

Usage Patterns and Beliefs about Therapeutic Ultrasound by Canadian Physical Therapists: An Exploratory Population-Based Cross-Sectional Survey

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ABSTRACT

Purpose: To explore the frequency and patterns of ultrasound (US) usage among physical therapists, to describe the most common purposes for using therapeutic US, and to investigate beliefs about therapeutic US. **Methods:** A survey was sent to 95% of physical therapists licensed to practise in the province of Alberta, Canada. **Results:** Of 2,269 physical therapists to whom email invitations were sent, 438 (19.3%) provided full responses. Results indicate that US is still frequently incorporated into treatment regimens and is widely believed to be effective; however, the study also found a decrease in US usage over the past 15 years. While physical therapists recognize the lack of evidence for the effectiveness of US, many consider it clinically useful. Physical therapists using US rely largely on their clinical experience when making decisions about its use, but this depends on level of education: clinicians with an MScPT degree tended to base more of their US decisions on research evidence, likely because of the increasing emphasis on research evidence in graduate education. **Conclusions:** Despite the questionable effectiveness of therapeutic US, physical therapists still commonly use this treatment modality, largely because of a belief that US is clinically useful. However, US usage has decreased over the past 15 years.

Key Words: ultrasonic therapy; surveys, beliefs.

RÉSUMÉ

Objectif : Explorer la fréquence et les tendances de l'utilisation de l'échographie chez les physiothérapeutes, décrire les raisons thérapeutiques les plus courantes d'utiliser l'échographie thérapeutique et analyser les croyances relatives à l'échographie thérapeutique. **Méthodes :** On a envoyé un questionnaire à 95% des PT autorisés à pratiquer en Alberta, au Canada. **Résultats :** Sur 2 269 physiothérapeutes qui ont été invités par courriel, 438 (19,3%) ont répondu au questionnaire au complet. Les résultats indiquent que l'échographie fait toujours partie fréquemment des protocoles de traitement et que l'on croit généralement qu'elle est efficace. L'étude a toutefois révélé aussi une baisse de l'utilisation de l'échographie au cours des 15 dernières années. Les physiothérapeutes reconnaissent peut-être le manque de données probantes sur l'efficacité de l'échographie, mais beaucoup d'entre eux la jugent utile sur le plan clinique. Les physiothérapeutes qui utilisent l'échographie s'en remettent en grande partie à leur expérience clinique lorsqu'ils prennent une décision sur son utilisation, mais tout dépend du niveau d'éducation: les cliniciens qui ont une maîtrise en physiothérapie ont tendance à fonder davantage leur décision d'y recourir sur des données de recherche, probablement parce qu'on accorde de plus en plus d'importance aux données de recherche au cours des études supérieures. **Conclusions :** En dépit de l'efficacité douteuse de l'échographie thérapeutique, les physiothérapeutes utilisent encore couramment ce mode de traitement, surtout parce que l'on croit qu'elle est utile sur le plan clinique. L'utilisation de l'échographie a toutefois diminué au cours des 15 dernières années.

Ultrasound (US) refers to mechanical vibrations (i.e., sound waves) below the range of human hearing, commonly at either 1 or 3 MHz (millions of cycles per second).¹ These waves travel through tissue and are preferentially absorbed in dense collagen structures with lower water content and high protein content (i.e., tendons, ligaments, joint capsules).² Therapeutic US has a long history of use in physical therapy practice; its clinical application has

evolved over the past several decades, from being used as a thermal modality to being employed for its non-thermal effects, particularly in tissue repair and wound healing.²

Therapeutic US has become one of the most commonly used electrophysical modalities; surveys carried out in different countries have consistently identified it as a central component of physical therapy practice.³⁻⁷

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Therapeutic US has been applied to a wide range of health conditions, including acute, sub-acute, and chronic musculoskeletal conditions. Benefits of therapeutic US have been claimed for a variety of phenomena, including wound healing,⁸ soft-tissue lesion management,^{9,10} increasing soft-tissue extensibility,^{11,12} remodelling scar tissue,^{9,13} diagnosing stress fractures,^{14,15} and pain relief.^{16–18}

Yet the clinical effectiveness of therapeutic US remains questionable.^{1,19–23} Overall, results of clinical studies have been mixed; only a few well-designed clinical studies have demonstrated positive effects on clinical outcomes.^{16,24,25} Several of the studies showing significant support for US application, particularly in the area of enhancing repair of soft tissue following injury, have been laboratory (i.e., cellular or animal) studies with questionable relevance to humans.^{26–32} The discrepancy in results between experimental and clinical studies warrants further research to clarify the therapeutic effectiveness of US in clinical practice. The limited clinical evidence also raises questions about why US is commonly used in clinical practice.

Previous surveys of therapists' US usage patterns have not explored in depth physical therapists' reasons for continuing to use US. Finding out why physical therapists value US so highly is an important step toward understanding the discrepancy between the clinical evidence and current practice. Lindsay and colleagues' (1995) report of US usage among private-practice physical therapists in Alberta, Canada, indicated very high levels of usage (94% reported using US at least once per day).³ This information is somewhat dated, however, and no information is available from therapists working in other practice settings. Moreover, the information was drawn from a survey of overall use of electrotherapy modalities that did not focus only on US and did not explore respondents' beliefs about therapeutic US. To overcome these limitations, we conducted a survey to investigate current usage patterns and beliefs about US use.

Our specific objectives in this study were (1) to measure the frequency and patterns of US usage among physical therapists licensed to practise in the province of Alberta, Canada, who had valid email addresses registered with the regulatory body; (2) to describe the most common therapeutic purposes for using US; (3) to investigate beliefs about therapeutic US and whether practice setting (private practice vs. other practice types) or the educational level of the therapist influenced US usage; and (4) to examine differences between therapists who report using US and those who report never using it.

METHODS

This exploratory population-based cross-sectional survey study was approved by the University of Alberta Health Research Ethics Board.

Target population

The survey was sent to all physical therapists licensed to practice physical therapy in Alberta who had valid email addresses listed with the regulatory body at the time of the study (October–December 2010).

Data collection

We developed a survey based on information from a literature review and discussions with experts in the field, including researchers who had previously conducted surveys of US usage among physical therapists. The authors of earlier surveys^{7,33} provided copies of their survey questions, along with permission to use or modify the questions for our study. We pilot-tested our survey with a convenience sample of 25 practising physical therapists, who gave feedback on content and form in four group discussion sessions. After the first pilot group, we made minor modifications to questions to improve flow and clarity, as well as minor grammatical changes to three questions; this revised version was then tested in the next three pilot groups. After the fourth pilot session, which generated no new suggestions for modifications, further pilot testing was deemed unnecessary and the survey questions were considered relevant for the objectives of the study. A copy of the survey is provided in Appendix 1 (online only).

The survey had four main sections. The first section gathered information on the use of US. The second asked about use of US for each of the following impairments or therapeutic purposes: to control acute inflammation, to improve chronic inflammation, to enhance fibroblast proliferation and improve collagen synthesis, to modulate acute pain, to modulate chronic pain, to remodel soft tissue or scar tissue, to increase extensibility of soft tissue or scar tissue, to meet patients' expectations, for placebo effect, or for other reasons. The third section assessed beliefs about the clinical importance of therapeutic US for managing these impairments; the fourth collected general demographic data.

Since most licensed physical therapists in Alberta (95%) have email addresses registered with the regulatory board, we distributed the survey electronically using SurveyMonkey. On October 21, 2010, one investigator (DG) sent an email to all registered physical therapists describing the study and providing a link to access the survey. We gave respondents 3 months to complete the survey, and sent two reminders (on October 28 and November 19, 2010).

Data analysis

Our analysis was primarily descriptive in nature, using percentages, means, and standard deviations to quantify responses to various survey items. Data were analyzed only for those who responded; we did not impute or

replace missing data. To determine whether there were differences by level of education (diploma vs. BSc vs. MSc) in US usage, beliefs about US and perceptions of effectiveness, we constructed contingency tables and conducted chi-square or Fisher exact tests to test for significance between factors. In addition, we conducted chi-square or Fisher exact tests to determine whether sample characteristics such as gender, age, practice area, conditions treated, training location, and beliefs about US and perceptions of the effectiveness of US were different between respondents who reported using US and those who reported never using it, or between those who work in private practice and those who work in other settings. The alpha level was set at $\alpha = 0.05$. We performed our analyses using the Statistical Package for the Social Sciences, version 17 (SPSS Inc., Chicago, IL) and STATA 10 (StataCorp LP, College Station, TX) statistical software.

RESULTS

General population demographics

Of the 2,269 physical therapists to whom we sent email invitations, 558 (25%) responded to the survey; of these, 438 (19%) had no missing data. There was no statistically significant difference between those with and without missing data in terms of US usage (18% and 17% respectively reported not using US, $p = 0.83$).

Respondents were predominantly women (338, 77%), and most (271, 61%) fell into the 31–50 age range. The primary areas of practice were private practice (237, 53%) and hospital practice (114, 25%); the primary case-load was musculoskeletal conditions (297, 66%). Approximately 67% (300) held a BSc in physical therapy, 23% (104) held either an MSc or an MHSc in physical therapy, and 9% (39) had a diploma in physical therapy; only 1% of all respondents (4) held a PhD. For full demographic details, see Tables 1 and 2.

Demographics by ultrasound usage and practice setting

Table 1 shows respondent demographics stratified by reported US use, while Table 2 shows the same data stratified by practice setting (private practice vs. other). Most respondents who reported using US work in private practice (58%) and treat mainly musculoskeletal conditions (75%), whereas most of those who do not use US work in hospital settings (37%). In addition, a slightly higher percentage of therapists who reported using US than of those who did not had taken a post-graduate course on US (41% vs. 33%). Therapists working in private practice reported significantly higher use of US than those working in other settings: approximately 61% reported using US daily.

Ultrasound usage: General sample

A high proportion of respondents (499, 89%) had access to an US machine in their area of practice. In

addition, 196 (36%) reported using US at least daily, and 124 (23%) at least weekly. On the other hand, 94 respondents (18%) reported that they never used US (see Table 3). Among the reasons respondents gave for not using US were that US is not applicable to their practice (73, 78%), that US is not effective in their clinical experience (20, 21%), that they achieve better results with other modalities (12, 14%), that US is too time consuming (7, 7%), and that US equipment is not available in their clinic (3, 3%).

General use of ultrasound for therapeutic purposes

Of those who reported using US, the largest proportion (74%) said they use it to resolve acute inflammation (see Figure 1). Most therapists answering this question (90%) believed that US is moderately to highly effective in accomplishing this therapeutic purpose. Remodelling soft tissue and scar tissue was also reported to be a very important reason for using US (74%); 95% believed that US is moderately (41%) to highly (55%) effective for this purpose. (For details of therapists' perception of US effectiveness, see Table 4).

A total of 65% of respondents reported using therapeutic US to increasing the extensibility of soft tissue and scar tissue. Control of chronic inflammation (61%) was also considered an important therapeutic goal; 89% considered US moderately to highly effective for this purpose. In addition, 59% of therapists reported using US to promote fibroblast proliferation, 37% for modulating acute pain, and 37% to meet patient expectations. A smaller number used US to obtain a placebo effect (18%) or to modulate chronic pain (24%; see Figure 1).

Why US is used: Opinion and confidence when using US

When asked about their opinions of US treatment and how confident they were that they apply US effectively, most respondents (74%, 322/435) reported feeling highly confident that they apply US effectively (see Figure 2); 67% felt they had adequate knowledge to determine US dosage. Similarly, 73% of respondents reported having "adequate knowledge about biophysical effects." Responses to the survey item asking about "adequacy of knowledge about the research evidence" for use of US varied: 16% of respondents felt their knowledge was not adequate, 42% reported "moderately adequate" knowledge, and 41% felt they had adequate knowledge about the research evidence for US use.

Respondents also had mixed beliefs about whether or not there is adequate research evidence to support the use of US: 39.3% reported believing there is not adequate research evidence, while 20.3% believe there is. While 64% of respondents (278) consider it unacceptable to use US for placebo and 59% (255) believe it is unacceptable to use it to meet patient expectations, 21% (94) feel that is acceptable practice to use US for its placebo effect, and 51% (223) reported using US at patients' request.

Table 1 Respondent Characteristics Stratified by Ultrasound Use

Characteristics	% of respondents*		
	Entire sample (<i>n</i> = 438)	Use US (<i>n</i> = 365)	Never use US (<i>n</i> = 73)
Sex			
Female	77.2	77.3	76.7
Age category, y			
20–30	16.5	17.0	13.7
31–40	35.4	36.4	30.1
41–50	25.1	24.1	30.1
51–60	17.8	18.1	16.4
>60	5.3	4.4	9.6
Years in practice			
<1	4.1	4.1	4.1
1–3	8.0	8.5	5.5
4–9	21.7	21.9	20.5
10–15	19.6	20.8	13.7
>15	46.6	44.7	56.2
Practice setting†			
Private physical therapy clinic	53.1	58.4	9.6
Hospital	25.4	21.4	37.0
Community health centre	5.8	4.9	8.2
Rehabilitation facility	5.8	4.9	8.2
Home care	4.8	4.1	6.8
Long-term care facility	2.7	1.9	5.5
Pediatrics	2.4	0.5	11.0
Other (academic, rheumatology, etc.)	5.5	3.8	13.7
Area of practice†			
Musculoskeletal	66.4	74.8	35.6
Geriatrics / long-term care	5.9	5.5	8.2
Neurological	4.8	3.3	12.3
Rheumatologic	4.8	5.2	2.7
Mixed caseload	3.4	2.5	8.2
Chronic pain	3.2	3.3	2.7
Hands/burns	3.0	3.3	1.4
Paediatrics	2.7	0	16.4
Cardiorespiratory	1.4	0.5	5.5
Women's health	0.9	0.8	1.4
Administration	0.9	0	5.5
Other (oncology, teaching, etc.)	0.7	0.8	0
Level of education			
Diploma	8.7	9.3	5.5
Bachelor's degree	67.1	66.3	71.2
Master's degree	23.3	23.8	20.5
Other (PhD, DSc, etc.)	0.9	0.5	2.7
Training location			
Canada	84.9	84.4	87.7
United Kingdom	5.5	4.9	8.2
Australia or New Zealand	2.1	2.2	1.4
Africa	1.8	2.2	0
India or Pakistan	1.6	1.6	1.4
United States	1.1	1.4	0
Mainland Europe	0.9	1.1	0
South America	0.7	0.8	0
Other (Jamaica, China, etc.)	1.4	1.4	1.4
Has taken post-graduate course on US	39.3	40.5	32.9

* *n* = 558; data are for 438 respondents (79%) with no missing data.

† Indicates statistically significant difference between those who reported using therapeutic US and those who reported not using therapeutic US.

US = ultrasound.

Table 2 Respondent Characteristics Stratified by Practice Setting (n = 438)

Characteristics	% of respondents	
	Private practice (n = 220)	Other setting (n = 218)
Frequency of US use*		
Never	3.2	30.3
Daily	60.9	16.1
Weekly	23.2	21.1
Monthly	9.1	12.4
Yearly	3.6	20.2
Sex		
Female*	70.9	83.5
Age category,* y		
20–30	22.3	10.6
31–40	40.0	30.7
41–50	23.2	27.1
51–60	11.8	23.9
>60	2.7	7.8
Years in practice*		
<1	6.4	1.8
1–3	9.1	6.9
4–9	24.1	19.3
10–15	22.3	17.0
>15	38.2	55.0
Area of practice*		
Musculoskeletal	93.6	42.7
Geriatrics / long-term care	0	11.9
Neurological	0.9	8.7
Rheumatologic	0	9.6
Mixed caseload	0.5	6.4
Chronic pain	3.2	3.2
Hands/burns	0.5	5.5
Paediatrics	0	5.5
Cardiorespiratory	0	2.8
Women’s health	1.4	0.5
Administration	0	1.8
Other (oncology, teaching, etc.)	0	1.4
Level of education*		
Diploma	5.9	11.5
Bachelor’s degree	63.2	71.1
Master’s degree	29.5	17.5
Other (PhD, DSc, etc.)	1.4	0.5
Training location		
Canada	83.2	86.7
Elsewhere	16.8	13.3
Has taken post-graduate course on US*	33.6	45.0

*Indicates statistically significant difference ($p < 0.05$) between private practice and other setting.

US = Ultrasound.

Sources of knowledge about US

When making clinical decisions about US use, respondents most commonly (~40%) used clinical experience as a source of knowledge (see Figure 3), followed by undergraduate training (19%), the research evidence base (13%), continuing-education courses (10%), opinion of experts or colleagues (6%), and electrotherapy books (6%).

The influence of level of education

When we analyzed the influence of level of education (diploma vs. BSc vs. MSc) on respondents’ attitudes

Table 3 Ultrasound Access and Usage for All Respondents

Variable	Mean (range)	No. (%)
US access in area of practice		
Yes		499 (89.4)
No		59 (10.6)
Therapists who use US in practice		
At least daily		196 (36.4)
At least weekly		124 (23)
At least monthly		57 (10.6)
At least yearly		67 (12.4)
Never		94 (17.6)
Who applies the US treatment?		
I apply it myself		247 (55.4)
The PTA or other support staff		13 (2.9)
Combination		186 (41.7)
Patients treated with US per day	11 (0–40)	
% of patients treated with US	40 (5–95)	

US = ultrasound; PTA = physiotherapy assistant.

toward, beliefs about, and use of US, we found no statistically significant difference in the frequency of US usage (Fisher exact = 0.75) or in level of confidence when applying US (Fisher exact = 0.53). However, there was a statistically significant difference in adequacy of knowledge for determining US dosage ($p = 0.020$) and adequacy of knowledge on the research evidence for US ($p = 0.05$): approximately 65% of respondents with a BSc believed they had adequate knowledge, versus 52% of those with an MSc, and approximately 37% of respondents with a BSc rated their knowledge of the research evidence as adequate, versus 59% of those with an MSc. However, there were no significant differences in respondents’ views on whether US has an important role in clinical practice (Fisher exact = 0.36). Nor did we find any difference in their views on whether it is acceptable to use US for its placebo effect (Fisher exact = 0.05); nevertheless, when respondents were asked if they themselves had used US for this purpose, there was a statistically significant difference by level of education (Fisher exact = 0.009): those holding a diploma or BSc were less likely than those with an MSc to report using US for its placebo effect (7%, 20%, and 29% respectively, $p = 0.003$).

There were significant differences by level of education in respondents’ feelings about using US to meet patient expectations (Fisher exact = 0.007): the majority (70%) of those holding a diploma considered this unacceptable, while the remaining 30% considered it moderately (27.03%) or highly acceptable (2.70%). Smaller majorities of those holding a BSc (58.60%) or MSc (47.87%) also considered this practice unacceptable.

We also found significant differences by level of education in respondents’ preferred sources of knowledge for deciding whether or not to use US (Fisher exact = 0.001). Comparing the highest preferences (graduate training, clinical experience, and research evidence

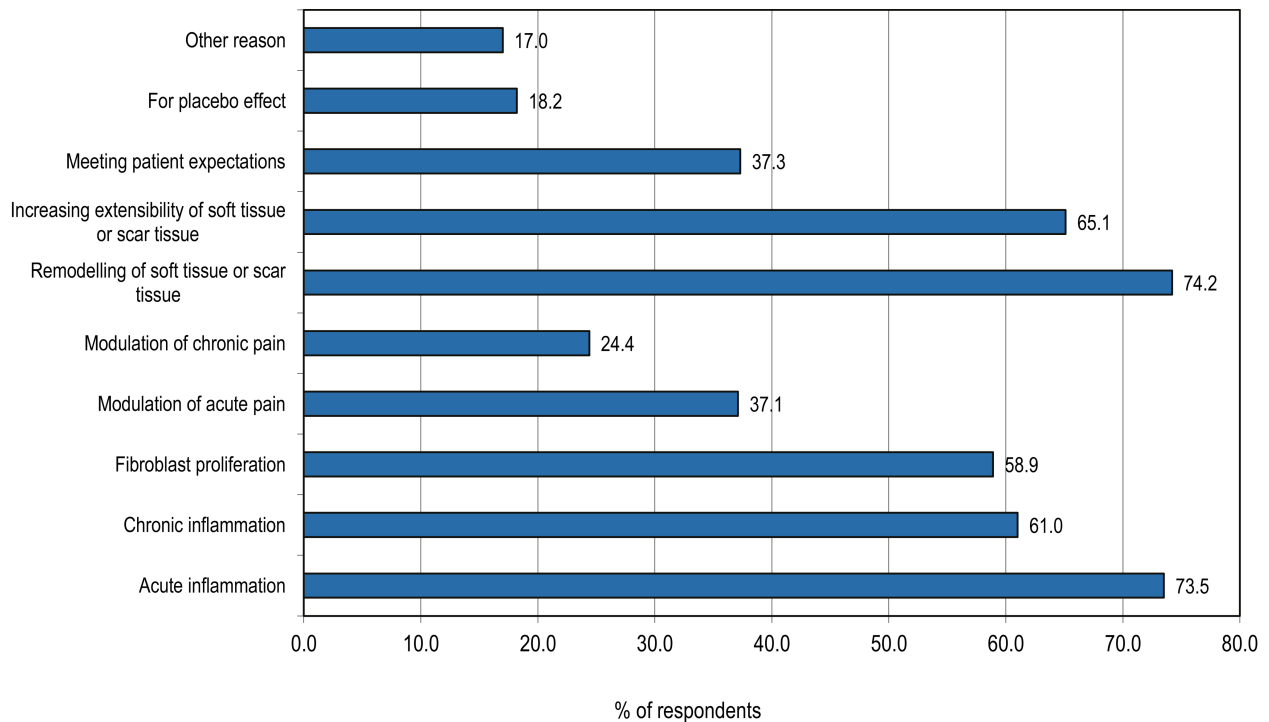


Figure 1 Percentage of therapists using ultrasound for different therapeutic objectives

Table 4 Therapists' Perceptions of the Effectiveness of Ultrasound for Specific Impairments or Specific Therapeutic Goals

Impairment or purpose	% (no.) of responses			
	Total responses (no.)	US not effective	US moderately effective	US highly effective
Acute inflammation	307	9 (29)	46 (142)	44 (136)
Chronic inflammation	251	12 (29)	46 (115)	43 (107)
Promote fibroblast and collagen synthesis	233	12 (27)	50 (117)	38 (89)
Modulate acute pain	146	7 (10)	51 (74)	42 (62)
Modulate chronic pain	95	9.5 (9)	41 (39)	49.5 (47)
Remodel soft tissue or scar tissue	291	4.5 (14)	41 (119)	54.5 (158)
Increase extensibility	249	4.4 (11)	40 (99)	55.6 (138)
Meet patient's expectations	145	6 (9)	27 (39)	67 (97)
Placebo effect	71	8.5 (6)	34 (24)	57.5 (41)
Other (e.g., muscle spasm)	63	8 (5)	29 (18)	63 (40)

US = ultrasound.

base) across levels of education revealed significant differences in the use of these sources of knowledge between diploma and BSc holders (Fisher exact = 0.001) and between diploma and MSc holders ($p < 0.001$). While 72% of respondents holding a diploma use their clinical experience when deciding whether to use US, those with a BSc or MSc—although still relying mostly on clinical experience (55% and 54% respectively)—also rely on entry-level training (30% and 39% respectively) and the research evidence base (15% and 7% respectively).

Ultrasound usage: Beliefs and opinions about US

When we analyzed the data dividing the population between those who use US on a regular basis and those who do not use it at all, we found statistically significant

differences in confidence in applying US, knowledge for determining US dosage, knowledge of the biophysical effect of US, knowledge of the research evidence for US, beliefs about adequacy of evidence for US, trusting clinical experience to decide on use of US, belief that US plays an important role in clinical practice, and belief that using US to meet patient expectations is acceptable. Practitioners who normally use US had higher levels of confidence in, knowledge of, and positive beliefs about US than those who never use it; furthermore, respondents who use US place more trust in clinical experience when deciding whether to use US (43% vs. 23%, $p = 0.013$), while those who never use US reported using their entry-level training significantly more than respondents who do use US (36% vs. 16%, $p = 0.030$).

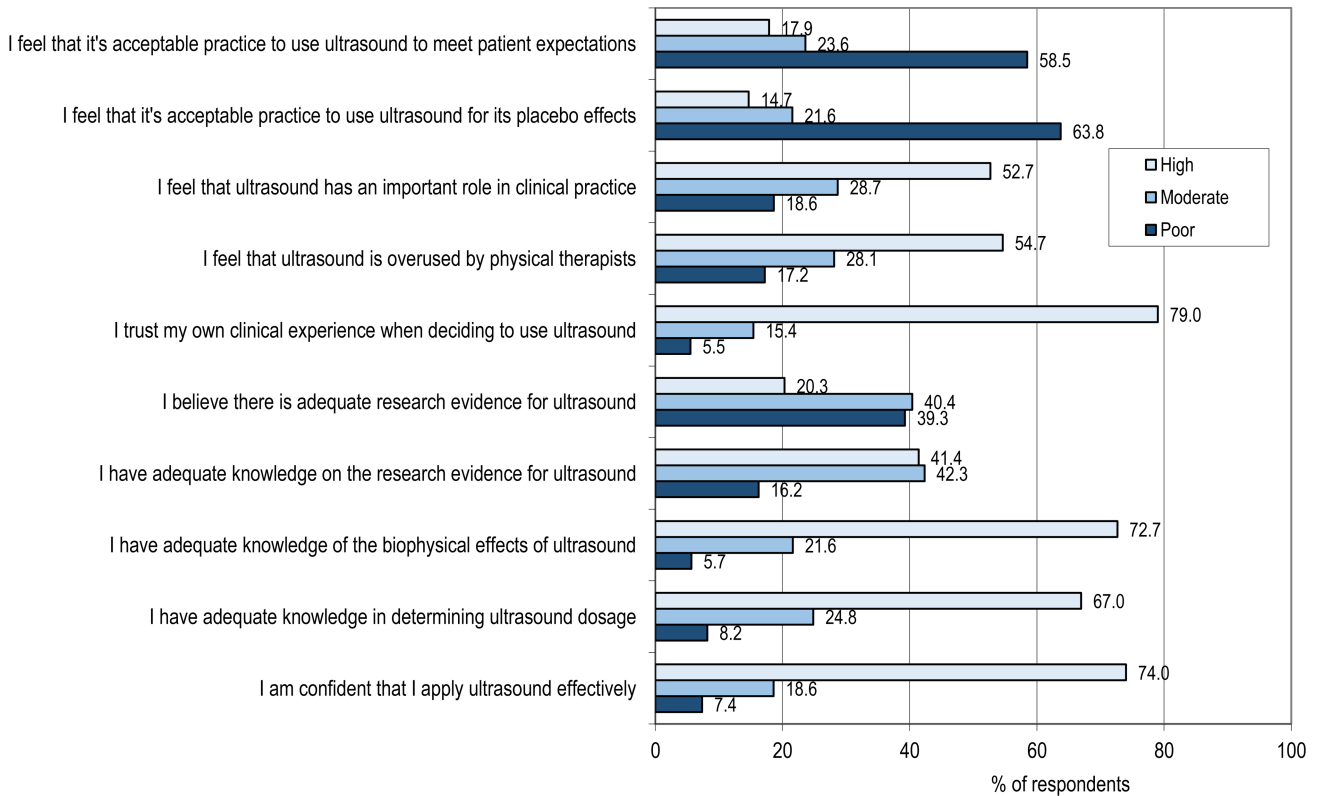


Figure 2 Therapists' opinions about ultrasound.

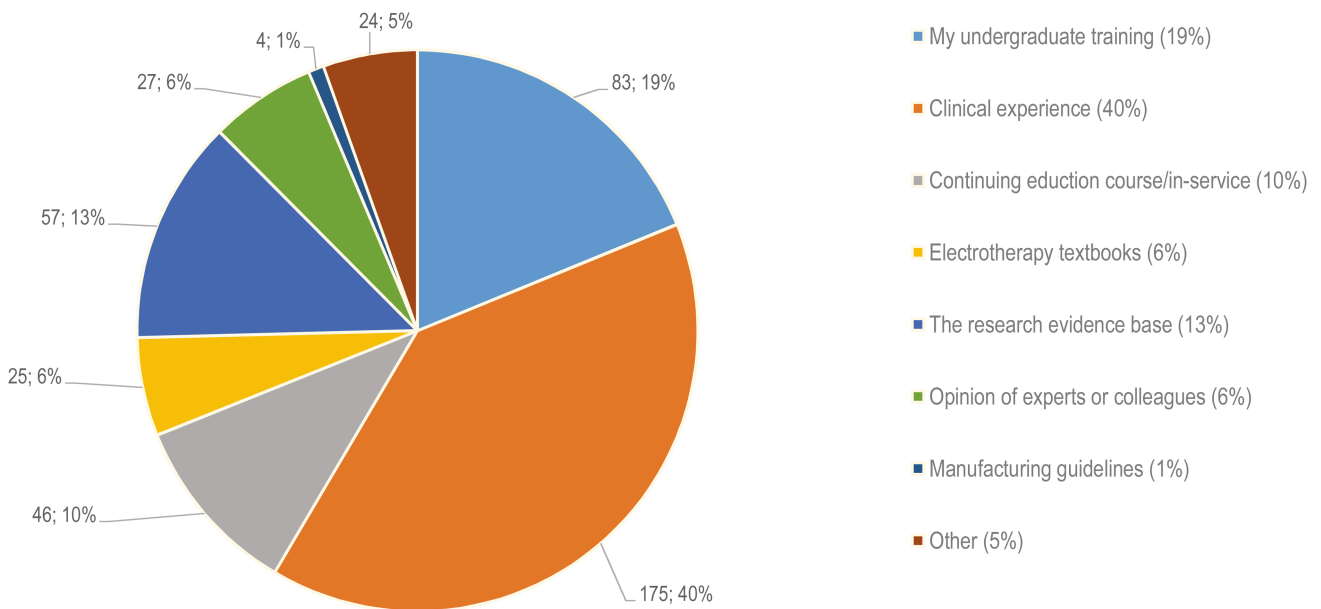


Figure 3 Sources of knowledge used when applying US.

Practice setting: Beliefs and opinions about US

When we analyzed the data stratified by practice setting (private practice vs. other settings), we found statistically significant differences in confidence in applying US, knowledge for determining US dosage, knowledge of the research evidence for US, opinions on whether

US is overused in clinical practice, and beliefs about whether US use is acceptable for placebo effect and to meet patient expectations. Respondents working in private practice generally had higher levels of confidence in, knowledge of, and positive beliefs about US than those working in other settings (see Appendix 2 online).

DISCUSSION

Therapeutic US continues to be commonly used by practising physical therapists. Although a high proportion of respondents to our survey had access to US (85%) and considered US use relevant to their practice (81%), the proportion who use US daily (36%) was lower than proportions reported in previous surveys (84–95%).^{3,33} This is probably because our survey targeted all physical therapists in Alberta, regardless of specialization area, and therefore involved physical therapists working in areas where US may not be relevant. In fact, 78% of respondents who reported not using US also said that US was not applicable to their practice setting. Even among respondents working in private practice, however, only ~61% reported daily use of US, which indicates that daily use is diminishing. Factors that may be contributing to this decreased use of US are unconvincing evidence for its effectiveness (35% of our respondents reported that US was not effective in their clinical experience and that they prefer other modalities to accomplish therapeutic objectives) and a lower rate of access to US equipment (81%) relative to that reported in other surveys (99%).^{3,33}

General use of US for therapeutic purposes

The majority of therapists surveyed use US for resolving acute inflammation, remodelling or modifying soft tissue or scar tissue, and increasing the extensibility of soft tissue or scar tissue. These findings concur with those of previous surveys in which physical therapists considered US clinically important for managing acute inflammation and chronic scar tissue.^{7,34} The use of US in the inflammatory process is not surprising, since clinicians believe that US has some anti-inflammatory properties. Experimental evidence, however, points in the opposite direction: for example, the application of US has been associated with a stimulating effect on mast cells, platelets, and inflammatory mediators.^{13,35} In fact, it is believed that US may optimize the inflammatory process, allowing tissues to move into their new phase (proliferation) more efficiently.^{2,13} It is not known whether the widespread use of US by physical therapists in the inflammatory phase is intended as an “inflammatory catalyzer” or whether it is used for its erroneously perceived “anti-inflammatory” effects.

Although rates of US usage to treat the above conditions are very high, existing research evidence on the clinical effectiveness, parameters, and clear biophysical effects of US does not provide strong support for using US for these objectives; it is not known whether the application of US for these therapeutic objectives makes a difference to patients’ health outcomes. It is surprising, therefore, that a high proportion of therapists (74%) felt confident that they apply US effectively, have adequate knowledge to determine US dosage (67%), and have ade-

quate knowledge of the biophysical effects of US (73%), yet also reported that US does not have adequate evidence. In addition, when we asked participants about their *opinions* on US use, a high proportion (79%) reported that they trust their own experience when deciding whether to use US (see Figure 2). This indicates that therapists who use US do so confidently while recognizing that there is limited research evidence supporting its use. Despite reduced US usage, there is still opportunity for knowledge-transfer activities aimed at disseminating research results for uptake in daily practice by clinicians.^{36,37}

Beliefs about the effectiveness of US as a treatment modality

Most respondents reported that they consider US moderately to highly effective for achieving specific treatment goals, echoing the findings of Warden and McMeeken’s survey³³ on the use of US for acute inflammation and for improving fibroblast proliferation: similar proportions of respondents in both surveys (81% and 74% for inflammation; 59% and 44% for fibroblast proliferation) reported using US to treat these conditions. However, there is an important difference between surveys in the use of US for treating pain: a majority of Warden and McMeeken’s respondents reported using US to treat acute and chronic pain (74% and 66% respectively),³³ while a much lower proportion of our respondents did so (37% and 24% respectively). In addition, a lower proportion of our respondents (65%, vs. 82% in Warden and McMeeken’s study³³) used US for tissue extensibility in chronic stages. These discrepancies may be explained by the specialty areas of respondents, as Warden and McMeeken’s survey focused on sport physical therapy, an area where pain and connective-tissue disorders are likely common.³³ In addition, sport physical therapists generally take a more aggressive treatment approach, and their patients (athletes) must often be treated very quickly for various musculoskeletal problems. Our survey respondents, in contrast, work in many practice areas, and some may not treat pain or connective-tissue disorders frequently.

Interestingly, a relatively large proportion of respondents in our survey considered US highly effective for meeting patients’ expectations (67%) and as a placebo (58%); these values are higher than those for other therapeutic objectives, which may be one reason that clinicians continue to use US in practice. This is important because providers’ personal beliefs and expectations can influence the outcome of therapy and placebo analgesia;^{38–40} thus, therapists’ positive expectations of US may translate to patients, possibly producing an enhanced placebo effect and resulting in therapeutic benefits. It is also plausible that the use of new, expensive, and technologically impressive US machines in physical therapy treatments may build an adequate psychosocial context

to help motivate patients to achieve better outcomes. Thus, US may have an important placebo effect, and this could contribute to the perception of its effectiveness among physical therapists.

Sources of knowledge used in making decisions about US

The majority of respondents reported basing their decisions about use of US on clinical practice experience (~40%); the next most common sources of knowledge reported were undergraduate training (19%) and research evidence (13%). Our results confirm that therapists who commonly use US are more likely than those who do not use it to base decisions on their clinical experience (43% vs. 23%, $p = 0.013$), which highlights the need to improve transfer of research knowledge into clinical practice and educate the clinical community on the importance of evidence and of implementing research findings in real-world situations.³⁶ Although the trend toward evidence-based practice seen among BSc and MSc degree holders is encouraging, additional knowledge-translation efforts, such as workshops or continuing-education modules, may be needed to change clinical practice,^{36,41} since physical therapists have rated “courses” as the most important method of keeping up to date in clinical practice.³⁶

Levels of education and differences in US use

Respondents holding a BSc reported greater “adequacy of knowledge in determining US dosage” than those holding an MSc. There could be many possible reasons for MSc degree holders to feel less confident in determining US dosage, one of which is that the lack of evidence on optimal dosimetry for US is widely discussed during the physical therapy entry-level programme at the University of Alberta;⁴² this suggestion is speculative, and additional research is needed to confirm it. In addition, BSc holders may have more years of clinical experience than MSc graduates, and thus feel more confident in applying US.

As expected, we found significant differences by level of education in respondents’ preferred sources of knowledge: physical therapists with higher levels of education use other sources of knowledge, including research evidence, rather than relying solely on their own clinical experience. This is an important finding because the development of stronger evidence-based practice curricula in physical therapy programmes may be one reason why therapists with higher levels of education prefer to use more formal knowledge sources when deciding whether to apply US in clinical practice. This should encourage educators and curriculum developers to reinforce the important concept of evidence-based practice in educating future physical therapists. However, clinical experience continues to be an important factor that influences physical therapists’ treatment choices, and its value should

not be undermined, especially when research evidence is inconclusive or lacking.⁴³

Strengths and limitations

Our study used a large, comprehensive population-based survey and achieved a response rate typical for population surveys (~20%). Although our sample was similar in gender to the population of all registered physical therapists practising in Alberta, a higher proportion of the sample worked in private practice; private practice therapists were both more likely to use US and more likely to respond to our survey. This is the largest survey of US use conducted to date and, as such, provides some insight into current use of, beliefs about, and perceptions of US in the clinical community. However, it was limited to physical therapists licensed to practise in Alberta, and therefore may not be generalizable to other jurisdictions. In addition, our results document only what respondents report that they do, not what they actually do. Finally, the descriptive analyses we conducted do not allow us to draw firm conclusions about the different factors influencing the use of US (education, years of experience, practice setting, etc.).

CONCLUSIONS

US is frequently incorporated into physical therapy treatment regimens, based largely on the belief that it is clinically useful. However, US usage has decreased over the past 15 years in the province of Alberta.³ Physical therapists using US rely primarily on their clinical experience to make decisions about its use, but their reliance on clinical experience depends on their level of education: clinicians with an MSc degree tend to base US decisions on research evidence, likely because of the increasing emphasis on research evidence in graduate education. The results of this survey should encourage educators to continue their focus on evidence-based educational content, but also to re-evaluate strategies for transferring research knowledge to daily practice.

KEY MESSAGES

What is already known on this topic

Surveys conducted in various countries have consistently identified therapeutic ultrasound (US) as a central component of physical therapy practice. However, the reasons why physical therapists continue to use US have not been explored.

What this study adds

Although US is still commonly used by physical therapists, its use has decreased over the past 15 years. Physical therapists using US rely largely on their clinical experience when making decisions about its use, although this varies by level of education.

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Physical Therapists Usage and Beliefs Regarding Therapeutic Ultrasound: A Survey of Therapists in Alberta.

Section 1: Information regarding your use of ultrasound:

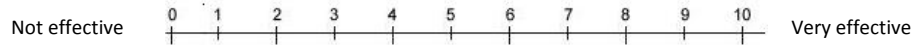
1. Do you have access to an US machine in your area of practice? <input type="checkbox"/> Yes <input type="checkbox"/> No
2. On average, how many patients do you treat per day? _____
3. On average, how often do you use ultrasound? (if you work part-time, indicate how often you use ultrasound based upon the days you are at work). Tick one box only. a. <input type="checkbox"/> At least daily. Specify on what % of your patients you use US _____% (proceed to question 5) b. <input type="checkbox"/> At least weekly. (proceed to question 5) c. <input type="checkbox"/> At least monthly. (proceed to question 5) d. <input type="checkbox"/> At least yearly. (proceed to question 5) e. <input type="checkbox"/> I never use ultrasound. (proceed to question 4)
4. For question 3, if you indicated that you never use ultrasound, please indicate why not; then proceed to question 16. a. <input type="checkbox"/> It's not applicable to my practice b. <input type="checkbox"/> It's not effective in my clinical experience c. <input type="checkbox"/> It's too time consuming to apply d. <input type="checkbox"/> It's too costly to purchase and maintain e. <input type="checkbox"/> I get better results with other interventions f. <input type="checkbox"/> Other, please specify: <div style="border: 1px solid black; height: 30px; width: 100%; margin-top: 5px;"></div>
5. If you do use ultrasound, who applies the ultrasound treatment? a. <input type="checkbox"/> I apply it myself b. <input type="checkbox"/> The Physical Therapy Assistant or other support staff c. <input type="checkbox"/> Combination

Section 2: why you use ultrasound and the parameters used for the following impairments:

6. Do you use ultrasound to resolve acute inflammation?

- a. Yes. (proceed to question 6.1)
- b. No. (proceed to question 6.2)

6.1. On a scale of 0-10, with '0' indicating not effective and '10' indicating very effective, how effective do you find ultrasound for resolving acute inflammation?



6.1.1. List the parameters you would typically use to resolve acute inflammation:

- a. Treating superficial tissues: 3Mhz 1Mhz
- b. Treating deeper tissues: 3Mhz 1Mhz
- c. Duty cycle: 10% 20% 50% 100%
- d. Intensity: _____ W/cm²
- e. Time: _____ mins

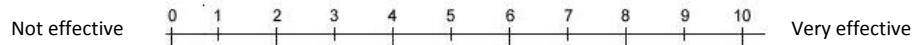
6.2. If you do not use ultrasound to resolve acute inflammation, indicate why not.

- a. Lack of research evidence
- b. Lack of undergraduate training
- c. It's not applicable to my practice
- d. It's not effective in my clinical experience
- e. I get better results with other interventions
- f. Other, please specify:

7. Do you use ultrasound to resolve chronic inflammation?

- a. Yes. (Proceed to Question 7.1)
- b. No. (Proceed to Question 7.2)

7.1. On a scale of 0-10, with '0' indicating not effective and '10' indicating very effective, how effective do you find ultrasound for resolving chronic inflammation?



7.1.1. List parameters you would typically use to resolve acute inflammation:

- a. Treating superficial tissues: 3Mhz 1Mhz
- b. Treating deeper tissues: 3Mhz 1Mhz
- c. Duty cycle: 10% 20% 50% 100%
- d. Intensity: _____ W/cm²
- e. Time: _____ mins

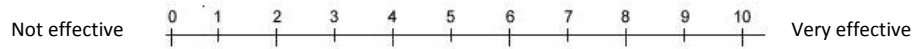
7.2. If you do not use ultrasound to resolve chronic inflammation, indicate why not.

- a. Lack of research evidence
- b. Lack of undergraduate training
- c. It's not applicable to my practice
- d. It's not effective in my clinical experience
- e. I get better results with other interventions
- f. Other, please specify:

8. Do you use ultrasound to promote fibroblast proliferation and collagen synthesis?

- a. Yes. (proceed to question 8.1)
- b. No. (proceed to question 8.2)

8.1. On a scale of 0-10, with '0' indicating not effective and '10' indicating very effective, how effective do you find ultrasound for promoting fibroblast proliferation and collagen synthesis



8.1.1. List parameters you would typically use to promote fibroblast proliferation and collagen synthesis

- a. Treating superficial tissues: 3Mhz 1Mhz
- b. Treating deeper tissues: 3Mhz 1Mhz
- c. Duty cycle: 10% 20% 50% 100%
- d. Intensity: _____ W/cm²
- e. Time: _____ mins

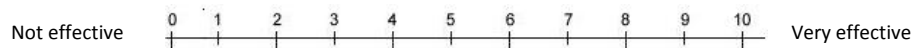
8.2. If you do not use ultrasound to promote fibroblast proliferation and collagen synthesis, indicate why not.

- a. Lack of research evidence
- b. Lack of undergraduate training
- c. It's not applicable to my practice
- d. It's not effective in my clinical experience
- e. I get better results with other interventions
- f. Other, please specify:

9. Do you use ultrasound to modulate acute pain?

- a. Yes. (proceed to question 9.1)
- b. No. (proceed to question 9.2)

9.1. On a scale of 0-10, with '0' indicating not effective and '10' indicating very effective, how effective do you find ultrasound for modulating acute pain



9.1.1. List parameters you would typically use to modulate acute pain

- a. Treating superficial tissues: 3Mhz 1Mhz
- b. Treating deeper tissues: 3Mhz 1Mhz
- c. Duty cycle: 10% 20% 50% 100%
- d. Intensity: _____ W/cm²
- e. Time: _____ mins

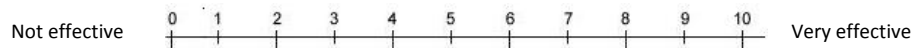
9.2. If you do not use ultrasound to modulate acute pain, indicate why not.

- a. Lack of research evidence
- b. Lack of undergraduate training
- c. It's not applicable to my practice
- d. It's not effective in my clinical experience
- e. I get better results with other interventions
- f. Other, please specify:

10. Do you use ultrasound to modulate chronic pain?

- a. Yes. (proceed to question 10.1)
- b. No. (proceed to question 10.2)

10.1. On a scale of 0-10, with '0' indicating not effective and '10' indicating very effective, how effective do you find ultrasound for modulating acute pain



10.1.1. List parameters you would typically use to modulate chronic pain

- a. Treating superficial tissues: 3Mhz 1Mhz
- b. Treating deeper tissues: 3Mhz 1Mhz
- c. Duty cycle: 10% 20% 50% 100%
- d. Intensity: _____ W/cm²
- e. Time: _____ mins

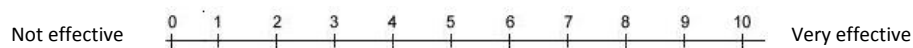
10.2. If you do not use ultrasound to modulate chronic pain, indicate why not.

- a. Lack of research evidence
- b. Lack of undergraduate training
- c. It's not applicable to my practice
- d. It's not effective in my clinical experience
- e. I get better results with other interventions
- f. Other, please specify:

11. Do you use ultrasound to remodel soft tissue or scar tissue?

- a. Yes. (proceed to question 11.1)
- b. No. (Proceed to Question 11.2)

11.1. On a scale of 0-10, with '0' indicating not effective and '10' indicating very effective, how effective do you find ultrasound to remodel soft tissue or scar tissue



11.1.1. List parameters you would typically use to remodel soft-tissue or scar tissue

- a. Treating superficial tissues: 3Mhz 1Mhz
- b. Treating deeper tissues: 3Mhz 1Mhz
- c. Duty cycle: 10% 20% 50% 100%
- d. Intensity: _____ W/cm²
- e. Time: _____ mins

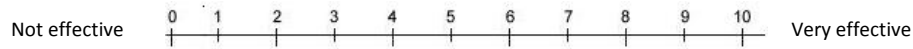
11.2. If you do not use ultrasound to remodel soft tissue or scar tissue, indicate why not.

- a. Lack of research evidence
- b. Lack of undergraduate training
- c. It's not applicable to my practice
- d. It's not effective in my clinical experience
- e. I get better results with other interventions
- f. Other, please specify:

12. Do you use ultrasound to increase the extensibility of soft tissue or scar tissue?

- a. Yes. (proceed to question 12.1)
- b. No. (proceed to question 12.2)

12.1. On a scale of 0-10, with '0' indicating not effective and '10' indicating very effective, how effective do you find ultrasound for increasing the extensibility of soft tissue or scar tissue



12.1.1. List parameters you would typically use to increase the extensibility of soft-tissue or scar tissue

- a. Treating superficial tissues: 3Mhz 1Mhz
- b. Treating deeper tissues: 3Mhz 1Mhz
- c. Duty cycle: 10% 20% 50% 100%
- d. Intensity: _____ W/cm²
- e. Time: _____ mins

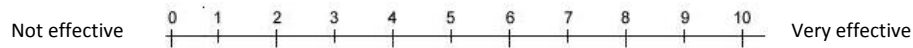
12.2. If you do not use ultrasound to increase the extensibility of soft tissue or scar tissue, indicate why not.

- a. Lack of research evidence
- b. Lack of undergraduate training
- c. It's not applicable to my practice
- d. It's not effective in my clinical experience
- e. I get better results with other interventions
- f. Other, please specify:

13. Do you use ultrasound to meet the patient's expectations?

- a. Yes. (proceed to question 13.1)
- b. No. (proceed to question 13.2)

13.1. On a scale of 0-10, with '0' indicating not effective and '10' indicating very effective, how effective do you find ultrasound is for meeting the patient's expectations



13.1.1. List parameters you would typically use to meet the patient's expectations

- a. Treating superficial tissues: 3Mhz 1Mhz
- b. Treating deeper tissues: 3Mhz 1Mhz
- c. Duty cycle: 10% 20% 50% 100%
- d. Intensity: _____ W/cm²
- e. Time: _____ mins

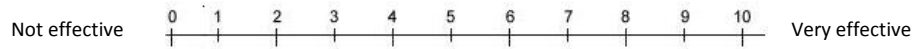
13.2. If you do not use ultrasound to meet the patient's expectations, indicate why not.

- a. Lack of research evidence
- b. Lack of undergraduate training
- c. It's not applicable to my practice
- d. It's not effective in my clinical experience
- e. I get better results with other interventions
- f. Other, please specify:

14. Do you use ultrasound for a placebo effect?

- a. Yes. (proceed to question 14.1)
- b. No. (Proceed to Question 14.2)

14.1. On a scale of 0-10, with '0' indicating not effective and '10' indicating very effective, how effective do you find ultrasound for providing a placebo effect



14.1.1. List parameters you would typically use to provide a placebo effect

- a. Treating superficial tissues: 3Mhz 1Mhz
- b. Treating deeper tissues: 3Mhz 1Mhz
- c Duty cycle: 10% 20% 50% 100%
- d. Intensity: _____ W/cm²
- e. Time: _____ mins

14.2. If you do not use ultrasound to provide a placebo effect.

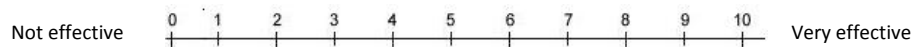
- a. Lack of research evidence
- b. Lack of undergraduate training
- c. It's not applicable to my practice
- d. It's not effective in my clinical experience
- e. I get better results with other interventions
- f. Other, please specify:

15. Do you use ultrasound for any other reason not stated?

- a. Yes. Please specify, then proceed to question 15.1.

- b. No. (proceed to question 15.2)

15.1. On a scale of 0-10, with '0' indicating not effective and '10' indicating very effective, how effective do you find ultrasound the reason provided above



15.1.1. List parameters you would typically use to provide a placebo effect

- a. Treating superficial tissues: 3Mhz 1Mhz
- b. Treating deeper tissues: 3Mhz 1Mhz
- c Duty cycle: 10% 20% 50% 100%
- d. Intensity: _____ W/cm²
- e. Time: _____ mins

Section 3: Provide your opinion on ultrasound treatment:

Rate the following statements concerning therapeutic ultrasound on a scale of 0-10, with '0' indicating strongly disagree and '10' indicating strongly agree.

<p>16. I am confident that I apply ultrasound effectively.</p>	
<p>17. I have adequate knowledge in determining ultrasound dosage.</p>	
<p>18. I have adequate knowledge of the biophysical effects of ultrasound.</p>	
<p>19. I have adequate knowledge on the research evidence for ultrasound.</p>	
<p>20. I believe there is adequate research evidence for the use of ultrasound.</p>	
<p>21. I trust my own clinical experience when deciding to use ultrasound</p>	
<p>22. I feel that ultrasound is over used by physical therapists</p>	
<p>23. I feel that ultrasound has an important role in clinical practice.</p>	
<p>24. I feel that it's acceptable practice to use ultrasound for its placebo effects.</p>	
<p>25. I feel that it's acceptable practice to use ultrasound to meet patient expectations.</p>	

<p>26. Have you used ultrasound on a patient's request?</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No</p>
<p>27. Have you used ultrasound for placebo effects?</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No</p>
<p>28. Have you used ultrasound based on physician referral?</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No</p>
<p>29. Have you used ultrasound to assist with caseload management?</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No</p>
<p>30. If your PTA applies ultrasound, would you use it as much if you had to apply it yourself?</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not Applicable</p>

31. What is your current source of knowledge when making decisions about whether to use ultrasound or not (choose the most applicable box).

- My undergraduate training
- Clinical experience
- Continuing education course/in-service
- Electrotherapy textbooks
- The research evidence base
- Opinion of experts or colleagues
- Manufacturing guidelines
- Other: please specify:

32. Ideally, what would you rely on most heavily when deciding to use ultrasound (**please rank the following in order from 1 to 5, with '1' being the most important, and '5' being the least important**)?

The research evidence: rank _____

Clinical experience: rank ____

Consensus opinion of experts. rank _____

Entry level training. rank _____

The patient's expectations. _____

Section 4: General Demographics:

33. What is your gender <input type="checkbox"/> M <input type="checkbox"/> F
34. What is your age? <input type="checkbox"/> 20-25 years <input type="checkbox"/> 26-30 years <input type="checkbox"/> 31-35 years <input type="checkbox"/> 36-40 years <input type="checkbox"/> 41-45 years <input type="checkbox"/> 46-50 years <input type="checkbox"/> >50 years
35. What is your primary area of practice? (Select only 1 box). If you work in more than one area, select the practice area where you spend the majority of your time)? <input type="checkbox"/> Hospital facility <input type="checkbox"/> Private Practice <input type="checkbox"/> Long term care or residential care facility <input type="checkbox"/> Community health centre <input type="checkbox"/> Private Rehabilitation facility (e.g. WCB, pain centre) <input type="checkbox"/> Home care <input type="checkbox"/> Other: please specify: <input type="text"/>
36. What is your primary caseload? (select only 1 box). If you treat different caseloads, select the caseload that you treat the majority of your time)? <input type="checkbox"/> Musculoskeletal conditions (e.g. sports injuries, work-related injuries, MVA's) <input type="checkbox"/> Arthritic conditions (e.g. RA, OA) <input type="checkbox"/> Hands, Burns or Wound care <input type="checkbox"/> Chronic pain conditions <input type="checkbox"/> Neurological conditions (e.g. Stroke, MS, Spinal Cord injuries) <input type="checkbox"/> Cardiorespiratory conditions (e.g. Post-surgical, transplants, ICU) <input type="checkbox"/> Other: please specify: <input type="text"/>
37. What is your level of Physical Therapy education? <input type="checkbox"/> Diploma in Physical Therapy <input type="checkbox"/> BSc in Physical Therapy <input type="checkbox"/> MSc or MHSc in Physical Therapy <input type="checkbox"/> Other: please specify: <input type="text"/>
38. Where did you receive your entry level Physical Therapy education? <input type="checkbox"/> Canada <input type="checkbox"/> United States <input type="checkbox"/> United Kingdom <input type="checkbox"/> Australia or New Zealand <input type="checkbox"/> Mainland Europe <input type="checkbox"/> India or Pakistan <input type="checkbox"/> Other: please specify: <input type="text"/>
39. How many years have you been employed since graduation? <input type="checkbox"/> < 1 year <input type="checkbox"/> 1 – 3 <input type="checkbox"/> 4 – 6 <input type="checkbox"/> 7 – 9 <input type="checkbox"/> 10 – 12 <input type="checkbox"/> 13 – 15 <input type="checkbox"/> >15
40. Have you taken an education course (in-service) on ultrasound since your undergraduate/graduate training? <input type="checkbox"/> No <input type="checkbox"/> Yes. If yes how long ago was this course? <input type="checkbox"/> < 1 year <input type="checkbox"/> 1 – 5 years <input type="checkbox"/> 6 – 10 years <input type="checkbox"/> 11 -15 years <input type="checkbox"/> > 15 years

You are done! Thank you for taking the time to complete this survey. If you have any further questions, please direct them to Doug Gross at dgross@ualberta.ca or 780-492-2690.

Appendix 2: Beliefs and Opinions regarding Therapeutic Ultrasound by Type of Practice

	Private Practice (n = 241)	Other Setting (n = 196)	
<i>Rating Scales out of 10</i>		%	
<hr/>			
<i>% of High Confidence</i>			
Confidence in applying*	58.09	57.81	0.002
Knowledge of dosage*	58.51	50.51	0.047
Knowledge of biophysical effects	64.73	55.10	0.065
Knowledge on research evidence*	45.00	27.69	0.001
Adequacy of evidence	20.83	15.31	0.274
Trust clinical experience to decide	62.50	59.90	0.131
Ultrasound is overused in practice*	39.33	31.22	0.007
Ultrasound has an important role	47.28	40.43	0.237
Acceptable to use for placebo*	14.05	7.81	0.003
Acceptable for meeting expectations*	19.50	7.77	0.000
<i>Rationale and Practice Behaviours</i>			
<i>Source of knowledge guiding usage</i>			
Clinical experience	41.74	37.24	1.00
Entry-level training	17.36	20.92	0.516
Evidence	14.05	11.22	0.830
Continuing education/in-service	9.50	11.73	0.518
Textbooks	5.37	5.61	0.776
Expert or colleague opinions	5.79	6.63	0.650
Manufacturer's guide	0.41	1.53	0.268
<i>Factor most relied on to make decisions</i>			
Evidence	11.98	13.78	0.577
Clinical experience	15.70	14.80	0.793
Patient's expectations	52.89	61.73	0.063
Expert opinion	6.20	4.59	0.463
Training*	13.22	5.10	0.004
Used based on physician referral*	57.02	42.35	0.002
Used based on patient request*	66.94	30.10	0.000
Used to help caseload management*	21.07	9.18	0.001
Reports previous use for placebo*	28.10	12.24	0.000

*Statistically significant at $\alpha=0.05$.