lower leg. It is made of low or non-stretch fabric (Benigni et al, 2023) and significantly, has adjustable straps or some means for the patient to adjust the fit and compression pressure.

Medium to low quality studies have described their use as a substitute for venous leg ulcer compression bandaging and the intensive phase of lymphoedema treatment (Borman et al, 2021; Al Saffar, 2022), as night-time support garments (Campione et al, 2021), and as a realistic alternative to stockings for many elderly clients in residential care (Balet et al, 2021). Wraps have been shown to produce more consistent and reliable pressure than compression bandages when self-adjusted by patients and give greater independence from the therapist (Partsch, 2019). While single case studies show wraps to be useful in a variety of specific cases, evidence reviews have recommended further clinical research (Williams, 2016).

Arguably, practices regarding compression are often ingrained due to its historical usage, with evidence from managing chronic venous insufficiency (CVI) underpinning its effectiveness. Thus, due to the high occurrence of lymphoedema and wounds, plus variable compression management systems available, in the authors' clinical opinion, a service evaluation including cost-efficiencies was justified. Indeed, increasing pressures on healthcare resources mean that service leads need to be constantly evaluating the efficiency and effectiveness of their provision, particularly for the increasing number of vulnerable, elderly and obese patients on their caseloads.

AIM AND OBJECTIVES

Using routinely collected assessment and follow-up data, the aim of this evaluation was to explore the clinical benefit, impact, outcomes and cost-efficiencies of using a ReadyWrap® adjustable compression garment instead of previous care.

The specific objectives were to:

- Measure changes in clinical and PROMs before and after compression wrap system intervention
- Assess the healthcare resource use and related costs
- Estimate health service changes by using the compression wrap system
- Estimate changes in health-related quality of life measures (HRQoL).

METHODS

The evaluation was an observational 'before-after design', capturing baseline resource use, costs and outcomes (clinical and patient) at the time of assessment for the compression wrap system and again at a maximum of six-month follow-up. 50 patients using the compression wrap system in Lymphoedema Wales Clinical Network from October 2021 to March 2023 were evaluated. Data comprised existing routinely collected information and all patients consented for their anonymous data to be used for the evaluation.

ETHICS AND RESEARCH GOVERNANCE

Swansea Bay University Health Board Research and Development (R&D) office deemed the study a service evaluation/data audit. Swansea University School of Health and Social Care (SHSC) ethics committee provided permission to analyse the anonymised data sets.

PATIENT SELECTION

The following inclusion criteria were used:

- All patients were aged 18 or over, and treated by lymphoedema staff within Lymphoedema Wales Clinical Network
- Patients with primary or secondary lymphoedema from a cancer or non-cancer origin were included
- No time limits were set on the onset of lymphoedema and swelling could be unilateral or bilateral
- Patients may or may not have had superficial or chronic wounds
- Midline lymphoedema patients were not included. Nor were patients who were unable to use and care for the compression wrap system.

INTERVENTION

The intervention for this service evaluation was the introduction of a compression wrap system. All 50 patients were fitted with the wrap system for the foot, calf and/or thigh region as per lymphoedema specialist recommendations. The patients were advised to wear the wrap for a minimum of eight hours and a maximum of 24 hours daily, dependent on their presenting history. Patients were provided with two sets of products for cleanliness.

DATA COLLECTION MEASURES

Data capture included soft and hard clinical and patient outcomes, including body mass index (BMI), International Society Lymphology (ISL) staging, British Lymphology Society (BLS) staging, Lymphoedema Wales Outcome Severity, health-related quality of life tool (EQ5D5L)/visual analogue scale (VAS), Lymphoedema-specific Patient Reported Outcome Measure (LYMPROM©, see below), circumferential measurements using

Table 1: Demographic data

Variable	Advice	N	(%)
Age	18–40	5	(10)
	41–50	2	(4)
	51–60	6	(12)
	61–70	14	(28)
	71–80	10	(20)
	81+	13	(26)
BMI	Normal weight (18.5–24.9kg/m^2)	3	(6)
	Overweight (25–29.9kg/m^2)	5	(10)
	Obese class 1 (30–34.9kg/m^2)	5	(10)
	Obese class 2 (35–39.9kg/m^2)	4	(8)
	Obese class 3	23	(46)
	Missing	10	(20)
ISL staging	Stage 0 (latent)	0	(0)
	Stage I (mild)	0	(0)
	Stage II a (pitting)	19	(38)
	Stage II b (non-pitting)	21	(42)
	Stage 3	10	(20)
Affected Limb	Lower limb (left)	4	(8)
	Lower limb (right)	3	(6)
	Lower limb (bilateral)	43	(86)
Rockwood Frailty Score	1 (very fit)	4	(8)
	2 (well)	1	(2)
	3 (managing well)	8	(16)
	4 (vulnerable)	10	(20)
	5 (mildly frail)	7	(14)
	6 (moderately frail)	14	(28)
	7 (severely frail)	5	(10)
	8 (very severely frail)	1	(2)
Reason for assessment	Lymphoedema	22	(44)
	Lymphoedema and wound care	28	(56)
BLS staging	Stage 0 (latent)	0	(0)
	Stage I (early	1	(2)
	Stage 2 (established)	2	(4)
	Stage 3a (complex unilateral)	6	(12)
	Stage 3b (complex bilateral)	41	(82)
Lymphoedema Wales Severity Outcomes	1 — at risk	0	(0)
	2 — mild oedema	0	(0)
	3 — moderate oedema	2	(4)
	4 — severe oedema	7	(14)
	5 — complex oedema	13	(26)
	5W — complex with a wound	28	(56)

tape measure, Rockwood Frailty Score, wound description, and number of cellulitis episodes and falls. Previous resource utilisation of health care, e.g. dressings, garments and staff time were captured before the compression wrap system was applied and again at six months.

PATIENT-REPORTED OUTCOME MEASURES (PROMs)

Patients completed a range of PROMs pre- and post-compression wrap system application. LYMPROM© (Lymphoedema-specific Patient Reported Outcome Measure), a

Table 2: Oedema location at onset

Oedema site	N	(%)
Distal	2	(4)
Distal, foot	15	(30)
Distal, foot, toes	9	(18)
Proximal	1	(2)
Proximal, distal	1	(2)
Proximal, distal, foot	13	(26)
Proximal, distal, foot, toes	9	(18)
Total	50	(100)

tool developed by Lymphoedema Network Wales clinicians and stakeholders (Gabe-Walters and Thomas, 2021), was used to record the impact of lymphoedema on patients. There are 13 questions in LYMPROM©, including home life, personal care, heaviness, pain, anxiety, work, finances, body image, walking, intimacy/desirability, hobbies, buying clothes/shoes and holidays, which can be divided into three dimensions of emotional, physical and social health. Items captured included impact of lymphoedema on heaviness, pain, anxiety, work, intimacy/desirability, hobbies, buying clothes/shoes and holidays on a scale of 0 (no impact) to 10 (highest impact) (Gabe-Walters and Thomas, 2021).

DATA AND STATISTICAL ANALYSIS

By assigning each patient a number in sequential order to preserve anonymity, descriptive demographic data was entered into MS EXCEL from clinical notes. Continuous variables were reported as a mean with standard deviation and categorical data as frequency. Differences in pre- and post-intervention were analysed using paired samples t-test with 95% confidence interval to examine the effect. A descriptive account of the resources and associated costs was captured to give an overall cost (e.g. primary care, secondary care, medication and dressing costs) and valued in pounds sterling using a price year of 2021/2022. The costs were determined from national published sources of the *British National Formulary* (BNF, 2023), 2020/2021 National Cost Collection Data (NHS England,

Table 3: Wound size and BLS staging baseline and post six months

Variable	Pre (baseline)		Post (six months)			
	n=50	(%)	n=43	(%)	Mean diff	p-value
Wound Size						
Small <10cm²	9	(18)	6	(14)	0.40	<0.001
Medium 10–25cm²	5	(10)	1	(2)		
Large >35cm²	5	(10)	0	(0)		
General maceration	2	(4)	1	(2)		
Multiple areas	7	(14)	1	(2)		
N/A	22	(44)	34	(79)		
BLS staging						
Stage 0 (latent)	0	(0)	0	(0)	-0.40	0.004
Stage I (early)	1	(2)	0	(0)		
Stage 2 (established)	2	(4)	10	(23)		
Stage 3a (complex unilateral)	6	(12)	11	(26)		
Stage 3b (complex bilateral)	41	(82)	22	(51)		

Table 4: EQ5D5L and VAS health scores and LYMPROM©

Health-related quality of life				95% Confidence interval of the difference			
QOL	N	Mean	Std. Dev.	Mean	Lower	Upper	p-value
EQ5D5L score pre	40	0.445	0.306	0.061	-0.020	0.141	0.134
EQ5D5L score post	40	0.506	0.261				
VAS health score pre	40	60.13	25.861	9.55	2.2	16.9	0.012
VAS health score post	40	69.68	19.241				
LYMPROM©	N	Mean	Std. Dev.	Mean	Lower	Upper	p-value
Pain pre	40	4.80	3.31	-1.48	-2.61	-0.34	0.012
Pain post	40	3.33	2.24				
Heaviness pre	40	6.23	2.96	-1.45	-2.29	-0.61	0.001
Heaviness post	40	4.78	2.74				
Shopping for clothes pre	33	6.94	2.95	-1.18	-2.39	0.03	0.055
Shopping for clothes post	33	5.76	3.08				
Body image pre	33	6.09	3.54	-2.27	-3.83	-0.72	0.006
Body image post	33	3.82	3.48				

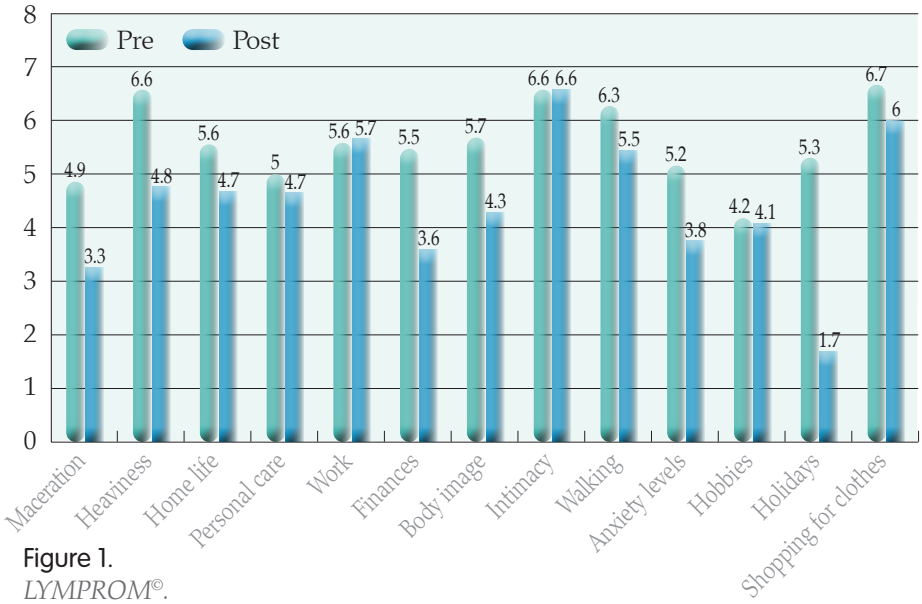

Figure 1.
LYMPROM©.

2022), and Personal and Social Services Research Unit (PSSRU, 2022). Results were analysed using MS EXCEL and IBM SPSS Statistics for Windows, version 26. A p-value <0.05 was considered statistically significant.

RESULTS

50 patients were provided with the compression wrap system of whom 18 were male (36%) and 32 female (64%), with a mean age of 67.8 years (range 18–100 years). Average BMI was 43.2 kg/m² (range 23.7–71kg/m²). The majority of patients (86%) had bilateral lymphoedema and 74% were classed as vulnerable or worse in the Rockwood Frailty Score. Further, 82% of the patients were recorded as complex in both the BLS and Lymphoedema Wales severity outcomes. Demographic data was captured (*Table 1*). Lymphoedema was located only below the knee (distal) in 52% and extended to the thigh region (proximal) in 48%; only eight people (16%) did not have foot swelling (*Table 2*).

Over half of the patients had a wound (56%) at onset of using the compression wrap system. These wounds ranged from being classified as small, <10cm², to macerated areas (*Table 3*). Analysing the data from baseline to six months highlights a statistically significant (p-value <0.001) reduction of wound presence from 56% to 21%. BLS severity outcomes also reduced in complexity from 94% to 77%, which again was statistically significant (p-value <0.004).

Circumferential measurements were recorded at baseline and post-intervention using circumferential tape measurements at 4cm intervals. Although the total right limb mean volume reduced from 11,228mls to 9,857mls and the total left limb mean volume reduced from 12,136mls to 10,410mls, the results were not statistically significant at p<0.299 and p<0.140 respectively. Episodes of cellulitis reduced from a reported 22 in the previous six months (two in hospital, 19 at home) to seven episodes post intervention (one in hospital and six at home).

Table 5: LYMPROM© and grouped health scores

LYMPROM©	N	Mean	Std dev	Mean	Lower	Upper	p-value
Physical health score pre	40	17.03	8.75	-3.48	-5.94	-1.01	0.007
Physical health score post	40	13.55	5.92				
Social health score pre	40	25.60	17.08	-2.85	-7.95	2.25	0.265
Social health score post	40	22.75	11.82				
Emotional health score pre	40	11.63	8.37	-1.70	-4.84	1.44	0.280
Emotional health score post	40	9.93	7.55				

Table 6: Intervention and resource costs

Intervention and resource costs				95% Confidence interval of the difference			
	N	Mean	Std dev	Mean	Lower	Upper	p-value
Cost dressing products pre	50	£269.4	£277.9	-£82.1	-£187.0	£22.9	0.123
Cost dressing products post	50	£187.4	£321.6				
Costs community nurse pre	50	£942.1	£1,134.2	-£298.3	-£647.2	£50.7	0.092
Costs community nurse post	50	£643.9	£1,371.9				
GP pre	50	£16.7	£39.8	-£11.2	-£24.6	£2.2	0.100
GP post	50	£5.5	£21.9				
Emergency department pre	43	£35.8	£120.4	-£14.3	-£60.4	£31.7	0.533
Emergency department post	43	£21.5	£79.4				
Cellulitis hospital pre	43	£162.8	£745.8	-£81.4	-£368.2	£205.4	0.570
Cellulitis hospital post	43	£81.4	£533.7				
Cellulitis home pre	43	£40.2	£91.9	-£26.8	-£54.4	£0.8	0.057
Cellulitis home post	43	£13.4	£39.6				
Total costs pre	43	£1,472.9	£1,721.2	-£383.7	-£974.0	£206.7	0.197
Total costs post	43	£1,089.2	£1,797.3				

Although 50 patients were assessed at baseline, this reduced to 43 at the six-month mark. The attrition was due to two deaths and five lost to follow-up. Other missing data was due to not having weighing scales present in clinic or information not captured at the time of review.

PROMS AND HEALTH-RELATED QUALITY OF LIFE

Table 4 details the change for the EQ5D5L, visual analogue scale (VAS) and LYMPROM©. Although both QOL scores improved, only the VAS health score demonstrated statistically significant improvements in general health ($p<0.012$).

LYMPROM© confirmed statistically significant improvements in pain, heaviness, shopping for clothes and shoes, and body image. Although LYMPROM© improved in other areas (*Figure 1*), these were not statistically significant.

When LYMPROM© was analysed into social, physical and emotional health, only physical health was statistically significant ($p<0.007$) (*Table 5*).

INTERVENTION AND RESOURCE USE

The mean resource utilisation for dressing consumables (including bandages, compression garments), staffing costs for community/lymphoedema staff, GPs and emergency department admissions for cellulitis treated at hospital or at home are shown in *Table 6*. At baseline, there had been considerable healthcare input in the six-month period before receiving the compression wrap system. Community nurse visits showed the highest frequency of resource inputs, with mean number of visits per patient being 11.6. At six months after application of the compression wrap system, visits had reduced to 9.1, but this was not statistically significant (p-value 0.09).

Episodes of cellulitis reduced with the use of the compression wrap system from 22 pre- to seven post-intervention. The number of people hospitalised due to cellulitis also demonstrated a reduction of 50% with an average per patient cellulitis cost reducing from £203 to £95. Lastly, dressing consumables also reduced from £269.4 to £187.4, including staff intervention and compression wrap system cost. Even though the mean reduction per patient was £383.70, the intervention and resource use did not show statistically significant results (p-value 0.197).

DISCUSSION

To the best of the authors' knowledge, this is the first evaluation of this kind looking at the cost, impact and outcomes of using a compression wrap system demonstrating statistically significant improvements in specific outcomes. A strength of the evaluation is the use of validated outcome tools with a larger population (50) than previous studies. As well as general health improvements reported by the EQ5D5L, this evaluation captured PROMs via LYMPROM©, with statistical significance in the elements making up the physical health score. It is recognised that the phenomenon of effort justification may partly explain the improved PROM scores, i.e. the novelty of using a new product could elevate the perceived value of the benefit. However, the work score did not improve despite patients reporting that the compression wrap system was comfortable and the ability for self-adjustments made them feel more in control. However, a factor affecting this particular score was the high mean age, BMI and frailty of the cohort. Further study with an exclusively working population would be interesting.

As with previous studies (Williams, 2016; Partsch, 2019), the mean volume measurements decreased in both limbs. However, in this evaluation, they were not statistically significant. The selection of patients may account for this difference. Of the 50 patients,

60% were previously managed in multilayered bandaging and 36% were already in compression garments prior to the compression wrap system intervention, therefore the worst of the oedema may already have been reduced.

Importantly, the indicator for the presence of a wound reduced with the introduction of the compression wrap system. This is similar to the findings of Lawrence (2014) and Nugent (2013). Even though the average age of the patient was nearly 68, with a high mean BMI of 43, and 74% of the cohort being vulnerable, the data showed that all types of wounds improved, including small, medium, large and macerated areas. This may imply that improvements to wounds can occur even when there are more risk factors such as frailty and high BMI. Further, in this evaluation, both pain and heaviness reduced and were statistically significant; this in turn showed an impact in improvements in EQ5D5L. Such implications are important and worthy of further investigation given the increasing challenge of obesity and frailty within caseloads.

Robust economic evaluations of using compression wrap system-type products compared to normal care are rare. By nature, multilayered bandaging is resource heavy in staffing and products, so using a compression wrap system may provide significant cost savings but requires further investigation. In this evaluation, community nurse visits lessened as did use of dressings such as 'superabsorbents'. Even emergency department visits, GP calls and cellulitis episodes decreased. While these factors did not reach statistical significance, they warrant further study. Williams (2016) reported a negative aspect of compression wraps to be the initial expensive outlay, but this evaluation found that over six months there was a mean cost reduction of over £383.70 per patient, which included the purchase price of the compression wrap system.

An interesting emergent question was 'why and when do practitioners choose a compression wrap system over other treatments, such as compression hosiery and multilayer bandaging?' Usefully, this evaluation has shown that older age, frailty and BMI are not a barrier to this intervention. These products clearly have the potential to maximise self-management and patient independence; particularly with complex patients whose care can be resource heavy. For practitioners to make efficient and effective use of compression wrap systems, specific guidance based on continued research in relation to specific patient types would be useful. The potential in terms of improved wound care, reduced infection and enhanced physical health scores is too important to ignore.

'This evaluation has highlighted that the potential of compression wrap systems for positive patient health impact and cost savings should not be ignored. It has never been more important to maximise self-management and patient independence, particularly with some of our most complex, obese and frail patients.'

It was a strength of the study that the population was as 'typical of caseload' as possible, but future research with a more homogenous participant population may identify which groups would show greatest cost benefits from the use of a compression wrap system compared to standard practice.

LIMITATIONS

Some patients were lost to follow-up, thus key measurements were unable to be captured. Nevertheless, 43/50 (86%) patients' data at six months is encouraging. While the population of the evaluation was limited to Wales, the demographics are clearly described and are likely to be representative of many UK services.

CONCLUSION

This evaluation has highlighted that the potential of compression wrap systems for positive patient health impact and cost savings should not be ignored. It has never been more important to maximise self-management and patient independence, particularly with some of our most complex, obese and frail patients. The evaluation findings regarding improved wound care, reduced infection and improved physical health scores can be further corroborated with research within specific demographic groups. Patient-reported outcomes and a robust resource evaluation allowed the authors to show that the purchase costs of the compression wrap system over the relatively short six-month period was economically justified and delivered tangible, measurable benefits to the patient and health system. JCN

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Conflicts of interest

None declared.

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- Your knowledge of compression therapy
- The findings of this evaluation and how they could change your practice
- The benefits of adjustable compression wrap systems.

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KEY POINTS

- Increasing pressures on healthcare resources require constant evaluation of the efficiency and effectiveness of provision, particularly for the rising number of vulnerable, elderly and obese patients.
- Since the pandemic, the complexity and incidence of oedema cases have increased, causing a rise in venous ulceration, falls, and cellulitis infections within NHS Wales.
- This evaluation explores the clinical benefit, impact, outcomes and cost-efficiencies of using an adjustable compression wrap system instead of previous care.
- Wraps have been shown to produce more consistent and reliable pressure than compression bandages when self-adjusted by patients and give greater independence from the therapists.
- An interesting emergent question was 'why and when do practitioners choose a compression wrap system over other treatments, such as compression garments and multilayer bandaging?'
- Patient-reported outcomes and a robust resource evaluation allowed the authors to show that the purchase costs of the compression wrap system over the relatively short six-month period was economically justified and delivered tangible, measurable benefits to the patient and health system.