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"Gleaning a lot from the history and physical exam," and "reasonably confident without imaging": a qualitative study of primary care clinicians' management of patients with low back pain

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Abstract

Background Routine seeking of imaging for patients with low back pain is not concordant with the evidence-based recommendation that imaging is rarely of diagnostic value. Inappropriate imaging is a waste of resources and can lead to undesirable downstream effects for individuals and health systems. To develop effective strategies to reduce unwarranted referrals for imaging in primary care, we must understand the drivers for, and barriers to, guideline-adherent practice. We explored clinicians' views to identify the dominant influences on clinicians as they choose to pursue, or avoid, imaging for their patients with low back pain.

Methods We interviewed a purposeful sample of 47 primary care clinicians (14 physiotherapists, 18 chiropractors, 15 physicians) throughout Ontario, Canada, with a guide based on the Theoretical Domains Framework (TDF). We investigated clinicians' views about their use of imaging in the management of low back pain. Interviews were recorded and transcribed verbatim. We analysed transcripts, then identified themes within TDF domains.

Results Most clinicians reported that, for most clinical encounters, they adhered to guideline recommendations about imaging. Many clinicians across disciplines expressed the following themes: (1) imaging may result in an incidental finding or otherwise cause harm to patients, and drive up health system costs (TDF domain *Beliefs about consequences*); (2) clinicians were confident in their abilities to diagnose, to explain to patients the rationale for not recommending imaging, and to respond to their needs (domains *Beliefs about capabilities; Skills*). Many clinicians identified that patients occasionally want the validation that imaging provides (domain *Social influences*). Some clinicians described the value of imaging to corroborate a diagnosis (domain *Beliefs about consequences*).

Conclusions This study is the first to examine influences on imaging behaviours of a large interprofessional sample of primary care clinicians in Canada. Even among knowledgeable, skilled, confident clinicians who reported mostly adhering to guideline recommendations, there are potential influences on deviating from guideline-adherent care.

Keywords Low back pain, Guidelines, Imaging, Theoretical Domains Framework

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Introduction

Non-specific low back pain, wherein the pathoanatomical cause of pain cannot be determined, represents a significant public health challenge in Canada and worldwide [1]. Every year, one in five Canadians experiences this type of low back pain, making it the second most prevalent symptom encountered in family practice [2]. Treatment for low back pain costs CAD\$6—12 billion per year and is associated with significant societal costs related to loss of worker productivity and associated disability payments [3, 4]. In Canada, patients experiencing low back pain have access to several primary care clinicians, including publicly funded family physicians and mostly fee-for-service physiotherapists or chiropractors.

Clinical practice guidelines for low back pain from Canada, the United States, the United Kingdom and the World Health Organization [5] provide consistent recommendations for managing patients in primary care with low back pain, focusing on advice, reassurance, and self-management [6]. Imaging for patients with low back pain has limited diagnostic value and is related to potential harm [7]. Despite recommendations to avoid imaging in the absence of suspicion of pathology, clinical practice is frequently not aligned with recommendations about imaging [8, 9]. Several clinician-focused interventions have been developed to reduce imaging for low back pain, including educational interventions for clinicians (Clinically Oriented Relevant Exam (CORE) back tool) [10], clinical decision support tools such as the Choosing Wisely Canada campaign [11], and providing clinician support by way of rapid access clinics [12]. However, a systematic review of qualitative studies identified that clinicians lacked content knowledge of low back pain guidelines [13]. To inform the development of effective knowledge translation interventions relevant to the Canadian context, we need to determine clinician beliefs about imaging for this patient population.

The Theoretical Domains Framework (TDF) is a comprehensive framework used to understand behaviour change among healthcare providers. The TDF identifies 12 domains that influence behaviour, including knowledge, skills, beliefs, and social influences, among others [14]. While we know that some clinicians believe there is value in imaging [13], there is limited insight into how well they are informed about the guidelines and contextual factors which may influence their decision-making processes. The Back ON study aims to: 1) determine the rate of and factors associated with inappropriate lumbar spine imaging (x-ray, MRI, CT) for people with non-specific low back pain presenting to primary care in Ontario; and 2) determine the barriers and enablers to reducing inappropriate imaging for low back pain in primary care settings. We report here on results related to Aim 2, based on using the TDF to gather the perspectives of primary care clinicians across Ontario, Canada, regarding imaging for acute non-specific low back pain. We used the TDF to design the interview guide and analyze the resulting data because the TDF is designed to provide insight about a comprehensive set of potential influences on behaviours. The TDF has been used extensively to understand healthcare behaviours, including in the analysis of clinicians' use of imaging in the management of low back pain [13, 15–17].

Materials and methods

Study design

This qualitative exploratory study used semi-structured interviews to examine contextual factors which may influence the decision-making processes regarding the ordering or referral for imaging for patients presenting to primary care with low back pain.

Participant selection, recruitment and data collection methods were restricted to those of the larger prospective cohort study, the Back ON study [18]. The current study adhered to the consolidated criteria for reporting qualitative research (COREQ) guideline [19].

Participants & recruitment

Our target group comprised community-based primary care physicians, chiropractors, and physiotherapists in Ontario who provided care to patients with low back pain. In Ontario, all family physicians can directly refer patients for imaging; most chiropractors and physiotherapists cannot, but they can influence imaging through referral to a patient's physician, and some chiropractors have plain x-ray imaging equipment in their own practices. We excluded physicians working in academic settings or exclusively urgent care settings.

For the Back ON study, clinicians were randomly selected for recruitment from registered clinicians in the College of Physicians and Surgeons of Ontario, the College of Physiotherapists of Ontario, and the College of Chiropractors of Ontario. We also used snowball sampling by asking participants to identify colleagues and other clinicians [18]. We used a purposive sampling approach for the interview phase to target a subset of Back ON participants.

Study clinicians were interviewed after they completed recruitment of patient participants in the Back ON study. We planned that only clinicians who recruited patients to the larger study would be interviewed and recruited our target sample of chiropractors who met this criterion. We made exceptions to this protocol for physicians and physiotherapists, as many clinicians experienced challenges in recruiting patients during the COVID pandemic. After the initial interviews with chiropractor participants, and to ensure variation, we sought additional chiropractor participants who either possessed or recently had access to their own imaging equipment.

Participating clinicians were given an information letter and consent form. Participants completed a demographic survey about their age, sex, training location, experience, and proximity to an imaging facility. Participants also completed a questionnaire that included familiarity with four low back pain guidelines [20–23], with an "other: please specify" option. They were asked to rate their level of agreement on statements about the value of imaging for non-specific low back pain (Appendix 1).

This research was approved by the Health Sciences and Affiliated Teaching Hospitals Research Ethics Board at Queen's University (REH-736–18) was conducted in accordance with the principles of the Declaration of Helsinki.

Interview guide

We developed three interview guides (physician / physiotherapists / chiropractors), modifying questions to reflect whether clinicians ordered imaging or recommended that the patient seek imaging from another provider. Interview guides were iteratively developed using the TDF framework [24] and results from a systematic review [13]. The guide (Table 1) included two or three questions from each of the 14 TDF domains, aiming to elicit: clinician knowledge; typical behaviours about imaging and/or referring for imaging; and barriers to, or enablers of, following guideline recommendations.

After completing three pilot interviews, one from each clinician group, we reviewed the transcripts and revised the interview guide. Participants had the option of conducting the interview over telephone or via Zoom. Participants were compensated with an honorarium upon the completion of the interview.

Data analysis

The analysis team comprised a mix of researchers (nursing, physiotherapy, chiropractic, health psychology) with qualitative expertise. We transcribed all interviews verbatim using NVivo[®] transcription software, with K.N. checking for accuracy. The TDF framework was used to analyze and code the narratives [24]. L.H–L., K.E.N., and I.M.T. met to review transcripts and develop a coding strategy. The coding strategy was initially based on a deductive approach to content analysis using the TDF domains alongside the ability of the coder to identify if an utterance appeared to be outside the domains.

Following the initial coding using NVivo[®], the team met to ensure optimal categorization of utterances within domains and identified that utterances difficult to code within the TDF themes often reflected avoidance of the

behaviour (e.g., participants talked about how they would avoid imaging). The team came to consensus about how to assign these utterances to TDF domains based on inductively determined themes. Intercoder reliability was carried out in accordance with the process described by O'Connor, et al. [25], with two coders (L.H-L., I.M.T.) independently coding 1 of every 5 interviews (27%) to ensure consistent application of code definitions and interpretations. Additionally, L.H-L., K.E.N., and I.M.T. met to review excerpts within each domain and themes to verify coding aligned with the definitions in consultation with a TDF expert (A.M.P.). Group discussions and consensus resolved any coding discrepancies. A codebook summary was shared with the authorship team to ensure accurate interpretation. Finally, L.H-L., K.E.N., S.F., A.M.P., and I.M.T. reviewed the findings and identified TDF domains as relevant if they had a high number of themes, or conflicting statements amongst respondents, or those with clinical significance towards changing practice behaviour [24].

Results

Participant characteristics

We invited 19 family physicians, 20 chiropractors, and 16 physiotherapists to participate; in total, 47 participants (15 physicians, 18 chiropractors, 14 physiotherapists) completed interviews. Interviews took place from June to October 2021. The audio-recorded interviews ranged from 29 to 104 min (mean 59 min). No repeat interviews were carried out. The participants had an average of 13.7 (range 1–59) years of experience and saw a median of 10 (range 1–100) low back pain patients per month (Table 2).

Key themes identified within relevant domains

Table 3 presents the TDF domains of greatest relevance with sample quotes. We identified six TDF domains that aligned to participants' attitudes about ordering imaging or referring patients to their physician for imaging: (1) *Knowledge*, (2) *Skills*, (3) *Beliefs about capabilities*, (4) *Beliefs about consequences*, (5) *Social influences* and (6) *Behavioural regulation*. The Cohen's kappa coefficient for inter-rater reliability in applying the codebook was 0.73 [26].

Knowledge

In the pre-interview questionnaire, 24 (51%) of the participants either indicated "Never heard of it" or "Likely read it at some point but can't recall" for all listed guidelines (Fig. 1). However, in interviews, all participants stated that they knew there were guidelines for imaging in low back pain *(Knowledge),* with some recalling that they were taught the guidelines during formal education.

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Table 1 TDF domains, definitions, and Provide P	an example interview question used for each domain	
Name of TDF domain	Definition	Example of Question
Knowledge	Existing procedural knowledge, knowledge about guidelines, evidence	Can you tell me what the key recommendations are of any clinical practice guidelines for the management of an episode of recent onset low back pain in the primary care setting?
Skills	Competence and ability about procedural techniques required	When assessing a patient with an episode of low back pain to determine the need for imaging, what do you find most straightforward, and what is most challenging?
Social professional role and identity	Boundaries between professional groups	Do you find that those professional colleagues approach low back pain man- agement the same way that you do, particularly around the use of imaging?
Beliefs about capabilities	Perceptions and competence and confidence in doing the behaviour (and how it influences)	Do you feel confident in your ability to accurately assess and diagnose a patient with recent onset low back pain without the use of imaging such as an x-ray / CT or MRI?
Optimism	Participant's optimism / pessimism about the behaviour influences actions	Do you think there are any instances where your avoidance of imaging would interfere or complicate your chiropractor-patient relationship?
Beliefs about consequences	Perceptions about outcomes, advantages, disadvantages about performing the behaviour and how that influences whether they perform the behav-iour	Generally, the guidelines recommend against routine imaging in this popula- tion. What is your opinion on this, and is this in line with your usual manage- ment of patients with low back pain? Hypothetically—what do you feel the consequences would be of imaging almost everyone with episodic low back pain? And what about the conse- quences of imaging almost no one with low back pain?
Reinforcement	Previous experiences that have influence whether or not the behaviour is performed	Are there any incentives (financial or otherwise) for you to have imaging done, or to avoid having it done, for your patients with low back pain?
Intention	A conscious decision to perform a behaviour or act in a certain way	Of the next 10 patients who present to you with an episode of recent onset low back pain, how many of these patients are you likely to refer for or undertake imaging?
Goals	Priorities, importance, commitment to a certain course of actions or behav- iours	Can you think of any situation other than the presence of "red flags" where you may decide to seek imaging?
Memory, attention, and decision processes	Attention control, decision-making, memory	Do you feel that you generally have enough time in a typical consultation to conduct a thorough assessment of a patient with an episode of low back pain and give the patient information about their condition (including imag- ing)?
Environmental context and resources	How factors related to the setting in which the behaviour is performed influence the behaviour	Pre-interview questionnaire
Social influences	External influence from people or groups to perform or not perform the behaviour	When you first started your practice, did you have any mentors or advisors that provided you with guidance on appropriate patients for imaging?
Emotions	How feelings affect (positive or negative) the behaviour	Can you share with me what it feels like to manage a patient's expectations for their care, specifically about their requests for imaging, or need for more of your clinical time?
Behavioural regulation	Ways of doing things that relate to pursuing and achieving desired goals, standards or targets	Are there any actions that you aim to improve or change regarding your current management of patients presenting with an episode of recent onset low back pain?

Table 2 Clinician demographic information

	Physicians (n = 15)	Chiropractors (n = 18)	Physiotherapists (n = 14)	ALL (n = 47)
Age at initial recruitment ¹ (mean (SD), [min–max])	44.7 (10.0) [30–65]	46.2 (13.8) [28–81]	35.2 (7.5) [27–51]	42.4 (12.0) [27–81]
Sex	3 M, 12F	11 M, 7F	8 M, 6F	22 M, 25F
Location of entry-to-practice education	14 Canadian 1 Internat'l	13 Canadian 5 Internat'l	8 Canadian 6 Internat'l	35 Canadian 12 Internat'l
Years in practice at initial recruitment ¹ (mean (SD), [min-max])	12.9 (8.3) [3–30]	19.2 (14.6) [1–59] n=17	7.3 (5.7) [1–20] n=13	13.7 (11.7) [1–59] n=45
Solo practice or group (≥2 providers)	2 solo 12 group n=14	2 solo 16 group	1 solo 13 group	5 solo 41 group <i>n=46</i>
Uni-profession or at least 2 profession types at the practice	6 uni 8 multi n=14	2 uni 16 multi	3 uni 11 multi	11 uni 35 multi <i>n=4</i> 6
Imaging services on-site (number of "yes")	2	3	1	6
Imaging services nearby (number of "yes")	1	0	1	2
Hours per week in practice (median (IQR), [min-max])	30 (31) [20–75]	30 (11) [12–50]	38 (5) [14–43]	35 (15) [12–75]
Number of patients, any type, per typical week (median (IQR), [min-max])	98 (80) [30–200]	50 (76) [20–150] n=17	57.5 (30) [23–100]	67.5 (55) [20–200] n=46
Number of patients per month consulting for low back pain (median (IQR), [min-max])	6 (16) [1–57]	30 (52) [2–100] n=15	9 (8) [5–23]	10 (24) [1–100] n=44
Time spent per patient, new visits (median (IQR), [min-max])	30 (15) [15–40]	53 (30) [20–60]	60 (15) [40–60]	45 (30) [15–60]
Time spent per repeat patient visit (median (IQR), [min-max])	15 (5) [10–23]	19 (10) [10–30]	30 (12.5) [18–45]	20 (10) [10–45]
Special interest in low back pain or related (number of "yes")	1	10	12	23
Recruitment to the initial phase of the study (number who received a letter by ran- dom selection rather than recruited by snowball)	12	14	9	35
Number of patients the clinician recruited to the study with usable data	2.3 (3.0) [0–9]	10.1 (10.4) [0–35]	8.1 (5.2) [0–20]	7.0 (8.0) [0–35]
Pre-interview questionnaire				
Self-reported familiarity with any of a list of low back pain practice guidelines ^ (mean (SD), [min-max]) $$	2.5 (1.5) [1–5]	2.9 (1.8) [1–6]	2.5 (1.3) [1–5]	2.7 (1.6) [1–6]
Agreement ³ with I am likely to refer low back pain patients for lumbar spine imaging (x-rays, CT or MRI) because patients often expect me to do so (mean (SD), [min-max])	1.8 (1.0) [1–5]	1.3 (0.5) [1, 2]	1.3 (0.6) [1–3] n=13	1.5 (0.7) [1–5] n=46
Agreement ³ with There is a role for lumbar spine imaging (x-rays, CT or MRI) when there are neurological signs associated with low back pain (mean (SD), [min-max])	3.9 (1.0) [1–5]	3.9 (1.0) [2–5]	3.5 (1.2) [1–5] n=13	3.8 (1.1) [1–5] n=46
Agreement ³ with Lumbar spine imaging (x-rays, CT or MRI) are useful to confirm the diagnosis and to direct appropriate treatment of low back pain, even in the absence of red flags for serious disease (mean (SD), [min-max])	2.0 (0.6) [1–3]	2.8 (1.0) [2–5]	2.0 (1.1) [1–4]	2.3 (1.0) [1–5]
Agreement ³ with I do not think it is really safe for a person with low back pain to be physically active (mean (SD). [min-max])	1.1 (0.3) [1, 2]	1.3 (0.6) [1–3]	1.4 (1.1) [1–5]	1.3 (0.7) [1–5]

SD standard deviation, min minimum, max maximum value, IQR interquartile range, CT computerized tomography, MRI magnetic resonance imaging

Data in all cells are based on sample sizes in the header row unless noted as having data missing (frequency count data) or an *n* value lower than the value in the header row

¹ Initial recruitment to the larger study occurred 1–3 years before the interviews. Thus, age and years of practice would have been higher than shown above at the time of interviews. Also, various descriptors about the clinician's practice may have changed since clinicians had completed the questionnaire

² Clinicians were asked to rate their familiarity with multiple guidelines and the highest rating was used. Rating scale was: 1 = Never heard of it; 2 = Heard of it, but have not read; 3 = Likely read it at some point but can't recall; 4 = I can recall reading it; 5 = I can recite some of the key points; 6 = I review it regularly

³ Clinicians were asked to rate agreement with statements: 1 = Strongly disagree; 2 = Disagree; 3 = Neither Disagree nor Agree; 4 = Agree; 5 = Strongly Agree

Table 3 Key themes identified within relevant domains

Domain	Theme	Example quote
Knowledge	Knowledge of guidelines	"I think that good practices would suggest minimized interven- tions and maximized treatment, such as physio, lifestyle changes and really avoid things like narcotics and opioids." [FP05] "Active exercises were two of the most recommended treat- ment modalities for mechanical back pain. Diagnostic imag- ing was not as recommended as previously thought." [CH13] "Movement is something that's important [] when you have a low back injury. Exercise is definitely something that is recommended." [PT07]
	Partial knowledge of important elements without know- ing guidelines	"If you're not responding in four weeks or whatever of care, then we can consider that [imaging]" [FP09] "Conservative approach, first and foremost in a six-week intervention." [CH14] "If they're showing no signs of improvement over, for example, three weeks to a month [as an indicator for imaging]." [PT14]
	Knowledge of good general practice in low back pain care	"I would discuss with the patient [] typically this type of pain does get better on its own over time. But there are some things that can help move that along, so remaining active is kind of the number one, staying mobile. Obviously some medication that can decrease the pain and inflamma- tion, basic things like that." [FP11] "Essentially if it's obviously the mechanical pain you gotta somehow reduce the pain and increase strength and mobil- ity." [CH15] "Once you build that rapport with them you can do a lit- tle bit of hands-on to decrease their pain, to allow them to do the exercises a little bit further, to build the trust, to calm down the pain sensitivity." [PT05]
	Source of knowledge (training)	"When we become independent family doctors, we sign up for the CFPC [College of Family Physicians of Canada] thing and then there comes the magazine and I think that's where I was first exposed to that. The CORE [Clinically Organized Rel- evant Exam] tool definitely came from colleagues." [FP14] "It's either through the Canadian Chiropractic Association or the Ontario Chiropractic Association." [CH16] "I did this McKenzie course and few years ago and I have also looked like on-line for guidelines when I have a question." [PT06]
Skills	Competence and ability at avoiding imaging	"I tried to understand what they're looking for, what their expec- tations are, what they're looking for in imaging basically." [FP12] "If I don't think it's necessary I will explain that for their age, their general health condition, their description of their pain, whatever it may bebut for their circumstances I don't feel that I would get any useful information out of x-rays and I feel that we'd be exposing them to radiation for no ben- eficial reason, always subject to re-visitation if treatment doesn't go as expected." [CH13] "That is often one of the first things that I educate patients about, is I tell them that based on what I'm hearing from you, you don't have any red flags that would warrant the need for imaging right away." [PT04]
	Identify tricky or challenging	"I had somebody go for testing, and I find this is another thing that happens, who goes for testing, has findings, but has several other comorbidities" [FP06] "I think that's the biggest challenge, that in a lot of cases people want to be better yesterday and you know they're in some severe pain and, to manage their expectations that 'You know, you might get a little bit worse before you get better, you're going to have to work through this." [CH18] "I think what's challenging isif again, going back to a com- plex patient, who may be elderly and has a lot of either co- morbidities or other issues going on. Sometimes it's hard to tell it's hard to really understand what is the cause of the symptoms and whether they truly do need the imag- ing or not." [PT13]

Domain	Theme	Example quote
Beliefs about capabilities	Beliefs about capability in managing pain, or responding to patient needs	"So I would say I'm reasonably confident. And without imag- ing, yeah, reasonably confident." [FP13] "I mean, everybody's an individual, but I'm confident in my ability to help people and if I can't, then I send them out, you know?" [CH10] "Clinically I am confident to let them know that they will get better. they just have to do the therapy and once they've done the sessions, they're good to go." [PT03]
	Confidence in ability to decide or explain rationale for not imaging	"I think you can glean a lot from the history and the physical exam and so rule out any of the red flags. I think, yeah, it can give you a very good idea of the type of pain the patient is experiencing. And also, the ability to follow up with them." [FP11] "I would explain to them that I don't want any unnecessary radiation, that I'm confident in what is going on and that we are able to help them reduce the pain or resolve it." [CH15] "But that's what I'm going to try to tell them'If you do want to know what you have you're going to have to talk to a doctor. I cannot order imaging but also, I don't feel it's that necessary right now.'So I'll try to put it in perspective and explain how I feel about it." [PT06]
	Confidence in NOT missing anything by not routinely seeking imaging	"If the history matches my understanding of common causes of low back pain, and if the patient starts to improve in response to my treatment and everything goes as expected, then that strengthens my confidence." [FP08] "Again, there's got to be very specific indications to do so [seek imaging]. I'm pretty confident in my assessment skills to identify whatever I need to." [CH14] "I can achieve a full recovery, with a high level of confidence, without any images. I can palpate, I can see, I can analyze. No, I don't feel like images will change the way I treat." [PT11]
Beliefs about consequences	Perception that imaging findings will be incidental	"It's unnecessary, doesn't change management, back pain is going to get better in 85% of patients after six weeks. An MRI, has cost, but again, it doesn't change anything. It just shows them that they have a degenerative disc disease and a disc bulge, which is clinically not even relevant." [FP13] "I would say that [imaging is] limited, again unless we are trying to rule out something of higher priority." [CH17] "Again, in light of the fact that the image is most of the time not reflective of why they're having their issue." [PT13]
	Perception about patient physical, psychological or finan- cial harm	"It's really not in their best interests and in fact more harmful than helpful. Even MRI which isn't radiation, and isn't inher- ently a harmful test, it often finds things that are abnormal but are really irrelevant but raise questions. [It shows] noth- ing that's actually going to help them live longer or function better. But it actually may add morbidity because of these false diagnoses." [FP09] [answering a question about patient harm] "Obviously the exposure to x-rays, or the radiation I think it's not nec- essary. I think similarly, with MRI and a patient's seeing a bulging disc and then all of a sudden 'Oh, my goodness, I have a bulging disc.' And it's not even clinically significant. But now in their head, they have this idea that they have this problem and that changes their behavior whether it's at work or at home, it just involves everything." [CH12] "I prefer that patients don't get imaging because I think there's some new research on patients' identifying them- selves or victimizing themselves with the pathology that's soon as they see that they've got arthritis then they kind of believe they victimize themselves and that can be worse." [PT01]

Domain	Theme	Example quote
	Perception of system pressures or consequences	"It's just the cost to the system which takes away money from other things. Why are we doing a test if it's not going to change our management, not going to [lead to] benefit?" [FP09] "And it's a waste of resources on an already hard-pressed health care system." [CH10] "I always feel for the health care system, because they're wasting money. Hundreds and hundreds of millions of dol- lars are wasted on imaging." [PT02]
	Value (consequence) of using imaging to guide treatment	[Imaging is] "helpful for ruling things out. Like if someone thinks there's something there and you're trying to sort of encourage them to think there isn't." [FP07] "Without images I don't know what's actually within the structure inside the body, what the spinal struc- ture is actually. Is there previous damage, is there a congeni- tal anomaly, is there arthritis that has caused or exacerbates what brought the patient to me on that particular day?" [CH13] "It doesn't explain exactly; it's opposite. Imaging for me is just to rule out other serious pathology, not to confirm, not to tell me what I need to do" [PT12]
	Perceptions that patients will seek imaging from other providers	"I mean that's never been an issue, but I do find if there's someone who really wants a lot of testing, they will not stay with a doctor who doesn't do a lot of testing. They will find someone who does the testing." [FP07] "There is pressure to accommodate your client. But if it's really not in their best interest then 'Sorry, I just don't feel this is in your best interest' and, very often, I said 'Listen this is what I expect to find on your x-ray.'I already know this in my head. Sometimes they will go to the GP [general prac- titioner], get the x-ray, take and get the x-ray report, bring it in and say 'Oh, what do you know, it's exactly what you told me.'' [CH08] "They will depend mostly on the images and they will go to the doctor. Because they have more trust in the doctors, more than a physio." [PT10]
	Belief about consequence on patient practitioner relation- ship	"Some patients, you know maybe if they're very, very insistent or stubborn and want this [imaging] no matter what. That [insistence] can definitely affect the relationship because it's they're not interested in your judgement or your opinions." [FP11] "But I think that would be the scenario [an adverse effect on the relationship], is that someone has the circumstance in which your judgement was questioned and then if it indeed turned out to be that there was something of rel- evance [revealed by imaging], right?" [CH17] "If I sense that they're not on my side I'm more than happy to say, 'Well, talk to your doctor and let them know you're getting better, but you're still scared or something like that. See what they can do for you." [PT05]
Social influences	Influence of patient	"Sometimes people are looking for some reassurance too. I don't really like to do that, but in certain cases if that makes somebody sleep better at night and prevents them from coming back a gazillion times because they're con- cerned that there may be something more to it." [FP06] "According to the x-rays that we did before you don't have anything really significant. You should continue the physi- cal therapy! And then he came back two or three times, was persistent. I did order an MRI." [FP04] "But if the patient says'I would, I do not feel mentally, emotionally at ease until or unless we do an x-ray to see if I have a fracture' or whatever it might be, then sometimes just to give them the peace of mind." [CH06] "Sometimes you have to accept that the patient mentally needs that result." [PT05]

Domain	Theme	Example quote
	Perceptions of patients wanting imaging done	"People want to have a label, they want a name, they want a diagnosis with a whole bunch of words. Being told that they have a normal blood work, blood pressure, echo., x-ray, that is not reassuring for a select group of anxious patients." [FP14] "Honestly, there's just some people that just need that reas- surance by being able to see it. Right? It's just that they need physical proof." [CH16] "It's like they feel they need to get an image to see what's damaged, to find out what's going on." [PT09]
	Perceptions of other providers	"Some of them I find order imaging a little more readily. I think they trained in a different era than I did. So I think their education went a little differently." [FP03] "I think that they would be consistent with the way that I do things. I have some peers who are very close by, we think alike and treat people the same way. I know that there's other chiropractors in proximity to me who routinely x-ray every patient." [CH07] "All of them have been really great mentors to me and they've really helped shape the way that I approach imaging and low back pain for sure. I can say that they do feel similarly." [PT04]
Behavioural regulation	Alternate behaviours (managing without imaging)	 "So, I say, 'We're going to treat it like a sprain.'I talk about Advil, Tylenol. Of course, Advil only if there aren't any other medical contra-indications, because it can be risky in older people, not in people with anticoagulants; Tylenol is much easier to use. I'll talk about other really conservative things like heat, Voltaren, self-massage. And I love a good trigger point ball example (chuckles). I keep some tennis balls and lacrosse balls in my clinic so I can show people. And then of course I talk about things like physio and, if I think that there's a lot of muscle tension for whatever reason, [then] a real massage." [FP14] "With patients their key thing is 'get me out of pain', so that's my first and ultimate goal is to reduce the pain with my modalities and physical or manual therapies and some education on things they can do at home to reduce the pain. And then we move on with flexibility, movement and strength." [CH12] "I try to reassure them that if it is acute or sub-acute; acute is like four weeks and sub-acute is anything between four and 12 weeks and then twelve weeks more is chronic. If it's acute or sub-acute I'd reassure them that it's gonna get better on its own regardless of any treatment. They just need to learn how to self-manage themselves. So, I educate them on that. But on top of that, if they're really, really in pain and they need some advice, I give them some stretches." [PT10]
	Negotiation strategies	"I can tell them 'OK, this is what I think it is, this is the plan. If your pain isn't improving in the next 2 weeks, for example, I want you to get in touch again. Book another appointment for follow-up.'If I had no options for follow-up at all, maybe I would be a little more liberal with maybe ordering tests right off the bat. But often if you can give it a bit of time it helps with confirming the diagnosis." [FP11] "I would say 'Let's go over a few treatments before even considering imaging. You don't want any unnecessary radia- tion in your body. I've seen a lot of good results with manual therapy, chiropractic care, with treating low back pain with- out any imaging. We'll go through a few weeks or a couple months of treatment. If you're still not getting any better, if pain's getting worse, then we'll order some imaging." [CH15] "So, I say 'Try eight weeks. If in eight weeks there's no change, I will gladly write a letter saying that we've tried physio, these are the things we've tried, and [refer] back to the doctor for further analysis." [PT08]

Domain	Theme	Example quote
	Principle, theory or approach used for low back pain patients	"I have lots of great tools [that support] decision-making. I usually use something very similar to the CORE back tool, or what Dr. Hamilton Hall used to talk about in his back pain approach." [FP14] "Specifically, for low back pain I'm usually using Kemp's test if I'm suspecting that might be from the facet joints. Then I'm using a straight leg raise, a Valsalva maneuver and a slump to try to rule in or out discogenic pain, and then I'll move on typically to rule in or out the hips and the SI joint. So, I'll screen the hips using just a scour or a FABER test." [CH05] "I follow a mostly McKenzie approach, so I most often start my assessment with McKenzie forms, asking questions like what their aggravating factors are, what the relieving factors are, what their occupation is, if they're like sitting a lot. trying to determine if it is mechanical in nature." [PT07]

Some participants referred to published sources of best practices, such as the Choosing Wisely Canada recommendations [11] (mentioned by 8 physicians), or the CORE Back tool [10] (2 chiropractors and 5 physicians), with the majority of participants admitting that they were unable to identify the name of a guideline that they followed in practice.

When probed about what they could remember about imaging guidelines, many provided examples of algorithms or methods utilized when assessing patients with low back pain: e.g., an algorithm published by the provincial health authority (1 chiropractor and 5 physicians); the McKenzie method of Mechanical Diagnosis and Therapy [27] (1 chiropractor and 11 physiotherapists). Although participants recognized they were not able to recall all components of any guidelines, almost all participants went on to articulate the importance of imaging only in the presence of red flags and were able to describe what these red flags were (*Knowledge*). They also described strategies they incorporated for managing low back pain, such as patient education and reassurance, lifestyle modifications, active recovery, and pain management (*Partial knowledge of important elements without knowing guidelines*). Many clinicians perceived imaging as potentially appropriate after a specified duration of time or if symptoms persisted beyond a certain number of weeks (*Partial knowledge of important elements without knowing guidelines*).

When asked about how they keep up to date on guidelines, participants identified two categories of methods – active and passive. Active methods included seeking out information themselves, which included peer-reviewed sources such as journals and Uptodate[®] (3 physicians), internet searches (1 chiropractor, 3 physicians, 1 physiotherapist), continuing education modules (3 chiropractors, 4 physicians, 4 physiotherapists), or participating in groups such as journal rounds (3 physicians; 3 physiotherapists). Knowledge was also obtained passively via communication bulletins sent to members by professional associations, identified by 17 participants (*Sources*



Fig. 1 Familiarity with low back pain guidelines



Fig. 2 Agreement with lumbar spine imaging usefulness in confirming a diagnosis

of knowledge). Four participants admitted to not keeping up to date with recommendations (1 chiropractor, 1 physician, 2 physiotherapists).

Skills and beliefs about capabilities

Participants expressed confidence in their ability to educate and reassure patients about low back pain management without imaging (*Beliefs about capabilities*). Participants attributed their proficiency and accuracy in diagnosing patients without imaging to adopting a consistent assessment approach (*Skills*), which instilled confidence in their ability to manage a patient's imaging expectations. Participants also identified that years of clinical experience plays an important role in arriving at a diagnosis without imaging (*Skills*). Conversely, some participants reflected that a lack of experience in newer professionals may cause a reliance on imaging to arrive at a diagnosis.

Participants provided scenarios they found to be 'tricky' or challenging, wherein they are more likely to image (*Beliefs about capabilities*). Participants described difficulty in deciding about the need for imaging in the presence of multiple co-morbidities, older age, or an ambiguous presentation. This view was more prevalent among chiropractors.

Beliefs about consequences and behavioural regulation

As imaging avoidance in patients with no red flags was the desired behaviour, we felt it was prudent to capture how participants incorporated low back pain management strategies into their practice to avoid imaging (Behavioural regulation – alternate behaviours / managing without imaging). Some recognized pain management as a priority goal and articulated the importance of exercise and referrals to physiotherapy (for physician participants) as an adjunct to pain management. Additionally, many participants expressed

that imaging results are frequently incidental and would not provide any additional information beyond what they had already obtained from their history and physical assessment findings (*Beliefs about consequences*).

Many participants expressed concerns about potential harm to patients from imaging, such as radiation exposure and out-of-pocket expenses (*Beliefs about consequences*). Furthermore, participants acknowledged that incidental findings could cause patients emotional distress, as the imaging might reveal a finding irrelevant to their symptoms. Participants also described being hesitant to order imaging due to reducing access to imaging for cases that warrant it or diverting funding from other areas of healthcare. Some also noted that imaging often fails to alter pain management strategies and offers no tangible benefits to patients. A few participants described why they value imaging to arrive at a diagnosis (*Beliefs about consequence – value of imaging*).

When completing the pre-interview questionnaire, 45 (96%) participants 'strongly disagreed' or 'disagreed' with the statement "I am likely to refer low back pain patients for lumbar spine imaging (x-rays, CT or MRI) because patients often expect me to do so" (Fig. 2). Nevertheless, in interviews, many participants expressed that they perceived that the patient was expecting imaging or sometimes felt pressured to accommodate a patient who wanted imaging (Social influence). Participants believed that patients wanted imaging to assign a diagnostic label to the source of the pain, which in turn helps to validate their degree of impairment (Beliefs about consequences, Social influence). Other participants highlighted that their ability to reassure the patient was a determining factor. As such, they felt that their ability to assess and promptly address a patient's concerns was a crucial skill set to prevent a patient's request for imaging (Beliefs about capa*bilities*). Participants did admit to occasionally 'giving in'

Table 4 Domains of lesser relevance

Domain	Theme	Example Quote
Social professional role and identity	Behaviour the participant identifies as part of another profession's role	"The chiropractors aren't allowed to work on them unless they know that there's no fracture." [FP09] [making referral] "We've seen your patient, this is what we've clinically diagnosed them with, this is what we've been doing to work with them and the response to date is not in keeping with our expectations of improve- ment. I have concerns for x, y, z. Please evaluate and refer for imaging as you deem relevant." [CH17] "I can't prescribe imaging I would just tell them, 'okay, I can write a note to your physician.' And I'll leave it up to them and kind of defer that back to them." [PT07]
	Behaviour the participant identifies as part of their profession's role	"It's a fairly important part of the assessment and the dis- cussion with a patient." [FP11] "I think this is my bread and butter. It's kind of like a cavity is to a dentist. It's kind of what I do. I do a lot of it." [CH18] "It's my job to just provide them with the best education I can give them, based on experience and you know the research. And it's up to them to decide what's best for them. And that's perfectly fine." [PT09]
Optimism	Perception, optimism or pessimism of value of imaging	"I think that it's not useful in the majority of people who present to me." [FP08] "Regardless of imaging, I think it [imaging] can add to the information and also help with education of the patient." [CH12] No, I don't feel that any images actually will help me with low back pain acute low back pain [PT11]
Reinforcement	Incentives or disincentives	"I'm not aware of any incentives to do or not to do inves- tigations." [FP09] "There's no financial because we use a lab and it's par- tially covered by OHIP." [CH18] "I don't bill or collect for any of my x-ray fees." [CH17] "There's no incentives." [PT08]
	Previous experience about imaging was not low back pain	"I think both of my examples are not low back pain but other areas of the back. um like mid back pain or higher up, where it sounded mechanical, and it very well could have been mechanical, but it ended up actually being like a tumour. So in that instance, you know, imag- ing might have helped me if I'd ordered it sooner." [FP01]
	Specific experience that validates (or not) why imaging not needed	"But I've looked at somebody who really didn't seem to have anything much, I can't think if it was lumbar spine but recently I had somebody that ended up hav- ing a stress fracture or something like that." [FP06] "In 2 specific cases involved cancer where nothing in the history or examination suggested cancer, but there were routine x-rays that showed tumours that were the ultimate cause of the pain." [CH13] "It's getting worse and worse and worse. And they found out there was a fracture, in the low back." [PT10]
Intention	Intention	[in response to a question about how many of the next 10 patients they would seek imaging for] "I'll say for the minority, one or two maybe." [FP04] "Less than one" [CH03];"10" [CH01] "One or two." [PT12]
	Intention about practice generally	"I think I'd like to look up the guidelines again. And you've alluded to handouts about imaging it would be nice to look those up and use them." [FP08] "I would definitely have educational materials on imaging neces- sity so that if they do have any questions or concerns" [CH11] "Educate more and keep myself up to date with new advances and techniques. There's patients that could potentially not need uh x-rays and could be treated with any type of new advances in physiotherapy that would help with the back." [PT03]

Domain	Theme	Example Quote
Goals	Having a focus on something other than imaging	"I'm very big into making sure the patient has orthotics in place, feet are intrinsically linked to back pain." [FP05] "My first and ultimate goal is to reduce the pain with my modalities and physical or manual therapies and some education on things they can do at home to reduce the pain." [CH14] "And I think empowering patients with the knowledge of their condition is really helpful in taking down some of the fear, which can actually aggravate the pain some- times." [PT13]
	Have a plan a priori	"And so, the first thing I need to do is to determine: do they have access to physio or not have access to physio?" [FP07] "Finding out really what the aggravating factor is very important, just because it gives you an idea of what might be causing their pain, right?" [CH05] "The main thing they need is to re-assure, to educate them how to self-manage. That should be the goal." [PT10]
Memory, attention and decision processes	Concept of a criteria that would prompt them to order an image	"If it's very prolonged, if the person has had pain you know, more than a few months. It's not really getting better as expected, sometimes I'll end up ordering an MRI." [FP11] "I believe in manual care for a few weeks and see if there's any changes in the patient. If nothing is working, if the patient is experiencing more and more pain then I would investigate and order imaging" [CH15] "If I can't help them with any of their symptoms, if there's no position and there's no movement, I can't help them with, then I strongly think that they'll need an imaging test." [PT01]
	Talking through the decision-making processes gener- ally	"I ask them 'How do you think that might help you? Is there any particular thing you're worried about?' So I try to explore the why before I get into it. And then I tell them about, the usefulness of imaging, when we might order it, what it might do for us." [FP06] "So, the main thing is first trying to get an idea of how the issue occurred. Getting all the details on what makes it worse, what makes it better, if this is an incident that's happened to them before, how it occurred." [CH12] "I just go based on the cluster of questions that we're all educated to ask, based on mechanism of injury, if there's some form of trauma that I'm thinking maybe there's a fracture or instability, then yes, I ask about subtle pares- thesia, cancer-related questions." [PT09]
Environmental context	Access to ISAEC or rapid access low back pain clinic	"I do send patients exercises so I've got prescribed exer- cises that are, I believe, from the ISAEC [Interprofessional Spine Assessment and Education Clinics] team." [FP12] "Both clinics that I'm practicing at it are multi-disciplinary, so myself as well as two physios, traditional Chinese medicine practitioners, massage therapists, all these things." [CH14] "But I work in a clinic that we provide, hydrotherapy; i.e., pool exercises." [PT06]
	Availability of imaging	"I think that's a resource issue, right? Because we just don't have the availability of that. It's just not that readily available" [FP06] "I think the wait times are a big deterrent as well." [CH10] "Then they have to wait six months for MRI. For no reason you're sending them for MRI." [PT10]

Domain	Theme	Example Quote
	Statements about time spent or needed when imag- ing ordered	"I'll say that it probably lengthens the visit because it's often patient requested. And then it takes extra time for me to explain why imaging is usually not helpful." [FP12] "We want to get to know the patient, we want to get to know the mechanism of injury, about their lifestyle and, just take our time with the physical examination. I definitely think there's plenty of time for that." [CH15] "The actual ordering is no big deal. The only thing would be if I do think they warrant having an MRI, and then there's the screening questions that we do have to ask them." [FP01] "I don't think it has any impact." [PT08]
	Use of handouts (or not)	"I have two handouts that I use, but neither one of them talk about imaging." [FP14] "I have a different sort of handout that I give them that explains their injury." [CH12] "Not for imaging recommendation, only for the home exercise program; I give handouts." [PT02]
Emotions	Emotional response for patient seeking care elsewhere	"Sometimes I do feel I hate to say it, but like almost like a little bit like irritated. Like 'not this again' like kind of feeling." [FP15] "Obviously, that frustrates me somewhat, but patients become emotional and make those decisions on their own." [CH18] "It feels a little frustrating 'cause it feels like there's no trust, right?" [PT06]
	Fear or doubt of missing something important	"Sometimes I worry that I haven't been through enough or really listened to the patient enough with their his- tory I would feel awful if my patient actually turned out to have multiple myeloma or multiple compression fractures and a secondary cause of osteoporosis" [FP15] "You might miss something I think that might be the positive [of imaging]. You might catch some- one with an incidental anomaly, right? Whether it's an abdominal aneurysm that is growing or it's a soft tissue mass". [CH17] You might miss something that is very pathological. [PT04]
	Good or bad feelings about ordering imaging / avoid- ing imaging	"Those frustrating discussions where, we did this test but it's not gonna help us manage your condition or you have this incidental finding and it could be this, that, or the other thing." [FP15] "I find it rewarding when I'm able to give them that infor- mation that that's not necessary and that there are other ways of determining what their problem is without hav- ing that unnecessary full spine imaging or low back imaging." [CH12] "But it can be frustrating and not always because it's a patient, but just because of how the system is." [PT08]

to imaging requests, particularly if the patient was insistent *(Social influence)*. When faced with a patient wanting imaging, participants said they would often adopt negotiation strategies, such as communication and education on outcomes to avoid imaging *(Behavioural regulation)*. Participants stated that they would offer patients imaging at a time in the future should the proposed treatment not be effective. This redirection allowed for additional

time to pass, with the expectation of resolution of low back pain symptoms. Several participants expressed the importance of establishing rapport with patients, which fostered a trusting relationship and, in turn, increased the patient's confidence in the participant's ability to address their needs without the reliance on imaging (*Beliefs about capabilities*). However, participants identified that in some cases, patient communication and education proved to be challenging for them (*Skills*), especially with patients who needed additional psychosocial support or ongoing reinforcement of adherence to the proposed treatment.

Domains of lesser relevance

Our analysis revealed that the TDF domains of 1) Social professional role and identity, 2) Optimism, 3) Reinforcement, 4) Intention, 5) Goals, 6) Memory, attention and decision processes, 7) Environmental Context and Resources, and 8) Emotions were not as influential on most participants' decisions to recommend or order imaging (Table 4). Participants were knowledgeable about both their professional limitations and the interprofessional expectations regarding referrals for imaging (Social professional role and identity). Many participants were not optimistic that imaging would be of any value; however, a few participants - principally chiropractors - found value in imaging (Optimism). Participants stated there was no financial incentive or disincentives to order imaging (Reinforcement). When asked about their intent to 'image the next 10 patients', there was a range of answers, with 38 (80%) of participants responding that they would only seek an image for 0 to 2 patients of the next 10; three (6%) responded the next 3 of 10; three (6%) responded with 4 to 5 of 10; and two (4%) said 5 to 7. One participant (a chiropractor) stated they would seek an image for all of the next 10 patients (Intention). Within the TDF domain Goals, participants often shared their priorities when interacting with a patient with low back pain. Most participants articulated a clear concept of criteria for deciding when to image (Memory, attention and decision processes – criteria that would prompt an image). Finally, most participants did not express emotional responses to patients seeking care elsewhere if they did not image (Emotion). Nevertheless, 15 (32%) participants articulated that they feared they would miss a critical finding if they did not image (Emotion - fear or doubt of missing something important).

Discussion

In this qualitative study that included a diverse group of primary care clinicians, we explored the perspectives of clinician beliefs about the use of imaging for patients experiencing low back pain. The majority of participants reported adherence to guideline recommendations by avoiding imaging in this population except when patients presented with 'red flags'. Our results indicate that participants' confidence appeared to be a key enabler in avoiding inappropriate imaging for patients with low back pain. The confidence was most described in relation to having a standardized assessment that included screening for red flags, and the ability to explain to patients why imaging was not needed to guide diagnosis or treatment in most cases. Our findings are very similar to the findings of a systematic review that practitioners' knowledge, skills, beliefs about consequences and social influences are all highly relevant TDF domains associated with why physicians may use imaging in the management of patients with low back pain [15].

In contrast, our findings are distinctly different from previous meta-syntheses by Slade, et al. [28] and Sharma, et al. [13], where they reported that clinicians felt imaging was a useful tool to explain the source of the pain and relieve a patient's anxiety. When we reflect on this contrast, it appears that, at least in the Ontario context, clinicians' perspectives about imaging for low back pain may have changed in recent years. This change may be partially due to the success of campaigns and tool development. For example, the Choosing Wisely Canada campaign [11] appears to have been a success: 67% of the physician group identified familiarity with the messaging. Also, many participants were familiar with the CORE back tool [10], identifying it as a reliable source for information. However, we note that both resources reference 'six weeks'-participants recalled this wording, yet not always in the appropriate context. For example, the CORE back tool indicates that "if your symptoms persist for >6 weeks, schedule a follow-up appointment"; it does not direct clinicians to image at that time. Some participants interpreted these statements as conveying that imaging is required if pain persists after six weeks.

Our study has findings similar to that of Slade, et al. [28], wherein they identified that clinicians commonly aligned with an 'accepted' practice among peers rather than guideline recommendations. This finding is unsurprising, as professionals learn from various sources, contributing to the development of 'mindlines'. Mindlines [29] refers to the internalization of knowledge within guidelines formed by traditional written material, yet also recognizing that knowledge is formed over a lifetime, from personal experience as well as the shared experience of peers and mentors. These sources were all noted as influencing our participants' knowledge; one-third of participants identified that they were kept abreast of clinical guidelines by communication sent out by their professional bodies. Almost two-thirds of participants perceived that their peers had a similar approach to imaging (Social influences). Thus, it is not surprising that participants expressed challenges and less confidence with managing 'tricky' patients (e.g., older adults, patients with more co-morbidities or psychosocial

issues, insistent patients), given that this 'atypical' patient would challenge content within existing mindlines [30]. Mindlines would likely be formed around the 'prototype' of a patient with low back pain, with an awareness of the content of guidelines (e.g., red flags) with knowledge limitations about managing the atypical low back pain presentation. An opportunity for future interventions would be to embrace this concept of how clinicians learn, and target both informal sources of knowledge (e.g., peer tutors) [31] in addition to formal sources (e.g., professional dissemination of updates), focusing specifically on the management of tricky cases. Another opportunity would exist with developing channels for clinicians to consult with peers before resorting to imaging (e.g., peer / expert case review; health systems to design rapid referrals).

There were very few participants who found high value in imaging, with chiropractors being the most prominent group of these few participants, which is a similar finding to that of other studies [13, 16]. Most of our study participants, including most chiropractors, believed that imaging would result in an incidental finding in most patients rather than aiding diagnosis, contrary to the findings within the previous meta-analyses [13, 28]. Based on a meta-analysis, Sharma, et al. [13] reported that clinicians may order imaging to reduce the risk of litigation due to missed diagnosis. In contrast, we found no evidence of this influence in our participants. There are differences between Canadian malpractice coverage and that elsewhere, which results in a significantly lower risk of a successful claim than in many other countries, particularly the USA [23]. In our data, concerns about missed diagnosis were primarily about poor patient outcomes rather than litigation.

Limitations

Since participants volunteered for the study, the study generalizability is limited as participants may have been more likely than most Ontario primary care clinicians to keep up with research findings and thus have been aware of the guidelines for imaging in non-specific low-back pain. We also recognize that low back pain is often managed in the context of a longitudinal relationship between the patient and clinician; the pros and cons of carrying out discussions to forgo imaging in the context of patient desire for imaging may vary from one visit to another.

Conclusion

This study reports on the findings from the first Canadian large interprofessional sample of primary care clinicians examining influences on low back pain imaging behaviours. Clinicians identified several opportunities for ongoing dissemination of guidelines and practice areas that can potentially reduce imaging in patients with non-specific low back pain.

Supplementary Information

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Supplementary Material 1. Appendix 1: Pre-interview questionnaire.

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Authors' contributions

L.H-L., K.E.N. and S.F. developed the interview guide, which was then reviewed by all authors. I.M.T., L.H-L., K.E.N., and A.E.P. reviewed transcripts and developed the coding strategy. I.M.T. and L.H-L. coded the interview transcripts. Preliminary coding and themes were reviewed by all authors (A.M.P, M.G., J.G., J.A.H., J.H., N.M.I., H.J. and S.F.). L.H-L. and K.E.N. wrote the main manuscript text, and K.E.N. formulated the tables. The manuscript was reviewed by I.M.T., A.M.P, M.G., J.G., J.A.H., J.H., N.M.I., H.J. and S.F., who contributed to revisions of the manuscript, and reviewed the final manuscript.

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Data availability

The dataset generated and/or analysed during the current study are not publicly available due to privacy and ethical restriction, but are available from corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This research was approved by the Health Sciences and Affiliated Teaching Hospitals Research Ethics Board at Queen's University (REH-736–18) was conducted in accordance with the principles of the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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References

 GBD. Low Back Pain Collaborators: Global, regional, and national burden of low back pain, 1990–2020, its attributable risk factors, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021. The Lancet Rheumatology. 2021;2023(5):e316-329.

- Schultz SE, Kopec JA: Impact of chronic conditions. In., vol. 82–003: Statistics Canada; 2003: 41–53.
- 3. Coyte PC, Asche CV, Croxford R, Chan B. The economic cost of musculoskeletal disorders in Canada. Arthritis Care Res. 1998;11(5):315–25.
- 4. Low Back Pain https://boneandjointcanada.com/low-back-pain/.
- 5. World Health Organization. WHO guideline for non-surgical management of chronic primary low back pain in adults in primary and community care settings. In. Geneva: World Health Organization; 2023.
- Almeida M, Saragiotto B, Richards B, Maher CG. Primary care management of non-specific low back pain: key messages from recent clinical guidelines. Med J Aust. 2018;208(6):272–5.
- Chou R, Qaseem A, Snow V, Casey D, Cross JT Jr, Shekelle P, Owens DK. Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. Ann Intern Med. 2007;147(7):478–91.
- Jenkins HJ, Downie AS, Maher CG, Moloney NA, Magnussen JS, Hancock MJ. Imaging for low back pain: is clinical use consistent with guidelines? A systematic review and meta-analysis. The Spine Journal. 2018;18(12):2266–77.
- Kamper SJ, Logan G, Copsey B, Thompson J, Machado GC, Abdel-Shaheed C, Williams CM, Maher CG, Hall AM. What is usual care for low back pain? A systematic review of health care provided to patients with low back pain in family practice and emergency departments. Pain (Amsterdam). 2020;161(4):694–702.
- Centre for Effective Practice: Clinically Organized Relevant Exam (CORE) Back Tool. In.: Centre for Effective Practice; 2016.
- Choosing Wisely Canada https://choosingwiselycanada.org/recom mendations/.
- 12. Rapid Access Clinics for Low Back Pain https://www.lowbackrac.ca.
- Sharma S, Traeger AC, Reed B, Hamilton M, O'Connor DA, Hoffmann TC, Bonner C, Buchbinder R, Maher CG. Clinician and patient beliefs about diagnostic imaging for low back pain: a systematic qualitative evidence synthesis. BMJ Open. 2020;10(8): e037820.
- Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. Implement Sci. 2012;7(1):37.
- 15. Hall AM, Scurrey SR, Pike AE, Albury C, Richmond HL, Matthews J, Toomey E, Hayden JA, Etchegary H. Physician-reported barriers to using evidence-based recommendations for low back pain in clinical practice: a systematic review and synthesis of qualitative studies using the Theoretical Domains Framework. Implement Sci. 2019;14(1):49.
- 16. Bussières AE, Patey AM, Francis JJ, Sales AE, Grimshaw JM, Brouwers M, Godin G, Hux J, Johnston M, Lemyre L, et al. Identifying factors likely to influence compliance with diagnostic imaging guideline recommendations for spine disorders among chiropractors in North America: a focus group study using the Theoretical Domains Framework. Implement Sci. 2012;7:82.
- Hall A, Richmond H, Pike A, Lawrence R, Etchegary H, Swab M, Thompson JY, Albury C, Hayden J, Patey AM, et al. What behaviour change techniques have been used to improve adherence to evidence-based low back pain imaging? Implement Sci. 2021;16(1):68.
- French SD, Green ME, Bhatia RS, Peng Y, Hayden JA, Hartvigsen J, Ivers NM, Grimshaw JM, Booth CM, Rühland L, et al. Imaging use for low back pain by Ontario primary care clinicians: protocol for a mixed methods study – the Back ON study. BMC Musculoskelet Disord. 2019;20(1):50.
- Tong A, Sainsbury P, Craig J. Consolidated criteeria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. Int J Qual Health Care. 2007;19(6):349–57.
- Stochkendahl MJ, Kjaer P, Hartvigsen J, Kongsted A, Aaboe J, Andersen M, Andersen M, Fournier G, Højgaard B, Jensen MB, et al. National Clinical Guidelines for non-surgical treatment of patients with recent onset low back pain or lumbar radiculopathy. Eur Spine J. 2018;27(1):60–75.
- National Insitute of Health and Care Evidence (NICE): Low back pain and sciatica in over 16s: assessment and management. In. London: National Institute for Health and Care Excellence (UK); 2016.
- Qaseem A, Wilt TJ, McLean RM, Forciea MA, Denberg TD, Barry MJ, Boyd C, Chow RD, Fitterman N, Harris RP, et al. Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of Physicians. Ann Intern Med. 2017;166(7):514–30.
- 23. Chou R, Qaseem A, Owens DK, Shekelle P. Diagnostic imaging for low back pain: advice for high-value health care from the American College of Physicians. Ann Intern Med. 2011;154(3):181–9.

- 24. Atkins L, Francis JJ, Islam R, O'Connor DA, Patey A, Ivers N, Foy R, Duncan E, Colquhoun H, Grimshaw JM et al: A guide to using the theoretical domains framework of behaviour change to investigate implementation problems. Implementation Science 2017, 12(77).
- O'Connor C, Joffe H. Intercoder Reliability in Qualitative Research: Debates and Practical Guidelines. Int J Qual Methods. 2020;19:1609406919899220.
- 26. McHugh ML. Interrater reliability: the kappa statistic. Biochemia Medica. 2012;22(3):276–82.
- What is the McKenzie Method? https://mckenzieinstitute.org/patients/ what-is-the-mckenzie-method/.
- Slade SC, Kent P, Patel S, Bucknall T, Buchbinder R. Barriers to Primary Care Clinician Adherence to Clinical Guidelines for the Management of Low Back Pain: A Systematic Review and Metasynthesis of Qualitative Studies. Clin J Pain. 2016;32(9):800–16.
- 29. Gabbay J, le May A. Mindlines: making sense of evidence in practice. Br J Gen Pract. 2016;66(649):402–3.
- Patel K. Introducing clinical mindlines: A discussion of professional knowledge sharing in clinical radiography education. Radiography. 2023;29(3):577–81.
- 31. French SD, Green SE, O'Connor DA, McKenzie JE, Francis JJ, Michie S, Buchbinder R, Schattner P, Spike N, Grimshaw JM. Developing theoryinformed behaviour change interventions to implement evidence into practice: a systematic approach using the Theoretical Domains Framework. Implement Sci. 2012;7(1):38.

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