Patient Preference and Adherence

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ORIGINAL RESEARCH

Developing a Suite of Resources to Improve Patient Adherence to Compression Stockings: Application of Behavior Change Theory

Laila Bar[1,2], Darryn Marks[3], Susan Brandis[1]

[1]Department of Occupational Therapy, Bond University, Faculty of Health Science and Medicine, Robina, Queensland, Australia; [2]Department of Occupational Therapy, Gold Coast University Hospital, Southport, Queensland, Australia; [3]Department of Physiotherapy, Bond University, Faculty of Health Science and Medicine, Robina, Queensland, Australia

Correspondence: Laila Bar, Department of Occupational Therapy, Level 4, Bond Institute of Health and Sport, 2 Promethean Way, Robina, Queensland, 4226, Australia, Tel +61 413 855 090, Email laila.bar@student.bond.edu.au

Purpose: Poor patient adherence to compression stockings remains a difficult and pervasive problem for clinicians, with costly repercussions for patients and health-care systems. The purpose of this paper was to describe the application of behavior change theory to the systematic development of a suite of resources, aimed at improving patient adherence to wearing compression stockings.

Methods: Employing a non-empirical approach, behavior-change theory was used to develop an innovative intervention as part of a multi-phase project. Target behaviors, barriers and potential enablers were identified in relation to stocking adherence. An impact-likelihood matrix for behavior prioritization was used to identify possible areas for intervention within occupational therapy outpatient clinics. Selection of suitable resources and their consequent development were based on a narrative and problem-solving process by a panel of clinical experts.

Results: Of 14 potential domains embedded in the Theoretical Domains Framework, the key target behaviors and barriers were associated with eight domains. Michie's Behavior Change Wheel revealed recommendations in six subdivisions and of these, four intervention functions were selected by the panel, based on their potential impact and likelihood of adoption in clinical practice. Findings led to the development of a suite of resources comprising a new questionnaire, a clinical decision tree, augmented by clinical answer sheets corresponding to each of the barriers.

Conclusion: Application of behavior change theory informed the design of a behavior change intervention comprising an integrated suite of resources for novice and experienced clinicians.

Practice Implications: These novel resources have potential to improve patient adherence to compression stockings and consequently generate health-care savings through reduced need for wound care products, and medical interventions with translation to other settings and conditions requiring compression stockings. Patient outcomes will likely be improved with reduced pain, improved quality of life and earlier resumption of usual occupations.

Keywords: compression stockings, adherence, behavior change theory, Behavior Change Wheel, COM-B model, Theoretical Domains Framework, venous leg ulcers

Plain Language Summary

The best way to treat and prevent venous leg ulcers is by wearing compression stockings every day. However, some people do not wear their stockings as much as they should, demonstrating "low adherence" to compression stockings. Using behavior change theory, three new resources have been developed to attempt to improve patient adherence. These include a new questionnaire to determine individual patient barriers, a decision tree to guide clinicians in addressing the barriers, and answer sheets listing recommendations to address each barrier.

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Background

Clinically prescribed compression stockings are considered best practice, for chronic venous insufficiency (CVI), to heal and prevent venous leg ulcers (VLU).[1–3] VLUs are wounds in the lower legs, occurring due to higher pressure within veins, often related to higher body mass index and/or impaired mobility.[3] They are a significant problem for those over the age of 65, with international prevalence studies reporting rates between 1.5 and 3.0 per 1000 people.[4] With demographics trending towards sedentary lifestyles and an ageing population, VLUs will likely remain a significant burden on society.[5] VLUs have negative impacts at the individual level, contributing to pain, reduced quality of life and work productivity,[6] while also burdening health-care systems due to wound management costs and hospitalization.[7]

Compression stockings must be worn consistently,[3] since low adherence contributes to delayed healing[8] and recurrence of VLU.[9,10] Unfortunately, worldwide adherence rates are low, reported to be between 12% and 52%.[11] Adherence to wearing compression stockings is a complex multi-faceted phenomenon, with over 200 barriers identified in the literature.[10,12] Many of these barriers relate to patients' lack of understanding of why stockings are required, difficulty with getting them on and off, and discomfort whilst wearing them.[13,14]

To determine each patient's specific barriers to adherence, a suitable questionnaire is required. This is supported by Michie,[15] a behavior theorist, who recommends that the reasons contributing to a "problem behavior", such as poor adherence to medical advice, should be identified, prior to implementing any intervention. Several purpose-made questionnaires[16–20] designed to determine patient-reasons for discontinuing compression therapy have been developed, however these do not adequately address the multi-dimensional aspects of adherence. Further, they lack sufficiently detailed questions for meaningful and personalized intervention planning. For example, Allaert's 2019 study[16] evaluated the psychometric properties of a self-questionnaire on adherence, Benigni[17] investigated difficulties with donning stockings through a survey, and Shannon[20] assessed adherence to wider clinical recommendations for preventing VLUs, but none of these included prior negative experiences,[21] low mood[22] or low self-belief[23,24] as potential barriers. In relation to the comfort of a stocking, Allaert's[16] only question was "I find it uncomfortable (heat, cold, pressure)" and Clarke-Moloney[18] simply asked "How do you find the feel/sensation' of the stocking on your leg?"

Unidimensional interventions that aim to improve behaviors associated with adherence to compression stockings have often been unsuccessful and none have demonstrated consistent superiority over others.[25] In contrast, research into improving adherence in other chronic health conditions including diabetes mellitus[26] and chronic kidney disease,[27] demonstrates more positive impacts from personalized and multidimensional approaches. A recent scoping review[25] of adherence to wearing compression stockings found that, while personalized and multi-dimensional interventions show promise, further high-quality research is required. It recommended that the design of a multidimensional behavior change intervention to improve adherence with compression stockings, must accommodate the multitude of adherence barriers and be sufficiently flexible to deliver tailored personal interventions.

Many authors[15,28,29] have employed theory in the development of other clinical interventions (prototypes) for behavior change, to promote clarity around planning, design, implementation, and evaluation. Theory can provide structure to complex knowledge, allowing for generalization across populations and settings.[15,30,31] This is particularly relevant in the context of the adherence phenomenon, where patients often present with several barriers at the same time, requiring a complex intervention.[28,32]

In consideration of an overarching framework to guide resource development, a design thinking approach[33] was given due consideration, since it aligns with the intent to implement a collaborative and human-centered approach to a real-world problem. However, since this framework encompasses prototype testing, it was considered beyond the scope of this paper. Behavior change theory allows for a more concentrated focus on development of a behavior change intervention.

Behavior change interventions can be defined as "coordinated sets of activities designed to change specified behavior patterns aiming to promote uptake of clinical services to support healthy lifestyles".[34] While there are several broad theoretical approaches available for developing interventions generally in health-care settings,[15,35–37] more specific

theories have also been used in the context of promoting adherence to medical recommendations.[30,38] This section describes justification for the selection of a specific behavior change theoretical model.

A 2011 systematic analysis[34] of 19 frameworks of behavior change interventions concluded that none covered the full range of intervention functions required for effective behavior change. Subsequently, Michie developed the Behavior Change Wheel (BCW).[34] This is an iteration of the popular Theoretical Domains Framework (TDF).[39] The BCW claims to be more flexible than the TDF alone, however the TDF is often used alongside it.[40]

The BCW has at its core, a "behavior system" involving three essential conditions: capability (C), opportunity (O) and motivation (M) to influence behavior (B). These form the basis of Michie's COM-B model[34] of behavior change. It proposes that at any given moment, a particular behavior will occur only when the person has the capability and opportunity to engage in a certain behavior, and when they are more motivated to perform that behavior than any other.[34,41]

The BCW on its own has demonstrated success and broad applicability in behavior change programs. A 2015 scoping[30] review of adherence promotion theories in pelvic floor muscle training critiqued 12 theoretical models/theories and identified Michie's BCW as helpful in informing future research into adherence interventions. BCW has also been used successfully to improve adherence to medical advice in diabetes management[42,43] and heart failure.[44] Furthermore, Gould et al[45] employed the BCW to systematically inform an intervention for health provider care of Australian indigenous pregnant women regarding smoking cessation. Similarly, a theory-based 2018 study[46] used the BCW to embed particular clinical behaviors into adult hearing aid fitting consultations, while Sinnott et al[47] described the use of the BCW to develop an intervention for use by general practitioners to improve medication management in multimorbidity.

Use of the COM-B model together with the 14 domains of the TDF facilitates a more detailed transition from a behavioral analysis of the problem to the selection of the most contextually and effective intervention functions, including modes of delivery.[41,45,46] The successful application of BCW and the TDF to other complex chronic conditions requiring multifactorial solutions argues well for its extension to the development of programs to improve adherence to compression stockings for the management of venous leg ulcers. Therefore, this paper describes the application of behavior change theory, specifically the COM-B model described by Michie in the BCW, supplemented by the additional details embedded in the TDF.

Methods

Michie's BCW was used to guide selection of intervention functions to address barriers to target behaviors, identified using the COM-B model and TDF domains; a target behavior being one that has been chosen, or "targeted" for change.[48]

Initially, a local metropolitan hospital expert clinical panel was established by the lead investigator. Individuals were approached for inclusion based on their clinical relatedness to the topic and availability for subsequent collaborative phases of brainstorming, reframing, and refinement of ideas to inform the selection of appropriate resources for development. The final panel, connecting through email and personal interviews, consisted of occupational therapists, vascular nurse practitioners, vascular surgeons, and university academic staff.

The steps involved in resource development reflect similar BCW methodology described by earlier authors.[46,47,49] Figure 1 illustrates the steps undertaken by the panel through the stages of defining the problem through to identification of appropriate behavior change techniques and their mode of delivery.

Firstly, the problem behaviors were defined, informing selection of target behaviors according to COM-B defined terms. The source (clinician or patient) of the desired behavior was then described alongside its linking TDF domain.[39,50] "Clinicians" comprises occupational therapists and occupational therapy assistants, and "patients" are adults who are referred to outpatient clinics for compression stockings, with a history of venous leg ulcers and reduced adherence to stockings. To avoid repetition, affirming language was used. For example, "the patient can't put stockings on and off by himself" became, "the patient can put stockings on and off by himself." The dominant barriers to the target behavior were identified and linked to potential enablers within the context of occupational therapy (OT) outpatient clinics. Potential recipients of a new intervention were considered, and included hospital administrators, vascular surgeons, vascular nurse practitioners, general practitioners, patients, and clinicians.

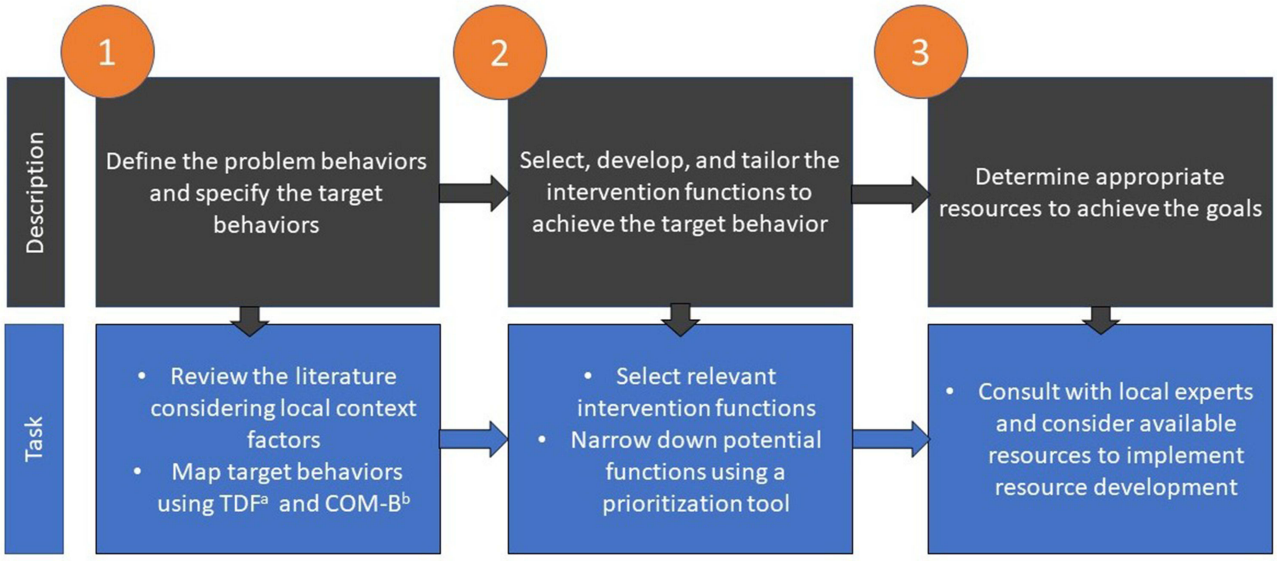

Figure 1 Overview of steps used in resource development using the BCW approach.

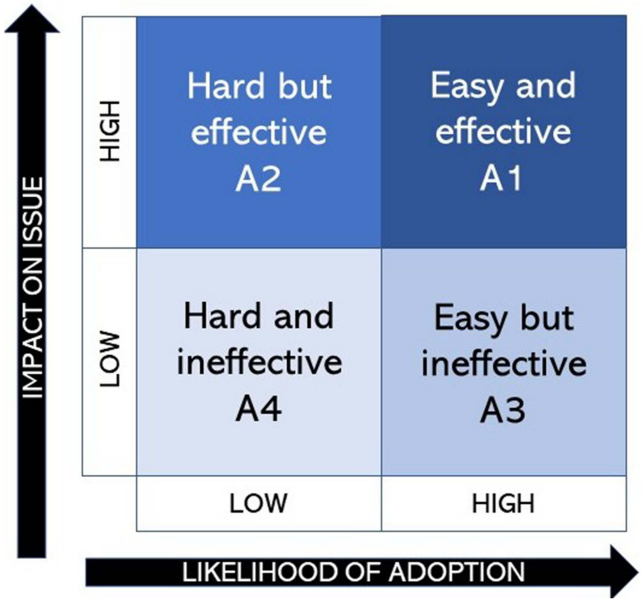

Figure 2 The impact-likelihood matrix for behavior prioritization.[53]
Notes: Reprinted from Kneebone SL, Fielding K. The impact-likelihood matrix: a policy tool for behaviour prioritisation. Environ Sci Technol. 2017;70:9–20, Copyright (2017), with permission from Elsevier.[53]

The second step was to select, develop, and tailor the intervention functions to achieve the target behavior. The COM-B model was applied to the target behaviors and barriers. Potential strategies were linked to the desirable patient behavior. COM-B intervention functions with potential to elicit behavior change[51,52] were considered by the panel in relation to each barrier, considering contextual relevance, and anticipated target acceptability. Kneebone's Impact-Likelihood Matrix for behavior prioritization[53] (Figure 2) prompted analysis of their likely impact and ease of implementation and was adapted with permission. Interventional strategies most likely to have a greater impact on stocking adherence were identified as those requiring the least effort and having the highest likelihood of adoption by clinicians.

This process led to the third step, where the specific details about the resources to be developed were determined using a narrative and problem-solving process.

In development of the first resource (a questionnaire), barriers to stocking adherence were grouped thematically, and a list of possible questions considered capable of revealing these barriers was assembled by the lead investigator. These questions were then refined through consultation with the local expert clinical panel to provide a level of satisfactory detail. Recognizing, for example that there are multiple reasons for lack of comfort in stockings, this new questionnaire comprises 11 questions that relate to this issue alone.

In designing the second resource (a decision tree), the COM-B component and TDF domains were considered in relation to the source of the enabling behavior, linking each barrier to multiple levels of existing local resources, including videos and handouts.

Potential clinical recommendations regarding each question (barrier) on the questionnaire were explored in development of the third resource (clinical answer sheets) through a review of the literature, supplemented by several phases of feedback from the expert clinical panel. These were revised until a consensus was reached regarding the final version of each corresponding answer sheet.

Results

The following section presents the results from the application of behavior change theory as described above. Initially, the expert clinical panel agreed that only patients and clinicians were appropriate recipients of the intervention. The step of defining the problem and specifying the target behaviors found that, of 14 potential TDF domains, the target patient- and clinician-behaviors and barriers were associated with the following eight domains: Knowledge, skill, environmental context and resources, social/professional role, memory/attention/decision process, beliefs about consequences, beliefs about capabilities, and social influences. Table 1 presents this information.

The second step resulted in the selection, development, and tailoring of the intervention, while also identifying intervention functions to achieve the target behavior. Application of the COM-B model to the target behaviors and barriers revealed recommendations in six sub-divisions isolating potential facilitators across multiple domains. The intervention functions were identified and prioritized and are also included in Table 1. Nine possible COM-B intervention functions were considered by the panel for contextual relevance and acceptability. Five intervention functions were excluded (persuasion, incentivization, coercion, restriction, and modelling) considered difficult to implement due to practical limitations of prebooked outpatient appointments which are inflexible (30- or 60-minute appointments) and patients are routinely only reviewed every six months. Those considered feasible were education, training, environmental restructuring, and enablement. Of 16 potential contextually relevant patient- or clinician-actioned enablers mapped onto a prioritization tool, four were excluded. Justification for omission is described in Table 1.

This process identified the need to develop a suite of resources to comprehensively address the variability and combined complexity of the intervention strategies and enablers identified. These resources were modelled around published evidence, strengthened by the expert panel's shared knowledge and experience.[54,55] A new patient questionnaire, sufficiently specific to determine individual patient barriers to adherence was created. Secondly, a decision tree was designed to assist clinician's efforts to systematically address each patient barrier to the target behavior. Finally, recommendations to address each barrier were agreed upon, and assembled conveniently as "clinical answer sheets". This suite of resources is shown in Figure 3.

The "Barriers to Compression Questionnaire" comprises 24 questions, thematically grouped into five categories. It prompts the treating clinician to make clinical observations and ask probing questions to identify participant-specific barriers to adherence. Each question requires a "yes" or "no" response. If a "yes" response is recorded, the clinician or participant rates the significance of this score on a Likert scale of 1 (mild) to 5 (severe). Table 2 demonstrates the link between each barrier, the question relating to the barrier, the relevant COM-B component and the TDF domain and source of enabling behavior.

The clinical decision tree links each barrier to multiple levels of resources. For example, if a patient's primary barrier is related to lack of skills in applying compression stockings, the decision tree will link to the relevant clinical answer sheet, recommend targeted skills-based training and/or enablement via assistive devices, and suggest pertinent patient handouts and videos. If the barrier relates to discomfort whilst wearing stockings, then the answer sheet will suggest a modified stocking type/sizing based on the reason for the discomfort and suggest further resources if appropriate.

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Table 1 Mapping of Barriers and Enablers to the Wearing of Compression Stockings, Linked to Michie's COM-B Functions, Grouped by TDF Domains, and Rated on Their Justification for Inclusion

COM-B[34] Component (Source of Behavior)	TDF[39] Domain Link to COM-B	Target Behavior	Barrier - Considering Patients and Clinicians	COM-B Intervention Function	Patient Actioned Enabler: Behavior Change Technique/Description of Intervention Strategies	Clinician-Actioned Enabler: Behavior Change Technique/Description of Intervention Strategies	Impact-Likelihood/ Justification
CAPABILITY[34]							
FUNCTIONS: Physical: Skills, abilities or proficiencies acquired through practice Psychological: Knowledge, memory, attention, decision processes, behavioral regulation					**POTENTIAL ENABLERS**: Physical: eg, workshops, skills-based training, assistive devices. Psychological: eg, distribution of educational material, educational meetings, mass media, Providing information or education		
Physical Capability		**Patient can put stockings on and take them off by themself**	Unable without another person to assist	Environmental restructuring and enablement	Patient arranges outside assistance through own network of supports or clinician assists with this	Assisting patients to locate a suitable helper: family/friend/non-government agency to visit	A3: Hard but effective For inclusion in intervention
	Environmental context and resources		Unable without an applicator	Environmental restructuring, training, and enablement	Patient sources own applicator	Clinician provides an applicator and/or information regarding hire Clinician teaches patient how to use an applicator	A3: Hard but effective For inclusion in intervention
	Skills Social/ professional role		Lack of patient skills/ training Clinicians do not consider how patients don/doff stockings, and/or prioritize skills training	Training, education, enablement, and environmental restructuring		Clinician helps patients to develop the skills to don/doff stockings Clinician are given prompts and reminders to facilitate skills training Clinicians are given prompts to provide handouts to support patient education	A1: Easy and effective For inclusion in intervention
	Knowledge Skills	**The patient can tolerate wearing stockings all day**	Stockings are not comfortable as not positioned correctly by the patient due to lack of knowledge / clinician not prompting for this	Training, education, enablement, and environmental restructuring	Patient reads and retains information around correct stocking positioning and the need for regular adjustment	Clinicians are given prompts to inform patients around correct stocking positioning/ need for regular adjustment with verbal education and provision of handouts	A1: Easy and effective For inclusion in intervention
	Knowledge Skills		Stockings are not comfortable as not the correct prescription/ill-fitting	Training, education, enablement, and environmental restructuring		Provide training/guidance for clinicians on how to choose the correct stocking Clinicians are given prompts to look for common problems with stocking comfort Provide prompts and tips for prescribing stockings so they are comfortable and well-fitting and problem-solving common problems	A1: Easy and effective For inclusion in intervention

Psychological Capability	Knowledge Social/ professional role	**The patient understands that stockings should be worn all day**	Lack of patient understanding of wearing regime Clinicians forget to provide the necessary information, or do not feel it is important	Enablement, environmental restructuring, and education	Patient hears, reads, and retains information around the timeframe for wearing stockings	Clinicians are given prompts via clinical templates, to remind patients at each appointment verbally and in writing Clinicians are given prompts to book OT Assistant phone calls for regular reminders	A1: Easy and effective For inclusion in intervention
	Knowledge Social/ professional role	**The patient is caring for stockings correctly (to avoid them becoming worn out and no longer effective)**	Lack of patient understanding of how to care for stockings Clinicians forget to provide the necessary information, or do not feel it is important	Education and enablement	Patient hears, reads, and retains information around how to care for stockings correctly	Clinicians are given prompts via documentation templates, to remind patients at each appointment verbally and in writing Clinicians are given prompts to book OT Assistants phone calls for reminders and support	A1: Easy and effective For inclusion in intervention
	Knowledge Social/ professional role	**The patient has the knowledge of how to put stockings on and take them off**	Lack of patient knowledge of how to put stockings on and off Clinicians forget to provide the necessary information, or do not feel it is important	Education, training, and enablement	Patient hears, reads, and retains information around how to put stockings on and off	Clinicians are given prompts to facilitate patient knowledge of how to put stockings on and off Clinicians are given prompts for relevant handouts to give to patients Clinicians are given prompts to book OT Assistant phone calls for support	A1: Easy and effective For inclusion in intervention
	Memory, attention, and decision process	**The patient can remember instructions**	Poor patient memory impacting ability to follow instructions	Environmental restructuring	Patient brings a carer to their appointment	OT calls each patient before an appointment to ask if they may need a carer to attend	A3: Hard but effective Not within scope of existing clinical processes to do this. Not for inclusion
	Memory, attention, and decision process Knowledge Social/ professional role	**The patient appropriately reports issues to treating team of OTs**	Lack of patient awareness of OT role extends beyond clinical appointment Clinicians forget to provide the contact details or reassurance to patients that they can call for help if needed	Education	Patient hears, reads, and retains information around phone number to call, and permission to seek help if needed	Clinicians are given prompts (including via clinical templates), to remind patients at each appointment verbally and phone number in writing	A1: Easy and effective For inclusion in intervention
MOTIVATION[34]							
FUNCTIONS Reflective: Beliefs about capabilities and consequences, roles, identify, intentions, goals, optimism Automatic: Emotions, reinforcement such as rewards, incentives, punishment					**POTENTIAL ENABLERS** Reflective: eg, increasing confidence and challenging assumptions Automatic: eg, avoiding embarrassment		
Reflective Motivation	Knowledge Skills Beliefs about capabilities	**Clinicians have awareness of own skill level and gaps in knowledge and confidence to seek guidance to improve skills**		Education, enablement, training and education		Clinicians are offered regular skills-based training and increased knowledge through Inservices and one-to-one training	A3: Hard but effective Existing clinicians do have regular training but outside scope to formally include this in the intervention Not included
	Knowledge Skills Beliefs about consequences	**Patients feel validated, heard, and understood**	Patients do not feel validated, heard, or understood leading to lack of motivation to follow instructions	Education and enablement		Clinicians are given prompts to consider the importance of their patient interactions Clinicians are given information with tips for how to improve this in practice	A1: Easy and effective For inclusion in intervention

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Table 1 (Continued).

COM-B[34] Component (Source of Behavior)	TDF[39] Domain Link to COM-B	Target Behavior	Barrier - Considering Patients and Clinicians	COM-B Intervention Function	Patient Actioned Enabler: Behavior Change Technique/Description of Intervention Strategies	Clinician-Actioned Enabler: Behavior Change Technique/Description of Intervention Strategies	Impact-Likelihood/ Justification
Automatic Motivation	Beliefs about consequences	**Patients can speak freely about issues that may be difficult or embarrassing**	Lack of patient or clinician confidence to speak about difficult topics/patients wish to impress the clinician			Clinicians are given prompts to consider the importance of their patient interactions and to create a safe environment Clinicians are given information with tips for how to improve this in practice	A2: Easy but not effective Prompts will be given. For inclusion in the intervention
OPPORTUNITY[34]							
FUNCTIONS Physical: Environmental context and resources Social: Social influences such as social pressure, norms, conformity, social comparisons					**POTENTIAL ENABLERS** Physical: eg, changes in physical structure, changes in scope of services, changes to the setting/site of service delivery, financial Social: eg, establishing social and cultural norms		
Physical Opportunity	Environmental context and resources	**Clinicians have sufficient time to deal with issues that arise during appointments**	Lack of time in short clinical appointments meeting KPIs	Environmental restructuring		Clinics consistently offer longer appointments. Seek service change regarding allocation of budgets to allow for longer appointments	A3: Hard but effective In consideration of budget restraints this is considered difficult and is not included
	Environmental context and resources	**Clinicians can offer urgent appointments at time of need**	Lack of available appointments in high demand clinic	Environmental restructuring		Seek service change regarding more clinics to open with corresponding increase in staff hours	A3: Hard but effective In current economic climate, this is seen as not viable and is not included
Social Opportunity	Social Influences	**Patients are comfortable to wear stockings in public and do so**	Patients feel they look old, frail when wearing stockings. Lack of patient understanding of importance Clinician lack of awareness of this as a potential barrier	Training and education	Patient hears, reads, and retains information around normalization Patient accepts information provided	Clinicians are provided with the knowledge and skills to identify and address this with patients (normalization, options for colors/ fabrics) -Clinicians are given prompts to consider this, and directions for how to approach this if identified	A1: Easy and effective For inclusion in intervention

Abbreviations: TDF, Theoretical Domains Framework; COM-B, Capability, Opportunity, Motivation, Behavior; OT, Occupational Therapy/Therapist.

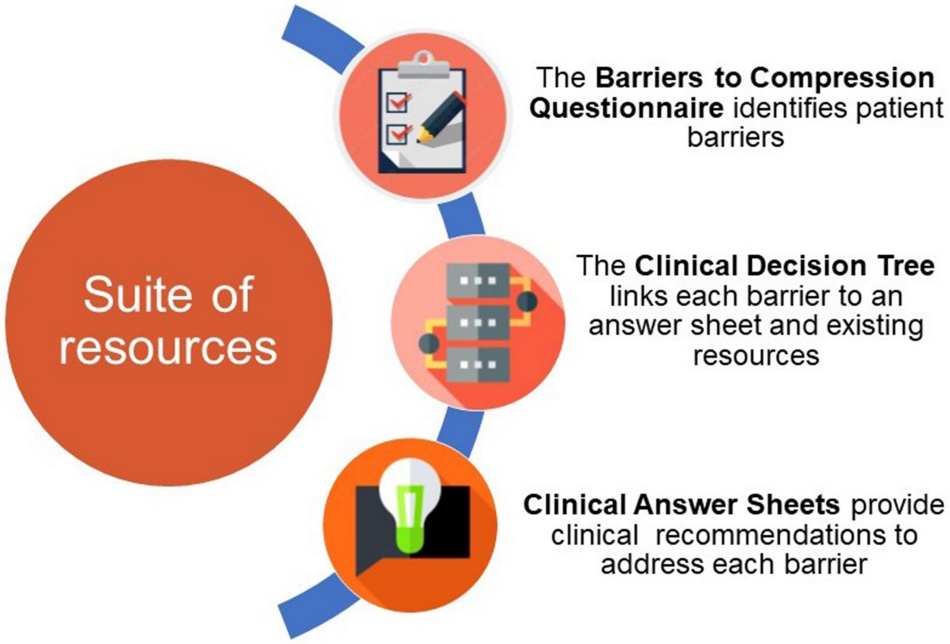

Figure 3 The suite of resources.

A separate clinical answer sheet corresponds to each of the 24 questions. Clinicians are instructed to identify their patients' top three barriers before designing and implementing a treatment plan, as per usual clinical practice.[56]

To illustrate the process from identification of a barrier through to selection of a behavior change intervention, using appropriate intervention functions, three examples are shown in Figure 4.

Discussion

This paper describes the application of an evidence-based, behavior theory-driven methodology for improving patient adherence to wearing compression stockings. It presents a suite of resources developed using Michie's BCW and the TDF. A recent scoping review[25] found that multidimensional approaches showed greater impact on adherence to stockings but have not yet been developed for testing. These new resources were developed to meet this gap.

These resources have potential to demonstrate positive impacts on health economics and patient outcomes. It is predicted that the development of a program to improve stocking adherence may have greater impact on this population than any improvement in medical or wound treatments.[57] In a review of the health economics regarding compression stockings, a 2018 Australian study[58] highlighted the important contribution of compression therapy in the management of VLUs. This study proposed that the provision of compression stockings to affected individuals nationally would initially cost the health system an additional AUS$270 million over 5 years but ultimately save AUS$1.4 billion over the same period of time. Further supporting the allocation of government funding, Pacella[59] reported that when patients were reimbursed for any costs related to compression stockings, their health-related quality of life improved. Importantly however, this economic modelling assumes that patients are adhering to compression stocking regimes.[3] Given the well documented low adherence to best-practice treatment with subsequent negative impacts on wound healing and recurrence,[13,14] improving compression stocking adherence may contribute to substantial cost savings and favorable patient outcomes[3,18] by allowing their full benefits to be realized.

It is also anticipated that these new resources will be transferable to other settings with a role in providing compression stockings for medical conditions where adherence is similarly low, such as lymphoedema, deep vein thrombosis, scarring and burns,[60] suggesting potential impact beyond venous leg ulcers.

The clinical information and guidance provided within these resources has the potential to influence clinician skill, confidence, and job satisfaction. Many may consider the specialized area of compression stockings outside their scope of

Table 2 Barrier Identification Expanded for Detail, Linked with Its COM-B[34] Component, TDF[39] Domain and Source of the Enabling Behavior

Barrier Expanded	Question	COM-B Component	TDF Domain and Source of Enabling Behavior
Theme: Stocking comfort			
Stockings are not comfortable as not the correct prescription/ill-fitting: Patient complains of/ clinicians observe stockings are digging in at ankle	Are stockings digging in at the ankle?	Physical capability Psychological capability	Skills/social and professional role (clinician) Knowledge, social/ professional role (c)
Stockings are not comfortable as not the correct prescription/ill-fitting: Patient complains stockings are too tight	Do stockings feel too tight generally?	Physical capability Psychological capability	Skills/social and professional role (clinician) Knowledge, social/ professional role (c)
Stockings are not comfortable as not the correct prescription/ill-fitting: Patient complains of/ clinicians observe stocking slides down leg	Do stockings slide down the leg?	Physical capability Psychological capability	Skills/social and professional role (c) Knowledge, social/ professional role (c)
Stockings are not comfortable as not the correct prescription/ill-fitting: Patient complains of/ clinicians observe stockings dig in at top of leg	Are stockings digging in at the top of the leg?	Physical capability Psychological capability	Skills/social and professional role (clinician) Knowledge, social/ professional role (c)
Stockings are not comfortable as not the correct prescription/ill-fitting: Patient complains stockings too tight at base of toes	Are stockings too tight at the base of the toes?	Physical capability Psychological capability	Skills/social and professional role (c) Knowledge, social/ professional role (c)
Stockings are not comfortable as not the correct prescription/ill-fitting: Patient complains stockings too tight over toes	Are stockings too tight over the toes themselves?	Physical capability Psychological capability	Skills/social and professional role (c) Knowledge, social/ professional role (c)
Stockings are not comfortable as not the correct prescription/ill-fitting: Patient complains fabric irritates skin/clinician observes physical evidence of this	Is the fabric irritating the skin?	Physical capability Psychological capability	Skills/social and professional role (c) Knowledge, social/ professional role (c)
Stockings are not comfortable as not the correct prescription/ill-fitting: Patient complains open toe stockings slide up foot with wear	Is the foot section sliding up the foot (open toe stockings)?	Physical capability Psychological capability	Skills/social and professional role (c) Knowledge, social/ professional role (c)
Stockings are not comfortable as not the correct prescription/ill-fitting: Clinician notes large foot compared to thin leg not fitting into standard sizing	Is there a large foot compared to a thin leg?	Physical capability Psychological capability	Skills/social and professional role (c) Knowledge, social/ professional role (c)
Patient complains stockings are too hot to wear at times	Do stockings feel too hot to wear sometimes?	Psychological capability Reflective motivation	Memory, attention, and decision process (p) Knowledge, social/ professional role (c) Knowledge, skills, beliefs about consequences (p)

(*Continued*)

Table 2 (Continued).

Barrier Expanded	Question	COM-B Component	TDF Domain and Source of Enabling Behavior
Stockings not tolerated as patient reacts to silicone top band: Patient complains fabric irritates skin/ clinician observes physical evidence of this	Is there irritation from a silicone grip top/band?	Physical capability Psychological capability	Skills/social and professional role (c) Knowledge, social/ professional role (c)
Theme: Patient understanding			
Patient has limited understanding of their medical condition. Clinician observes patient is not able to describe why they have received a medical referral for stockings	Is there a limited understanding of their medical condition?	Physical capability Psychological capability	Knowledge skills (c) Memory, attention, and decision process (p) Skills/social and professional role (clinician)
Patient has limited understanding of the medical reason stockings are required. Clinician observes patient is not able to describe why they have received a medical referral for stockings	Is there a limited understanding of why stockings are needed?	Physical capability Psychological capability	Knowledge skills (c) Memory, attention, and decision process (p) Skills/social and professional role (c)
Patient describes a previous negative experience with stockings	Was there a previous negative experience with stockings	Psychological capability Reflective motivation	Memory, attention, and decision process (patient) Knowledge, skills, beliefs about consequences (p)
Patient describes conflicting medical advice	Was there previous conflicting medical advice?	Psychological capability	Memory, attention, and decision process (patient)
Patient describes low mood / clinician observes possible low mood	Could the patient be experiencing low mood?	Psychological capability Reflective motivation Automatic motivation	Memory, attention, and decision process (p) Knowledge, skills, beliefs about consequences (p) Beliefs about consequences (p)
Patient describes a low belief in their own abilities to manage wearing compression stockings	Does the patient have a low belief in their own abilities	Psychological capability Reflective motivation	Memory, attention, and decision process (p) Knowledge, skills, beliefs about consequences (p)
Theme: Concern about appearance			
Patient describes a concern that stockings will make them look old/frail	Is the patient concerned that stockings would make them look old/frail?	Psychological capability	Memory, attention, and decision process (p)
Theme: Applying and removing stockings			
Patient describes / clinician observes inability to put stockings on	Is the patient unable to put stockings on?	Physical capability Psychological capability	Knowledge, social/ professional role Environmental context and resources (c and p) Knowledge, social/ professional role (c)

(*Continued*)

Table 2 (Continued).

Barrier Expanded	Question	COM-B Component	TDF Domain and Source of Enabling Behavior
Patient describes difficulty putting stockings on or taking them off due to existence of dressings that are disturbed in the process	Does the patient have wounds or dressings?	Physical capability Psychological capability	Knowledge, social/ professional role Environmental context and resources Knowledge, social/ professional role (c)
Patient describes / clinician observes inability to take stockings off	Is the patient unable to get stockings off?	Physical capability Psychological capability	Knowledge, social/ professional role (c) Environmental context and resources (c and p) Knowledge, social/ professional role (c)
Theme: Caring for stockings			
Clinician observes that the patient does not know how to correctly care for their stockings	Does the patient not know how to take care of their stockings (knowledge)?	Psychological capability	Memory, attention, and decision process (p) Knowledge, social/ professional role (c)
Clinician observes that the patient knows how to correctly care for their stockings but is not doing it correctly or consistently	Does the patient have difficulty taking care of their stockings (memory/planning)?	Psychological capability	Memory, attention, and decision process (p)
Clinician observes that patients have not contacted clinician to report a problem, instead waiting till their next scheduled review	Does the patient not know who to contact if they have any problems/ stockings need replacing?	Automatic motivation Psychological capability Reflective motivation	Beliefs about consequences (p) Memory, attention, and decision process (patient) Knowledge, social/ professional role (c) Knowledge, skills, beliefs about consequences (p)

Abbreviations: TDF, Theoretical Domains Framework; COM-B, Capability, Opportunity, Motivation, Behavior; c, clinician; p, patient.

practice[57] while clinical frustration related to the care of patients who are considered non-adherent to other forms of medical advice, has been linked to clinician stress, burnout, and general dissatisfaction with the health profession.[61] Competence in influencing patient adherence may therefore impact clinician satisfaction in caring for this patient cohort with potential generation of interest in gaining further expertise in this clinical area.

Strengths and Limitations

The strength of this new suite of resources lies in the breath of analysis completed prior to their development and the multifactorial aspects considered. The underpinning theory-based approach is augmented by input from highly experienced local clinical experts. The developed resources meet the requirements of an innovative personalized and multidimensional approach to intervention, as recommended by earlier authors.[14]

A substantial evidence base supports the selection of behavior change theory to guide the development of a new intervention. Other models were considered, for example, a design thinking approach,[33,62] however this is a relatively new framework. The BCW and TDF have been employed extensively[42–44] to explore barriers and enablers to behavior change for other medical recommendations and they provide the scope to encompass the complexity surrounding compression stocking adherence.

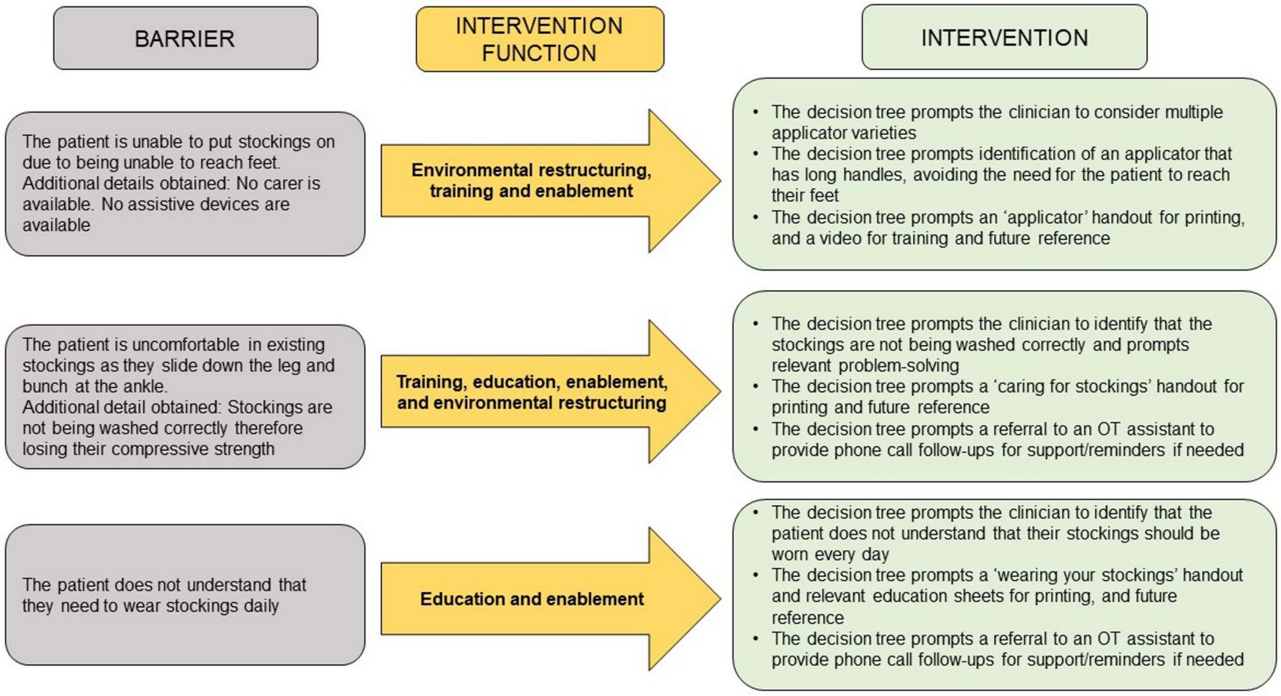

Figure 4 Three examples demonstrating links between barriers, intervention function and intervention prompted by the clinical decision tree.

Several limitations are acknowledged. Complex problems lend themselves to non-empirical approaches; however, empirical methods are required to draw conclusions and test their efficacy. Repeatability of research methodology is hindered by variability of site-specific factors including local clinical context, patient demographics and panel expertise. Further challenges exist because of the novelty of the resources and absence of similar comparative models. It is also acknowledged that the developed resources are required to be used together which, in consideration of their combined complexity, would require a behavior change for the clinicians using it. A paper-based delivery format could be considered cumbersome and, therefore, implementation of developed resources require attention regarding their delivery method.

Directions for Future Research

Given the known benefits of medical software applications, including increased access to point-of-care tools, better clinician communication, portability of information resources[63] and improved clinical decision-making,[64] the combined resources could be delivered on an App platform. A pilot study to investigate user acceptability, feasibility, and potential early proof of concept of these resources is recommended. This could then inform a larger randomized controlled trial with health-economics analysis, to test if these resources can improve stocking adherence and determine if there is a cost-benefit related to their use.

Conclusion

Behavior change theory was used to inform the design of a behavior change intervention to improve adherence to compression stockings. An analysis using Michie's BCW[34] and the TDF[39] considered expert opinion and available literature, to determine barriers to wearing compression stockings, and identify potential intervention methods. These were rated on their ease of implementation and target acceptability within occupational therapy clinics, culminating in the development of a suite of resources including a questionnaire, a clinical decision tree, and clinical answer sheets for novice and experienced clinicians to improve patient stocking adherence.

Abbreviations

BCW, Behavior Change Wheel; COM-B, Capability, Opportunity, Motivation, Behavior; CVI, Chronic Venous Insufficiency; OT, Occupational Therapist; TDF, Theoretical Domains Framework.

Disclosure

The authors report no conflicts of interest in this work.

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