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Editorial Board

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The Ontario Chiropractic Association's Evidence-Based Framework Advisory Council: Enhancing patient care through the comprehensive integration of the pillars of evidence-based practice

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Supporting chiropractors to deliver Evidence Based Care (EBC) is an important role that professional organizations fulfill in the practice ecosystem. This is a journey that can be accelerated when there is a shared understanding of the elements of Evidence Based Practice (EBP) and the benefits that accrue when applied comprehensively to patient care. The Ontario Chiropractic Association (OCA) undertook a significant project to advance this understanding and enhance these benefits.

Le Conseil consultatif sur le cadre fondé sur des données probantes de l'Ontario Chiropractic Association: Améliorer les soins aux patients au moyen de l'intégration complète des piliers de la pratique fondée sur des données probantes

Soutenir les chiropraticiens dans la prestation de soins fondés sur des données probantes (SFDP), voilà un rôle important que les organisations professionnelles jouent dans l'écosystème de la pratique. Il s'agit d'un parcours qu'il est possible d'accélérer lorsqu'il y a une compréhension partagée des éléments de la pratique fondée sur des données probantes (PFDP) et des avantages qui en découlent lorsqu'elle est appliquée de manière globale aux soins aux patients. L'Ontario

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Conflicts of Interest:
This research was funded by the OCA. The lead authors received a per diem for the team meetings they attended as part of the project. The authors declare no other conflicts of interest, including no disclaimers, competing interests, or other sources of support or funding to report in the preparation of this manuscript.

This paper describes the principles, processes and outputs of our work, which is a series of papers examining the EBP framework in detail. It details why this work is necessary for the chiropractic profession, how it was accomplished, and introduces the themes of each of the six other papers in the series. We aim to support chiropractors in delivering comprehensive care through the application of the evidence-based framework enabling them to practice within the full chiropractic scope of practice in compliance with applicable regulations and legislations.

Author's Note: This paper is one of seven in a series exploring contemporary perspectives on the application of the evidence-based framework in chiropractic care. The Evidence Based Chiropractic Care (EBCC) initiative aims to support chiropractors in their delivery of optimal patient-centred care. We encourage readers to review all papers in the series.

(JCCA. 2025;69(3):224-237)

KEY WORDS: chiropractic, evidence-based practice

Chiropractic Association (OCA) a entrepris un projet important pour faire progresser cette compréhension et améliorer ces avantages.

Ce document décrit les principes, les façons de procéder et les résultats de notre travail, qui est une série de documents examinant en détail le cadre de la PFDP. Il décrit en détail la raison pour laquelle ce travail est nécessaire pour la profession chiropratique, la manière dont il a été réalisé et il présente les thèmes de chacun des six autres articles de la série. Nous visons à soutenir les chiropraticiens dans la prestation de soins complets au moyen de la mise en œuvre du cadre fondé sur des données probantes leur permettant d'exercer leur profession au sein de l'ensemble de leur champ d'exercice en conformité avec les règlements et les lois applicables.

Note de l'auteur : Ce document fait partie d'une série de sept documents examinant les perspectives contemporaines sur la mise en œuvre du cadre fondé sur des données probantes pour les soins chiropratiques. L'initiative de soins chiropratiques fondés sur des données probantes (SCFDP) vise à soutenir les chiropraticiens dans la prestation de soins optimaux axés sur le patient. Nous encourageons les lecteurs à consulter tous les articles de la série.

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MOTS CLÉS : chiropratique, pratique fondée sur des données probantes

Introduction

Since the birth of the Evidence-Based Medicine (EBM) movement in the 1990s, there has been much debate within the chiropractic profession, and across diverse healthcare settings, as to what precisely evidence-based care ought to entail in practice.[1–7] What role do patient values and preferences play in the planning and delivery of evidence-based care plans? How are patient values and preferences best ascertained by clinicians and what happens when they conflict with best available research evidence? Is clinical expertise best understood as a form of evidence or, instead, as a lens through which research evidence is appraised and integrated with other clinically relevant information? What are the barriers to successful integration of research evidence in clinical practice and how can these be overcome? These are important questions, and this paper introduces and describes the principles, processes and outputs of our work to answer these questions and advance a shared vision for evidence-based practice (EBP). Specifically, our objectives here were to describe the formation of the Evidence-Based Framework Advisory Council (EBFAC), the selection of an EBP model around which to structure our work, and the development of initial deliverables for promoting a shared understanding of EBP.

The Ontario Chiropractic Association's (OCA) EBFAC was created to support chiropractors in their delivery of evidence-based, patient-centred and interprofessional

care in collaboration with their patients. Beginning in January 2020 the EBFAC delved into the nuances of these debates, outlined above, and their implications for the theory and practice of evidence-based chiropractic care. Through this work, the EBFAC provided professional input surrounding optimal models of EBP for chiropractic care and engaged in a series of discussions designed to provide a foundation for a holistic understanding of EBP in the chiropractic profession. The results of these research driven conversations are presented here in a series of papers and a clinical decision tool, which the EBFAC reviewed and approved. The goal of these papers is to create a foundation upon which the OCA will build as it works to develop programming and foster partnerships to support the profession in Ontario – and elsewhere – to grow and advance through a shared understanding of evidence-based chiropractic care.

The work presented in this special edition of the JCCA explores leading practices from other professions globally and aligns with important professional advancement and thought leadership work underway elsewhere, including the World Federation of Chiropractic's #EPIC model of care,[8] the Canadian Memorial Chiropractic College's work on core competencies,[9] and the Diversity, Equity and Inclusion (DEI) work undertaken at the Canadian Chiropractic Association[10]. These initiatives are essential to raise the quality of care that all health professionals provide.

Why undertake this work?

Over the past 30 years, the Global Burden of Disease Group[11] have recognized that musculoskeletal (MSK) disorders – particularly low back and neck pain – are the leading cause of disability globally. In North America, acute and chronic MSK conditions and associated work disability have been characterized as a public health crisis.[12,13] They are associated with poverty and suffering at the individual level and place tremendous strain on both public and private health and social services systems.[12,13]

In addition to accounting for a substantial use of financial resources, neuromusculoskeletal (nMSK) conditions negatively impact the quality of life of people, their families, and communities.[12,14] The impact of the social determinants of health mean that the negative impacts of ill health are felt more acutely by some than others. Socially and economically marginalized populations – such as people living in poverty, Indigenous people, racialized people, and women – experience higher instances and greater severity of disease. This necessitates the urgent advancement of effective, equitable and accessible treatment strategies to help manage those with chronic health conditions and pain as well as to mitigate the burden they place on healthcare systems.[12,14,15]

The chiropractic profession recognizes the importance of reducing inequity and advocating for all patients regardless of who they are, where they live or where they come from. As a low-cost, safe, and conservative approach,[16] evidence-based chiropractic care is well positioned to address these issues, many of which were both exacerbated and highlighted by the recent COVID-19 pandemic.

Our goal is to support chiropractors in providing equitable, quality care for all patients, and to be essential partners in their patients' circle of care. This partnership is achieved through meaningful communication and collaboration with patients and their healthcare providers, through participation in interdisciplinary healthcare teams, and by referral to other healthcare professionals where appropriate. The optimization of this vision requires advancing our collective understanding of the complexity of delivering evidence-based care – which is, fundamentally, all about the patient. This paper introduces a series of six papers focused on various concepts of EBP to advance this vison.

Evidence-Based Medicine and Practice

The term "Evidence Based Medicine" (EBM) was initially coined by Gordon Guyatt, David Sackett, and Brian Haynes to describe a new approach to teaching medicine.[1] It has since been taken up by a range of professions as "Evidence Based Practice" (EBP).[3,17,18] The first model of EBM, which came to be known as the "Sackett model" defined the three pillars as research evidence, clinical expertise and patient preferences.[2] Recognizing evolution of thought around EBM, the model was subsequently revised in 2002 by Haynes, Guyatt and Devereaux.[3] The revised "Haynes model" understands clinical expertise as the lens that integrates the pillars of patient preferences and actions, clinical state and circumstances (e.g., the patient's health condition and the external factors impacting medical decisions), and best available research evidence into forming a clinical decision. Considering each of these pillars within care forms the basis of EBP, it reinforces the

importance of addressing social determinants of health to ensure equitable and accessible care.

Local Association's role and contributions

It is well documented across healthcare professions that there are numerous challenges to the timely and effective integration of emerging research into practice.[19–24] Research has also demonstrated that knowledge translation efforts have tended to focus more on individual behaviour change within clinical and health services contexts and less on broader system-level change.[23] However, given the complexity of the knowledge translation ecosystem, multi-level, multi-strategy approaches are needed.[19,23–25]

Canadian chiropractors have been found to have positive attitudes towards Evidence-Based Practice (EBP), high self-reported EBP skills and expressed significant (over 90% of respondents) interest in improving these skills.[26,27] Notwithstanding this level of enthusiasm, research has reported that opportunities remain to improve EBP in clinical practice. Key barriers to chiropractors' participation in EBP are: [26–28]

1. lack of appropriate/relevant clinical research evidence
2. lack of time
3. lack of industry support for EBP
4. insufficient skills to critically appraise the literature and
5. insufficient skills for interpreting research

These suggest that passive strategies do not necessarily result in clinical application of new knowledge and research, and underscores the need for strategies that are active, diverse, and on-going to meet the continuing education needs of the profession and advance evidence-based practice.[27]

To this end, there have been several important developments within the profession since the publication of these studies. In recent years, the Canadian Chiropractic Guideline Initiative (CCGI)[29] and the Canadian Chiropractic Research Foundation (CCRF)[30] have made considerable progress in their respective areas of expertise in research funding and guideline development. The CCRF has invested over $1.5 million for nMSK projects and developed unique partnerships to support chiropractic-relevant research. Likewise, CCGI has created rich content and resources to support chiropractors' increased uptake of EBP, including evidence syntheses, practice guidelines, clinician briefs, and patient handouts and videos. The establishment of EBFAC and the contributions presented here seek to build on this important work.

Established in 1929, the Ontario Chiropractic Association (OCA) has ~3,800 members, representing more than 80 per cent of Ontario's chiropractors. The OCA's mission is to serve its members and the public by advancing the understanding of chiropractic care and demonstrating the benefits to the broader healthcare system by reducing barriers to access chiropractic care.[31] Advancing evidence-based practice and research are integral to this work. The OCA is therefore well positioned to play a key role in strengthening the existing knowledge translation ecosystem for Ontario chiropractors. The OCA's EBFAC is building accessible tools to support chiropractors in their delivery of evidence based, patient-centred and interprofessional care in collaboration with their patients.

Why the OCA's EBFAC was established

The OCA's EBFAC was established to develop a shared understanding in the Ontario context around what exactly "evidence-based practice" means for chiropractic care, how it can be advanced through the work of chiropractors and chiropractic organizations, and what factors facilitate or restrict its application. During strategic planning in 2018, senior management at the OCA met with chiropractors from across the province to understand their needs and visions for the future. During these conversations, it became clear that, in addition to the range of views on what EBP meant, there was also a gap between the research evidence being generated and a chiropractic clinician's access, knowledge, and skillset needed to apply it into daily practice. This observation aligns with a key finding from the research on barriers and facilitators to the integration of EBP in many professions including chiropractic.[26,27,32–35]

The evidence-base for the safety and efficacy of spinal manipulative therapy (SMT) and other types of clinical interventions chiropractors use for low back pain is well documented in high quality research and guidelines.[16,36] However, guidelines and other forms of high-quality research are not always applicable to the circumstances of individual patients. Moreover, in the Ontario context, there is much that falls within the chiropractic scope of

practice, in addition to the management of back pain, that is still being investigated to generate a robust evidence base.

Legislation in Ontario defines the chiropractic scope of practice as:

> "the assessment of conditions related to the spine, nervous system and joints and the diagnosis, prevention and treatment, primarily by adjustment of:
> - dysfunctions or disorders arising from the structures or functions of the spine and the effects of those dysfunctions or disorders on the nervous system; and
> - dysfunctions or disorders arising from the structures or functions of the joints."[37]

This chiropractic scope of practice does provide for a chiropractor's expert role in addressing the breadth of MSK needs of patients with treatment that includes not only joint manipulation or adjustment, but also behaviour modification coaching, exercise prescription, soft tissue therapy, and education to name a few. However, the legislated chiropractic scope of practice in Ontario and elsewhere does not articulate the patient-centred, biopsychosocial model of health that chiropractors use to practice in collaboration with their patients.

The OCA is both an advocacy organization and a contributor of significant funds to research foundations, such as the Canadian Chiropractic Research Foundation (CCRF), a registered charity dedicated to funding chiropractic research. The organization is well positioned to support the growth of the evidence base to drive optimal, high-quality patient-centred care across the full scope of practice. It is important that research informs practice, and that practice also informs research. The OCA can do this by cultivating stronger connections between existing clinical practice – which is frequently where the generative questions and observations that fuel new generations of research come from – and the research community, where the knowledge, skill, and resources to answer most pressing clinical questions is concentrated.

It was in response to these challenges and opportunities that the idea for the OCA EBFAC was born. EBFAC was conceived as a group of experts consisting of chiropractic clinicians, educators and researchers, including a person with lived experience, representing a breadth of professional experiences and viewpoints about EBP. The OCA sought to bring these experts together to engage in a process of shared learning and consensus development around what EBP means for the Ontario chiropractic community.

Evidence Based Framework Advisory Council

EBFAC consisted of 13 members[38] drawn from across Ontario, representing a diverse cross-section of the profession. The EBFAC also included a patient. The recruitment method used to compose EBFAC was purposeful sampling: that is, members were chosen who were considered 'information rich',[39] based on their career stage, recognition within the profession, education, awards, and international experience among other criteria.[38] Care was taken to ensure that gender, age and geographic diversity across the province, as well as different specializations and practice styles were taken into account when selecting members of EBFAC, ensuring broad representation from a variety of different stakeholders. The purposeful sampling method also prioritized the value of breadth and diversity of experience and practice. The OCA sought to include chiropractors who were primarily engaged in clinical practice, those primarily engaged in clinical and/or basic sciences research, as well as those primarily engaged in education/teaching. If the disconnect between clinical research and clinical practice is to be addressed, then it is important to bring these groups together.

EBFAC members were also selected for their potential to act as thought leaders and knowledge brokers within the Ontario context. This was essential to lay the foundation for future dissemination, impact, and sustainability of this work. From the outset, it was recognized that building consensus through a process of deep exploration and shared learning would just be the beginning. Future steps will be to take the lessons and implications from this work and use it to develop practical strategies and resources to support Ontario's chiropractors in transforming their positive attitudes towards EBP into concrete, patient-centred clinical practices and outcomes.

EBFAC members were initially invited to meet for a period of 18-24 months, however that period was later extended as the scope of the work grew. During this time EBFAC met as a whole council on 12 occasions. EBFAC also formed five smaller working groups, members of

which met dozens of times to develop specific outputs (e.g. separate but interconnecting articles) included in the overarching project. Except for the first meeting, which took place over a day and a half in January 2020, all meetings were conducted virtually due to the COVID-19 pandemic.

Consensus development and shared learning

To guide the structure of the meetings and facilitate consensus development within EBFAC, we used a modified version of the Nominal Group Technique (NGT).[40–43] We combined this method with the Glasser technique[43] to extend our consensus outcomes into a series of papers which document the outcomes of our process of shared learning. Consensus on article structure (e.g., identifying chiropractic topics that require further exploration) and content (e.g., outlining key discussion points for each topic) within our group was deemed to have 100% agreement. Each of these papers were then extended into research papers to situate our views within the contemporary literature on the constituent elements of EBP. Each review then came with its own, separate methodology, which is detailed in each respective paper. It is this consensus development and shared learning process to initially develop 'white papers' on each of these topics that served as initial rationale for the research papers presented in this series.

The Nominal Group Technique is a method of conducting "a structured meeting that attempts to provide an orderly procedure for obtaining qualitative information from target groups who are most closely associated with a problem area".[43] In this method a professional facilitator poses structured questions to the group, provides time for quiet reflection, and facilitates round robin discussion before moving the group to final agreement on a given issue or question.[40,43] NGT provides participants an opportunity to have their voices heard and opinions considered by other members. It is therefore conducive to building the sense of collaboration and shared purpose needed to undertake a complex and lengthy process of developing helpful, value added outputs. In our application of this method, all meetings were led by an external facilitator with expertise in consensus development and organizational learning and development and NGT.

The structured questions were developed by OCA leadership and staff in collaboration with the facilitator and were designed to encourage EBFAC members to offer critical reflections and engage in detailed discussions of each topic. Some questions solicited open comment while others directed attention to specific issues, including research methods, strengths and weaknesses of evidence and argument, and clarity of the paper's structure and language relative to its intended audience which, crucially, includes practicing chiropractic clinicians.

The Glasser method is an iterative process through which a small group of invited participants develop a consensus paper on an important topic. The group drafts an initial position paper and subjects it to rounds of revisions. Once the group agrees that the draft is ready to be shared, it is circulated for comment and critique among a wider group of experts chosen for their strategic importance and knowledge in the field of interest. Once the core group has received comments from external reviewers, members further revise the paper to the point of agreement.[43]

The Glasser method is specifically designed to ensure broad visibility and endorsement of the work. This method attempts to build a high degree of support for the work undertaken by, for example, having prominent groups or individuals determine the need for and value of a comprehensive statement clarifying the level of knowledge about the issue.[43]

In our application of this method, each paper was developed by a writing team. The writing team for each paper consisted of the working group members as well as a scientific writer, an OCA staff member, and an intern for research support (e.g., preliminary literature searching, and database and citation management support). OCA staff members of the writing teams took part in all meetings and meetings were recorded and transcribed for later reference by members of the writing team.

Because the OCA is a not-for-profit member driven organization governed by an elected Board of Directors, an intermediary step was added to the process. For each paper, after the working group agreed upon a first draft, it was then shared with the wider EBFAC and the OCA Board of Directors. After feedback from this stage was incorporated, external stakeholder groups in the chiropractic healthcare ecosystem (e.g., associations, regulators, academic institutions, and so forth) (Figure 1) were consulted and each provided additional feedback. This process involved requesting meetings with stakeholders in which drafts of papers were shared with them in advance. Stakeholders then had an opportunity to share their feedback. The feedback was referred back to the council to

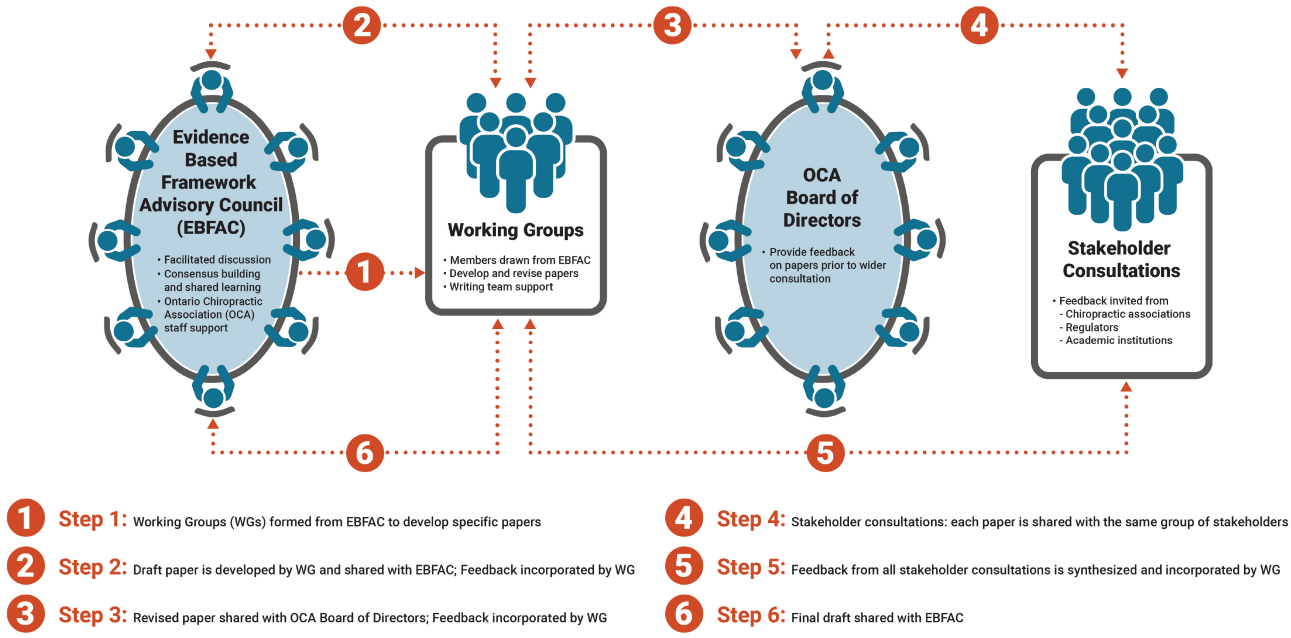

Figure 1.
Process for generating outputs

discuss and debate to achieve consensus on the relevance of the feedback to the paper. While each stakeholder provided their own feedback/perspectives, all were supportive of the work. Furthermore, each paper was reviewed at least once by the patient member of the EBFAC.

The methodology used by the EBFAC fostered a collaborative approach to resolve all issues on the ideological spectrum, even those that could potentially lead to professional division and impasse. This collaboration, in turn, lays the groundwork for the OCA's long-term plan to address foundational issues around knowledge translation and the relationship between clinical research, clinical practice and patient preferences and values.

Working groups and writing teams

All working groups were composed to capture the range and breadth of experience and expertise of the EBFAC. For example, all working groups had at least one clinician and at least one researcher. At an early meeting, the facilitator administered a short thinking styles assessment to the group to help in identifying those who are "big picture" divergent thinkers and those who are more "detail oriented" convergent thinkers. This feedback was also used to inform working group development and ensure a range of intellectual approaches were represented within the working groups as well.

The methodology of shared learning

The papers in this series are both process and product. They are the result of a process that was undertaken to arrive at a shared understanding of what evidence-based practice means for chiropractors caring for patients in Ontario (and elsewhere) today. It is through the process of conceiving, planning, revising, and publishing this set of papers that a substantial depth of consensus among advisory EBFAC members was able to be achieved over a period of some two and a half years. This depth of understanding and consensus was made possible by a process of shared learning.

To speak of writing as learning means that we are attentive to the fact that there is much that comes unexpectedly, or is seen in new light, as we proceed through the processes of transforming our questions and ideas into research outputs.[44] Writing as learning means that, as a group, we committed to ourselves and each other to maintain a safe and respectful space of dialogue across our differences

and to be open to integrating new realizations about material or concepts with which we are already familiar.[44] We acknowledged from the outset that such shifts in thinking and understanding would inevitably come from open-minded participation in transforming the results of round robin discussion into written sentences and paragraphs, circulating, debating and discussing drafts, and integrating external comment and critique arising through stakeholder consultation and peer review.[44]

As one expert on this topic writes – paraphrasing groundbreaking 20th century painter Francis Bacon – "the scholarly and scientific sentences and paragraphs in which we paint our descriptions of the world induce new understandings in us, even as we attempt to convey what we think we have to say through them".[44,45] In the case of collective writing, this effect is magnified. As drafts are reviewed, discussed, and critiqued authors bring the breadth of their backgrounds and experiences to the work. This in turn generates fresh insights into the manuscript through the generative force of conceptual tensions and under-explored themes as well as excitement of a particularly well-observed statement.

Selecting the Haynes model

One of the first priorities EBFAC needed to address was coming to consensus on the model of Evidence-Based Practice that would underpin this work. The EBFAC conducted a thorough review of landmark EBP models [4,6,7] Over the course of several discussions during meetings, the EBFAC arrived at a unanimous consensus decision to adopt the Haynes (2002) model as the preferred model of EBP for its work (Figure 2).[3] The Haynes model was chosen for the balance it strikes between comprehensiveness and clarity. Importantly, Haynes and colleagues were explicit in characterizing their model as normative: they described what EBP ought to look like, not necessarily its actual state.

EBFAC's aim is to build and expand upon these foundational contributions for the chiropractic profession. While the papers contained in this series make extensive use of available research, they are also consciously prescriptive and future focused. With this future focused goal, the EBFAC group and our work is designed to overcome the well-documented challenges associated with real-life uptake and implementation of EBP frameworks.[46]

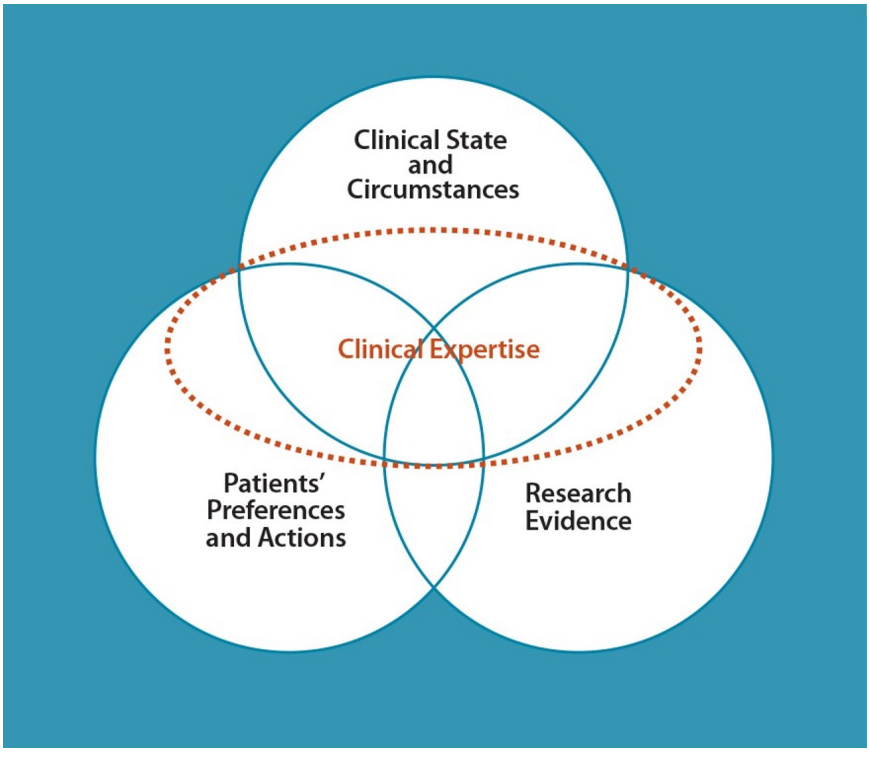

Figure 2.
Evidence-based practice model, adapted from Haynes and colleagues' updated model for evidence-based clinical decision-making.[3] Reproduced and adapted with permission of the American College of Physicians, from Haynes et al.[3]; permission conveyed through Copyright Clearance Center, Inc.

Cautious of the poor implementation of EBP frameworks despite positive attitudes toward EBP in the chiropractic profession,[46] our selection of EBFAC promotes utilization of EBP. Specifically, our group involved multiple levels of stakeholders in the chiropractic profession which is suggested to enhance implementation both longitudinally and contextually of EBP delivery.[47]

EBFAC deliverables

In selecting the topics to deliver, the EBFAC was motivated by a conviction that the advancement of evidence-based chiropractic care must begin with a detailed examination of foundational principles. For example, 'Bridging the Knowledge-to-Action Gap in Evidence-Based Practice' (Paper 5, described below), ties the findings of Papers 2-4 together through a practical reflection on how the stakeholders in the chiropractic ecosystem can further advance evidence-based chiropractic. Paper 6, the clinical decision tool, was developed in recognition of the fact that there are many situations where there is little or no high-quality research evidence, or where evidence is conflicting or inconclusive for the clinical state and circumstance of the patient. To visualize this and how our work deepens understanding and application of the selected Haynes' EBP model, please see Figure 3.

The seven EBFAC papers offer comprehensive insights into each pillar of the selected Haynes EBP model to produce a shared understanding of EBP and subsequently

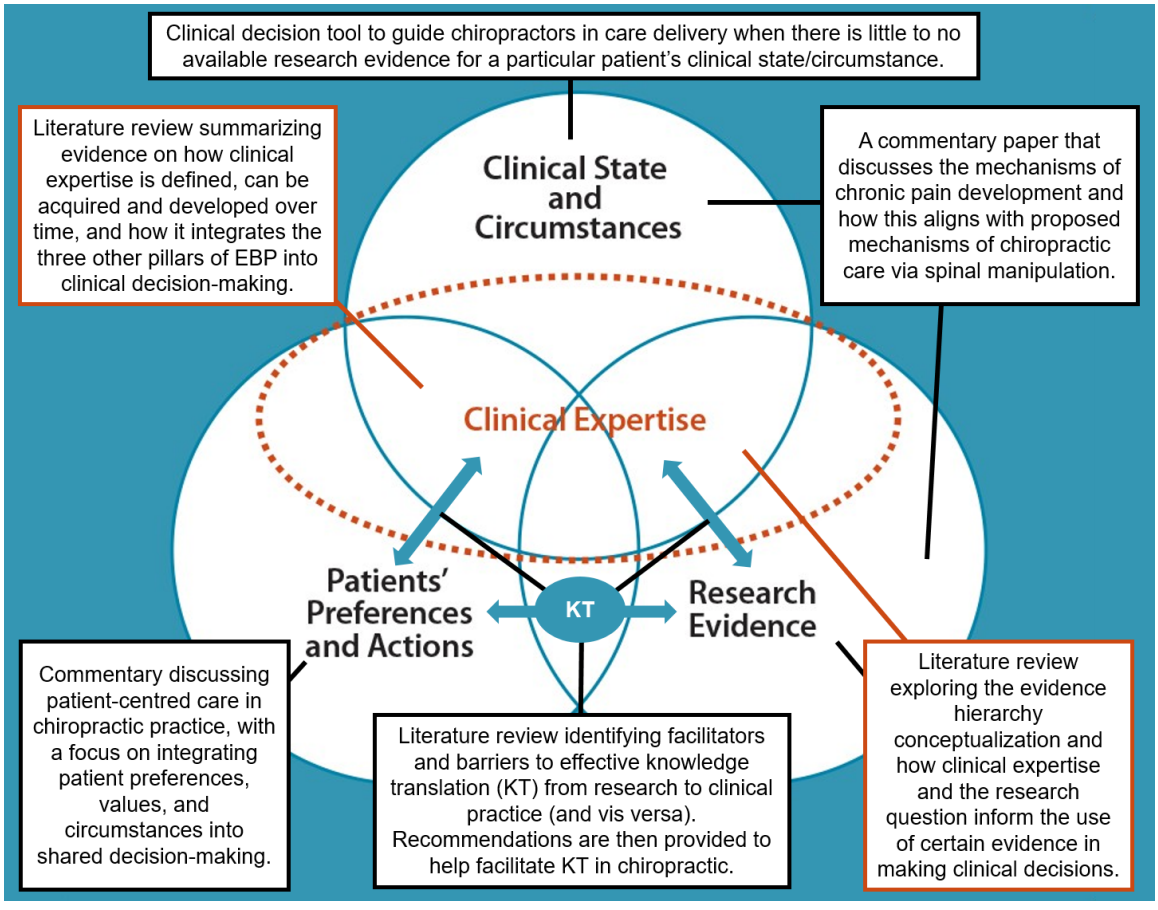

Figure 3.

Description of EBFAC papers as they relate to Haynes' model of EBP.[3] Each paper is interconnected as the Venn-diagram illustrates, providing an understanding on how our work contributes to supporting the delivery of EBP in chiropractic.

support its delivery in the chiropractic profession. These papers collectively aim to summarize research on each pillar and how they are connected, providing a holistic view of the current state of EBP. They offer a foundation of understanding, and valuable insights and recommendations for implementing these practices. These papers are described in more detail below. Each paper directly reflects the work achieved by the EBFAC group, integrated with contemporary literature.

1. *The Ontario Chiropractic Association's Evidence-Based Framework Advisory Council: Enhancing patient care through the comprehensive integration of the pillars of evidence-based practice*. This paper, presented above, provides an in-depth description of the rationale and process of the overarching project.
2. *Conceptualizing the Evidence Pyramid for Use in Clinical Practice: a narrative literature review*. This paper reviews how the evidence pyramid has evolved since its conceptualization and explores contemporary iterations. It identifies the strengths and the limitations that clinicians must consider when using it to evaluate the quality of healthcare research within the context of the Haynes Model.
3. *Person-Centred Care in Chiropractic: A Foundational but Evolving Commitment in Contemporary Practice*. This commentary examines the alignment between chiropractic approaches and person-centred care, highlighting the profession's strengths while identifying gaps in consistent implementation. It explores barriers and strategies for overcoming them at the clinician, patient, and organizational levels, and calls for a system-wide commitment to patient-centred care as a relational and evidence-informed standard of care.
4. *Conceptualizing clinical expertise in evidence-based practice: A narrative literature review with implications for clinical decision-making*. This paper reviews the recent literature on the role and definition of clinical expertise in EBP, specifically: (i) how clinical expertise is defined and considered across disciplines, (ii) how clinical expertise, as illustrated by the Haynes model, operates as a lens and mechanism of integration for the EBP factors of clinical state and circumstances, patients' preferences and actions, and research evidence, and (iii) how clinical expertise can be acquired and developed over time. Following Wieten, Paez and others,[5,6] the EBFAC perspective increases the weight of clinical expertise relative to previous models, especially the evidence pyramid, where this is located at the bottom.[2]
5. *Enhancing evidence-based chiropractic practice: bridging the knowledge-to-action gap for the needs of community-based chiropractors*. This paper reviews recent literature on Knowledge Translation (KT) in EBP. It provides an overview of the acknowledged facilitators of, and barriers to, knowledge translation through evidence integration and research utilization in chiropractic and manual therapy-based care: identifies strategies for the successful implementation of KT in clinical practice from across disciplines and jurisdictions; and draws on examples of success to propose strategies for how member-based associations can support KT and EBP for chiropractors in private community-based care settings.
6. *When there is Little or No Research Evidence: A clinical decision tool*. The purpose of this tool is to provide clinicians a logical, systematic, and evidence-based process to guide clinical decision making in situations where there is little or no high-quality research evidence, or where evidence is conflicting or inconclusive. The paper provides a detailed, systematic, and visually supported approach that is broadly applicable and provides an update on previously published similar tools (e.g. Leboeuf-Yde et al 2013[48]). Readers will note that Parkinson's disease (PD) was included in the set of pedagogical examples used in the tool. This was to highlight an example when there is no evidence or biological plausibility to support the use of chiropractic care and illustrate how the tool helps chiropractors in decision-making when presented with these situations.

To inform and support our use of examples which accompany the tool, an additional paper was incorporated as part of this series:

7. *The Pathophysiologic Mechanisms of Spinal Manipulative Therapy in the Management of Chronic Musculoskeletal Pain*. This paper provides clinicians with an up-to-date discussion of the evidence on how central sensitization functions in the pathophysiology of chronic pain. It provides insight into bench research which helps explain why chiropractic care is effective in treating chronic pain including chronic low back pain, osteoarthritis and other nMSK pain. In addition, it discusses how SMT may be applied therapeutically to modulate the effects of central sensitization and treat associated pain. This paper highlights the relevance of fundamental neuroscience research in chiropractic care (paper 3) as well as its biological plausibility in clinical reasoning (paper 5). We included this paper in this special journal edition, both because of the crucial role that the work has played in the development of our own thinking and decision-making, and also because of the inherent interest and importance of the topic to the chiropractic profession. In the future we hope to add to this section of the series by producing robust research to further inform the "research evidence" pillar of Haynes' EBP model.

Limitations

We recognize that the body of work we present here, while thorough, is not exhaustive. Given the nature of commentaries and narrative literature reviews, there are inherent limitations including the potential for selection bias within the articles produced throughout this work. Additionally, the clinical decision tool presented may have limitations related to its development process (e.g., potential bias from expert consensus) and the need for external validation. Our work is iterative, and it will continue to evolve as new knowledge becomes available. Future research in the form of scoping or systematic reviews is needed to further strengthen the evidence base in these areas.

While our purposeful sampling method, described above, sought to include a breadth of viewpoints and experiences, it is not necessarily a representative sample of the full breadth of the profession in Ontario. Another potential source of bias is the pre-knowledge of the members of the EBFAC.[49,50] It is therefore possible that a different composition of EBFAC members would have generated different outputs or arrived at different conclusions.

Furthermore, while EBFAC was drawn from members of the Ontario chiropractic community with the intention to serve the local needs of OCA members, our perspective on research and leading practices was always international in its focus. As such we believe that our results and findings will be of interest to the broader chiropractic community. Indeed, our attention to local specificities, such as the legislated scope of practice, is intended to help the reader in understanding our project so that they may better compare to or apply in their own context.

Notwithstanding this, it is hoped that the reader will find that the fruits of this work make up a series of papers and practical tools to advance competencies of chiropractors across the full breadth of their scope of practice.

Conclusion

These deliverables are just the beginning. The Ontario Chiropractic Association will develop programming and partnerships that will form a cornerstone of strategic foci going forward. The aim of producing, publishing and disseminating this work is to:

- Undertake a thoughtful investigation of what evidence-based practice means for the present and future of the chiropractic profession, through thorough historical and cross disciplinary examination of the core concepts of EBP [Papers 2-5]
- Enhance patient-centred care by initiating and sustaining conversations on the right place of clinical expertise and patient preferences and values within evidence-based chiropractic care; and by catalyzing new partnerships and initiatives to sustain this work [papers 3 & 4]
- Support the competencies of chiropractors as nMSK experts by providing theoretical knowledge as well as practical tools for the integration of evidence into clinical practice [papers 4, 5 & 6]
- Develop a process for chiropractors to apply an evidence-based framework logically to patients presenting with nMSK and non-nMSK conditions, and to diagnostic and therapeutic procedures while adhering to the standards of practice, guidelines and policies of the jurisdiction in which they are practicing. [paper 6]
- Support chiropractors to practice to their full scope of practice, as set out by the applicable regu-

latory bodies and legislation in their jurisdiction [paper 7]

The body of work presented in this series seeks to clarify the distinct, but equally integral, forms of evidence that ought to inform chiropractor's clinical decision making and to provide a rigorous and systematic path forward in situations where little or no high-quality research evidence exists. It recognizes the most important element of care: the clinician-patient relationship, and the challenges of mitigating the barriers to care patients face. Reflecting the Haynes model, the OCA created a logo to represent their EBCC work (Figure 4).

Chiropractors educate and advocate for their patients and contribute to the health of their community. Chiropractors also recognize the diverse population they serve and prioritize health equity, inclusion, and the removal of barriers to healthcare access – all of which are supported and enhanced through people-centred EBP. This work therefore aims to support all chiropractors in the science and art of chiropractic care, while respecting the diversity of practices that chiropractors bring to help patients achieve their highest quality of health and life.

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Figure 4.
EBCC logo created by the OCA to represent their work within EBP. Logo informed by Haynes et al.[3]

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Conceptualizing the evidence pyramid for use in clinical practice: a narrative literature review

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Objective: *To explore contemporary iterations of the evidence pyramid as applied in evidence-based practice.*

Methods: *We searched for articles published in PubMed, Web of Science, and Scopus databases between 2016 and 2024 that assessed the evidence pyramid and its application in clinical practice. Title/abstract and full-text screening were conducted by one reviewer to determine eligibility, followed by data extraction and analysis to summarize themes.*

Results: *Of 83 full-text articles identified, 28 were included. Extracted information centred on three*

Conceptualiser la pyramide des données probantes pour usage en pratique clinique: une revue narrative de la documentation

Objectifs: *Examiner les itérations contemporaines de la pyramide des données probantes comme elle est mise en œuvre dans la pratique fondée sur des données probantes*

Méthodes: *Nous avons recherché des articles publiés dans les bases de données PubMed, Web of Science et Scopus entre 2016 et 2024 qui évaluaient la pyramide des données probantes et sa mise en œuvre dans la pratique clinique. Un évaluateur a procédé à l'examen du titre ou du résumé et du texte intégral pour déterminer l'éligibilité, suivi de l'extraction et de l'analyse des données pour résumer les thèmes.*

Résultats: *Parmi les 83 articles en texte intégral cernés, 28 ont été inclus. Renseignements extraits axés*

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common themes: (1) use of the evidence pyramid as a guide, not a rigid tool; 2) importance of the clinical question; and (3) necessity of clinical expertise to integrate research findings into clinical decision-making.

Conclusion: *Preliminary findings of our review suggest that, when applying the evidence pyramid in practice, clinicians should consider context (i.e., the clinical question, best available evidence, patient preferences, and clinical circumstances), to optimize clinical decision-making and patient outcomes.*

Author's Note: *This paper is one of seven in a series exploring contemporary perspectives on the application of the evidence-based framework in chiropractic care. The Evidence Based Chiropractic Care (EBCC) initiative aims to support chiropractors in their delivery of optimal patient-centred care. We encourage readers to review all papers in the series.*

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KEY WORDS: chiropractic, clinical decision-making, clinical competence, evidence-based practice, evidence-based medicine, patient care

sur trois thèmes communs : 1) usage de la pyramide des données probantes comme guide et non comme un outil rigide; 2) importance de la question clinique et 3) nécessité de l'expertise clinique pour intégrer les résultats de recherche dans la prise de décision clinique.

Conclusion: *Les résultats préliminaires de notre examen suggèrent que, au moment de la mise en œuvre de la pyramide des données probantes dans la pratique, les cliniciens devraient tenir compte du contexte (c'est-à-dire la question clinique, les meilleures données probantes disponibles, les préférences des patients et les circonstances cliniques), afin d'optimiser la prise de décision clinique et les résultats pour les patients.*

Note de l'auteur: *Ce document fait partie d'une série de sept documents examinant les perspectives contemporaines sur la mise en œuvre du cadre fondé sur des données probantes pour les soins chiropratiques. L'initiative de soins chiropratiques fondés sur des données probantes (SCFDP) vise à soutenir les chiropraticiens dans la prestation de soins optimaux axés sur le patient. Nous encourageons les lecteurs à consulter tous les articles de la série.*

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MOTS CLÉS : chiropratique, prise de décision clinique, compétence clinique, pratique fondée sur des données probantes, médecine fondée sur des données probantes, soins aux patients

Introduction

The conceptualization and application of the evidence hierarchy in evidence-based practice (EBP) has iteratively evolved since EBP was first introduced.[1–3] Early papers on EBP advocated for a shift in the manner in which medicine was taught and clinical decisions were made. Initially, the focus of EBP was to educate clinicians on assessing and applying published literature to clinical decision-making to improve patient care, while placing a lower value on clinical expertise, on its own, than in the traditional medical model.[2] As EBP evolved, clinical expertise (i.e., the competence and decision-making abilities that clinicians acquire throughout their career) was seen as integral to incorporating the best available research with a patient's values and preferences to improve clinical decision-making.[3]

By 1997, EBP was viewed as a life-long process of self-directed learning,[4] rather than "cookbook" medicine.[3] More recently, however, some in the field have asserted that EBP has at times been co-opted, misappropriated, or "hijacked" by others to serve unintended agendas or conflicts of interest.[5] Moreover, clinicians face continual challenges in selecting and appraising appropriate and available, 'high-quality' evidence (e.g., meta-analyses, systematic reviews, and clinical practice guidelines) to integrate in their day-to-day practices with the remaining pillars of EBP.[4]

Though the evidence hierarchy remains useful for understanding which research study designs are most

valid and reliable, such as systematic reviews of randomized controlled trials (RCTs) for clinical questions about therapy, misconceptions exist on the use of other forms of evidence such as observational studies, and their application in clinical practice. The impact of these misconceptions reaches beyond medicine to other health professional fields of practice, such as chiropractic, and therefore the evidence hierarchy requires an analysis from this perspective. A comprehensive, inclusive understanding of the appropriateness of different forms of evidence, informed by the clinical question and context, is important in order for clinicians to deliver optimal patient-centred care and improve patient outcomes. Therefore, the purpose of our review is to explore contemporary iterations of the evidence pyramid as applied in EBP, as well as to summarize contextual factors and limitations associated with these evidence hierarchies.

Methods

Study design

We conducted a narrative review[6] to summarize contemporary iterations, contextual factors, and limitations of evidence hierarchies by examining published scholarly literature on the evidence pyramid in relation to EBP.

Data sources and searches

We searched PubMed, Web of Science, and Scopus databases to identify English-language articles on evidence hierarchies in EBP that were published between January 1, 2016 and July 1, 2024. This timeframe was used to capture recent developments and perspectives in the field. We used combinations of the following key terms for our database searches: "evidence based medicine," "evidence based healthcare," "evidence based practice," "evidence based nursing," "evidence based chiropractic," "evidence based care," "evidence pyramid," "evidence hierarchy," "rules of evidence," "evidence rules," "classification of evidence," "quality of evidence," "grading system," "grading guidelines," "best evidence," and "canon* pyramid".

We defined the *evidence hierarchy* in EBP, according to Guyatt *et al*.[7], as a system to rank different types of evidence and research, from unsystematic clinical observations to RCTs, based on their methodological rigour and ability to provide reliable evidence for clinical decision-making.[7] We defined *EBP*, according to Haynes *et al*. , as an approach to clinical care that emphasizes the integration of the best available research evidence with clinical expertise, patients' preferences, and clinical state and circumstances to make informed clinical decisions.[7,8] In the Haynes *et al*. model, clinical expertise is the central pillar responsible for integrating each of the other three components into forming a clinical decision.[8]

Selection criteria

We included empirical research articles as well as secondary sources of evidence (e.g., systematic, scoping, or narrative reviews, and commentaries) that explored the evidence hierarchy or evidence pyramid within the context of EBP. We excluded conference abstracts, protocols, and EBP articles that did not explicitly analyze the evidence hierarchy or evidence pyramid.

Screening process

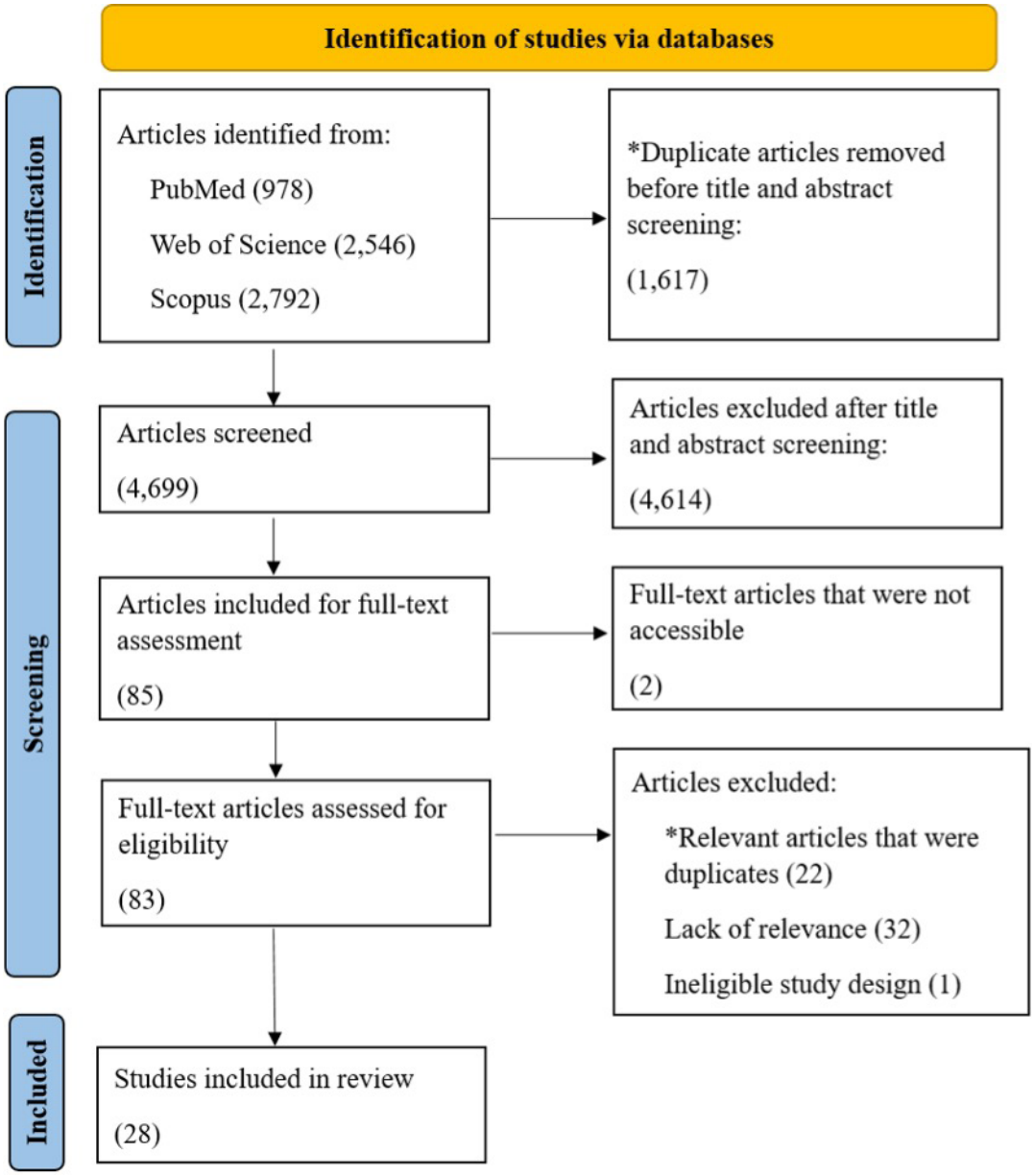
One author assessed titles and abstracts of identified articles to determine eligibility. Articles deemed potentially relevant underwent full-text review by the same author. The rest of the working group confirmed inclusion of each full-text article.

Data extraction and analysis

Descriptive information was extracted from included full-text articles, including discipline, first author, year of publication, title, study design, and insights on the evidence hierarchy, including relevant findings or author perspectives as applicable. For this last item, data from each paper were grouped into one of three categories: (1) contemporary understandings of the evidence pyramid, including how it is used and understood; (2) critiques of the evidence pyramid in relation to EBP; and (3) contextual considerations when applying the evidence pyramid to clinical decision-making. These categories were determined *a priori,* in line with the purpose of our review. All data were extracted, summarized, and presented in tabular form by one reviewer. The data extraction table underwent independent review among the full working group, and required unanimous consensus among the full group.

Results

Of 4,699 articles identified, 83 underwent full-text review and 28 met our inclusion criteria (Figure 1). Each of the 28 included articles explored the evidence hierarchy,



*The search was conducted in two separate phases. Phase one included articles from 2016-2021. In these searches, duplicate articles were removed automatically, prior to screening. For phase two, which included searches for articles from 2022-2024, duplicates were not removed prior to screening. As such, for phase two, duplicates were only accounted for once an article was included following full-text screening.

Figure 1.
Flowchart diagram showing the search and selection process of studies included in this review.

along with methodological approaches for appraising research literature or provided discussion on the importance of aligning evidence to the clinical question. The fields of clinical practice (24 articles)[9–32] , public health (3 articles)[33–35], and geoscience (1 article)[36] were represented across the analyzed literature (Table 1).

Table 1.
Descriptive information extracted from the 28 articles included in our review.

Field	First author, year	Title	Study design	Evidence hierarchy insights [a]
Clinical practice	Aldous, 2024[14]	Wheel replacing pyramid: better paradigm representing totality of evidence-based medicine	Narrative review	1. Propose a 'totality of evidence' wheel that provides a non-hierarchical framework to include all study designs to offer a comprehensive view of medical evidence, for use in fast-evolving situations like the COVID-19 pandemic, enabling quicker, informed decision-making. 2. The evidence pyramid places RCTs at the top, potentially overshadowing other study designs. For example, well-conducted observational studies are sometimes neglected because of their lower position. The authors argue that the traditional evidence pyramid restricts the scope of information and thereby hampers medical progress, particularly in emergencies. The wheel structure they proposed, which is non-hierarchical in nature, would enable medical professionals to consider a broader array of evidence, including population studies and narrative accounts, which are often excluded in traditional pyramid-based thinking.
	Antoniou, 2022[15]	An overview of evidence quality assessment methods, evidence to decision frameworks, and reporting standards in guideline development	Narrative review	1. Distinguishes between strength of evidence assessments and evidence hierarchies. While both aim to provide clinicians, patients and researchers a comprehensive evaluation of the evidence, assessments provide judgements on confidence in study findings and hierarchies rank evidence by study design (e.g., RCTs highest, expert opinion lowest). Hierarchies are simple and easy to use by non-experts, aiding guideline development for therapeutic effects, harms, and other clinical questions. They are also easy to comprehend for clinical practice guidance. Within hierarchies, the level of evidence does not necessarily reflect the strength of a recommendation. The authors developed their own hierarchy to align evidence with class of recommendation. They suggested within the discipline of vascular surgery that evidence from multiple RCTs showing favourable results for a given treatment should be associated with the wording "is recommended", clearly favourable results from a single RCT or large non-randomized study "should be considered", unclear favourable results (efficacy less well established) from these single studies "may be considered", and unfavourable results potentially suggesting harm from consensus of experts or small studies "is not recommended" when making clinical decisions. 2. They felt that hierarchies are overly simplistic, failing to account for important factors of evidence beyond study design that are essential for clinical decision-making.
	Anttila, 2016[9]	Conclusiveness resolves the conflict between quality of evidence and imprecision in GRADE	Commentary	1. Highlights that the GRADE guideline presents significant challenges in the understanding of the key concepts of "quality of evidence" and "imprecision," particularly when considered together. This confusion may hinder the practical process of evidence assessment, indicating a need for explicit guidance in the GRADE framework. Quality is not objectively calculated but instead reflects reviewers' confidence in how close the estimate is to the true effect, expressed on a 4-point ordinal scale. Imprecision, a reason for downgrading evidence quality, incorporates aspects such as sample size, statistical power, confidence intervals, and critical margins regarding benefits and harms. However, the inclusion of critical margins within the concept of imprecision leads to confusion, as these elements do not necessarily reflect the statistical closeness of the parameter value to the estimate.
	Bosdriesz, 2020[10]	Evidence-based medicine: when observational studies are better than randomized controlled trials	Narrative review	3. RCTs are the gold standard for evaluating the intended effects of interventions due to their use of randomization, which minimizes confounding by indication. However, RCTs can have limitations, including limited generalizability, high costs, short follow-up, ethical concerns, and smaller sample sizes. When RCTs are not feasible, observational studies (e.g., cohort or case-control) are used. While observational studies may have confounding concerns, they provide more generalizability and the ability to measure naturally occurring exposure on an outcome. Ultimately, the research question should guide the study design to be considered.
	Chloros, 2023[16]	Has anything changed in evidence-based medicine?	Commentary	1. The evidence pyramid ranks research designs, with meta-analyses and systematic reviews at the top, followed by RCTs, cohort and case-control studies, case series, case reports, and expert opinion at the bottom. While fine-tuned periodically, the top of the pyramid remains consistent, but the lower levels may vary, sometimes including laboratory and animal research. The pyramid separates evidence into "robust" (levels 1 and 2) and "less robust" categories for prioritizing the best evidence in research and clinical practice. Many view the pyramid as a hierarchy. However, not all research questions can be addressed by RCTs, which primarily aim to reduce bias and confounding. 2. The traditional evidence pyramid, based solely on methodology, is oversimplified and potentially misleading. A poorly conducted RCT can yield unreliable results, while a well-executed observational study may produce strong evidence. 3. Urgent public health needs (e.g., COVID-19 pandemic) sometimes necessitate considering multiple forms of evidence, such as robust observational studies, in addition to RCTs.

Field	First author, year	Title	Study design	Evidence hierarchy insights [a]
Clinical practice (cont'd)	Cuello-Garcia, 2022[17]	GRADE guidance 24: optimizing the integration of randomized and non-randomized studies of interventions in evidence syntheses and health guidelines	Commentary	1. The authors recommend using the GRADE methodology to assess the certainty of evidence from RCTs for each outcome individually. If high certainty is achieved, further evaluation of non-randomized studies of interventions (NRSI) is unnecessary. However, if RCT evidence is of low or very low certainty, NRSIs can be considered to enhance overall certainty. In cases where RCT evidence is moderate, NRSIs may be integrated to address issues like indirectness. The authors caution that while large NRSIs with precise estimates may be appealing, they should be carefully evaluated for bias using appropriate tools (e.g., ROBINS-I).
	Djulbegovic, 2022[18]	High quality (certainty) evidence changes less often than low-quality evidence, but the magnitude of effect size does not systematically differ between studies with low versus high-quality evidence	Meta-epidemiological study	1. Within a traditional evidence hierarchy, the authors found lower-quality evidence changes more often than higher-quality evidence, suggesting that higher quality evidence is more valid and reliable. However, the magnitude of treatment effects did not significantly differ between low and high quality of evidence. Therefore, the GRADE approach may not effectively differentiate the impact of quality of evidence on treatment effect sizes. The authors suggest current appraisal methods of evidence may need reassessing to capture quality of evidence as intended. If both low and high quality of evidence studies produce similar effect sizes, it challenges the assumption that higher quality evidence is always more valid or applicable for informing clinical decisions. 2. As above.
	Djulbegovic, 2024[19]	High certainty evidence is stable and trustworthy, whereas evidence of moderate or lower certainty may be equally prone to being unstable	Meta-epidemiological study	1. Found that high-quality evidence, free from limitations, rarely changes with new data, while evidence with even one limitation (moderate quality) is more likely to change. Moderate-quality evidence often has a single limitation and should be interpreted cautiously when issuing strong recommendations. Lower quality evidence (moderate, low, or very low) exhibited more frequent changes, larger deviations, and greater uncertainty. Limitations, especially imprecision and indirectness, significantly impacted changes in effect estimates and their significance.
	Galbraith, 2017[28]	A real-world approach to evidence-based medicine in general practice: a competency framework derived from a systematic review and Delphi process	Systematic review and Delphi process	1. Propose a competency framework to bridge real-world practice and EBP. Propose viewing evidence as what is more appropriate, suggesting that relying solely on evidence to guide a search for 'real-world' evidence is not best practice. 3. Emphasize the importance of clinician expertise, as viewing evidence alone is insufficient and suggest that EBP is rigid in its application.
	Hohmann, 2018[29]	Research pearls: how do we establish the level of evidence?	Commentary	1. Acknowledge a traditional evidence hierarchy in research as categorized into five levels (I-V), where Level I represents the highest quality, and Level V the lowest. They state these levels are to help classify studies based on design and rigour, with higher levels often offering more reliable results for clinical practice. 3. They suggest that the level of evidence assigned to studies in the hierarchy reflects study design rather than quality, and even a poorly executed 'level 1' trial can be downgraded if it lacks power or proper design. Level of evidence is just one measure of quality, but relying on this alone does not reflect the definition of EBP.
	Mayoral, 2021[30]	Decision-making in medicine: a Kuhnian approach	Commentary	2. Criticizes the traditional thought process of using an evidence pyramid to guide evidence consideration, suggesting it imposes constraints on clinical decision-making that can contribute to a lack of holistic care for individual patients with their own contexts and circumstances.
	Mercuri, 2018[31]	The evolution of GRADE (part 1): is there a theoretical and/or empirical basis for the GRADE framework?	Narrative review	2. Critiques the GRADE framework for lacking theoretical and empirical justification in its criteria for assessing evidence quality and making clinical recommendations. They state that GRADE relies on a modified hierarchy of evidence, which itself does not have a solid theoretical foundation, suggesting the EBP hierarchy is based more on belief than scientific proof. These hierarchical limitations are emphasized in the prioritization of RCTs over other well-designed studies. They suggest that empirical studies have shown that the superiority of RCTs in controlling bias is inconclusive, with some non-randomized studies yielding similar effect estimates when well-designed. The article suggests that without addressing these foundational issues, GRADE may not effectively improve upon the limitations of the EBP evidence hierarchy, and could suffer from the same limitations in guiding clinical practice.

Field	First author, year	Title	Study design	Evidence hierarchy insights [a]
Clinical practice (cont'd)	Mercuri, 2018 [32]	The evolution of GRADE (part 2): still searching for a theoretical and/or empirical basis for the GRADE framework	Narrative review	2. Highlights research critiquing the GRADE framework for adopting Bradford Hill's criteria (implicitly and explicitly) without fully integrating them into a coherent theoretical basis and not clearly articulating the connection. They also note that GRADE lacks explicit consideration of biological plausibility and mechanisms, which are downplayed in EBP hierarchies but are important for understanding causation. They critique EBP's reliance on evidence hierarchies, particularly the emphasis on randomization. Proponents of EBP argue that randomization balances study groups, leading to more reliable effect estimates. However, literature is presented that questions the philosophical and empirical basis of randomization's superiority. Even with balanced groups, external validity and individual patient applicability remain problematic, as generalizability and patient-specific outcomes are not always addressed effectively.
	Mercuri, 2018[11]	The evolution of GRADE (part 3): a framework built on science or faith?	Narrative review	2. States that GRADE categorizes studies into RCTs and observational studies, with the latter consistently rated as lower-quality evidence, without clear reasoning for why these types of studies are grouped together or rated similarly. They suggest the decision to classify observational studies as starting at "low certainty" was made based on internal discussion rather than empirical evidence. They suggest that clarity is lacking on why certain criteria for assessing evidence quality and making recommendations were selected and others excluded. They suggest changes to the framework have been introduced based on consensus rather than scientific evidence, and the lack of operational definitions for key criteria leaves too much room for user-judgement, raising concerns about the validity of the recommendations produced. They conclude that GRADE's foundation is weak, as it lacks the necessary theoretical or empirical support to justify its approach. They argue that until the framework is substantiated by scientific evidence, the validity of its recommendations remain uncertain, and reliance on it should be cautious.
	Mercuri, 2018[12]	What confidence should we have in GRADE?	Commentary	1. Summarize that within GRADE and the evidence hierarchy, RCTs receive a "high" grade, signifying high confidence in the effect estimate, while observational studies are rated "low" and other sources (e.g., lab studies, case reports) are graded "very low." Criteria are provided to adjust these grades, either increasing or decreasing confidence based on factors such as study limitations, effect size, or bias. 2. They criticize GRADE for suggesting that certain types of evidence, like observational studies or expert opinion, are discarded when stronger evidence (e.g., RCTs) is available. They suggest it also lacks clarity on how to integrate evidence from diverse sources (e.g., RCTs with observational or basic science findings), and that the hierarchy implies that higher-quality evidence, such as RCTs, automatically outweighs lower-quality studies, which may undermine the value of the broader evidence base.
	Mugerauer, 2020[13]	Professional judgement in clinical practice (part 3): a better alternative to strong evidence-based medicine	Narrative review	3. Suggests a major issue with EBP is its unrealistic focus on certainty, leading to the mistaken belief that if clinicians make different decisions, it means they do not know what they are doing. This results in a push for rigid, standardized guidelines based on evidence 'level' or quality, with RCTs seen as the most "objective." However, they argue that skilled practitioners recognize that uncertainty is normal, especially when treating unique patients with multiple conditions in complex and varying environments. They suggest that clinician expertise is therefore not only important, but necessary when considering EBP and evidence hierarchies.
	Noman, 2024[20]	Simplifying the concept of level of evidence in lay language for all aspects of learners: in brief review	Commentary	1. The authors conceptualized the evidence hierarchy as divided into filtered and unfiltered categories, reflecting different levels of synthesis and evaluation. Filtered information, positioned at the top of the pyramid, includes systematic reviews, meta-analyses, and critically appraised topics and articles. These forms of evidence undergo rigorous assessment and synthesis, providing highly reliable information that can guide clinical practice without further scrutiny from practitioners. Unfiltered information, located in the middle tiers, comprises primary research studies, such as RCTs and observational studies, which, while potentially more current and specific, require practitioners to critically evaluate their quality and relevance before application. 3. While filtered evidence is easier to apply due to its pre-evaluated nature, it may not always be available or applicable to specific clinical scenarios, necessitating a reliance on unfiltered sources. Additionally, the base of the pyramid, which includes expert opinion and background information, though not considered high-level evidence, still plays a role in forming the foundation of clinical knowledge, especially in areas where high-level evidence is lacking. Practitioners are encouraged to carefully select and apply the best available evidence, balancing the reliability of filtered sources with the immediacy and specificity of unfiltered ones, and to remain mindful of the context and limitations inherent in lower levels of evidence.

Field	First author, year	Title	Study design	Evidence hierarchy insights [a]
Clinical practice (cont'd)	Ritson, 2023[22]	Bridging the gap: evidence-based practice guidelines for sports nutritionists	Narrative review	1. Suggests the hierarchy is based on susceptibility to bias from study design. For intervention-focused questions, systematic reviews and meta-analyses of RCTs (Level 1) and evidence syntheses (Level 2) are preferred due to their rigorous appraisal process. Evidence hierarchies provide practitioners with insight on the degree of certainty they can have when providing recommendations. The authors further suggested that practitioners prioritize evidence from the top of these hierarchies as a result, but should not disregard evidence at the bottom of hierarchies when making recommendations, particularly when evidence at the top has gaps. 3. Despite the defined hierarchy informing levels of bias and trustworthiness, in applied sports and exercise nutrition, this hierarchy is not always definitive. Such high-level evidence can take years to publish and may not fully address a practitioner's specific PICO question, leading them to rely on lower-tier evidence. While RCTs offer strong internal validity, their high control levels can reduce practical relevance. Although the top of the hierarchy should be prioritized, the full hierarchy should still be considered.
	Semrau, 2023[23]	Common misunder-standings of evidence-based medicine	Commentary	1. The evidence pyramid is appropriate to highlight the highest quality evidence for doubtful, mechanistically unexplained effects requiring a control group. As in these cases, a control group baseline is needed to inform the treatment effect. However, they feel the pyramid's structure is misleading when assessing parameters associated with specific interventions, where RCTs may not provide the highest quality evidence in cases when a comparator group does not impact the quality of evidence. 2. When available, they feel that different study designs (or levels of evidence) should be assessed. For example, RCTs can demonstrate a probable cause-effect relationship or indicate a treatment's practical usefulness, but significant results do not guarantee a true effect. Positive RCTs cannot definitively prove a therapy's benefit, and negative results cannot disprove a known cause-effect relationship. 3. They suggested to reconsider traditional evidence pyramids, advising that the most suitable evidence should be determined based on the specific parameter being evaluated.
	Sekhon, 2024[24]	Synthesis of guidance available for assessing methodological quality and grading of evidence from qualitative research to inform clinical recommend-ations: a systematic literature review	Systematic review	1. Identified two approaches for summarizing the quality of qualitative research for clinical guidance: a qualitative evidence hierarchy and a research pyramid. Both rank qualitative systematic reviews and meta-syntheses at the top, similar to quantitative research, and each suggests that the top of the hierarchy is reserved for studies providing the most 'evidence'. However, qualitative research focuses on experiences, barriers, facilitators, and the feasibility of implementation, which are not easily ranked in the same hierarchical way as quantitative evidence.
	Szajewska, 2018[21]	Evidence-based medicine and clinical research: both are needed, neither is perfect	Commentary	3. Acknowledges the appropriateness of an evidence hierarchy and that systematic reviews are the strongest form of evidence. However, it is emphasized there are contextual factors to consider. Depending on the clinical question, observational studies may be more applicable. A framework is proposed to account for this.
	Vere, 2019[26]	Evidence-based medicine as science	Commentary	2. Critiques the notion that EBP, through the evidence hierarchy, fits neatly into traditional scientific methods such as inductivism and falsificationism, which focus on theory confirmation or falsification through observation. EBP prioritizes empirical evidence through hierarchies (RCTs, meta-analyses) but this does not align well with traditional scientific theories. Hierarchies rank evidence quality but do not necessarily test or advance scientific theories directly.
	Wieten, 2018[27]	Expertise in evidence-based medicine: a tale of three models	Commentary	1. Summarizes three initial models of EBP, one being the evidence pyramid. They note how the first pyramid comprised of four layers is used to inform the GRADE framework. 2. Explains clinician expertise is an important consideration when evaluating evidence for use in practice. They argue that clinician expertise is incorrectly considered a form of evidence in many pyramids. Instead, expertise should be considered as a process for appraising and integrating various forms of evidence.
	Wallace, 2022[25]	Hierarchy of evidence within the medical literature	Commentary	1. Defines the hierarchy similar to others (observational studies up through to RCTs, systematic reviews, and meta-analyses). The authors believe the hierarchy should be applied when performing literature searches, particularly when clinicians are pressed for time. However, the overall quality of evidence of each study design is still dependent on study strengths and limitations identified in the critical appraisal process. An abundance of only lower-level observational studies for a particular clinical question should also inform the development of higher-level studies on the same topic.

Field	First author, year	Title	Study design	Evidence hierarchy insights [a]
Geo-science	St. John, 2017[36]	The strength of evidence pyramid: one approach for characterizing the strength of evidence of geoscience education research (GER) community claims	Commentary	1. Proposes a modified 5-level evidence pyramid in geoscience education that places "Practitioner wisdom/expert opinion" at its foundation, recognizing educators' unique insights into what and how to teach. The pyramid distinguishes between qualitative and quantitative studies, separating case studies and cohort studies, while emphasizing the role of clinical expertise in assessing quality. At the top are meta-analyses and systematic reviews, which are less common as they summarize primary research. This model is similar to the EBP hierarchy, highlighting the need for context-sensitive decision-making using hierarchical frameworks.
Public health	Irving, 2016 [33]	A critical review of grading systems: implications for public health policy	Narrative review	2. While RCTs are considered the best method to minimize bias and are frequently regarded as the ideal research design within evidence hierarchies, this does not mean RCTs are appropriate for all types of questions. The authors suggest that some grading systems often overlook issues like flawed randomization or unequal group sizes in RCTs. Additionally, RCTs may not always be appropriate or ethical for all research areas. Observational studies, especially large population-based studies, may offer applicable findings and include more diverse participants, enhancing their external validity.
	Jervelund, 2022[35]	Evidence in public health: an integrated, multi-disciplinary concept	Commentary	2. The authors feel the typical hierarchy of ranking study designs based on methodological rigour and risk of bias with systematic reviews and meta-analyses at the top, and expert opinions at the bottom, is less applicable in a field with large epistemological diversity (e.g., context variability) such as public health. 3. They advocate for an evidence typology that evaluates the quality of evidence based on the appropriateness of study designs to specific research questions, rather than following a rigid hierarchy. This approach suggests that quantitative methods are best for studying causal relationships, while qualitative methods are relevant for understanding social contexts, or the use of mixed methods to optimize public health outcomes.
	Parkhurst, 2016[34]	What constitutes "good" evidence for public health and social policy-making? From hierarchies to appropriateness	Commentary	2. The authors acknowledge that "good evidence" for clinical practice often relies on evidence hierarchies, with RCTs typically viewed as the gold standard due to their scientific rigour. However, they suggest there is growing recognition that these hierarchies may not always provide the best guidance for policy-making. Evidence hierarchies prioritize internal validity, but policy decisions require broader considerations, such as social, political, and economic factors, which are often not suitably investigated using RCTs. 3. The authors argue for a framework based on the appropriateness of evidence, which considers relevance to policy concerns, applicability to local contexts, and alignment with public health goals.

COVID-19 = coronavirus disease of 2019; *EBP* = evidence-based practice; *GRADE* = grading of recommendations assessment, development, and evaluation; *NRSI* = non-randomized studies of interventions; *PICO* = patient, intervention, comparison, outcome; *RCT* = randomized controlled trial; *ROBINS-I* = risk of bias in non-randomized studies – of interventions.
[a] Review categories: (1) contemporary understandings of the evidence pyramid, including how it is used and understood; (2) critiques of the evidence pyramid in relation to EBP; and (3) contextual considerations when applying the evidence pyramid to clinical decision-making.

Evolution and contemporary iterations of the evidence pyramid in EBP

Three initial models of EBP were identified, each providing distinct perspectives on the role of clinical expertise in evidence hierarchies.[27] The first pyramid, established by the Evidence-Based Medicine Working Group in 1992, formed the foundation of the symbol of the evidence pyramid (Figure 2).[2,27] The pyramid includes four layers, and is used to inform the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) framework for systematically rating certainty of evidence. In much of the reviewed literature, the evidence pyramid is often viewed as either identical or closely aligned with this original model, which places systematic reviews and meta-analyses at the highest level, followed by individual RCTs, then observational studies, and finally expert opinion.[9–13,15–19,21–23,25–27,29–32,35] The second model, presented by Sackett and colleagues, utilizes a Venn-diagram to highlight the convergence of patient values and expectations, best external evidence, and individual clinical expertise at the core of EBP (Figure 3).[3,27] The third model, proposed by Haynes and colleagues in 2002, introduces a shifted Venn diagram with components of research evidence, clinical state and circumstances, and patients' preferences and actions, all converging with clinical expertise at the core (Figure 4).[8,27] These models collectively contribute to the evolving understanding of how clinical expertise is considered and valued within the landscape of evidence in EBP.

More recent literature from the field of geoscience

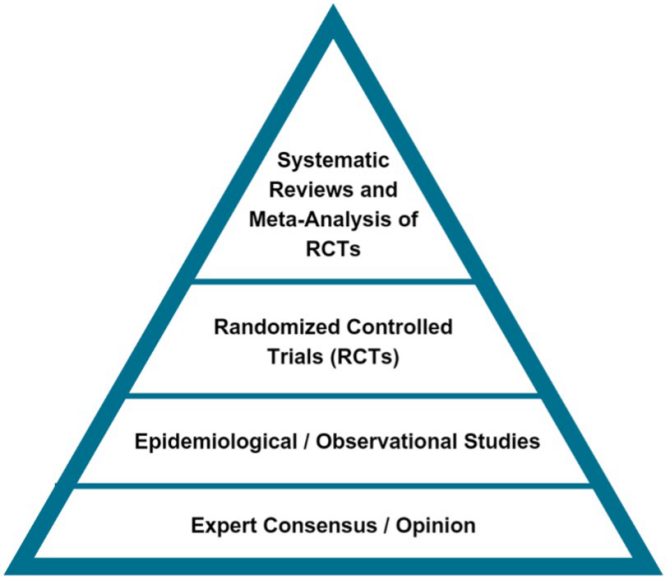


Figure 2.
Initial evidence pyramid conceptualizing the strength of various forms of evidence. Information provided by the Evidence-Based Medicine Working Group,[2] and figure adapted from Wieten et al.[27]

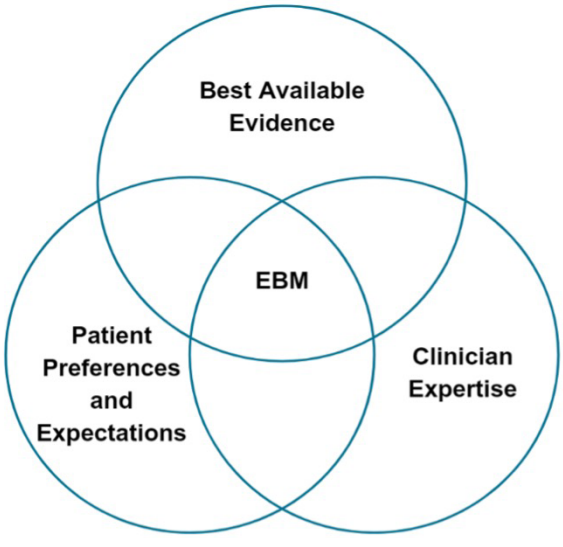


Figure 3.
Haynes and colleagues' initial model for evidence-based clinical decision making. Reproduced and adapted with permission of the American College of Physicians, from Haynes et al.[37]; permission conveyed through Copyright Clearance Center, Inc. (EBM = evidence-based medicine).

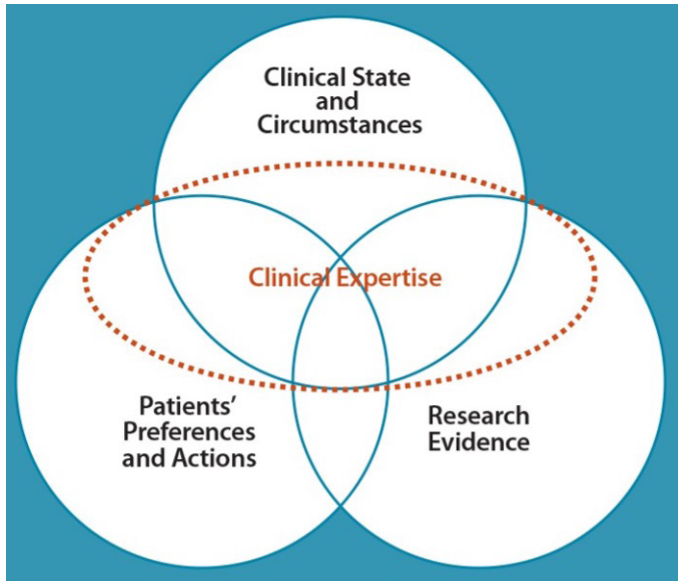


Figure 4.
Haynes and colleagues' updated EBP model to conceptualize the optimal integration of various considerations into clinical decision-making.[8] Reproduced and adapted with permission of the American College of Physicians, from Haynes et al.[8]; permission conveyed through Copyright Clearance Center, Inc.

education presents a 5-level modified evidence pyramid (Figure 5), with the foundational level as practitioner wisdom/expert opinion.[36] The pyramid's foundation is based in "what we know", recognizing that practitioners are in a unique position to share pedagogic content knowledge (e.g., in geoscience education, knowing what to teach and how to teach).[36] As the pyramid ascends, it proposes separating qualitative and quantitative studies into case studies and cohort studies, emphasizing the importance of clinical expertise in assessing study robustness.[36] At the pinnacle of this pyramid are meta-analyses and systematic reviews, which are the least common designs due to their being collations or summations of primary research studies.[36] The pyramid is similar in nature to the EBP evidence hierarchy, indicating the need for context-dependent, nuanced understandings and decision-making procedures using hierarchical instruments or approaches (e.g., GRADE).[36] Following the COVID-19 pandemic,

Figure 5.
Proposed Strength of Evidence Pyramid for evaluating the strength of evidence in geoscience education research, reproduced and adapted from St. John and McNeal.[36] Originally published by the National Association of Geoscience Teachers (NAGT) and licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License (CC BY-NC-SA 4.0). Changes were made to the original.

Aldous *et al*. proposed a 'totality of evidence' wheel (see Table 1).[14] Provided in a circular format, this system purposefully avoids the hierarchical framework to lead clinicians in considering all sources of information.[14] Aldous *et al*. argue that this approach may be useful in emergent situations, enabling quicker, informed decision-making from evidence that the traditional evidence hierarchy may otherwise neglect.[14]

Evidence pyramid considerations and critiques

Several articles supported the use of a traditional evidence pyramid in clinical practice, while noting considerations in its application.[20,22,25] Noman *et al*. viewed the traditional evidence pyramid as having filtered (e.g., systematic reviews and meta-analyses) and unfiltered categories (e.g., RCTs and observational studies), and encouraged use of both sources of evidence while acknowledging that filtered evidence has the highest reliability between the two.[20] Moreover, filtered evidence is easier for clinicians to apply because of its pre-evaluated nature; however, it may not always be available or relevant to specific clinical situations, thereby requiring reliance on primary, unfiltered sources.[20] This notion is also supported by others.[22,25]

The role of clinician expertise must also be considered.[27] In evidence hierarchies, clinician expertise (i.e., expert opinion), on its own, is ranked as the lowest internal form of evidence. However, Wieten[27] argues that EBP models should not consider clinician expertise as an internal form of evidence at all. Instead, they argue that clinician expertise should be thought of as a process to incorporating and appraising all factors that go into a clinical decision, such as available evidence, patient preferences and clinical circumstances[27], in line with the Haynes *et al*.[8] model (see Figure 4). Noman *et al*. further note that when filtered information (e.g., systematic reviews, meta-analyses) is unavailable, practitioners must critically assess the quality and relevance of unfiltered sources before applying them in practice, reiterating the importance of clinical expertise in this context.[20]

Several articles also challenged the traditional evidence hierarchy[13–16,26,28–30], particularly in clinical scenarios where the design feasibility is a challenge (e.g., ethical or cost considerations in using RCTs to examine questions involving risk or prognosis).[29] A more nuanced approach to the hierarchy is proposed in such circumstances, where the research question (e.g., therapeutic, diagnostic, prognostic, etc.) and study type (e.g., RCT, cohort, cross-sectional study) needs to be established prior to assigning a 'level' of evidence.[29] A 2020 narrative review questioned the traditional placement of RCTs atop other primary research designs in the evidence hierarchy, arguing that the choice of study design should be driven by its suitability for addressing the specific research question.[10] In a 2018 commentary, Szajewska[21] advocated for a pragmatic acknowledgement of the appropriateness of evidence hierarchies and the significance of systematic reviews as the "strongest" form of evidence, while also encouraging a flexible approach to EBP that adapts to the diverse demands of clinical practice. Thus, a dynamic and context-specific approach to applying evidence in practice is needed,[10,21] including one that values professional judgement, acknowledges uncertainty, and considers individual patient complexities.[13,29,30]

Evidence hierarchies and the GRADE framework

Ten articles discussed the GRADE framework and how this systematic approach to evidence rating relates to evidence hierarchies in EBP.[9,11,12,17–19,23,27,31,32] In brief, the GRADE framework is used to assess the certainty of evidence and strength of recommendations regarding patient-important outcomes for clinical decision-making, where studies are 'pre-ranked' based on study design, following the traditional evidence pyramid (e.g., RCTs are ranked as high certainty, observational studies are low certainty). The ranking can then be adjusted up or down based on several factors (i.e., higher if there is a large magnitude of effect, a dose-response gradient, or if all plausible residual confounding would reduce a demonstrated effect or suggest a spurious effect if no effect was observed; lower if there is serious risk of bias, inconsistency, indirectness, imprecision, or publication bias).[38]

Authors in five commentaries[11,12,23,31,32] expressed concerns over the GRADE framework with regard to its initial categorization of RCTs as "high" grade evidence and observational studies as "low". However, observational studies in GRADE can initially be categorized as "high" grade evidence if these constitute the best study design(s) for a particular clinical question (e.g., cross-sectional studies to address a clinical question about prevalence, or cohort studies to address a clinical question about prognosis). The certainty of evidence can then be downgraded if there is, for example, serious risk of bias.[38]

Concerns regarding GRADE and its foundation on an evidence hierarchy were raised by Mercuri and Gafni[11,31,32] in a three-part narrative review. In part 1, the authors suggested the evidence hierarchy which the GRADE framework is based on lacks theoretical and empirical justification for assessing certainty of evidence, and in turn, making clinical recommendations.[31] They argued that current literature suggests randomization contributes minimal differences to estimated effects when compared to well-designed studies lower in the hierarchy, and that the superiority of RCTs over these studies is inconclusive.[31] In part 2, they questioned whether randomization actually balances all important factors between groups, and if it did, limitations of external validity and individual patient applicability (i.e., generalizability) become more prevalent and problematic.[32] However, this is less of a concern in pragmatically conducted RCTs that investigate the effects of "real-world" interventions on "real-world" patients.[39]

In part 2, Mercuri and Gafni cite literature that suggests GRADE lacks explicit consideration of biological plausibility and mechanisms, which are downplayed in evidence hierarchies because animal model and basic science research have limited value in clinical decision-making yet are important for generating hypotheses for understanding causation.[32] In part 3, they questioned the separation of RCTs and observational studies in hierarchies arguing that the GRADE framework does not provide clear rationale for categorizing observational studies or why these are grouped together and rated similarly.[11] The authors discussed how changes made to the framework throughout its development were introduced based on consensus methods, and suggested that assessments and recommendations produced leave too much room for user-judgement.[11] However, GRADE was designed to provide a systematic framework for assessing certainty of evidence that encourages transparency and an explicit accounting of judgements made, making it a more valid and reliable method than the alternative.[38]

Evidence hierarchies in public health

Critiques of evidence hierarchies are also offered in the public health literature[33], including the difficulty in some cases with applying evidence hierarchies to guiding policy decisions.[34] In a 2016 article, Parkhurst and Abeysinghe[34] argued that while evidence hierarchies prioritize RCTs and experimental designs as "high-quality" evidence, the complexity of policy decisions in public health, influenced by economic, social, and political factors, at times requires a broader consideration of evidence, a sentiment further supported by Jervelund and Villadsen.[35] Accordingly, literature in this field proposes an "appropriateness" framework that enables consideration of the multifaceted nature of policy concerns and values, and encourages reflection on goals of evidence utilization[34,35], and the alignment of study design to the specific research question.[35] In emergent public health situations (e.g., war/conflict, natural disasters, or global pandemics), there may also be a need to consider additional forms of evidence, other than strictly RCTs, to inform rapid decision-making.[16]

Discussion

Summary of findings

Preliminary findings from our review of the literature exploring the evidence pyramid, or evidence hierarchy, in EBP centred on three common themes: (1) use of the evidence pyramid as a guide, not a rigid tool; 2) importance of the clinical question; and (3) necessity of clinical expertise to integrate research findings into clinical decision-making. We briefly discuss each of these in further detail below.

(1) Use of the evidence pyramid as a guide, not a rigid tool

The evidence pyramid is viewed as a guideline to help clinicians determine which types of evidence, if conducted soundly, are more likely to provide valid, reliable, and trustworthy answers to their clinical questions.[21] Updated evidence pyramids have been developed to reflect how the GRADE framework, a tool that is based on the evidence hierarchy and designed to systematically rank a body of evidence, considers factors in addition to study design. These factors include risk of bias across studies, inconsistency of results, indirectness of the evidence to the clinical question, imprecision and magnitude of the effect estimate, whether there is a dose-response gradient, and the likelihood of publication bias. While GRADE overcomes certain restrictive limitations of the evidence pyramid, and its application can be a valuable tool for clinicians, some authors have expressed concern over the traditional evidence hierarchy inherent in its application.[11,23,26,31,32] For example, Murad *et al*.[40] developed an evidence pyramid that depicts layers of evidence as waves (to reflect uncertainty) instead of rigid, flat lines. There is also agreement among authors in the contemporary literature that the application of evidence hierarchies in the clinical context is dependent on a patient's clinical state and circumstances and should align with the clinical question at hand (e.g., therapy, etiology, diagnosis)[13–16,26,28–30,41], rather than as an algorithmic tool to be rigidly applied without discussion.[13,28,35]

(2) Importance of the clinical question

Recent commentaries on the evidence hierarchy have emphasized the importance of tailoring the selection of evidence to the clinical question.[10,16,22,24,29,34–36] This requires an understanding that observational studies, for example, may be more suitable when investigating the unintended effects or harm of an intervention[10,21,23], or when addressing questions around etiology or prognosis.[21] A recent systematic review examined the course and prognostic factors associated with whiplash injuries in cohort and case-control studies, helping to inform chiropractors on patient management.[42]

Although clinical research relies heavily on quantitative research methods,[39,43] the broader methodological literature should also be considered, including qualitative and mixed methods research. These methodologies have traditionally been excluded from the evidence pyramid, despite that certain clinical questions may be best answered using these approaches.[24] For instance, insights into patient behaviour or experiences, and greater in-depth understanding of clinical outcomes, may be best answered by qualitative or mixed methods studies, grounded in established theory and thoughtful, relevant questions.[44–47] An alternative to the evidence pyramid, proposed in 2005 by Miller and Jones-Harris[44], is an "evidence pathways model", which allows clinicians to consider high-quality quantitative and qualitative research with different pathways according to the type of clinical question (Figure 6).

(3) Necessity of clinical expertise to integrate research findings into clinical decision-making

Clinical expertise involves understanding the nuances of a clinical scenario, weighing different factors (e.g., best available evidence, patient preferences, and clinical circumstances) to make informed decisions that will optimize patient care.[13,27] Multiple authors[13,20,28,29,48,49] further suggest that clinical expertise is important, particularly in scenarios where evidence is limited or lacking. It is from the experience-informed position that clinicians are able to make appropriate decisions that are guided by contextual understanding of patient circumstance and evidence to determine the most appropriate course of action.[13] In essence, it is the clinician, with their inherent expertise, that seeks out the best available evidence and critically appraises it in terms of its validity, importance, and applicability to managing an individual patient within the context of their unique values and clinical circumstances.

Role of chiropractic professional stakeholders

Chiropractors in the field who lack training in research methodologies will need assistance in applying the best

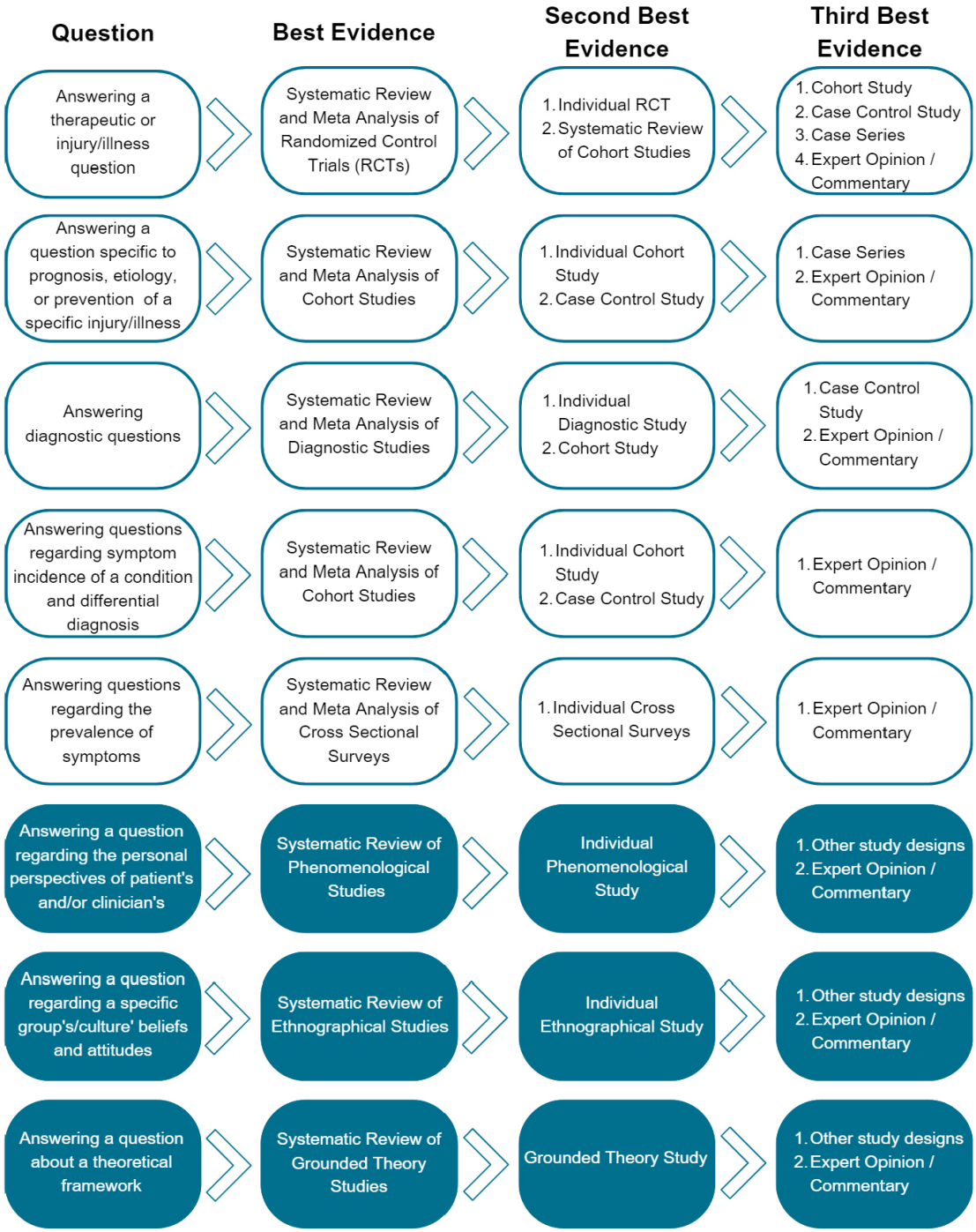


Figure 6.

Evidence pathways model proposed by Miller and Jones-Harris[44], illustrating how different forms of evidence are best suited to answer different clinical questions. Study designs most appropriate for addressing qualitative research questions are highlighted in the bottom three rows. Figure is reprinted and adapted from Miller and Jones-Harris[44] with permission from Elsevier.

available evidence to patient care if EBP is to be conducted in clinical practice successfully and appropriately. Therefore, there is an opportunity for the support and leadership of professional organizations to assist clinicians in learning how to use an EBP framework, as it is intended to be used. In Canada, several chiropractic organizations could work cooperatively to not only fund research but to invest in knowledge translation (KT) of research findings into clinical practice. These organizations include the Canadian Chiropractic Research Foundation, Canadian Chiropractic Guideline Initiative, Canadian Memorial Chiropractic College, Canadian Chiropractic Association, Département de Chiropractique, Université du Québec, à Trois Rivières, and provincial advocacy associations such as the Ontario Chiropractic Association (OCA). We discuss KT in chiropractic in more detail in a subsequent paper of this JCCA special edition.

Limitations

Our review has several limitations. First, all relevant papers on the evolution of the evidence pyramid, or evidence hierarchy, in EBP may not have been captured. Second, restricting our searches to three databases and English-only articles published between January 1, 2016 and July 1, 2024 may have further excluded potentially relevant papers. Third, we did not hand-search references of included articles, and only one reviewer performed article screening and data extraction. Fourth, we did not assess included articles for risk of bias. The strength of our review was the diverse working group of clinicians, educators, researchers, and OCA staff members. Our findings are nevertheless exploratory in nature. As such, a systematic literature review in this topic area may be warranted. Future research in the form of interviews and/or surveys could also be conducted to seek practitioner and institutional perspectives on the evidence pyramid and its use in clinical practice.

Conclusions

In line with the model by Haynes *et al*.[8], preliminary findings of our review suggest that the value placed on clinical expertise, as the central pillar of EBP, reinforces that care is delivered in collaboration with patients and their unique values and clinical circumstances, supported by the best available research evidence. Clinical questions, including those that are qualitative in nature, must be answered using the most appropriate research methodologies (i.e., quantitative, qualitative, or mixed methods). As clinicians and researchers, the manner in which questions are framed along with the language that is used, are essential for structuring and seeking research that helps to inform clinical practice. The principles and goals that were initially developed in EBP continue to be informative and ought to be applied in a dynamic and contextualized manner as intended.[2]

Acknowledgments

Acknowledgements for this paper, and for the entire special edition, are listed and detailed within the Preface paper.

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Conceptualizing clinical expertise in evidence-based practice: a narrative literature review with implications for clinical decision-making

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Objective: *This review aimed to explore clinical expertise within evidence-based practice (EBP) by examining contemporary definitions of clinical expertise, how it can be acquired and developed over time, and its role within EBP.*

Methods: *PubMed, Web of Science, and Scopus databases were searched for literature on clinical expertise published between January 2016 and August 2024. Titles and abstracts were screened for relevance. Full-text review was conducted for papers deemed potentially relevant.*

Results: *23 articles were included in this review. Clinical expertise receives different treatments across*

Conceptualiser l'expertise clinique dans la pratique fondée sur des données probantes: une revue narrative de la documentation ayant des implications pour la prise de décision clinique

Objectifs: *Cette revue visait à examiner l'expertise clinique dans la pratique fondée sur des données probantes (PFDP) en examinant les définitions contemporaines de l'expertise clinique, la manière dont elle peut être acquise et perfectionnée au fil du temps, et son rôle dans la PFDP.*

Méthodes: *Les bases de données PubMed, Web of Science et Scopus ont été consultées pour obtenir de la documentation sur l'expertise clinique publiée entre janvier 2016 et août 2024. Les titres et les résumés ont été examinés pour déterminer leur pertinence. Une revue intégrale a été réalisée pour les articles jugés potentiellement pertinents.*

Résultats: *On a inclus 23 articles dans cette revue. L'expertise clinique reçoit des traitements différents*

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Conflicts of Interest:
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literature. However, a commonality is that clinical expertise requires proficiency, skill, and clinical judgement that can be acquired only through clinical experience, collaboration, and hands-on clinical practice. Operating within Haynes' model of EBP, clinical expertise is central to integrating patient preferences and bridging the gap between standardized objective evidence and personalized care.

Conclusions: *Clinical expertise represents the core of integrating EBP to inform clinical decision-making and is developed through experience and keeping current with research.*

Author's Note: *This paper is one of seven in a series exploring contemporary perspectives on the application of the evidence-based framework in chiropractic care. The Evidence Based Chiropractic Care (EBCC) initiative aims to support chiropractors in their delivery of optimal patient-centred care. We encourage readers to review all papers in the series.*

(JCCA. 2025;69(3):255-272)

KEY WORDS: chiropractic, evidence-based practice, evidence-based medicine, clinical competence, professional competence, clinical skills

dans la documentation. Cependant, une caractéristique commune est que l'expertise clinique nécessite de la compétence, des habiletés et un jugement clinique qui ne peuvent être acquis que par l'expérience clinique, la collaboration et la pratique clinique pratique. En opérant selon le modèle de la PFDP de Haynes, l'expertise clinique est essentielle pour intégrer les préférences des patients et combler le fossé entre les données probantes objectives normalisées et les soins personnalisés.

Conclusions: *L'expertise clinique représente le cœur de l'intégration de la PFDP visant à orienter la prise de décision clinique et elle s'acquiert au moyen de l'expérience et de la tenue à jour en matière de recherches.*

Note de l'auteur: *Ce document fait partie d'une série de sept documents examinant les perspectives contemporaines sur la mise en œuvre du cadre fondé sur des données probantes pour les soins chiropratiques. L'initiative de soins chiropratiques fondés sur des données probantes (SCFDP) vise à soutenir les chiropraticiens dans la prestation de soins optimaux axés sur le patient. Nous encourageons les lecteurs à consulter tous les articles de la série.*

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MOTS CLÉS : chiropratique, pratique fondée sur des données probantes, médecine fondée sur des données probantes, compétence clinique, compétence professionnelle

Introduction

Clinical expertise is a central component of evidence-based practice (EBP), initially introduced within Sackett *et al*.'s evidence-based medicine model[1] and later refined by Haynes *et al*. in their constructive engagement with this model.[2] In Haynes *et al*.'s enhanced and prescriptive model, clinical expertise expands across, informs, balances, and integrates the three components of evidence-based clinical decision-making: clinical state and circumstances, patients' preferences and actions, and research evidence (Figure 1).[2] By emphasizing the central role of clinical expertise in EBP, the Haynes model provides a comprehensive and practical framework for examining clinical expertise further.

Clinical expertise is considered to be a lifelong learning process wherein clinicians amass primary knowledge over the course of their clinical interactions, as opposed to knowledge only gained from journal articles, randomized control trial (RCT) findings, systematic reviews, meta-analyses, or explicit medical education.[3–5] Clinical expertise is also considered to comprise many components including formal education in the field, multiple years of clinical experience, advanced credentials, visibility in the professional community, and demonstration of superior skill

Figure 1.
Haynes and colleagues' updated model for evidence-based clinical decision-making.[2] Reproduced and adapted with permission of the American College of Physicians, from Haynes et al.[2]; permission conveyed through Copyright Clearance Center, Inc.

in practice. These components contribute to a clinician's ability to provide EBP informed by the best relevant research, patient preferences and characteristics, and context of the problem. Clinical expertise draws together these components, guiding case formulation, clinical assessment, and clinical decision-making.[6]

Despite increasing recognition of the central role of clinical expertise in EBP,[4–7] the evidence pyramid continues to be heavily relied upon within research and training as a guide for determining the quality and usefulness of scientific evidence. In this model, 'expert opinion' is traditionally placed at the bottom of the pyramid, with observational studies, randomized controlled trials (RCTs), systematic reviews and meta-analyses of RCTs positioned above.[5] While the pyramid highlights the strengths of systematic research, its rigid hierarchy and lack of consideration of clinical expertise warrants reconsideration. For instance, the 'gold standard' in scientific evidence, RCTs, are not always attainable, may lack external validity, and can be difficult to apply in practice.[8] Potential bias within RCTs is also not always easily identifiable,[9] requiring expertise to interpret findings within context. The usefulness of the evidence pyramid must be understood within the broader Haynes model, recognizing that clinical expertise and informed judgement are essential for assessing and applying evidence in practice. Clinical expertise, developed over time, is required to understand and appreciate practical consequences of bias within scientific literature, to unpack and apply trial results in an informed and contextualized manner.[10] Ultimately, clinical expertise is essential for interpreting and applying research findings to balance the evidence with individual patient circumstances and preferences, regardless of the state of evidence.

While its importance is recognized, clinical expertise remains poorly defined beyond its limited consideration in the evidence pyramid, creating challenges for chiropractic clinicians, educators, and researchers in fully integrating it into EBP. Accrediting chiropractic bodies and regulatory boards endorse EBP principles, yet a clear framework for conceptualizing, developing, and applying clinical expertise within EBP is lacking.[11,12] Given the

growing expectation for chiropractors and other healthcare professionals to incorporate EBP into practice, refining the discussion on clinical expertise is essential. Following Haynes' EBP model,[2] clinical expertise should not be seen as a standalone form of evidence to be placed on an evidence pyramid, but as a crucial mechanism for effectively applying research to patient care.[5] As noted by Haynes *et al*., "evidence does not make decisions, people do".[13] Clearly defining clinical expertise, examining how it can be acquired and developed by clinicians, and elucidating its pivotal role in guiding EBP will help overcome barriers to applying research and integrating all pillars of EBP in clinical decision-making.

This review aims to provide contemporary insight on the Haynes model's conceptualization of clinical expertise and further refine its practicality,[2] providing clinicians with i) an enhanced definition of clinical expertise in an EBP context, ii) how clinical expertise can be acquired and developed over time, and iii) how clinical expertise operates within the Haynes model of EBP. This analysis is timely, given the development of updated clinical competencies in chiropractic education, and the expectation of accrediting bodies and regulatory boards for chiropractors and other health professionals to endorse EBP throughout their professional careers.[11,12,14]

Methods

Study design

We conducted a narrative review[15] of the literature to summarize contemporary definitions of clinical expertise, how clinical expertise is acquired and developed over time, and how it operates within the Haynes EBP model.[2] The narrative review method is appropriate in instances such as this, where the aim is to research a broad topic which has been studied and conceptualized differently across disciplines and traditions.[16]

Data sources and searches

The literature search for this review sought English-language peer-reviewed research articles published between January 1, 2016 and August 1, 2024 within PubMed, Web of Science, and Scopus databases. The search was restricted to 2016 and onward to focus on providing a comprehensive understanding on recent perspectives of clinical expertise. We employed a range of search terms to achieve our objectives and capture relevant literature on clinical expertise (Appendix 1).

Selection criteria

We included empirical research articles as well as secondary sources of evidence (e.g., systematic, scoping, or narrative reviews, and commentaries), that substantively explored, described and considered clinical expertise within the context of EBP or evidence-based medicine (EBM), published between 2016 and 2024. We did not exclude articles based on country of origin. We excluded conference abstracts, protocols, and articles that lacked substantive exploration of clinical expertise within an EBP or EBM context.

Screening process

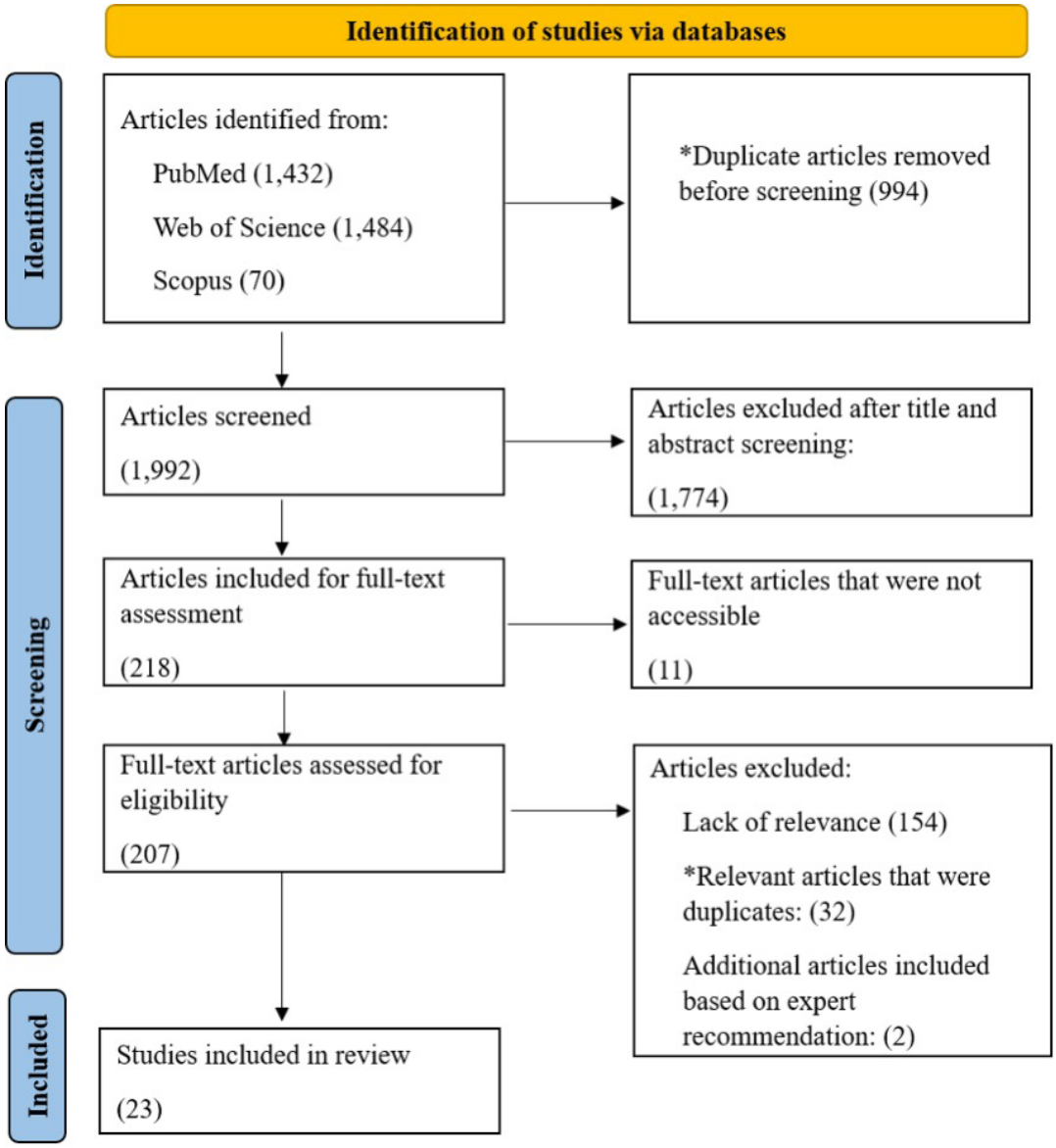
One author assessed titles and abstracts of articles returned in the search of each database to determine eligibility. Articles deemed potentially relevant underwent full-text review by the same author, considering each articles' potential contribution to our exploration of clinical expertise within EBP/EBM. The rest of the working group confirmed inclusion of each full-text article.

Data extraction

Descriptive information was extracted from each article deemed relevant after full-text review, including first author, title, discipline, and information pertaining to exploring or analyzing clinical expertise, specifically within the context of EBP. For this last item, data from each paper were grouped into one of three categories: (1) defining clinical expertise; (2) acquiring and developing clinical expertise; and (3) clinical expertise operating within EBP. These categories were determined *a priori*, in line with the purposes of our review. Themes within the extracted data corresponding to each of these categories were then determined iteratively. Data was extracted and summarized into a table by one reviewer. The data extraction table underwent independent review among the full working group, and required unanimous consensus among the full group.

Results

The search identified 1,992 articles to be screened from PubMed, Web of Science, and Scopus. The flowchart outlining article identification, screening, eligibility and inclusion is shown in Figure 2. Each of the 23 articles that



*The search was conducted in two separate phases. Phase one included articles from 2016-2021. In these searches, duplicate articles between databases were removed automatically, prior to screening. For phase two, which included searches for articles from 2022-2024, duplicates were not removed prior to screening. As such, for phase two, duplicates were only accounted for once an article was included following full-text screening.

Figure 2.
Flowchart diagram showing the search and selection process of studies included in this review.

met the inclusion criteria defined and/or analyzed the concept of clinical expertise in the context of EBM or EBP in health fields, which included medicine (11 studies),[4,7,17–25] nursing (2 studies),[26,27] occupational and physical therapy (4 studies),[28–31] chiropractic (1 study),[32] rehabilitation education (1 study),[33] psychotherapy (1 study),[34] speech-language therapy (2 studies),[35,36] and nutrition (1 study),[37] as shown in Table 1.

Table 1.

Relevant articles identified and included within the search results, along with extracted data from each

Discipline	First Author, Year	Title	Study Design	Themes Discussed
Chiropractic	Ivanova, 2024[32]	The development of working alliance in early stages of care from the perspective of patients attending a chiropractic teaching clinic	Qualitative Interview	**Clinical Expertise Operating within EBP:** – Patients needed to feel confident in their chiropractor's expertise before developing a bond or agreeing on treatment goals. This confidence was influenced by the clinic's reputation and thorough initial assessments which reassured patients. This showcases how expertise facilitates the patient-clinician relationship, and as a result, integration of patient preferences. – Patients highlighted self-confidence in the trainee chiropractors as crucial to building their trust. Overconfidence was viewed negatively, but balanced confidence reassured patients. – Clear explanations fostered collaboration on treatment plans and agreement on care goals. Patients valued explanations that helped them understand the causes of their issues and what they needed to do to improve their condition.
Medicine	Issel, 2018[18]	Paradoxes of Practice Guidelines, Professional Expertise, and Patient Centeredness: The Medical Care Triangle	Commentary	**Defining Clinical Expertise:** – EBP guidelines have shaped healthcare, forming what the authors call the "Medical Care Triangle." This triangle represents the interplay between clinician expertise, patient-centredness, and institutionalized guidelines. – Clinician expertise is the result of extensive education, and is proven through licensure and certifications – Clinical expertise is characterized as independent of organizational structures and is heavily emphasized as a core feature in primary care delivery. – Paradox of Expertise: the tension between the clinician's autonomy (based on expertise) and the standardization imposed by evidence-based guidelines. This paradox acknowledges that expertise must be balanced with the use of guidelines and patient preferences, illustrating a complex decision-making process.
	Paez A, 2018[7]	The "architect analogy" of evidence-based practice: Reconsidering the role of clinical expertise and clinician experience in evidence-based healthcare	Commentary	**Defining Clinical Expertise:** – The "Architect Analogy of EBP" describes clinical expertise as consisting of three overlapping skill sets: clinical, technical, and organizational. The clinical component involves clinical and communication skills, and knowledge and experience with patient engagement. The technical component involves skills in forming questions and appraising and implementing evidence in clinical practice. Organizational skills cover interdisciplinary teamwork. **Clinical Expertise Operating within EBP:** – Clinical expertise is essential for filtering and applying evidence in practice, integrating scientific knowledge, critical thinking, and patient assessment. Clinicians must evaluate evidence for its relevance and quality. Expertise is crucial for navigating large volumes of evidence, assessing its applicability, and addressing clinical "gray zones" where evidence is lacking or unclear. Expertise also supports ethical decision-making, patient education, and informed consent, ensuring that treatment aligns with both evidence and patient preferences. Expertise helps identify new research questions and detect emerging trends, contributing to the advancement of practice.
	Persson, 2019[19]	Science and proven experience: a Swedish variety of evidence-based medicine and a way to better risk analysis?	Commentary	**Defining Clinical Expertise:** – Suggest EBM is a restructuring of "science and proven experience" (VBE – an acronym for Swedish terms). Both EBM and VBE aim to incorporate science into decision-making but differ in their focus. The authors suggest EBM emphasizes using contemporary research to guide clinical decisions, while VBE focuses on ensuring patient safety by avoiding unnecessary risks. – The concept of VBE highlights the importance of blending both clinical experience and scientific knowledge to ensure effective healthcare decisions. – VBE emphasizes patient safety by minimizing risks through experienced clinical judgement. Clinicians must often balance scientific evidence with real-world conditions and individual patient needs to avoid harm. – EBM emphasizes a structured, research-based approach to guide clinical decisions, which complements the more individualized, experiential knowledge in VBE. Clinical expertise in EBP relies on synthesizing both—leveraging structured evidence with nuanced, personalized decision-making drawn from clinical experience.
	Peterson, 2016[20]	The three-legged stool of evidence-based practice in eating disorder treatment: Research, clinical, and patient perspectives	Commentary	**Clinical Expertise Operating within EBP:** – Important to use research, clinical expertise, and patient preferences in guiding treatment for eating disorders – While randomized trials support specific treatments for these disorders, inconsistencies remain across the spectrum of disorders and for certain populations with the disorders. – Highlights how clinical expertise is vital in addressing this complexity of eating disorders, given the limitations of research in guiding treatment for diverse patient profiles. Factors like comorbidities, age, cultural context, and the patient's physical state complicate treatment selection, making expert judgement crucial.

Discipline	First Author, Year	Title	Study Design	Themes Discussed
Medicine (cont'd)	Ratnani, 2023[25]	Evidence-Based Medicine: History, Review, Criticisms, and Pitfalls	Commentary	**Clinical Expertise Operating within EBP:** – Argue that EBM has shifted away from its original pillars of clinical expertise and patient values, now emphasizing protocol-driven, guideline-based care that limits clinician judgement and patient autonomy. – This stems from the 'foundations' of EBM, which are the evidence pyramids, emphasizing standardized research evidence, particularly RCTs and systematic reviews. Suggest clinical decisions are reduced to following templates, sidelining physicians' critical role in personalized care. – Argue EBM struggles in treating multi-morbid patients, as RCTs and systematic reviews, which form the backbone of EBM, focus on single conditions, failing to accommodate the needs of an aging population with multiple chronic diseases. In these situations, clinician expertise is needed to uniquely consider each patient, developing an appropriate care plan tailored to them.
	Salloch, 2018[24]	What does physicians' clinical expertise contribute to oncologic decision-making? A qualitative interview study.	Qualitative, Semi-Structured Interviews	**Defining Clinical Expertise:** – Introduce clinical expertise as "internal evidence" to be integrated with "external evidence". – Identified direct patient contact on an individual basis and experience treating many patients contributed to a clinician's expertise. – Bodily experience (the personal, lived aspect of clinical practice), non-explicit knowledge, and implicit biases were noted as likely influencing clinical expertise, but the use of measurable indicators in the study did not account for these factors. – Concluded clinical expertise may not be adequately understood using standardized quantitative measures, and must account for various independent factors
	Schlegl, 2017[21]	Different Weights of the Evidence-Based Medicine Triad in Regulatory, Health Technology Assessment, and Clinical Decision Making	Commentary	**Clinical Expertise Operating within EBP:** – EBM integrates best research evidence, clinical expertise, and patient values to address uncertainty in clinical decision-making – Regulatory bodies in healthcare primarily rely on research evidence, particularly RCTs, but have been adapting to real-world data and patient involvement due to recognition that certain treatments may still be beneficial for individual patients based on clinical judgement. – Clinical expertise is essential to ensuring that research evidence is applied in a way that aligns with the needs of individual patients in real-world settings.
	Szajewska, 2018[22]	Evidence-Based Medicine and Clinical Research: Both Are Needed, Neither Is Perfect	Commentary	**Clinical Expertise Operating within EBP:** – Suggests the traditional EBM evidence hierarchy, suggesting diminishes clinical expertise, oversimplifies care, and serves commercial interests. – Concerns stated regarding the influence of industry, the overwhelming amount of evidence, and EBM's failure to address complex, multi-morbidity cases. – Notes RCTs are the gold standard for determining efficacy of healthcare interventions, but criticizes them for limitations in external validity, leading to issues when generalizing results. – Emphasizes that EBM should prioritize the patient, indicating an important role for clinical expertise. The noted issues with clinical research rely on a clinician's ability to effectively appraise and apply research – Argue that strict adherence to guidelines can overlook the nuances of clinical practice. – The acknowledgment of such criticisms indicates that clinical expertise is essential for interpreting guidelines in the context of individual patient needs.
	Tonelli, 2020[4]	Experiential knowledge in clinical medicine: use and justification	Commentary	**Acquiring and Developing Clinical Expertise:** – Suggests clinical expertise is derived from primary experience of day-to-day clinician activities. – Highlights the value of primary experience for clinicians to develop experiential knowledge such as diagnosing, treating, and assessing individual patients. – Suggests relying on clinician experience through care and engagement with patients contributes to the development of iterative and experiential knowledge, which is necessary for clinicians to posses in day-to-day practice. – Emphasizes clinical expertise should never be overlooked in EBP, but valued and strived for.
	Van de Vliet, 2023[17]	The Application of Evidence-Based Medicine in Individualized Medicine	Commentary	**Clinical Expertise Operating within EBP:** – Clinical expertise allows practitioners to apply external evidence to the specific needs of individual patients. While systematic research informs clinical decisions, it does not replace the judgement of the clinician. The process of EBM involves balancing three key components: best research evidence, clinical experience, and patient preferences. – Suggest EBM is often limited by an over-reliance on RCTs as the sole source of "best" evidence, overlooking real-world data and clinical experience, restricting clinicians from applying their expertise and adapting treatments to individual circumstances. – The risks of neglecting any of the three pillars of EBM include: Disregarding patient values, leading to impersonal or overly rigid care; Ignoring research evidence, resulting in outdated or empirical treatments; Overlooking clinical expertise, which may expose patients to inappropriate treatments. – In oncology, EBM's success depends on the proper integration of these elements to ensure safe (which is the function of clinical expertise), high-quality care tailored to individual patients

Discipline	First Author, Year	Title	Study Design	Themes Discussed
Medicine (cont'd)	Welink, 2020[23]	GP trainees' perceptions on learning EBM using conversations in the workplace: a video-stimulated interview study	Qualitative, Semi-Structured Interviews	**Acquiring and Developing Clinical Expertise:** – Suggests "learning conversations" as a key tool for learning and discussing the implementation and practice of EBM for medical practitioners. – These conversations were defined as discussions that included a medical topic/question, prompting practitioners to reflect on these topics as they occurred in every day practice – Emphasize that respect is an important element in peer-to-peer conversations, and these conversations can prompt discussion and develop new insight and knowledge. – Highlight the important role of supervisors in these conversations, as supervisors guide their mentees to consider context-related factors specific to the individual patient, contributing to a comprehensive understanding beyond just the specific medical condition of the patient.
Nursing	Dewitt, 2021[26]	The epistemic roles of clinical expertise: An empirical study of how Swedish healthcare professionals understand proven experience	Survey Analysis	**Defining Clinical Expertise:** – Discuss the concept of VBE, acronym in Swedish terms translating to "science and proven experience" – Suggests the VBE model allows for a more explicit understanding of the integration of evidence into practice, and its role. – States "proven experience" refers to the quality of having experience, instead of describing the content of the experience. This is tailored to the idea that clinical expertise in EBM is something clinicians acquire through experience. – VBE promotes reflection within clinicians, informing their application of relevant evidence to their patients' clinical circumstances.
	Teolis, 2020[27]	Improving Nurses' Skills and Supporting a Culture of Evidence-Based Practice	Commentary	**Acquiring and Developing Clinical Expertise:** – Suggests that training programs that include hands-on workshops can improve a practitioner's ability (nurses in this context) to seek, appraise, and apply evidence in practice. – Recommended collaborative learning between librarians and nursing education departments to develop evidence-based competencies within a supportive learning environment. **Clinical Expertise Operating within EBP:** – Authors reference a 7-step EBP model, highlighting the importance of clinical expertise in this model to integrate the best evidence with patient preferences to inform clinical decision-making. This tailors care to each individual patient's needs. – Suggests EBP is not consistently implemented across healthcare systems, particularly in the nursing profession, as some nurses lack competence in certain EBP skills such as forming research questions and critically appraising evidence.
Occupational and physical therapy	Thomas, 2023[31]	Being and Becoming an Evidence-Based Practitioner: Occupational Therapists' Journey Toward Expertise	Qualitative interpretive descriptive, semi structured interviews	**Acquiring and Developing Expertise:** – Humility, conscientiousness, curiosity, open-mindedness, and leadership were noted by therapists as essential for developing their expertise. – Defining moments in therapists' careers, such as being at an impactful EBP conference, that made practitioners realize there was a gap in their care/knowledge – Motivators such as a desire to achieve better outcomes for patients, recognition of ethical obligations to provide the best care informed by evidence, and students acting as mentors by bringing new and recent information into practice – Questioning standard practices, using critical thinking, sharing knowledge, addressing knowledge gaps and integrating experience with research evidence were noted as factors used by EBP practitioners to integrate EBP into care (e.g., emulating clinical expertise) – Engaging in ongoing learning, formal teaching, and interacting with peers, students, and research were noted factors for improving practice – Extensive scientific resources available in the field facilitates expertise development
	Hallé, 2018[29]	Attributes of evidence-based occupational therapists in stroke rehabilitation	Qualitative Analysis	**Defining Clinical Expertise:** – Authors defined two fields of expertise, including expert evidence-based occupational therapists and outstanding occupational therapists. – Expertise was attributed to clinician dedication, motivation to learn, achieving great patient outcomes, and working in a specialized setting. – 'Expert evidence-based clinicians' had extensive knowledge, skills, and experience, and were involved in continuing education and knowledge translation initiatives – 'Outstanding clinicians' had extensive specialized experience, expertise and expert qualities of intelligence, skill, and clinical knowledge.
	Carr, 2020[30]	Developing clinical expertise in musculoskeletal physiotherapy: using observed practice to create a valued practice-based collaborative learning cycle.	Qualitative – "Constructivist Grounded Theory Study"	**Acquiring and Developing Clinical Expertise:** – Propose a three-staged cyclical process to support the advancement of clinical expertise using a mentor-learner model – Model functions to develop clinical expertise in the MSK physiotherapy workforce, and included three phases, including "requirements prior to learning activity", the "learning activity", and a "collaborative reflection and analysis" phase.

Discipline	First Author, Year	Title	Study Design	Themes Discussed
Occupational and physical therapy (cont'd)	Benfield, 2020[28]	Initial development of a measure of evidence-informed professional thinking	Survey Analysis	**Defining Clinical Expertise:** – Notes that expertise requires the integration of external research evidence into clinical practice. Expertise must reflect critically on their practice, seek and discuss their experiences with their colleagues, and reflect on their own knowledge, beliefs, and values – Highlights clinical expertise involves both critical clinical reasoning and evidence informed practice activities, with a big overlap between the two. The study found practitioners who engage in more clinical reasoning also engage more in evidence-based practices, indicating the two are interconnected. – Note numerous qualities that should be considered when measuring clinical expertise, that their study did not, such as: specific client-related skills, evaluating evidence quality, communication abilities, and adapting/tailoring care to individual clients. **Acquiring and Developing Clinical Expertise:** – Requires the continued development of "habits of mind". Habitual engagement in both critical clinical reasoning and evidence-informed practice behaviours is essential for developing and applying clinical expertise in practice. – Authors suggest the importance of participating in activities that foster clinical reasoning and reflection to improve or maintain clinical expertise, as these activities are strong indicators of clinical competency
Rehabilitation education	Halvari, 2021[33]	Social, health and rehabilitation sector educators' competence in evidence-based practice: A cross-sectional study	Descriptive Cross-Sectional	**Acquiring and Developing Clinical Expertise:** – Institutions can help health and rehabilitation educators develop clinical expertise by making educational resources and research accessible, as well as facilitating learning conversations. – While most educators rated their EBP competence positively, there were areas for improvement, particularly in knowledge retrieval and scientific publication engagement. Continuous education and time management were also highlighted as factors that could enhance EBP competence.
Psychotherapy	Huisman, 2018[34]	Evidence-Based Practices in Cognitive Behaviour Therapy (CBT) Case Formulation: What Do Practitioners Believe is Important, and What Do They Do?	Survey Analysis	**Defining Clinical Expertise:** – Define clinical expertise in relation to the EBP model, as the mechanism of integrating the best available evidence into clinical practice to form a decision. **Acquiring and Developing Clinical Expertise:** – Case formulation (CF): described as a process within cognitive behavioural therapy where the clinician has the opportunity to integrate relevant theory and research into a particular individual case – Suggested that effectively using external evidence in CF is a clinical skill that can be developed with experience. More experienced clinicians, especially clinical psychologists, tend to endorse practices that involve external evidence as more important than less experienced clinicians. – Experienced psychologists rate certain evidence-based activities like evaluating hypotheses and using structured CF methods as 'more important'. However, this perceived importance didn't necessarily translate into more frequent practice, indicating a potential gap between knowledge and practical application.
Speech Language Therapy	Jackson, 2017[35]	Professional expertise amongst speech-language therapists: "willing to share"	Survey Analysis	**Defining Clinical Expertise:** – Highlighted that expertise is not a given result of years of experience, nor knowledge, despite the two still being important for expertise – High experience and contextual knowledge were ranked as top elements of expertise, aligning with traditional views of expertise rooted in knowledge and experience. However, research expertise, such as holding a PhD or being involved in research, ranked lower, reflecting a preference for clinical over research expertise. – Suggests that building expertise involves both knowledge contribution and collection, and balancing these could enhance professional development. Shared knowledge, through teaching and learning helps shape the identity of an expert.
	Douglas, 2019[36]	Narratives of expert speech-language pathologists: Defining clinical expertise and supporting knowledge transfer	Interview Analysis	**Acquiring and Developing Clinical Expertise:** – Notes the importance of experience in developing expertise, but that it is not the sole contributor to expertise. – The length of time spent in practice does not equate to a clinician's expertise. In some cases, the opposite can be true, in terms of reinforcing bad habits and a lack of new knowledge integration. – Factors like training, personal traits, networking opportunities, learning from mistakes, and good work sites contribute to clinical expertise.

Discipline	First Author, Year	Title	Study Design	Themes Discussed
Nutrition	Johnston, 2019[37]	The Philosophy of Evidence-Based Principles and Practice in Nutrition	Commentary	**Clinical Expertise Operating within EBP:** – Highlights how optimal clinical decision-making requires the best available evidence and balancing this evidence with the patient context – Emphasizes importance of systematic summaries of evidence, and concerns over RCT results with regards to small study sizes and slow adoption by experts. Still, note that "high-quality" evidence is preferred, noting the example of the long-standing yet flawed dietary fat guidelines, which were based on lower-quality observational studies, eventually overturned by higher-quality evidence. – Acknowledge that large, consistent effects from observational studies can also yield high-certainty conclusions. – To be able to treat each patient uniquely, and apply accurate evidence, EBP requires clinical skills, such as accurate diagnosis, communication, and sensitivity to the patient's context. Evidence should be integrated with each patient's values, and clinician must address challenges such as time constraints and access to resources.

Identifying themes

Three central themes emerged from the literature in line with the three review objectives: (1) clinical expertise within EBP is the integration of clinical reasoning, experience, and evidence-based skills, guiding person-centred decision-making in healthcare, (2) clinical expertise is acquired through collaboration, reflective practice, hands-on experience, and continuous learning over time, and (3) clinical expertise acts as a mechanism of integrating evidence with patient-specific factors, guiding clinical decisions.

Clinical expertise is the integration of clinical reasoning, experience, and evidence-based skills

Clinical expertise has been defined in relation to the EBP model, as a necessary part of decision-making and central to the integration of best available evidence in practice.[34] Clinical expertise in the field of occupational therapy and allied health professions has been defined as "the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values and reflection in daily practice".[28] Expertise is considered to be more than "just time in practice," since it involves the integration of clinical or professional reasoning, EBP, and assessing and measuring outcomes.[28] Importantly, clinical expertise is central to guiding clinical practice since not every clinical question has directly relatable or available data, requiring experience-informed decision-making.[20,22,34] Expertise is complex, requiring the explicit integration of best external research evidence into clinical practice, reflecting critically on practice, seeking and discussing experiences with colleagues, and reflecting on one's own knowledge, beliefs, and values.[28] This complexity of expertise is evident within 'paradoxes' of evidence-based care, in which clinicians are responsible for navigating the balance between the standardization of guidelines and both clinician and patient autonomy to integrate individual patient preferences into a clinical decision.[18]

A qualitative analysis of expertise in the occupational therapy field defined two categories of expertise: expert evidence-based and outstanding occupational therapists.[29] In both categories, expertise was attributed to clinician dedication and motivation to learn, achieving great patient outcomes, and working in a specialized setting.[29] Expert evidence-based clinicians had extensive knowledge, skills, and experience, were engaged in professional development and knowledge translation.[29] Outstanding therapists had specialized experience, exceptional skills, professional competencies, and served as role models, mentors, and advocates, with strong client-centred approaches and collaboration.[29] In this way, clinical expertise is recognized for its important role in informing clinical decision-making based on critical appraisal of evidence and patient values and preferences, rather than on external evidence alone, which may be inapplicable or inappropriate for an individual patient.[21,27] This is reflected in the "Architect Analogy of EBP", in which Paez describes clinical expertise as consisting of three overlapping skill sets: clinical, technical, and organizational.[7] The clinical component involves communication skills and knowledge and experience with patient engagement, the technical component involves skills in forming questions and appraising and applying evidence in clinical practice,

and the organizational component covers skills within interdisciplinary teamwork.[7] Paez notes that together, these elements of expertise complement evidence-based practice (EBP) by structuring and enhancing clinical decision-making, rather than serving as evidence themselves.[7]

Clinical expertise is also defined as being derived from primary experience and being necessary for ideal clinical practice.[4] Primary experience has value and knowledge utility that is central to clinical practice in order for a clinician to possess the experiential knowledge required to diagnose, treat, and assess individual patients.[4] Reliance on clinician experience through hands-on practice and engagement with patients and colleagues leads to a development of iterative, experiential knowledge on which clinicians rely each day in practice.[4] A critical element of achieving expert status is accumulating the vast hands-on experience that enables those experts to recognize patterns in diagnosis and treatment effortlessly most of the time and to recognize when signs and symptoms fail to fit that pattern, requiring alternate action, such as referral to other professionals.[4,18]

Conversely, a survey analysis in the discipline of speech-language pathology defined professional expertise with the objective of assisting healthcare organizations in developing expectations of their professionals, highlighting that measuring years of experience alone is not sufficient to inform expertise.[35] Rather, Jackson *et al*. argue an evolved shift in the understanding of clinical expertise requires viewing expertise as a quality that is possessed by an individual clinician and is perceived as such by those who bear witness to the clinician's behaviours and practice.[35] An interview study with oncologists added that because clinical expertise involves a complex integration of many interrelated factors, it cannot be fully appreciated using quantitative measures alone.[24] For example, factors such as non-explicit knowledge and implicit biases were mentioned to not be captured through quantitative measures of clinical expertise, yet play a crucial role in informing a clinician's expertise.[24] Still, the importance of considering experience when informing expertise is not debated, as Salloch *et al*. found that two dimensions of clinical experience (direct patient contact on an individual basis and having treated many patients over the course of one's career) contributed to one's level of clinical expertise in this interview-based study.[24]

Comparatively, studies originating from Sweden emphasized the continuation of a century-long history of *vetenskap och beprövad erfarenhet* (VBE), recognizing the importance of clinical expertise and judgement in healthcare.[19,26] The centrality of the role of VBE in Swedish healthcare is illustrated by Sweden's legal regulation of healthcare, which requires VBE, best translated as 'science and proven experience.' VBE is considered to be the gold standard in decision-making practice in Sweden, though it has not been well-defined in the literature.[19,26] The concept of VBE extends beyond the concept of 'clinical expertise' and can function as a stand-alone construct, independent from clinical expertise. In this regard, EBM is considered a reformulation of the Swedish standard.[19] This notion of VBE has been required by law in Sweden since 1981 and has been engrained into the training of all clinicians. This has resulted in Swedish clinicians having a good understanding of the role and nature of clinical experience and judgement, balanced by knowledge gained through research.[19,26] The Swedish model of 'proven experience' allows for a more explicit understanding of the integration of evidence into practice and conceptualization of the role of evidence in practice.[26]

A key concept within VBE is 'proven experience', which refers to the quality or characteristic of being experienced or possessing experience, rather than to describe the content of the experience.[26] The concept of proven experience is aligned with clinical expertise in EBP, and it is a trait to be acquired by clinicians throughout their clinical careers.[26] VBE promotes more reflective analysis by clinicians by informing their applications of relevant evidence to their patients' clinical circumstances.[26] Where the EBM model may be interpreted as casting a hierarchy over various kinds of scientific evidence, the VBE model regards good decision-making as considering both science and proven experience, together.[19] Although the Swedish concept of 'science and proven experience' has clear parallels with characteristics of the EBM model, VBE offers additional clarity in terms of the epistemological role of expertise and clinical judgement.

Clinical expertise is acquired through collaboration, reflective practice, hands-on experience, and continuous learning over time

Experience on its own is reflected across multiple disciplines as being important to developing clinical expertise.[4,31,34] Within medicine, it is suggested that primary

experience, such as diagnosis, treating, and assessing individual patients, facilitates development of experiential knowledge of care and patient engagement, which is necessary in practice.[4] In psychotherapy, a survey analysis highlighted how effectively using external evidence in case formulations (the process of integrating theory to a particular case) is a clinical skill that is developed through experience.[34] Despite the importance of experience in the development of clinician expertise, a speech language therapy study argued that practice alone did not equate to highly proficient clinicians.[35,36] Douglas *et al*. suggest that length of time in practice does not necessarily result in a higher level of clinical expertise as many senior clinicians maintain practice patterns related to habit rather than integrating new knowledge on an iterative basis.[36] Several key elements to impact and support the development of clinical expertise were identified by Douglas *et al*., including: training; individual clinician traits and actions; work sites; having a holistic view versus disorder-specific view; professional networking; peer and patient recognition; embracing the creative/mysterious; technical excellence and acknowledgment of and learning from one's own mistakes.[36]

Clinical expertise also requires the continued development of "habits of mind," suggesting the importance of participating in activities that foster critical clinical reasoning and reflection to improve clinicians' clinical expertise.[28] This may include engaging in "learning conversations", described in a study that interviewed general practitioners. Authors found that "learning conversations" were important tools for learning and discussing the implementation and practice of EBM for general medical practitioners.[23] Learning conversations were defined as discussions that focused on a medical topic or question in which those engaged had no specific instructions on how to do so.[23] Within these discussions, practitioners reflect on medical cases or topics that are of relevance to their daily practice.[23] Respectful, learning conversations were found to be especially important elements in peer-to-peer communication, interprofessional collaboration, and in training or mentorship of new practitioners.[23] A cross-sectional study within rehabilitation education highlighted how institutions can help with facilitating learning conversations, and as a result, promote clinical expertise development.[33] Such support may come from regulatory bodies, associations, or educational institutions, and include educational and research opportunities, as well as resources and accessible research.[33]

Supporting the importance of collaboration in professional skill development, Carr *et al*. described a three-staged cyclical process to support the advancement of clinical expertise using a mentor-learner model.[30] The sequential phases included: 'requirements prior to learning activity' (a self-reflection), the 'learning activity' (observing clinical practice), and 'collaborative reflection and analysis' (reflection on the experience, also known as professional craft knowledge).[30] Utilization of this phased approach was considered to facilitate effective development of clinical expertise.[30]

Characteristics such as humility, conscientiousness, curiosity, open-mindedness, and leadership were noted by occupational therapists as essential to developing expertise.[31] Specifically, expertise required the ability to be adaptable in practice, in addition to deliberate, motivated effort to continuously grow and improve oneself professionally.[29,31] Motivators to achieve expertise may include a desire to achieve better patient outcomes, the recognition of ethical obligations, or a defining moment in a clinician's career that made them recognize they could achieve a higher level.[31] Students acting as mentors by bringing new knowledge into clinics can also serve as motivators to developing expertise.[31] The strengthening of innate characteristics, such as compassion and other soft skills, and the continued humble recognition of gaps in a clinician's knowledge, coupled with the desire for continued learning beyond a clinician's current state of knowledge, further contributes to developing adaptive expertise.[29,31] This strengthening requires support through education, knowledge translation and research opportunities, and hands-on clinical practice.[29] Expertise is then evidenced by advanced educational credentials, pedagogical, ethical, and cultural competence, personal interaction, professional conduct, cooperation and network competence, as well as knowledge of administrative and occupational well-being.[33,34]

Clinical expertise acts as a mechanism of integrating evidence with patient-specific factors

While some current literature considers the updated Haynes model of EBP (Figure 1),[7,19,21] other contemporary literature and regulatory bodies rely on the older EBP model for its evidence hierarchy and differential attribu-

tion of value and weight to various knowledge sources.[21,27] Institutions often prioritize clinical data through a strict ranking system, treating RCTs as the gold standard while considering other forms of evidence as inferior.[21] While RCTs are indeed the gold standard, effective clinical decision-making requires more than simply following study outcomes – it necessitates the integration of clinical expertise to apply evidence in a way that aligns with individual patient needs.[17,20–22,25] Clinical expertise is not an alternative to research evidence,[5] but rather a dynamic mechanism that balances a patient's clinical state and circumstances, relevant research, and the patient's preferences and actions.[17,21,22,37] It remains essential whether strong research evidence is available or lacking. For example, when RCT results are not applicable to a particular patient due to study design limitations (e.g., restricted inclusion criteria), clinical expertise is necessary to assess other relevant research, evaluate potential risks, and incorporate patient preferences.[21,22] In this case, RCTs would be the gold standard for the demographic their study included, but clinical expertise ensures the evidence is interpreted and applied appropriately for each individual case.[21,22] Importantly, clinical expertise should not be conflated with expert opinion,[5] which represents a static form of evidence that may not account for patient-specific factors.

In a commentary, Szajewska suggests there is an overwhelming amount of clinical research, much of which is low quality due to poor design, being statistically underpowered, and over reliance on p-values, leading to potentially incomplete or false conclusions.[22] In a study of RCT results for treating eating disorders Peterson et al. add the complexity of applying inconsistent study results.[20] Specifically, diverse patient profiles such as comorbidities, age, and cultural context complicate treatment and evidence selection, making expert judgement crucial in caring for each individual patient.[20] Two additional commentaries also raise concerns about the lack of ability of RCTs and systematic reviews to inform treatment in multi-morbid patients, arguing that a transition to protocol-driven care limits clinician judgement and patient autonomy, when treating such patients.[17,25] While the importance of research is never debated, authors suggest that the over-reliance on systematic research alone neglects the other pillars of EBP, leading to care that may not be optimal.[17,25] Van de Vliet *et al*. emphasize this does not diminish the role of research in patient care as neglecting any pillar within EBP poses a risk, including disregarding patient values leading to overly rigid care, ignoring research evidence resulting in outdated treatments, or overlooking clinical expertise potentially exposing a patient to inappropriate treatment.[17] Clinical care therefore relies on a clinician's ability to effectively appraise, interpret, and apply the research, as opposed to adhering to strict guidelines and overlooking the nuances of clinical practice.[17,20,22,25]

Through a similar consideration of the value of clinical expertise, Paez explicitly and purposefully situates clinician expertise at the centre of EBP in their model, together with the clinical question/patient problem.[7] This positions the clinician as the "architect" or creator of the clinical path forward for the patient.[7] Paez views the clinician's role as important in framing clinical questions, assessing the evidence, and, ultimately, influencing patients' lives and the generation of evidence through practice; in turn, creating new research questions and identifying new needs for evidence.[7] These clinician responsibilities across all disciplines reflects the importance of clinical judgement and iterative decision-making processes in evaluating the merits and appropriateness of evidence-based interventions on the health and wellbeing of patients.[7,19,26,37]

An interview analysis with chiropractic trainees and patients highlighted the importance of the clinician-patient relationship for optimal care.[32] Patients valued clear explanations from their chiropractor which helped them understand the cause of their issue and what they needed to do to help themselves improve.[32] It was the patients' confidence in their chiropractor's expertise that developed a bond and facilitated progress with treatment goals.[32] Thorough initial assessments and confidence of the chiropractor contributed to a strong patient-provider relationship, emphasizing the importance of expertise acting as a mechanism of integration within chiropractic care.[32]

Discussion

In this review we aimed to synthesize contemporary literature providing insight on a definition of clinical expertise, how clinical expertise can be acquired and developed, and how clinical expertise operates within EBP. Three key themes emerged, each addressing our main objectives. First, clinical expertise is recognized as a dynamic integration of clinical reasoning, experience, and evidence-based skills, crucial for personalized healthcare

decisions. Second, clinical expertise is developed through a combination of reflective practice, collaboration, hands-on experience, and continuous learning. Finally, clinical expertise serves as a mechanism for synthesizing evidence with patient-specific factors, ensuring that clinical decisions are not solely dictated by research evidence but are instead a balanced integration of all three other pillars of EBP: best available evidence, clinical state and circumstances, and patient preferences. These findings underscore the multifaceted nature of clinical expertise, as it intertwines professional experience with EBP.

The concept of clinical expertise does not have a standardized, uniform definition; rather, clinical expertise is a dynamic concept that continues to evolve over time.[5] While clinical expertise has received different definitions and treatments across studies, common among the literature is that clinical expertise requires proficiency, skill, and clinical judgement that can be acquired only through clinical experience, collaboration, and hands-on clinical practice.[5,7,18,35,38] Clinical expertise is not static however, as it must continuously evolve alongside advancements in research and changes in patient needs, reinforcing its essential role in bridging the gap between evidence and personalized care. The Swedish concept of VBE contributes an evolved understanding and expanded definition of clinical expertise as a concept that has value for not only individual clinicians, but also their patients and the institutions within which they work.[19,26] A more clarified, nuanced, and holistic perspective on clinical expertise, such as the one provided here, allows clinicians to not only strive for professional growth, but also understand the goalposts.

The traditional EBM evidence hierarchy inherently considers clinical expertise as a form of knowledge or method of knowing that is independent of, and potentially inferior to, the classic evidence pyramid.[5] The placement of expert opinion at the bottom of the evidence pyramid has a mixed legacy. On the one hand, it may correctly signal that research questions can and should be informed by clinical experience and observation. On the other hand, this has been traditionally and wrongfully interpreted to imply that clinical expertise is wholly internal to evidence and, as such, is comparable and subordinate to research evidence. The latter view conflates the role of clinical expertise within research with clinical expertise in the context of delivering patient care. While related, these contexts are distinct and should be explicitly acknowledged as such. Specifically, expert opinion represents a static form of evidence that may not account for patient-specific factors, unlike clinical expertise which dynamically integrates research evidence, a patient's clinical state and circumstances, and their preferences to guide personalized decision-making.

Regardless of whether clinical expertise should be considered as internal or external to the evidence pyramid, authors in the reviewed literature argue the evidence hierarchy cannot be used alone in guiding clinical practice.[4,7,17,20–22,25] The clinician needs to appropriately integrate evidence with patient preferences and their own experience into their decision-making.[4,7,17,20–22,25] However, these authors suggest the emergence of EBP and this evidence hierarchy has led some to rely exclusively on "objective" evidence, thereby presenting challenges when specific individual patients don't 'fit' within the proposed care plans.[7,17,20–22,25] While these views largely come from commentary papers, and are therefore essentially opinions, the value in these points should not be dismissed. An overreliance on systematic data does threaten a lack of consideration of patient preferences and clinical judgement. On the other hand, the value of research should also never be diminished either. Therefore, a non-hierarchical understanding of clinical knowledge and clinical judgement contributes to more well-rounded, collaborative, and customized clinical care.[4] Particularly, one that recognizes clinical expertise as the central mechanism through which the three EBP pillars – evidence, clinical circumstances, and patient preferences – are meaningfully combined in real-world decision-making.

The Haynes model of EBP advances this perception of clinical expertise to one that overlays and integrates their modified factors of clinical state and circumstance, patients' preferences and actions, and research evidence (Figure 1).[2] Clinical expertise must, therefore, be considered as a complementary and informative form of knowledge, since the clinician must use their clinical skill, judgement, and experience to understand and interpret systematic reviews and trials, and then apply (or hold) treatment, as appropriate. This is instead of ranking clinical expertise on a scale of actual evidence, and inferior to published data. Clearly, individual clinical expertise is formed, evolves over time, and is built on a strong foundation of clinical practice, skill, judgement, collaboration,

active involvement in teaching and research to advance the clinician's field and advocate for advancement.

The integration of the three components of EBP in the Haynes model relies on the application of clinical expertise inherently, as part of practice.[2] For instance, the component of clinical state and circumstances requires clinical expertise to not only understand, but also parse the structural determinants – social, political, economic – of health, as well as personal, individualized constraints and factors arising from physiological, emotional, and psychological circumstances.[2,26] A clinician's expertise will guide their implementation and continued assessment of a proposed therapeutic plan that accounts for these circumstances. Without an educated, experience-based assessment of these structural and individual determinants, proposed treatment plans may be too costly, burdensome, or stressful, leading to reduced compliance.

Akin to the clinical state and circumstances component, the patient values and preferences component requires an informed and aware attention to, and accounting for, diversity, equity, and inclusion, as well as the power differential between clinicians and their patients, when proposing and prescribing therapeutic interventions. A clinician's consideration of these factors requires effective and thoughtful communication and observational skills, important elements of expertise.[7,28,37] Patient preference may, at times, conflict with research evidence and a clinician's compass based on their experience. In these instances, clinicians should be guided by principles of informed consent, shared decision-making, ethics, and their fiduciary duties to the patient.[39] Their clinical expertise should also serve as a reliable guide on which they can rely for strategies to navigate these circumstances.[7] This reinforces the role of clinical expertise as a dynamic, applied skill set – one that allows clinicians to negotiate complex, sometimes conflicting, elements of patient care while ensuring decisions remain grounded in ethical, evidence-informed practice.[3,7,39] The model of EBP in a context of caring provides another framework for understanding the integrated role of clinical expertise and reliance on the clinician for their assessment of the patient and their circumstances, preferences, and values, alongside research evidence.[40]

Clinical expertise is a lifelong journey that begins, and continues to develop, with training, education, and practice.[3] Beginning with basic training through formal education, accreditation, and licensure as regulated health professionals, clinicians such as chiropractors begin to develop the core competencies that form the foundation for their clinical expertise. In Canada, for instance, chiropractors develop seven areas of competency: (1) expertise in neuromusculoskeletal (nMSK) health, including differential diagnoses, evidence-based patient-centred management, and diagnostic procedures and therapeutic interventions, (2) clear, responsible communication, including informed consent, (3) skillful collaboration with inter- and intra-professional practitioners, (4) advocacy for health, safety, and quality of life, (5) application of EBP in patient-centred care, (6) professionalism, including ethical skill, cultural sensitivity, and self-reflection, and (7) leadership to improve healthcare delivery and professional development.[11,12] The Canadian Memorial Chiropractic College (CMCC)[11] and the Federation of Canadian Chiropractic (FCC)[12] adapted the CanMEDS Framework[14] of the Royal College of Physicians and Surgeons of Canada, in which the clinical expert is positioned at the centre of the competencies, illustrating the multitude of roles that the clinical expert endeavors to master. Contributing to clinical expertise, these competencies deepen and develop through continuing chiropractic education and rigorous clinical practice including ongoing evaluation of a patient's condition, progress and intervention effectiveness, and ongoing discussion with the patient regarding the patient's goals and expectations for their ongoing care.[41]

In accordance with the literature, chiropractic expertise develops and evolves over time and with ongoing participation in opportunities for collaboration, conversation, keeping up-to-date on developments in knowledge (which tends to decline following graduation), as well as hands-on clinical practice.[6,42] The iterative development of chiropractic clinical expertise is well-suited to adopt and enact EBP also through mentorship and open learning conversations, participating in research and conferences, continuing education, collaboration, contribution to learning, and participation in advancement of the field.[35,43] As a regulated health profession, the institutions that support the professional development of chiropractors should continue to provide opportunities for deepening and optimizing each of the factors that contribute to a comprehensive foundation for clinicians to develop their clinical expertise.

The value of clinical expertise to clinicians, their patients, their communities, and health institutions cannot be understated. It is a continuously evolving skill set that ensures evidence-based care remains patient-centred, adaptable, and contextually relevant. As such, it is imperative for all clinicians to commit to lifelong learning and for institutions to provide sustained support for their ongoing professional development.

Limitations

This narrative review had the following limitations. Firstly, restricting the search to English-only articles published after 2016 excluded potentially relevant papers published prior to 2016 that could have offered insights into clinical expertise. Secondly, certain fields of study may have been excluded by exclusively relying on articles from three databases, including potentially valuable narrative or anecdotal evidence that may not have been considered. Moreover, we did not use a systematic search strategy or conduct formal risk of bias assessments, as the goal was to broadly cover the healthcare landscape capturing literature that explored clinical expertise from multiple disciplines. This flexibility facilitated the integration of diverse sources and insight on clinical expertise in EBP. Additionally, only one reviewer conducted screening and data extraction, which introduces an inherent degree of subjectivity in thematic synthesis and categorization, particularly on a topic that already has subjectivity around it. This limitation was mitigated by having the full working group review inclusion of papers and data extraction from included studies. Lastly, no interviews were conducted in this review, so clinicians' contemporary attitudes and perspectives concerning our construction of clinical expertise and how clinicians can acquire it require further research.

Conclusion

This narrative review has described current definitions of clinical expertise and illustrated it within Haynes' model of EBP. Three key themes emerged from the literature: (1) clinical expertise integrates reasoning, experience, and evidence-based skills for person-centred care; (2) it is acquired through collaboration, reflection, experience, and continuous learning; and (3) it serves as a mechanism for integrating research evidence with patient-specific factors to inform clinical decisions. This review provides examples of how clinical expertise can be developed and maintained over time and the importance of ongoing participation in a clinician's profession to realize the status of possessing and continually advancing clinical expertise. It highlights that clinical expertise is a lifelong, dynamic, evolutionary process in which clinicians should engage throughout their professional careers. Newer approaches to EBP such as the Hayne's model recognize that clinical expertise (developed through personal experience, keeping current with research and lifelong learning) is an important element in ensuring the delivery of quality care to patients.

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Appendix 1.
Search phrases

We used the key terms "clinical expertise", "professional development", "continuing education", EBP, "evidence-based medicine (EBM)", "competence", "clinical judgment", "experience", "experiential knowledge", "clinician communication", "chiropractor/doctor-patient relationship", "patient-centered care", "skills development", and "training". These terms were utilized in the following phrases to conduct searches in PubMed, Scopus, and Web of Science: (1) "Clinical Expertise" and "evidence based medicine" or "evidence based practice" and "development" and "experience", and "patient" (2) "Clinical Expertise" AND "evidence-based medicine" OR "evidence-based practice" AND "clinical communication", (3) "Clinical Expertise" AND ("evidence-based medicine" OR "evidence-based practice") AND "continuing education", (4) "Clinical Expertise" AND ("evidence-based medicine" OR "evidence-based practice") AND "continuing medical education", (5) "Clinical Expertise" AND ("evidence-based medicine" OR "evidence-based practice") AND "continuing professional development", (6) "Clinical Expertise" AND ("evidence-based medicine" OR "evidence-based practice") AND "doctor patient relationship", (7) "Clinical Expertise" AND ("evidence-based medicine" OR "evidence-based practice") AND "patient-centred care", (8) "Clinical Expertise" AND ("evidence-based medicine" OR "evidence-based practice") AND "skills development", (9) "Clinical Expertise" AND ("evidence-based medicine" OR "evidence-based practice") AND "clinical competence", (10) "Clinical Expertise" AND ("evidence-based medicine" OR "evidence-based practice") AND "chiropractor patient relationship", (11) "clinical expertise" and "evidence-based medicine" or "Evidence-based practice" and "chiropractor patient relationship", (12) "Clinical Expertise" AND ("evidence-based medicine" OR "evidence-based practice") AND "skills development" AND "training", (13) "Clinical Expertise" AND ("evidence-based medicine" OR "evidence-based practice") AND "chiropractor", (14) "Clinical Expertise" AND ("evidence-based medicine" OR "evidence-based practice") AND "regulated health care professional", (15) "Clinical Expertise" AND ("evidence-based medicine" OR "evidence-based practice") AND "healthcare professional", (16) "Clinical Expertise" AND ("evidence-based medicine" OR "evidence-based practice") AND "clinical judgement", (17) "Clinical Expertise" AND ("evidence-based medicine" OR "evidence-based practice") AND "experiential knowledge"

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Person-centred care in chiropractic: a foundational but evolving commitment in contemporary practice

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Background: Person-centred care (PCC) is widely recognized as a cornerstone of high-quality healthcare, linked to improved outcomes and stronger therapeutic relationships. Its core principles of respect, empowerment, and responsiveness to individual needs, are closely aligned with core elements of the chiropractic approach. Yet, translating PCC into consistent practice remains a challenge.

Discussion: This commentary explores the value and complexity of PCC in chiropractic, examining barriers such as time constraints, training gaps, patient expectations, and inadequate systemic supports.

Les soins axés sur la personne en chiropratique: un engagement fondamental, mais en constante évolution dans la pratique contemporaine

Contexte: Les soins axés sur la personne (SAP) sont largement reconnus comme étant une pierre angulaire des soins de santé de haute qualité, en lien avec de meilleurs résultats et des relations thérapeutiques plus solides. Ses principes fondamentaux de respect, d'autonomisation et de réactivité aux besoins individuels sont en étroite harmonie avec les principaux éléments de l'approche chiropratique. Cependant, traduire les SAP en pratique cohérente demeure un défi.

Discussion: Ce commentaire examine la valeur et la complexité des SAP en chiropratique, en examinant les obstacles comme les contraintes de temps, les lacunes en matière de formation, les attentes des patients et les mesures de soutien systémiques inadéquates.

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Conclusion: This paper argues that while chiropractic is well-positioned to embrace PCC, doing so requires a shift from viewing PCC as an inherent feature of the profession to embracing it as an intentional, ethical, and relational commitment. Strategies for advancing PCC are discussed across clinician, patient, and organizational levels to support its consistent and equitable implementation.

***Author's Note:** This paper is one of seven in a series exploring contemporary perspectives on the application of the evidence-based framework in chiropractic care. The Evidence Based Chiropractic Care (EBCC) initiative aims to support chiropractors in their delivery of optimal patient-centred care. We encourage readers to review all papers in the series.*

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KEY WORDS: chiropractic, evidence-based practice, patient-centred (centered) care, person-centred (centered) care, patient preference, shared decision-making

Conclusion: Ce document soutient que bien que la chiropratique soit bien placée pour adopter les SAP, cela nécessite un changement de perspective, passant de la considération des SAP comme étant une caractéristique inhérente à la profession à son adoption en tant qu'engagement intentionnel, éthique et relationnel. Nous discutons des stratégies pour faire progresser les SAP dans l'ensemble des niveaux cliniques, des patients et organisationnels afin de soutenir leur mise en œuvre cohérente et équitable.

***Note de l'auteur:** Ce document fait partie d'une série de sept documents examinant les perspectives contemporaines sur la mise en œuvre du cadre fondé sur des données probantes pour les soins chiropratiques. L'initiative de soins chiropratiques fondés sur des données probantes (SCFDP) vise à soutenir les chiropraticiens dans la prestation de soins optimaux axés sur le patient. Nous encourageons les lecteurs à consulter tous les articles de la série.*

(JCCA. 2025;69(3):273-280)

MOTS CLÉS : chiropratique, pratique fondée sur des données, soins axés sur le patient, soins axés sur la personne, préférence du patient, prise de décision commune

Introduction

Person-centred Care (PCC) is widely endorsed as a cornerstone of high-quality healthcare.[1] Yet, translating this ideal into consistent clinical practice remains a challenge across professions.[1] This commentary critically examines the current state of PCC in chiropractic, a field with traditional elements that align with person-centred principles. Aimed at chiropractors, educators, regulators, and researchers, this paper explores how PCC is being implemented, where gaps persist, and what strategies can strengthen its delivery in contemporary practice. In doing so, it invites the chiropractic profession to reflect not only on its identity but on its responsibility to deliver relational, equitable, and evidence-informed care.

PCC is a model of care that respects and responds to individual preferences, needs, and values.[2–4] Chiropractic care has historically emphasized a person-centred approach, grounded in hands-on treatment, holistic orientation, and individualized care.[5] Indeed, this has been communicated through standards of practice, as the College of Chiropractors of Ontario note that chiropractors are required to provide PCC within the chiropractic scope of practice, focusing on each patient's unique motivations and treatment goals.[6,7] This regulatory emphasis reflects broader principles including respect, communication, empowerment, and relational trust, which are foundational to individualized chiropractic care[8–10] and aligned with modern definitions of PCC.[2,4]

PCC is associated with improved patient outcomes, higher clinician satisfaction, stronger therapeutic relationships, and more efficient resource use.[11–15] Within the broader framework of evidence-based practice (EBP),

Haynes *et al*. emphasize that high-quality care rests on the integration of best research evidence, clinical expertise, ***patient preferences and actions***, and clinical context.[16] Although each pillar of EBP has been individually well explored in the literature, the actual interaction of patient preferences and actions with clinical expertise and research evidence remains comparatively underexplored, particularly in chiropractic. By emphasizing PCC, this paper advances that discussion and highlights its importance for achieving more balanced and integrated evidence-based practice. This positions PCC as a foundational component of clinical decision-making.[17,18]

Given these benefits and conceptual alignment, chiropractic appears well-suited, and has strong reasoning, to embrace PCC. However, as this paper explores, the routine implementation of PCC in chiropractic care is complicated by real-world constraints, inconsistencies in training and expectations, and broader systemic challenges.[8,19] Moreover, as the health systems literature increasingly recognizes, PCC is not just about adopting better communication or adding new tools.[20] Rather, it requires a fundamental reorientation of how we understand clinical authority, patient agency, and evidence itself.[1,20]

This commentary aims to: 1) affirm the profession's strengths and values in relation to PCC; 2) critically examine the persistent barriers to its full realization; and 3) propose strategies at the level of the clinician, patient, and organization to advance PCC as both an ethical imperative and a professional standard. Through this lens, the paper encourages the chiropractic profession to move beyond symbolic alignment with PCC and toward its consistent, measurable, and equitable implementation across all settings.

Discussion

Why PCC matters

Chiropractors operate within a therapeutic model that naturally lends itself to PCC. Patients managing chronic conditions or seeking alternatives to pharmacological interventions often report a strong therapeutic bond with their chiropractors, built on empathy, time, and trust.[8,9,21,22] Research has identified core elements of chiropractic encounters, such as trust, communication, and active listening, as central to patient satisfaction and adherence.[21,22] In interdisciplinary settings, patients receiving chiropractic services alongside medical care rated the quality of care more highly, particularly in terms of information provided, treatment recommendations, and provider concern – reporting greater satisfaction, perceived improvement, and quality of life compared to medical care alone.[23] Chiropractic patients also report higher scores on self-management support and shared decision-making compared to those in conventional settings.[24] This indicates a clinical culture that prioritizes partnership and co-creation of care.

While these findings highlight clear benefits, much of the chiropractic evidence on PCC relates to outcomes such as perceived satisfaction, trust, and improvement rather than endpoints like pain or disability.[21-24] This gap does not diminish the ethical or relational importance of PCC, but underscores the need for research that evaluates its effect on the outcomes that brought patients to seek care in the first place.

Importantly, the impact of PCC is not just in outcomes, but in process. As Ivanova *et al*. suggest within chiropractic care, patients' sense of being understood and respected is itself a therapeutic mechanism, fostering trust, reducing tension, and enhancing engagement.[25] Whether through goal-setting in various patient contexts or the ability to raise psychosocial concerns in clinical practice, the therapeutic alliance enables chiropractors to address physical, emotional, and contextual dimensions of health. [26,27] Accordingly, PCC becomes not a "nice-to-have" feature but a defining element of effective care.

Nevertheless, research points to inconsistencies in care provision. A pilot study found that while chiropractors and patients shared good rapport, many clinical interactions lacked structured follow-up or goal-setting.[22] Another study found chiropractic students were rated highly for empathy and active listening, but less so for adapting care to patient circumstances.[28] These gaps suggest that while PCC is often present in spirit, it may not be consistently embedded in the habits, systems, and training structures of practice.

Barriers to PCC in chiropractic

If PCC aligns so well with chiropractic approaches, why is its implementation uneven? The answer lies not in professional resistance, but in the real-world frictions of practice that shape all healthcare: time, systems, training, and power.

Time and workload pressures

Time constraints are repeatedly identified as a key barrier to PCC, for both clinicians and patients.[8,10,19,27,29] It takes time to build trust, explain diagnoses, explore values and concerns, and co-develop plans.[22,25,30] In fee-for-service models or multidisciplinary settings, these efforts can feel unsustainable. One study documented significant variation in consultation time among sports chiropractors, even with the same patients, highlighting inconsistencies in how space for PCC is created.[26]

Training and communication gaps

Effective communication between healthcare professionals and patients is often assumed rather than taught. Studies show that chiropractic students demonstrate empathetic intent but struggle with complex shared decision-making and adapting care to diverse contexts.[28,31] Practicing chiropractors similarly report limited training in communication, trauma-informed care, or culturally safe practice, which involves creating an environment where patients feel their cultural identity is respected.[19] High-performing health systems adept at delivering both EBP and PCC have both structured training and interdisciplinary communication, facilitating the clinical skills needed to balance evidence-based recommendations with individual patient preferences.[17] Without intentional development of these skills, PCC risks being interpreted as bedside manner rather than a rigorous clinical competency.

Patient expectations and roles

Not all patients want to engage in shared decision-making. Some patients expect directive care; others are wary of voicing disagreement.[8,9,32–34] In chiropractic, this can create tension when patients expect manual therapies but receive exercise prescription, lifestyle counselling, or behavioural interventions.[8,9] Tensions can also emerge when patient preferences conflict with evidence and recommended care.[17,35] For example, patients are often more willing than clinicians to accept potential side effects in exchange for desired health outcomes, highlighting a potential disconnect between clinical decisions and patient values.[36] Clinicians must bridge these gaps, honouring patient expectations while gently introducing new models of partnership.

Systemic and structural limitations

Perhaps most importantly, chiropractors operate without many of the supports that enable PCC elsewhere, such as hospitals. These include decision aids, interdisciplinary rounds, communication tools, or structures that reward reflective and individualized care.[17,19] Structural enablers such as culturally appropriate resources, funding for longer visits, or outcome measures that reward relationship-building are often missing.[19] Expecting clinicians to deliver PCC without system-level support not only undermines its feasibility, but also risks burnout and moral distress.[17,19,37]

Beyond technique: reimagining PCC as a relational and ethical practice

To truly advance PCC in chiropractic, the profession must move beyond a focus on technique to embrace PCC as an epistemological and ethical commitment.[1,38,39] PCC is not just about how care is delivered, but whose knowledge counts, whose voice leads, and how decisions are made.

Relational ethics literature emphasizes that ethical decisions and care arise in the context of the relationship between patient and provider and urges us to see care as co-created in the interaction, not delivered by a provider to a passive recipient.[38,39] This demands humility, reflexivity, and an openness to difference. It requires acknowledging the limitations of professional knowledge, and actively inviting lived experience, cultural identity, and social context into the clinical dialogue.

There is strong reasoning for chiropractic to adopt PCC as a central direction for the profession, which would then drive change in education and practice. Chiropractors' model of care already emphasizes elements of PCC, such as touch, time, and trust. But to remain relevant and responsible, the profession must ensure these assets are used in the service of shared power, not professional authority.

The way forward: strategies for advancing person-centred chiropractic care

Clinicians: cultivating relational and reflective practice

PCC begins with how chiropractors present themselves in the clinical encounter. Active listening, clear explanations, curiosity, empathy, and explicit invitations to

co-design care are small but powerful components that can build an effective therapeutic alliance.[8,9,21,22,30,40–44] Reflective practice, encompassing critical self-awareness and continuous learning, helps clinicians develop the capacity to notice and respond to power imbalances, and avoid assumptions and blind spots that undermine PCC.[19,45,46] Mentorship, particularly for early-career chiropractors, also plays a vital role in supporting the development of these capacities and modelling person-centred behaviours in practice.[19,40] Cultural humility, understood as an ongoing commitment to self-reflection, openness, and lifelong learning about patients' diverse values and experiences, must also be part of routine training, not treated as an optional extra. Chiropractors would benefit from culturally appropriate resources in delivering PCC,[19] and studies show clinician respect for cultural influences can enhance communication, collaboration, and care quality.[47,48]

PCC also requires recognizing that relational care is *efficient* care. When clinicians and patients connect meaningfully, they reduce misunderstandings, improve patient confidence in the treatment, avoid unnecessary treatments, and co-create plans that patients are more likely to follow.[26,27,41] Even in time-limited settings, PCC can be implemented efficiently through intentional communication and shared decision-making. As clinicians build relational and reflective skills, PCC becomes a natural part of care that reduces delays, enhances outcomes, and ultimately saves time.

Patients: supporting confidence, voice, and participation

While clinicians must invite collaboration, patients need support to participate. Clinicians have a role and a responsibility to help patients engage in collaborative decision-making, both by encouraging confidence building and offering tools to support advancing the patient's competency in engaging in patient-partnered practice.[49] Educational materials, visual decision aids, and plain-language explanations empower patients to engage in their care and enhance PCC.[24,25,27,45,50,51] Clinicians should normalize disagreement, validate lived experience, and challenge hierarchies that silence patient voices through fearing judgement or assuming their input will not be valued.[33] This includes challenging assumptions that clinician expertise always outweighs lived experience, or that asking questions are disruptive, so that patients feel safe to speak openly and participate as equal partners in their care.[45,52] An open, curious approach fosters meaningful dialogue and helps ensure care is developed with patients, not for them.[25,45]

This is especially important for patients with lower health literacy, linguistic barriers, or cultural distrust of medical systems.[37,47] PCC requires not just clinical competence but relational justice: care that actively removes barriers to full participation.[38,39,47]

Organizations: embedding PCC into systems and culture

Sustainable PCC depends on systems that value and reward it. Clinics and professional bodies, such as associations and regulators, shape the culture that enables and strengthens PCC through clear expectations and strong leadership.[17,19,40,53] Embedding these constructs into chiropractic systems through strategic initiatives, leadership, training, and incentives, organizations can shape the profession's norms and capacities with PCC.[42,48,54–56]

System design structured through follow-ups, interdisciplinary coordination, and standardized communication provides a foundation to make PCC a lived experience.[30] Clinics can integrate PCC competencies into mentorship and through cultures of reflective practice such as holding regular clinical rounds.[17,19,57] Institutions can offer continuing education on PCC concepts such as shared decision-making and cultural safety to bridge PCC skills with EBP.[19,56] Intake forms, care plans, and outcome tools should be used that reflect psychosocial as well as physical domains, consistent with a biopsychosocial and person-centred approach.[19]

At the professional level, associations should embed PCC in accreditation, promote research on patient experience, and provide clinicians with evidence-based PCC tools.[19,54] For example, available in this series of papers is a clinical decision tool that supports person-centred, evidence-based decision-making in circumstances where high-quality research evidence is limited.[58] Educational institutions must ensure PCC is not siloed into communication skills modules, but woven throughout clinical reasoning and ethics.[19,31] Implementation in clinical settings is strengthened when institutional structures, such as clinician release time, interprofessional education, and collaborative infrastructure, are aligned to reinforce and enable person-centred, team-based care.[23]

Conclusion

Reaffirming a core identity

PCC is a defining feature of evidence-based chiropractic care. It enhances patient and clinician outcomes, while reflecting the profession's foundational values. PCC is not simply an interpersonal dynamic. It is a justice-oriented, evidence-informed and relational process. Practicing PCC consistently requires more than intent, it demands action. Chiropractors must engage patients as partners, organizations must invest in supportive systems, and patients must be empowered to participate fully in care. Barriers like time, training, and infrastructure are real, but solutions exist in leadership, education, practical tools, and reflective practice.

By embracing PCC not only as a method, but as a mindset and ethic, the chiropractic profession can ensure its care remains deeply human, scientifically sound, collaborative and socially accountable. Future research should also evaluate the influence of PCC not only on relational and experiential outcomes, but clinical outcomes such as pain and function.

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Enhancing evidence-based chiropractic practice: bridging the knowledge-to-action gap for the needs of community-based chiropractors

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Objective: *To summarize key factors of knowledge translation (KT) and offer actionable recommendations to improve uptake and application of evidence-based practice (EBP) in chiropractic care*.

Methods: *We conducted a narrative review searching for KT literature in PubMed, Web of Science, and Scopus from January 2016 to August 2024. Titles and abstracts were screened for eligibility and relevant articles underwent full-text review. We used an expert consensus approach to form our recommendations*.

Améliorer la pratique de la chiropractie fondée sur des données probantes: combler le fossé entre la connaissance et l'action pour les besoins des chiropraticiens communautaires.

Objectifs: *Pour résumer les principaux facteurs du transfert des connaissances et offrir des recommandations concrètes pour améliorer l'adoption et la mise en œuvre des pratiques fondées sur des données probantes (PFDP) dans les soins chiropratiques*.

Méthodes: *Nous avons réalisé une revue narrative à la recherche de documentation sur le transfert des connaissances dans PubMed, Web of Science et Scopus pour la période allant de janvier 2016 à août*

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Results: *We identified KT barriers and facilitators at individual, collegial, and organizational levels. Recommendations include advocating for individual clinicians to pursue continuous education and mentorship, and for professional organizations to support KT funding and foster supportive and collaborative environments for individual clinicians to engage in KT.*

Conclusions: *To bridge the knowledge-to-action (KTA) gap in the chiropractic profession, chiropractors should engage in learning environments to develop necessary EBP skills, while associations should focus on supporting and incentivizing chiropractors to enhance their KT abilities.*

Author's Note: *This paper is one of seven in a series exploring contemporary perspectives on the application of the evidence-based framework in chiropractic care. The Evidence Based Chiropractic Care (EBCC) initiative aims to support chiropractors in their delivery of optimal patient-centred care. We encourage readers to review all papers in the series.*

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KEY WORDS: chiropractic, clinical skills, evidence-based practice, institutional practice, interdisciplinary research, knowledge translation, organizational policy

2024. Les titres et les résumés ont été examinés pour déterminer leur admissibilité et les articles pertinents ont été présentés en vue d'un examen complet. Nous avons utilisé une approche de consensus d'experts pour formuler nos recommandations.

Résultats: *Nous avons cerné des obstacles et des facilitateurs au transfert des connaissances aux niveaux individuel, collégial et organisationnel. Les recommandations incluent de plaider en faveur de la formation continue et du mentorat pour les cliniciens particuliers, et les organisations professionnelles doivent soutenir le financement du transfert des connaissances et favoriser des milieux de soutien et de collaboration pour que les cliniciens particuliers participent à ce transfert.*

Conclusions: *Pour combler le fossé entre la connaissance et l'action dans la profession chiropratique, les chiropraticiens devraient participer dans des milieux d'apprentissage pour améliorer les compétences des PFDP nécessaires, tandis que les associations devraient se concentrer sur le soutien et l'incitation des chiropraticiens à améliorer leurs capacités en transfert des connaissances.*

Note de l'auteur: *Ce document fait partie d'une série de sept documents examinant les perspectives contemporaines sur la mise en œuvre du cadre fondé sur des données probantes pour les soins chiropratiques. L'initiative de soins chiropratiques fondés sur des données probantes (SCFDP) vise à soutenir les chiropraticiens dans la prestation de soins optimaux axés sur le patient. Nous encourageons les lecteurs à consulter tous les articles de la série.*

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MOTS CLÉS : chiropratique, compétences cliniques, pratique fondée sur des données probantes, pratique institutionnelle, recherche interdisciplinaire, transfert des connaissances, politique organisationnelle

Introduction

Evidence-based practice (EBP) is essential to enabling the highest standard of clinical care. Central to EBP is the incorporation of the best available research evidence with clinical expertise, clinical circumstances, and patient preferences, as we discuss in companion articles throughout this JCCA special edition.[1,2] Integrating research evidence into each of these factors of EBP facilitates optimal clinical decision-making, contributing to enhanced patient outcomes.[1]

Effectively applying the best evidence into practice is dependent on the resources available to a clinician,

as well as on a clinician's ability to translate new knowledge into improved practice.[3] This process, however, is often 'slow and haphazard', thereby delaying the benefits of new research and subsequently, improved outcomes for patients.[4,5] There are also inconsistencies across disciplines in the application of high-quality research in practice, posing risk of providing potentially ineffective or even harmful treatments through either outdated or prematurely adopted research.[4] Clinicians also face ever-expanding bodies of literature, making it challenging to keep up-to-date with the latest evidence.[4] Additionally, the support available to clinicians is context-dependent, making it harder for clinicians in private practice settings to efficiently translate new evidence into practice. In Ontario, for example, the majority of chiropractic practitioners are in small, community-based private practice settings, and do not have access to the same institutional supports as other healthcare professions, such as medicine or nursing, practising in the publicly-funded system.

The increasing availability of high-quality research, corresponding with a lack of uptake and utilization of such research has been described as the "knowledge-to-action (KTA) gap".[4] This gap between what clinicians know as opposed to what clinicians actually do has been identified to be an important determinant of overuse, misuse, and underuse of healthcare services, caused by the limited ability of healthcare providers to translate research, policy, and new technology into practice safely and appropriately.[6] As a consequence, patients may not always receive safe and effective healthcare, and even if they do it may not be in a timely manner.[6]

The term "knowledge translation (KT)" has gained prominence in Canada, where KT refers to addressing this gap between knowledge gained from research and knowledge implementation by key stakeholders, including patients, policy-makers, healthcare professionals and others, to improve health outcomes and healthcare efficiency.[4] Bridging the KTA gap therefore requires identifying and overcoming barriers to KT at each of these levels (Figure 1). One significant, looming KTA barrier is the lack of conceptual clarity regarding the meaning of "knowledge translation", creating a source of confusion for researchers and clinicians alike.[4,5] With many existing definitions of KT, one that has been largely adopted comes from the Canadian Institutes of Health Research (CIHR) in 2007,[5] which was subsequently updated in 2016 to describe KT as a:

> *"…dynamic and iterative process that includes synthesis, dissemination, exchange and ethically-sound application of knowledge to improve the health of Canadians, provide more effective health services and products and strengthen the healthcare system".*[3]

Nonetheless, ambiguity surrounding a universal understanding of KT remains. Potentially explaining, in part, findings from a recent scoping review analyzing KT, evidence implementation, and research utilization in chiropractic that found there is still a KTA gap between research and practice despite favourable attitudes toward EBP among clinicians.[7] Collectively, this calls for more robust dissemination and implementation of research to improve the application of research into practice.[4,7] Accordingly, the objectives of our paper were to: (1) Summarize key facilitators and barriers to KT of EBP from the published literature; and (2) offer actionable recommendations to improve the uptake and application of EBP in routine chiropractic care.

Methods

Working group

The working group included researchers (n=4), clinicians (n=4), educators (n=3), and Ontario Chiropractic Association staff members (n=2). The group's content expertise and experiential knowledge of the unique challenges faced by healthcare professionals working in private community-based practice settings were incorporated with the literature review findings to guide recommendations.

Study design

We conducted a narrative review of the literature to summarize barriers and facilitators to KT of care providers across all healthcare relevant disciplines, at the individual, collegial/peer, and organizational level. The working group then reviewed the findings and developed actionable recommendations to improve the uptake and application of EBP into chiropractic care.

Data sources and searches

We searched PubMed, Web of Science, and Scopus databases to identify KT articles published between January

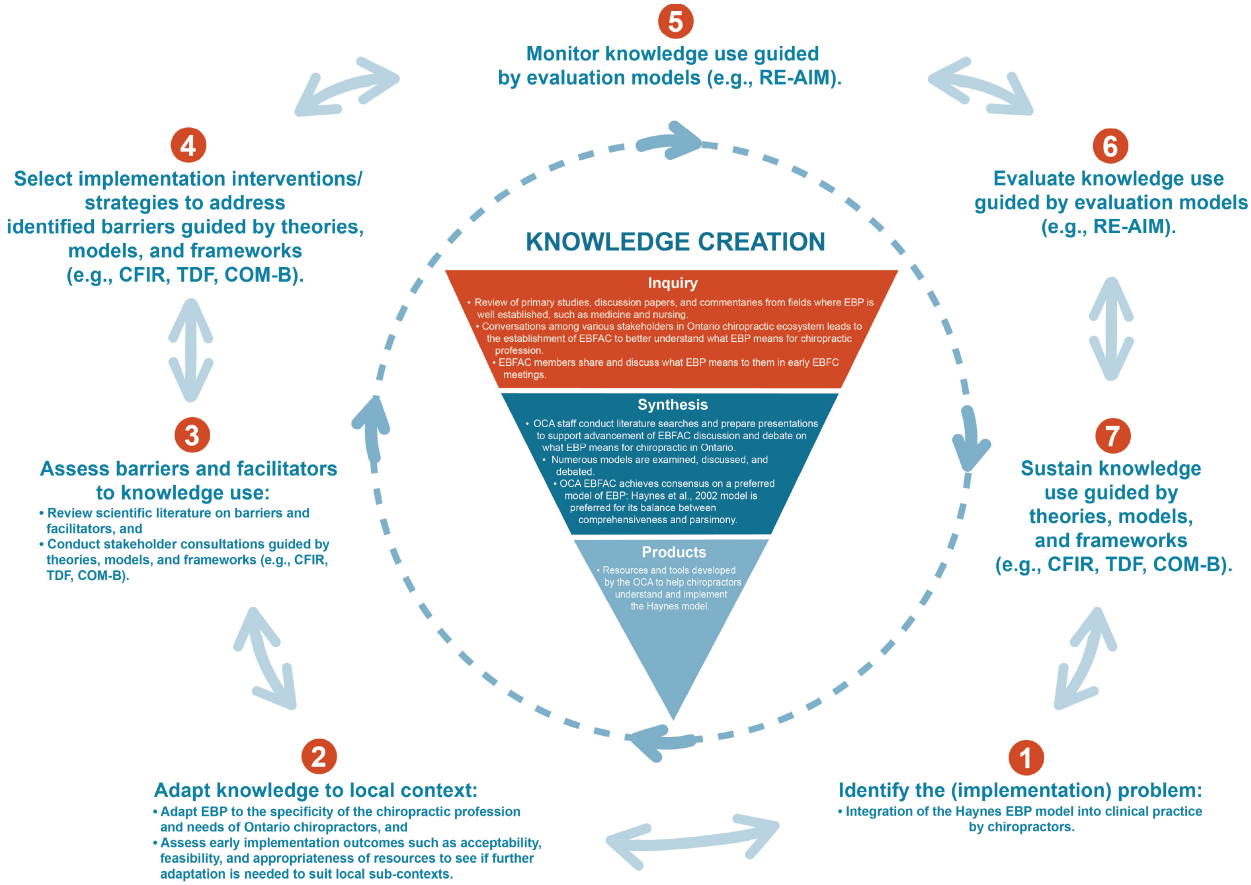

Figure 1.

The knowledge-to-action process: a framework to implement the Haynes EBP model with chiropractors in Ontario and close the KTA gap. Adapted from "The Knowledge to Action Process" by the Canadian Institutes of Health Research (CIHR), as available on the CIHR website.[3] *CFIR = Consolidated Framework for Implementation Research, TDF = Theoretical Domains Framework, COM-B = Capability, Opportunity and Motivation model of Behaviour, RE-AIM = Reach, Effectiveness, Adoption, Implementation, Maintenance.*

1, 2016, and August 1, 2024. This date range was imposed to extend the findings of the 2016 scoping review by Bussières *et al.*[7] and provide a contemporary summary of barriers and facilitators to KT that are applicable to today's clinical chiropractic environment. We employed a range of search terms to capture pertinent literature on barriers and facilitators to KT, evidence integration (EI), or research utilization (RU), in line with our objectives (Appendix 1).

Selection criteria

We included empirical research articles as well as secondary sources of evidence (e.g., systematic, scoping, or narrative reviews, and commentaries) that explored the barriers, facilitators, and strategies for successful KT of EBP, EI, or RU across disciplines. We included articles regardless of discipline because KT implementation strategies are valued and transferable across sectors. We excluded conference abstracts and letters or editorials, as well as articles that did not explicitly analyze KT, EI, or RU.

Screening process

One author assessed titles and abstracts of identified articles to determine eligibility. Articles deemed potentially relevant underwent full-text review by the same author.

The rest of the working group confirmed inclusion of each full-text article.

Data extraction

Descriptive information was extracted from included full-text articles (i.e., first author, year of publication, field/discipline, and barriers and facilitators to KT, EI, or RU). Extracted data were summarized and presented in tabular form and grouped within overarching themes of KT, EI, and RU barriers and facilitators from the reviewed literature by one reviewer. Each barrier and facilitator were also categorized according to whether KT was influenced by individuals alone, the collegial/peer relationship, or organizations/institutions for recommendations by the same reviewer. The data extraction table underwent independent review among the full working group, and required unanimous consensus among the full group.

Data analysis and development of recommendations

Recommendations were developed and proposed individually via e-mail by members of the working group. All recommendations required unanimous consensus to be approved, which was achieved through iterative discussions among the working group, also via e-mail. The recommendations were focused specifically on what professional associations and similar organizations could do to support their members' KT, EI, and RU needs and responsibilities.

Results

Of 1,432 articles identified in database searches, 45 were included in our review (Appendix 2). Included articles encompassed 20 unique health related disciplines with each providing insights into KT and offering barriers and/or facilitators to the effective integration of evidence into clinical practice (Appendix 3).

Barriers and facilitators to KT

We found many key determinants of KT in the reviewed literature that are relevant to community-based chiropractors (Appendix 3), and categorized these into three levels: (1) individual practitioner[7–32], (2) collegial/peer community[7,12,14,16–18,20,23–25,30,32–44], and (3) institutional/organizational[7,8,10–20,23,25–28,31–35,37,38,40–42,44–51] (Figure 2). Regardless of the field of practice, determinants of KT, EI, and RU in practice were found to share commonalities.

Level 1: Barriers and facilitators to KT for the individual practitioner

At the individual level, we identified barriers and facilitators to KT in the reviewed literature that influenced a practitioner's and/or researcher's ability to engage in KT initiatives (Appendix 3).

Barriers

Without adequate training (and/or time to train) in research methods and KT implementation, practitioners across fields often lack the confidence and ability necessary to assess and appropriately translate research into practice.[7,9,10,13,20,22,28,29,32] One systematic review investigating KT of health research found that insufficient critical appraisal skills and difficulty in understanding and applying research among clinicians were major barriers to KT.[10] This issue was also raised in veterinary medicine, in that practitioners tend to focus on journal abstracts rather than the full-text articles, which prevents them from gaining a deeper understanding of the findings and methods described in the parent article.[9] A scoping review exploring uptake of new research and technologies in neurorehabilitation identified that steep learning curves associated with applying new findings or technologies in research also pose barriers to KT, exacerbating challenges of limited research training and KT skills.[20] Moreover, chiropractic literature adds that time constraints faced by practitioners hinders robust dissemination of research into practice, posing challenges to KT regardless of a clinician's KT knowledge, skill, or attitudes.[7,11]

Research involving the disciplines of health policy and physical rehabilitation has identified that tensions within researcher-clinician interactions further serve as a barrier to effective KT, EI, and RU at the individual level.[30,31] In particular, research investigators often develop robust programs of research; however, clinicians face challenges with applying research results to the realities of clinical practice and individual patient circumstances.[30,31] Contextually, these tensions can sometimes arise as a consequence of investigators making recommendations based on ideal circumstances (e.g., carefully calibrated characteristics and inclusion criteria for research participants in fastidiously conducted clinical trials), as compared with

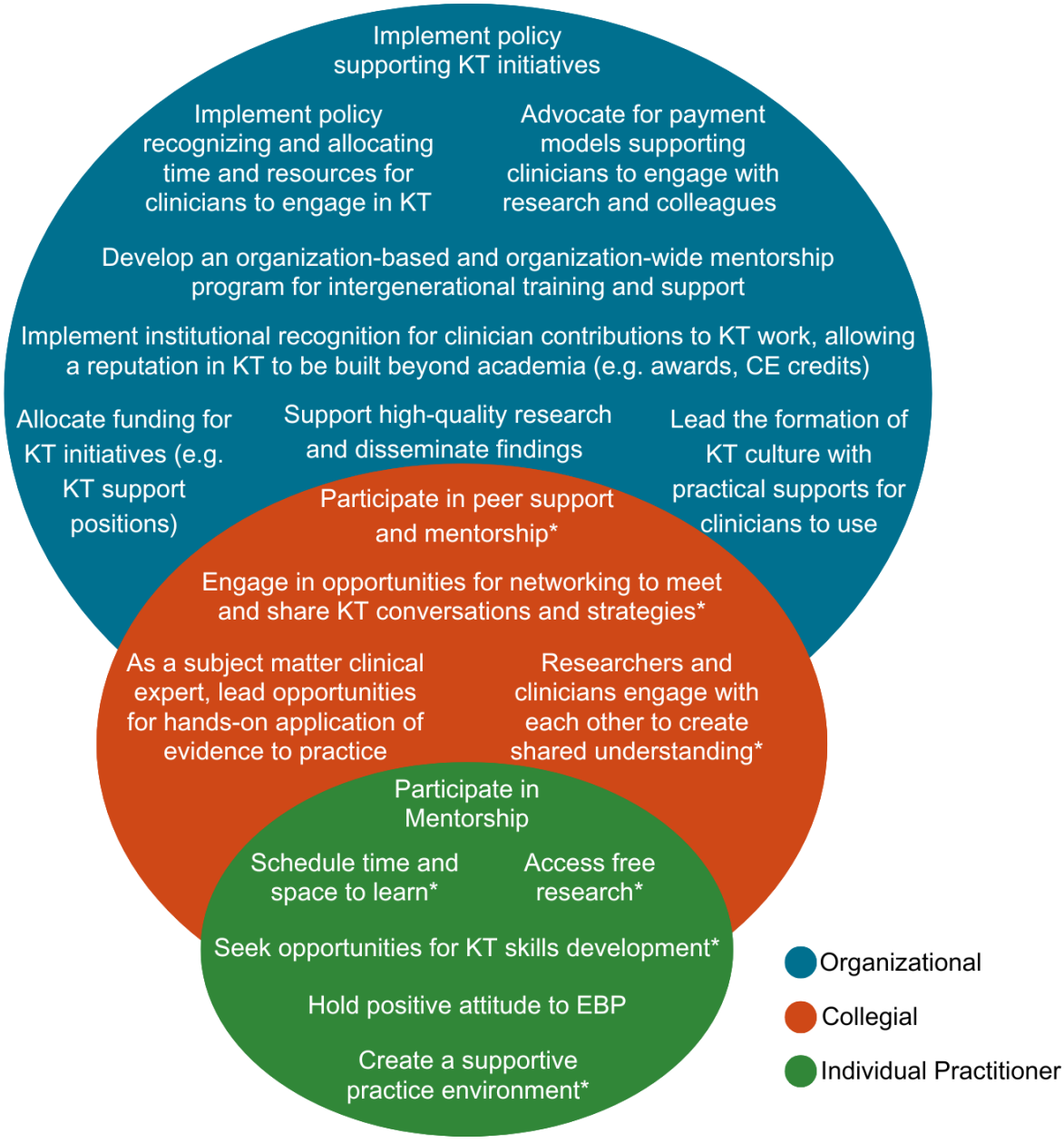

Figure 2.

*Summary of facilitators, enablers, and recommendations for implementing effective KT, EI, and RU in community-based clinical practice. *Indicates individual and collegial level facilitators that can be directly supported by organizations.*

the imperfect and uncalibrated realities faced by practitioners serving patients in clinical practice.[30] Moreover, poor methodological rigour of studies, lack of standardized outcome measures, and feasibility issues for implementing results (e.g., lengthy protocols for clinicians to follow), have additionally been shown to hinder uptake of research into practice.[15,44] A survey of Swiss chiropractors further indicated that a perceived lack of clinical evidence in the chiropractic field itself contributed to limited application of research findings in daily practice.[11]

Facilitators

Research in occupational therapy and physiotherapy education suggests that collaboration between academic faculty, clinical preceptors, researchers, clinicians, and patients in classroom settings can enhance EBP and KT competencies among individual students.[16] Findings from a mixed methods study by Roberge-Dao *et al*. showed that involving clinicians at the start of a research project's conceptualization, as well as throughout the research process, can help improve the external validity of the results and the likelihood of their implementation in practice.[30] Provider internal motivation and willingness to learn have also been shown to be major facilitators for uptake of research and implementation of EBP among individual practitioners in nursing.[10,24]

As suggested in academic and education-related literature, individual level barriers to KT can be balanced by formal institutional recognition of the value of KT work, and the opportunity for researchers to build a reputation in KT, beyond academic publishing, to enhance career development.[19,31] This could incentivize and personally motivate researchers and practitioners alike to overcome barriers to KT at the individual level, and promote better research culture and implementation in general.[19,31] A scoping review investigating KT of EBP practices within cerebral palsy care highlights how protected, or compensated, time for individual clinicians to engage with research facilitates KT and implementation of EBP.[17] Others have similarly shown that compensated 'release time' for clinicians to engage in KT activities effectively facilitates KT.[23]

Research findings themselves can also offer potential incentives for KT.[25] For example, a qualitative study involving Swiss pharmacists and clinicians found that when research favoured implementation of pharmacist/clinician services that had potential to offer economic value to these practitioners, it facilitated uptake of the research findings into clinical practice.[25]

Level 2: Barriers and facilitators to KT for the collegial/peer community

We found several variables in the reviewed literature that influence effective KT at the collegial/peer community level (Appendix 3). In particular, we identified several facilitators that can help overcome common barriers surrounding KT initiatives.

Barriers

Lack of interpersonal skills or physical proximity represent the major barriers to effective KT at the collegial/peer community level. These can lead to limited interdisciplinary collaboration, which has been shown to hinder implementation of care services that are beneficial to patients.[25] A difficult or poor work culture in which colleagues/peers show resistance to change has also been shown to hinder uptake of new findings or methods.[12,14] Due to the collaborative nature of work involving the interdisciplinary and public health fields, literature in these areas offer a unique context for overcoming barriers to effective KT,[35,36,43] as described below.

Facilitators

Findings from both interdisciplinary and public health research suggest that early engagement with stakeholders facilitates KT at the collegial/peer community level by ensuring research is tailored to the end-user.[36,38,43] Moreover, the use of effective knowledge brokers (e.g.., intermediary organizations or persons) to disseminate research or engage stakeholders in collaborative training activities can facilitate evidence-informed decision-making for institutions and clinicians, as well as increase understanding for patients and the public.[17,18,30,35,43] Reviewed literature further suggests that researchers, policy-makers, and practitioners across disciplines must engage in collaborative efforts to enhance their KT abilities.[8,30,32,35,36,38–43] Such efforts contribute to acquired collaborative skills and strengthened partnerships among those involved in the care and research process, further facilitating KT.[34,35,43] Members of multidisciplinary teams, given their unique position to perceive contextual barriers across disciplines, also play a major role in facilitating collaborations and advancing KT.[52]

Another major facilitator of collaboration and KT at the collegial/peer community level is physical proximity (e.g., shared office or clinic space).[23,30,32] Close physical proximity enables more frequent, engaging, and in-person conversations allowing for the sharing of motivations for engaging in KT work and skills development.[30,32] Conversations among practitioners in particular help frame individual clinical projects (e.g., sharing of patient cases, study findings, lectures, etc.) within the broader context of research, fostering an understanding that each project is a part of a larger initiative.[30,36] Moreover, close physical

proximity between researchers and clinicians facilitates researcher and knowledge-user interaction and collaboration, further promoting KT.[23]

Collaborative dialogue among KT stakeholders depends on a strong 'top-down' organizational culture valuing KT, EI, and RU.[37] In the nursing profession, for example, nurses are seen as integral members of care teams, and research utilization in practice depends on access to electronic resources, organizational support for KT-related skills development, and a culture that values continuous learning.[37] A qualitative study of program directors in medical education also found that easy access to summaries, reviews, and guidelines of primary research, facilitated use of research within the field.[14] Some studies further suggest that mentorship programs are effective strategies in facilitating KT (e.g., supportive KT "champions"), bridging knowledge-practice gaps and fostering collaboration among different generations.[7,12,14,17,24,33,39,52]

Level 3: Barriers and facilitators to KT at the institutional/organizational level

At the institutional/organizational level, the main barriers and facilitators to KT that we identified in the reviewed literature included factors that either supported or restricted KT initiatives at the individual or collegial/peer community level (Appendix 3).

Barriers

Lack of funding is a key barrier for KT at the institutional level. For funding to most effectively enable KT, it is necessary to be geared by way of policy to KT, EI, and RU as well as align with the researchers' and institutions' goals and priorities.[47,48] However, developing and maintaining continuity and motivation in funding partnerships is a challenging and intensive process, hence there is a need for institutions to establish KT leaders within their organization to maintain engagement with all stakeholders, including funding agencies.[48,51] A lack of funding and/or institutional restrictions have been demonstrated in the literature to be major organizational barriers to optimal KT.[45] Professional associations, educational institutions, funding agencies, and organizations therefore play an important role in shaping the culture of KT, EI, and RU within practitioner communities.[46] This is particularly done through policy adoption and creating an environment that values KT.[26,53]

Facilitators

A national environmental scan found that demonstrable institutional support and advocacy for practitioners to engage collaboratively with literature was needed to address barriers of evidence-informed healthcare and KT.[38] In particular, institutional backing demonstrated through policies mandating dedicated time for literature review, organizing educational events, and promoting research literacy was suggested in the scan to set the tone for KTA priorities.[38] Organizational supports provided within these expectations included opportunity for building capacity and networks to participate in KT activities, sharing accessible evidence, education, training, motivation/incentives, and enabling researchers to carry out KT activities.[38] Additional literature suggests that tailored capacity building, education, and training sessions for KT purposes offered by organizations in particular, should be recommended across disciplines to bolster KT.[7,12,16,17,19,20,28,33,37,38,45,50] Certain disciplines such as dementia care and neurorehabilitation recommend continuous learning and aligning methods with KT goals, learner preferences, and workplace dynamics to facilitate optimal KT knowledge, skills, and implementation, as well as sustainability and effectiveness of KT.[19,20,33,38]

The reviewed literature also suggested that institutional-level actors are positioned to develop key messaging around KT, EI, and RU that resonates with diverse populations that access the institutions' resources.[19,34] Resources that are dedicated to ensuring the utilization of evidence in practice, such as free educational materials, access to critical reviews, full-text articles and support for RU in practice necessitates leadership, with a commitment to outcomes of KT-advancing initiatives.[7,27,38,50] This requires developing and allocating these resources for staff to foster a culture conducive to effective KT[10–13,18,23,33,38,46], as well as ensuring all resources are easily accessible.[8,14,28,37,50] Medicine-based literature suggests that institutions should also provide practitioners with pre-digested, trusted information, and paid time in daily practice devoted to systematic reading of clinical journals.[27] By providing these resources, organizations can optimize staff time, and improve confidence and ability in effectively translating research into practice.[28,37,50] Additional resources for facilitating KT at the institutional level include continuing education workshops and opportunities for networking with researchers.[10,16,17,23] Organizations

can offer incentives to their members for engaging in KT work[31,32,40–42], as a lack of KT incentives has been demonstrated to restrict KT in the chiropractic literature.[7]

Engaging knowledge-users (e.g., clinicians) in the research process was also found in our review as a key facilitator of KT in practice, particularly when building consensus around policy issues.[35,41,54] Institutions can contribute to this by fostering collaboration among stakeholders.[10,35,41,54] An institution's ability to have well-placed and credible KT researchers helps to facilitate KT activities through the effective installation of leaders who can facilitate and develop strategies to champion KT initiatives and motivate practitioners to join and participate meaningfully.[12,14,17,49] Individuals with such KT expertise would also be able to assist with informing funding agencies to ensure proper allocation of resources, maximizing KT benefits of EBP.[49]

Actioning review findings: context and recommendations

Context

The evolution of the historical boundaries between the public and private health systems in Canada is significant in context, shaping both the nature and level of institutional support for research and KT in these parallel but entangled systems. In the public single-payer system, data collection is centralized at the provincial level and is used to set the strategic direction of payment policy to drive clinical practice improvements and support for research.[55] KT is further supported by physical and social infrastructures characteristic of interprofessional team environments in, for example, hospitals, family health teams, and community health centres.

The situation for community-based private practice is substantially different, and this difference matters for how we conceptualize, plan for, and support KT initiatives in the chiropractic profession. For example, in Ontario, there are some 5,120 licensed chiropractors,[56] ~3,944 of which are members of the OCA. According to market research undertaken by the OCA in 2019, approximately 80% of the chiropractic care delivered is paid for through the private health insurance system,[57] primarily employer-sponsored plans. Though the market in Canada is dominated by a small number of large companies, there are over 160 insurance providers.[58] This results in a high degree of fragmentation and proprietary ownership of data collected by payors and clinics. This largely for-profit context does not have the same drivers of change as a public-payer system.

With respect to research funding, the CIHR has an annual budget of approximately $1 billion allocated across four pillars, which are (understandably) reflective of the priorities of the public system: (1) biomedical; (2) clinical; (3) health systems services; and (4) population health.[59] While research related to chiropractic practice fits within these pillars and does get funded, musculoskeletal (MSK) research related to rehabilitation and prevention does not get as much attention as other priority areas. By contrast, the major funder of chiropractic research in Canada is a private foundation, the Canadian Chiropractic Research Foundation (CCRF) (https://canadianchiropracticresearchfoundation.ca/). The CCRF relies on contributions from individuals, charities, and, in large part chiropractors themselves, via their membership dues in their provincial associations. Over a three-year span up until 2021, the CCRF provided just under $900,000 in grants to support chiropractic research.[60] However, both CCRF and CIHR funding are highly competitive and difficult to access. In 2021, for example, the average size per CIHR grant was $770,000 (CAD) over four years, with only a 17% success rate.[61] Moreover, the CCRF placed a recent funding cap of $25,000 on individual projects and no longer funds chiropractic university-based research chair positions, further limiting access to Canadian chiropractic research funding and support. Thus, there is an opportunity for chiropractic associations to collaborate with research and teaching institutions to monitor the research funding landscape with the aim of supporting chiropractic researchers, and especially early career researchers, to access the diverse sources of funding available.[62] In the Ontario environment these would also include the Natural Sciences and Engineering Research Council (NSERC), the Social Sciences and Humanities Research Council (SSHRC), and Mitacs. However, to access government grants, chiropractic researchers need to hold a faculty position at an academic institution or be directly affiliated with one of the few chiropractic researchers who does.[62] Accordingly, if the chiropractic profession wishes to compete for large research grants and keep pace with other healthcare professions, there needs to be support for university-based faculty positions for chiropractic researchers.

Given this context, while chiropractic clinicians have

Table 1.
Recommendations and corresponding actionable steps to support KT within evidence-based chiropractic practice, focusing on individual, peer/collegial, and organizational levels.

Recommendations	Actionable steps
1. Clinician development in research literacy – the ability to find, understand, evaluate, and apply research evidence (Individual Level)	– Dedicate regular time for reading and critically analyzing relevant research articles. – Participate in workshops or online courses focused on research literacy, including evidence appraisal and interpretation.
2. Participation in clinical research to improve understanding and generate clinically relevant insights (Individual Level)	– Volunteer as a clinician participant in research studies and support research teams by gathering clinical data. – Advise researchers on practical considerations for addressing the research question within real-world clinical settings. – Seek opportunities to collaborate with researchers as a co-investigator or contributor.
3. Engagement in collaborative peer communities, mentorship and networking for continuous learning (Individual and Collegial/Peer Level)	– Join or establish mentorship programs within professional associations. – Participate in peer-led events like webinars and networking meetings to share experiences and challenges related to research application. – Form local or virtual practice groups to discuss challenges and solutions in applying EBP. – Advocate for regional associations to sponsor events or digital platforms that facilitate collaboration.
4. Implementation of KT as a core strategic goal (Organizational Level)	– Include KT goals in strategic and annual plans. – Allocate resources to support KT initiatives among members (e.g., provide free educational materials, digestible summaries of research findings, journal subscriptions). – Host relevant webinars, training, and networking events.
5. Recognition of engagement in research and evidence-based practice initiatives (Organizational Level)	– Establish awards, certifications, or other forms of recognition for members who actively engage in research initiatives and EBP. – Provide incentives for member engagement, such as financial rewards, continuing education credits, or public acknowledgement.
6. Bridging the gap between researchers and clinicians (Organizational Level)	– Organize webinars, workshops, and networking events that facilitate collaboration between researchers and clinicians. – Develop committees or initiatives designed to create practical tools, educational materials, and strategies to bridge the research-to-practice gap.

KT = knowledge translation, *EBP* = evidence-based practice.

a responsibility to provide care that is based on the best available evidence, they need support for all aspects of KT, EI, and RU. Our next section of this paper identifies the opportunities and responsibilities for associations like the OCA to support KT for their members. The recommendations made here are done in accordance with the KT facilitators identified in our literature review.

Recommendations

A summary of our recommendations made based on the findings of this review, along with actionable steps corresponding to each recommendation can be seen in Table 1.

Recommendations: the individual

At the individual level, chiropractors have a responsib-

ility to seek out the best available research evidence and hone the necessary skills for integrating this evidence into their treatment plans with patients.[9,26,27,45] Clinicians should seek to create time and space for learning and development of research literacy and critical appraisal skills to gain the confidence required to apply research in context.[9–12,16,17,23,26,27,45] This should include developing an understanding of core KT competencies[26] and use of specific organizational resources.[26] Clinicians at all career stages can seek out and contribute to supportive professional learning environments, for example, through participation in mentorship and preceptorship programs[7,33,39,52], or by leading or attending webinars, lunch-and-learns, or networking events.[10,16,17,23,30,32,43] This also includes participation in research, whether as a study clinician collecting data from patients, or being involved within the core author group through study development and completion.[8,30,35,41] Clinicians should also advocate on behalf of themselves and the profession for improved supports.

Recommendations: collegial/peer community

At the collegial/peer community level, key recommendations include creating supportive environments for mentorship and modelling of inter-generational learning,[7,33,39,52] as well as opportunities for hands-on application of putting evidence into practice.[30,32,43] Close locational proximity to colleagues and collaborators will help to facilitate this.[23,30,32,43] Given many practitioners in Ontario are in solo practice, organizations such as professional associations could establish or support practice communities in specific geographic areas (e.g., local chiropractic societies or clusters) or across areas of professional interest and expertise. Opportunities for networking to meet with colleagues and researchers to share in substantive KT conversations could improve morale and attitudes regarding KT, EI, and RU, and could be facilitated at the organizational level through the sponsorship of in-person and virtual events.[30,32,43] Organizations could devote resources to keeping abreast of leaders in clinical research and KT, and facilitate access to these people and groups for "rank and file" clinicians.[48,49,51] This may include provision of human resources in KT, financial resources (e.g., providing salary support for a KT champion), and incentivized clinician time.[49] Organizations can also support KT at the collegial/peer community level by promoting conversation and collaboration.[35,43] For example, this might be accomplished by engaging with knowledge brokers to disseminate research[17,18,35] and stakeholders (e.g., clinicians, researchers, patients) to participate in collaborative training activities,[10,16,18,43] or promoting regular dialogue with their members and affiliates on research priorities to inform research investments. Organizations should also facilitate collaboration among researchers and field practitioners to ease noted tensions (or misunderstandings) between the two groups, which will further facilitate KT in clinical practice.[8,30,35,41]

Recommendations: institutional/organizational

At the institutional/organizational level, professional organizations and associations like the OCA are leaders for their membership and, therefore, their values, goals, and mandates serve as a model for those of their professional members and associated research communities. The importance of KT, EI and RU should therefore be reflected at the organizational level as a core aspect of strategic planning, for example, and of formal reporting and other communications to members and stakeholders.[26,38,46] This includes implementing institutional recognition for practitioner contributions to KT and research[19,31,32,40–42], such as through mentor or preceptor awards or certifications. Engagement with the expertise of recognized specialties within the profession, as well as fostering new specialties, could further advance this goal.[49] For example, organizations could allocate dedicated funds to support KT specialists (e.g., knowledge-brokers) to engage with community practitioners.[35] Furthermore, organizations can model the culture of KT via a focus on evaluation and continuous learning in their own programs and initiatives[37], such as through impact evaluations. The OCA and other chiropractic associations can sponsor or organize conferences, seminars, webinars, workshops and other educational platforms to enhance learning opportunities for KT[7,19,28,33,37,38,45,50], ensuring robust scientific validity through careful vetting of presentations and presenters.

In the Ontario environment, the OCA has developed an electronic patient record and practice management platform, called "OCA Aspire,"[63] that allows for the integration of evidence-based pathways into care planning. This platform will assist in transforming both the physical and temporal availability of evidence and best practices, and enable care plan adherence and outcome mon-

itoring. Longer term, the OCA Aspire platform also has significant potential to address issues of data ownership and fragmentation. This could, for the first time, allow individual practitioners and researchers in Ontario (and beyond) to have access to centrally aggregated de-identified data specific to the chiropractic profession, generated through daily encounters with patients logged in electronic health records across the province. Such data could be used to inform future clinical trial research (i.e., higher quality evidence), to support the development of robust clinical guidelines for conditions commonly seen within the chiropractic scope.

Chiropractic organizations might also support KT by developing incentives [9,42,43,51,64–66] tied to healthcare providers' overhead costs, such as membership fees or administrative costs. For example, healthcare professionals could earn reward points or credits for continuing professional development (CPD) hours with substantial KT, EI or RU elements, which could then be used for discounted membership fees. Likewise, organizations including associations and regulatory bodies have an important role to play in the adoption and enforcement of policy and incentives for affording practitioners the time during business hours to collaboratively engage with KT in clinical practice.[19,31] Recognition for mentorship and preceptorship would likewise be contingent on the demonstration of successful role modelling of EI and RU in practice with student interns in clinic. In addition, chiropractic organizations could provide pre-digested and trusted information sourced from recent relevant literature to chiropractors to be considered for implementation into practice.[27] These recommendations all target the need for dedicated time and resources for clinicians to engage in KT, EI, and RU.[7,9,27–29,32]

Discussion

In this paper we aimed to summarize key determinants of KT across disciplines and offer actionable recommendations to improve uptake and application of EBP in routine chiropractic care. We identified KT barriers and facilitators at three levels: (1) individual practitioner, (2) collegial/peer community, and (3) institutional/organizational, in alignment with previous findings.[45] Articles included in our review spanned multiple disciplines. Regardless of the field of practice, we found that barriers and facilitators to KT, EI, and RU in practice shared commonalities, largely because human practitioners were the research users in every case. Importantly, KT, EI, and RU require human research users to become informed, skilled, collaborative, and pragmatic implementers of the best available evidence. The values, supports, and resources attributed to KT require active participation of actors at all three aforementioned levels (i.e., individual, collegial, and institutional), and the efforts and abilities of individual practitioners should be intertwined with organizational RU and EI values, cultures, expectations, attitudes, and opportunities to engage in KT work.

In the chiropractic profession, barriers exist at the individual level regardless of how strongly a practitioner believes in EBP.[2,11,64,66] For instance, chiropractors report "positive attitudes" toward EBP, yet uptake of research into practice, as measured by the use of clinical practice guidelines, is less favourable even when clinicians express confidence in the ability to identify clinically relevant research.[2,64,66] This suggests that chiropractors may be more comfortable consuming research than integrating evidence into clinical practice, which requires additional skill, collaboration, mentorship, and institutional resources, all of which have been identified in the literature as being significant influencers of KT.

Chiropractors' difficulties in integrating evidence into practice may be exacerbated by tensions within researcher-clinician interactions. [30,31] A mixed methods study in physical rehabilitation suggested that tensions develop when researchers provide recommendations that are not easily generalizable to 'real-world' practice.[30] In the 2004 UK BEAM trial[67], for example, 89% of the 11,929 back pain patients identified were either unavailable or excluded prior to randomization, thereby reducing the study's generalizability to a niche low back pain population. In line with reviewed literature, we recommend engaging knowledge-users in the research process to facilitate KT in clinical practice, as well as to build consensus around policy issues.[30,35,36,38,41,43,54]

A lack of time, shown to impact individual, collegial/peer community, and institutional/organizational levels, also likely contributes to limited research uptake into chiropractic practice.[2,11,64,66] Several chiropractic surveys indicate that clinicians report "lack of time" as the most common barrier to developing their EBP skills, despite being interested in improving them.[64,65] In line with our review, this perceived lack of time amongst clinicians can

create significant barriers to KT, including a lack of confidence or ability to locate, interpret, and critically appraise research to apply in clinical practice. [7,32,40,41] As such, organizational provision of training, resources, and pre-digested information to chiropractic clinicians, as well as incentivizing time dedicated to KT (e.g., through reduced membership fees), could enhance KT in the chiropractic profession, particularly because clinicians' attitudes appear to already be favourable toward EBP. Furthermore, in addition to academic journals, knowledge dissemination should occur through additional outlets, including those focusing on community-based providers (e.g., chiropractic opinion leaders) to further bridge the KTA gap.[11,66,68]

Regardless of strategy, effective KT approaches require flexibility to account for varying clinical and local contexts,[69] and must be tailored to overcoming barriers to knowledge use identified in those contexts. KT efforts often fail when KT barrier assessments are not conducted, or KT interventions/implementation strategies are not aligned. Assessments of barriers should therefore be comprehensive, and assessed using frameworks such as the Theoretical Domains Framework (TDF) or Consolidated Framework for Implementation Research (CFIR).[70,71] Additional frameworks such as the Capability, Opportunity, Motivation – Behaviour (COM-B) model can then be used to design KT interventions tailored to address locally identified KT barriers.[21,72] To optimize time and resources in the chiropractic profession, individual practices and chiropractic organizations should assess KT barriers unique to their context, in light of the broader stakeholder and policy landscape.[73]

Overall, the reviewed literature suggests that institutions/organizations play a major role in facilitating KT, as they can cultivate the landscape for KT, EI, and RU culture through their strategic priorities, values, and allocation of resources. In line with our recommendations, organizations can offer sponsorship of in-person and virtual events, devote resources to developing and maintaining leaders in research and KT, and reflect the importance of KT as a core aspect of strategic planning, formal reporting and other communications to members and stakeholders.[8,10–14,16–18,20,23,28–31,40,41,46–48,51] Organizations can also incentivize practitioners by affording them time during business hours to engage with the research literature, as well as with their colleagues, and collaborate on ways to implement the best available evidence into clinical decision-making.[19,31]

Implications for patient outcomes

Integrating best evidence into clinical practice can enhance care quality and patient outcomes (e.g., more effective pain relief, greater functional improvement).[39,74] KT strategies that promote active patient engagement and education have also been shown to result in higher levels of satisfaction, improved adherence to treatment plans, and reduced reliance on opioid prescriptions.[74,75,76,77] As such, the strategic implementation of KT in clinical practice is essential for healthcare providers in delivering higher-quality, effective, safe, patient-centred care.

Limitations

This narrative review has several limitations that are inherent to its design. First, we did not use a systematic search strategy or formal risk of bias assessments, as the goal was to broadly capture literature on KT, EI, and RU from multiple disciplines to inform chiropractic practice rather than to exhaustively review all possible evidence. In narrative reviews, this flexibility can allow for the integration of diverse sources and perspectives, which may be valuable for generating actionable insights. Additionally, only one reviewer initially conducted screening and data extraction, posing bias risk that some authors may have included articles this reviewer excluded in the screening process. However, final inclusion and data extraction of studies was reviewed by the full working group, helping to ensure a broader validation of included studies.

Another limitation is that only English-language articles were included, which may have excluded relevant studies published in other languages. However, given the quantity of literature returned in our searches published in English, we expect that the key findings and recommendations are still well represented. Additionally, the selected timeframe (January 1, 2016, to August 1, 2024) may have limited the findings to recent literature, potentially overlooking studies with relevant insights published prior to 2016. However, this timeframe was chosen to extend the foundational insights from the 2016 landmark scoping review by Bussières *et al*.[7], allowing us to build on previous work while focusing on contemporary barriers and facilitators that are directly applicable to today's clinical environment.

Finally, we did not employ a formal consensus method (e.g., Delphi or nominal group technique) to develop recommendations. Instead, recommendations were derived through iterative discussions among the working group, composed of chiropractors, researchers, and educators with relevant expertise. While this informal consensus process may limit reproducibility, it allowed for practical, context-specific recommendations tailored to the needs of community-based chiropractic practice. Future research could enhance rigor by employing systematic review methodologies, including studies from multiple languages, expanding the timeframe, and using formal consensus methods, such as Delphi panels, to further validate and refine recommendations.

Strengths

This review contributes valuable, context-specific insights that address the practical needs of KT within chiropractic care. By tailoring its focus to the unique barriers and facilitators relevant to community-based chiropractic practice, the review offers recommendations that are directly applicable to clinicians and professional organizations in this field. While it does not introduce new theoretical frameworks, the review fills a gap by providing discipline-specific guidance for chiropractors, a group often underrepresented in broader KT literature. Additionally, the inclusion of cross-disciplinary perspectives enriches the findings, as KT strategies validated in other healthcare disciplines are adapted here for use in chiropractic practice, promoting a more integrated approach. Recognizing the time constraints of busy practitioners, the review emphasizes accessible and practical recommendations, making the KT process more manageable for chiropractic professionals. This flexible approach allows for the integration of recent and relevant literature, which supports actionable steps that can be feasibly implemented in real-world settings.

Future directions

Future research could expand on this review by incorporating primary data collection methods, such as interviews or surveys, to gather in-depth insights from individual practitioners, peer groups, and institutions. Such studies could further explore perspectives on and engagement with KT, EI, and RU initiatives within chiropractic care. Additionally, examining the views and experiences of various stakeholders—ranging from clinicians to organizational leaders—would enhance understanding of the factors that support or hinder KT efforts, potentially leading to more targeted and effective strategies.

Conclusions

Knowledge translation (KT) through evidence integration (EI) and research utilization (RU) in clinical practice is a collaborative endeavour between clinicians and their stakeholder ecosystem. Professional organizations and associations must not only adopt policy and model their value of KT, EI, and RU, but also clearly demonstrate their commitment to improving patient outcomes by equipping their membership with the tools and resources they need to succeed in developing the required skills, research literacy, and confidence for the most effective implementation of KT. The structural significance of professional organizations, regulators and associations cannot be understated, since structural reform has a widespread and influential trickle-down effect for practitioner-members and the patients they care for.

Actionable steps we feel that professional organizations, associations, and funding agencies should take include, but are not limited to: (1) allocating funding to EI and RU implementation initiatives; (2) adopting policy that encourages and incentivizes KT (i.e., paid time during business hours to develop clinicians' KT skills and practical strategies for implementation of EI and RU); (3) developing institution-based and institution-wide mentorship programs that support and prioritize inter-generational mentorship, modelling, and collaboration; and (4) offering programs to facilitate KT using various educational platforms. Practitioners would also benefit from formal, professional, career advancing recognition of their KT implementation work.

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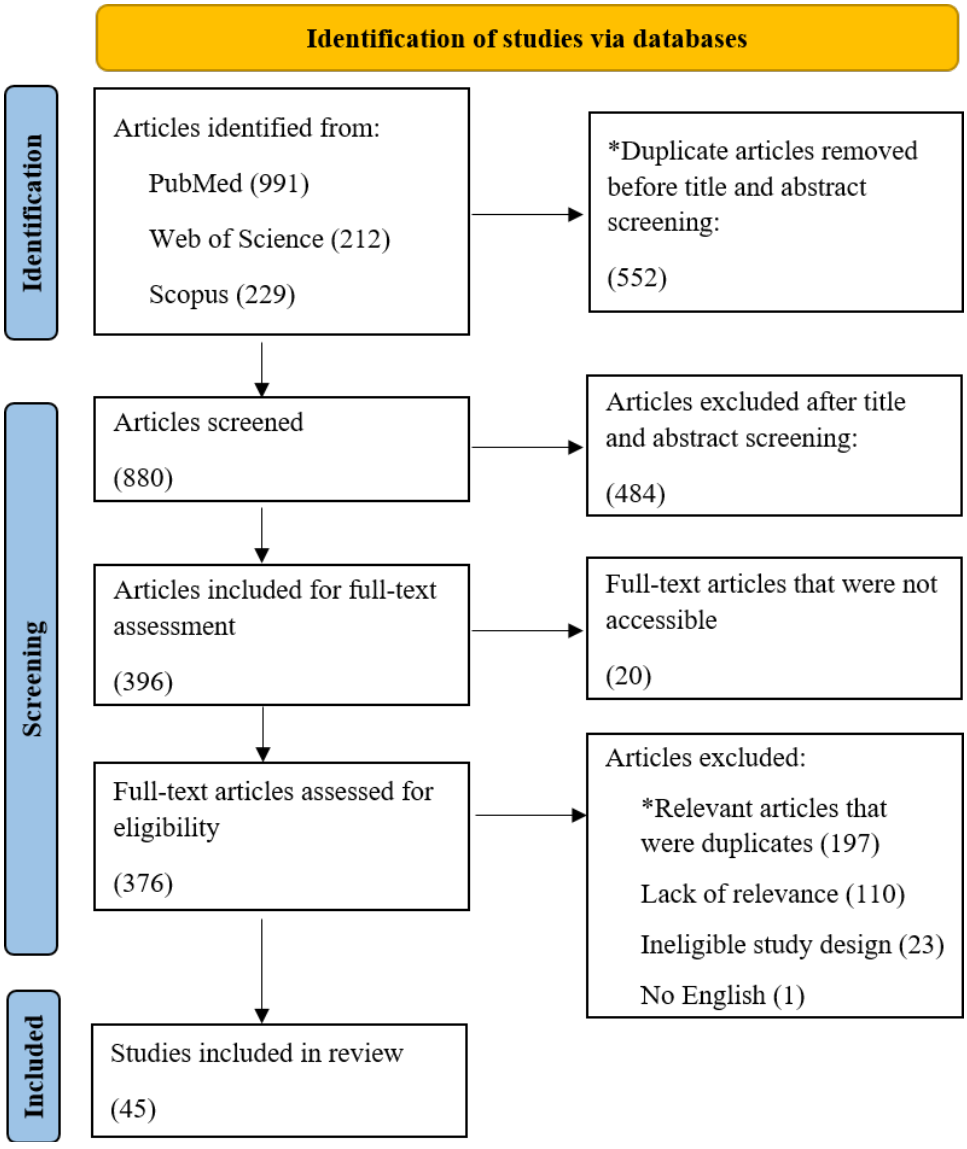
Appendix 1.
Search terms and phrases.

We used the key terms "knowledge translation," "knowledge-to-action," "evidence integration," "research utilization," "evidence-based practice," "evidence-based medicine" (EBM), and "clinical practice" to identify relevant literature. These terms were utilized in the following phrases to conduct searches in PubMed, Scopus, and Web of Science: (1) "Barriers to Knowledge Translation and Evidence Integration", (2) "Barriers to Knowledge Translation and Evidence Integration and Strategies", (3) "Barriers to Knowledge Translation and Evidence Integration in Evidence Based Medicine", (4) "Barriers to Knowledge Translation and Evidence Integration in Clinical Practice", (5) "Barriers to Knowledge Translation and Evidence Integration in Evidence Based Practice", (6) "'Knowledge Translation' and 'Research Utilization'", (7) "'Evidence Integration' and 'Research Utilization'", (8) "Strategies for Knowledge Translation and Evidence Integration in Clinical Practice", (9) "Strategies for Knowledge Translation and Evidence Integration in Evidence Based Medicine", and (10) "Strategies for Knowledge Translation and Evidence Integration in Evidence Based Practice".

Appendix 2.

Flowchart diagram showing the search and selection process of studies included in this review.



*The search was conducted in two separate phases. Phase one included articles from 2016-2021. In these searches, duplicate articles were removed automatically, prior to screening, both within databases and between databases. For phase two, which included searches for articles from 2022-2024, duplicates were not removed prior to screening. As such, for phase two, duplicates were only accounted for once an article was included following full-text screening.

Appendix 3.

Included papers from our database searches that identify barriers, facilitators and strategies for successful KT of EBP.

First author, year	Field	Barriers	Facilitators	Recommendations for KT strategies*
Abu-Odah, 2022[10]	Clinical care	-Time constraints, insufficient critical appraisal skills, difficulty applying research -Lack of access or ability to interpret research due to low technology literacy -Insufficient resources to apply research -Lack of training for policy makers and skepticism about research value	-Motivation and interest to engage in research -Institutional support and communication through workshops and knowledge dissemination -Stakeholder early involvement and strong collaboration	**Individual level**: Build KT knowledge capacity. **Institutional/organizational level**: Host workshops and participate in knowledge dissemination initiatives to build clinician motivation and interest of engaging in research.
Albisser, 2022[11]	Chiropractic	-Lack of time -Perceived lack of clinical evidence in chiropractic health field	-Access to free online databases, full-text journal articles, and internet at workplace -Education and training	**Individual level**: Build KT knowledge capacity. **Institutional/organizational level**: Promote existing and valid research within the chiropractic field. Provide free access to various research related materials.
Alvarez, 2018 [49]	Global health	-Lack of guidance, ownership, and engagement for/of stakeholders -Lack of KT knowledge capacity	-Credible leaders for KT initiatives - Institutions that seek or develop KT research experts -KT experts leading and guiding stakeholders, holding them accountable for group progress	**Individual level**: Build KT knowledge capacity among individuals. **Collegial/peer community level**: Develop leadership and expert roles in KT to guide and hold stakeholders accountable. **Institutional/organizational level**: Seek or develop KT research experts within organizations.
Bennett, 2016 [29]	Occupational therapy	-Lack of education and training offered in methods and operationalizing KT -Limited confidence translating research to practice	N/A	**Individual level**: Focus on overcoming the lack of education and training in KT methods. **Collegial/peer community level**: Build confidence in translating research to practice through peer support networks.
Bussières, 2016 [7]	Chiropractic	-Lack of awareness of EBP -Limited access to research and minimal incentives -Limited time, skills (inadequate training in critical appraisal), collaboration, communication and resources -Unfavourable attitudes to EBP	-Access to educational materials, critical reviews, full text articles, and support for RU in practice	**Individual level**: Increase awareness and skills in EBP through training. **Collegial/peer community level**: Promote access to educational materials and collaborative learning opportunities. **Institutional/organizational level**: Provide institutional support and incentives for using EBP.
Cameron, 2020 [34]	Domestic violence	N/A	-Effective institutional communication centering KT that resonates with diverse populations accessing institutional resources	**Institutional/organizational level**: Implement institutional communication strategies that effectively reach diverse populations.

First author, year	Field	Barriers	Facilitators	Recommendations for KT strategies*
Cassidy, 2021 [45]	Academic research	-Organizational barriers include institutional restrictions, physical location, and lack of funding -Inter-related organizational and interpersonal barriers include competing priorities and power dynamics -Individual barriers include lack of skills -Inter-related individual and interpersonal barriers include being an 'outsider'	-Inter-related organizational and interpersonal facilitators include financial resources, existing relationships, and KT expert support -Individual facilitators include flexibility, adaptability, and reflexivity -Inter-related individual and interpersonal facilitators include trusting relationships, and setting common goals early	**Individual level**: Enhance skill development through targeted training programs. **Institutional/organizational level**: Address institutional restrictions and enhance funding strategies to support KT initiatives.
Cassidy, 2024[12]	Intensive care	-Lack of time -Resistance to change -Insufficient resources for implementation	-Ongoing training -KT champions -Mentorship programs and peer-to-peer learning -Multidisciplinary team meetings -Tailored educational materials	**Individual level**: Continuously engage in KT capacity building and research literacy. **Collegial/peer community level**: Develop leadership and expert roles in KT to lead peers. Engage with other disciplines and researchers. **Institutional/organizational level**: Seek or develop KT research experts within organizations. Provide tailored accessible and easily digestible summaries of research to clinicians
Collie, 2016 [31]	Policy	-Tensions within researcher-clinician interactions	-Institutional provision of human and financial resources -Institutional recognition of KT work -Institutional provision of opportunity for researchers to build a reputation in KT beyond academic publishing -Institutional consideration of KT as a career asset	**Institutional/organizational level**: Provide human and financial resources, recognition of KT work, and opportunities for researchers to build a KT reputation.
Dagne, 2021 [50]	Midwifery	-Lack of access to supports	-Access to free educational materials, critical reviews, full text articles, etc. -Support for RU in practice	**Individual level**: Enhance access to supportive materials for RU practice. **Institutional/organizational level**: Facilitate the provision of free educational materials, critical reviews, and full-text articles.
Dam, 2023[13]	Public health	-Lack of consensus on what constitutes research evidence -Limited skills, time, and organizational support through resources -Evidence-based priorities conflicting with political goals -Gaps in research evidence	-Capacity building on understanding and applying research -Clear communication from research findings -Local evidence to inform context-specific policies -Integrating evidence with other evidence	**Individual level**: Enhance skill development through targeted training programs. Learn to compare and contrast evidence and consider all 'levels' of evidence to address complex issues. **Institutional/organizational level**: Provide human and financial resources, recognition of KT work, and opportunities for researchers to build a KT reputation. Promote the bridge between political goals and evidence-based priorities.

First author, year	Field	Barriers	Facilitators	Recommendations for KT strategies*
De Leo, 2019 [28]	Midwifery	-Lack of education and training offered in methods and operationalizing KT -Limited confidence translating research to practice	N/A	**Individual level**: Target the lack of education and training with specific KT methods and operationalizing KT. **Collegial/peer community level**: Address limited confidence in translating research to practice through mentorship and peer learning.
Dobbins, 2018 [43]	Public health	N/A	-Close physical proximity amongst practitioners, peers, and colleagues enabling collaboration -Technology allowing for virtual communication to collaborate -Sponsorship of in-person or online events -Mentorship and modeling for intergenerational learning that includes hands-on application of evidence to practice in supportive environments -Organizational support of communities of practice in specific geographical areas to provide opportunities for networking allowing practitioners and researchers alike to meet and share in substantive KT conversations improving morale and attitudes regarding KT	**Collegial/peer community level**: Enhance collaboration through physical proximity and technology. **Institutional/organizational level**: Support in-person events and mentorship for applying evidence in practice.
Doja, 2022[14]	Medical education	-Time constraints -Resistance to engage in the literature from colleagues	-Easily accessible summaries, reviews, and guidelines of primary research -Supportive "champions" for engaging in the literature	**Individual level**: Build KT knowledge capacity and research literacy among individuals to reduce time needed to engage in research. **Collegial/peer community level**: Develop leadership and expert roles in KT to guide and hold stakeholders accountable. **Institutional/organizational level**: Seek or develop KT research experts within organizations. Provide accessible and easily digestible summaries of research to clinicians.
Edwards, 2023[15]	Clinical care (stroke rehabilitation)	-Poor methodological rigor of studies (study design, sample size, inconsistent or incomplete reporting) -Lack of standardized outcome measures in studies -Feasibility issues, including high costs and lengthy protocols for clinical implementation	-Adhering to reporting guidelines in research (e.g., CONSORT) -Standardized outcome measures across domains -Systematic studies and adherence to transparent reporting practices	**Individual level:** Engage in research studies with high methodological rigor, as well as transparent outcome measures and complete reporting of findings. **Institutional/organizational level:** Develop standardized outcome measures for specific protocols within chiropractic related studies. Contribute funding to such studies.

First author, year	Field	Barriers	Facilitators	Recommendations for KT strategies*
Généreux, 2019 [33]	Disaster management	-Poor communication between researchers, policy makers, and practitioners	-Intergenerational collaboration (transfer of knowledge between experienced and novice professionals) -Mentorship programs -Strong culture valuing KT	**Individual level**: Develop intergenerational collaboration and mentorship programs. **Collegial/peer community level**: Build a strong culture that values KT through peer support. **Institutional/organizational level**: Encourage effective communication strategies within organizations.
Glegg, 2021[38]	Pediatric research	N/A	-Organizational supports that include building resource capacity and networks to participate in KT activities, sharing accessible evidence, providing education and training, providing motivation/ incentives, assisting with research by providing access to consultations, and providing research-dedicated space	**Institutional/organizational level**: Enhance organizational support to build resource capacity and networks for KT activities, including providing education, training, and motivation/ incentives.
Grant, 2020 [37]	Nursing	N/A	-Organizations forming the landscape of priority, value, and allocation of resources for KT -Organizations forming a KT culture -Access to electronic resources -Organizational time and space to participate in KT-related skills development	**Institutional/organizational level**: Develop an organizational culture and landscape that values KT, including providing access to electronic resources and dedicated time for KT-related skill development.
Hallé, 2024[16]	Physical and occupational rehabilitation therapy	N/A	-Partnership and communication between academic faculty and clinical preceptors -Continuing professional development workshops -Involving panels of stakeholders (researchers, clinicians, patients) in classrooms to discuss EBP -Creating joint clinical-academic positions to strengthen EBP roles	**Individual level:** Engage in KT professional development workshops and courses. **Collegial/peer community level**: Collaborate with academic faculty as a clinician, and engage in consistent communication. **Institutional/organizational level:** Integrate researchers, clinicians and patients into classroom discussions surrounding KT. Foster collaborative positions within both academic and clinical settings.
Haynes, 2018 [46]	Academic research	N/A	-Organizations forming the landscape of priority, value, and allocation of resources for KT -Organizations forming a KT culture	**Institutional/organizational level**: Foster a culture and landscape that prioritizes and values KT.
Hanson, 2024[17]	Clinical care (erebral palsy rehabilitation)	N/A	-Knowledge broker, KT champion, mentorship support -In-person workshops -EBP summaries/tools -Communication with researchers -Compensation/protected time	**Individual level:** Communicate with topic-relevant researchers and offer perspective. **Collegial/peer community level**: Develop leadership and expert roles in KT to champion KT initiatives and mentor colleagues. **Institutional/organizational level**: Seek or develop KT research experts within organizations. Provide accessible and easily digestible summaries of research to clinicians. Compensate clinicians for time dedicated to KT work. Host KT workshops.

First author, year	Field	Barriers	Facilitators	Recommendations for KT strategies*
Heinsch, 2018 [51]	Social work	-Difficulty developing and maintaining continuity and motivation in funding partnerships	N/A	**Institutional/organizational level**: Tackle the challenge of maintaining funding partnerships to support continuous motivation for KT.
Jakobsen, 2019 [40]	Policy	-Lack of time, skills, and incentives	N/A	**Individual level**: Address the lack of time, skills, and incentives through focused education and training.
Keay, 2020 [9]	Veterinary medicine	-Lack of education and training offered in methods and operationalizing KT -Limited confidence translating research to practice	N/A	**Individual level**: Improve education and training in KT methods. **Collegial/peer community level**: Build confidence in translating research to practice through peer engagement.
Kerr, 2023[18]	Clinical care	-Time constraints -Limited resources -Lack of communication between involved stakeholders	-Knowledge brokers -Electronic evidence library	**Individual level**: Engage with accessible and relevant research. **Collegial/peer community level**: Foster collaborative partnerships between researchers, practitioners, and patients that encourages consistent communication. Consider engaging with knowledge brokers. **Institutional/organizational level**: Address the lack of time, resources, and support for KT and dissemination efforts.
Kwok, 2022[44]	Speech language pathology	-Organizational restrictions -Questioning relevance and validity	-Support from personnel and technology	**Collegial/peer community level**: Support colleagues in appraising and understanding new research and translating findings. Promote open mindedness to colleagues for considering all relevant research prior to questioning relevance and validity. **Institutional/organizational level:** Establish a culture that is supportive of research integration into practice.
Lawrence, 2019 [41]	Policy	-Lack of time, resources, funding, incentives -Limited collaboration and communication amongst researchers and policy makers -Limited understanding of research evidence	- Research-users engagement in the research process (especially when building consensus around policy issues)	**Individual level**: Enhance understanding of research evidence among policymakers. **Collegial/peer community level**: Facilitate engagement in the research process for building consensus on policy issues.
Mallidou, 2018 [26]	Medicine	N/A	-Organizational policy and working environment that values KT and EBP	**Institutional/organizational level**: Emphasize the creation of policies and environments that value KT and EBP.
McGinty, 2019[35]	Inter-disciplinary	N/A	-Research-users engagement in the research process (especially when building consensus around policy issues)	**Collegial/peer community level**: Facilitate research-user engagement in the research process.

First author, year	Field	Barriers	Facilitators	Recommendations for KT strategies*
McLean, 2018 [47]	Academic research	-Lack of funding -Funding with unclear goals or allocation	-Funding directly informed by and geared toward policy for KT -Funding that aligns with researcher and institutional goals -Research funders collaborating with other stakeholders	**Individual level**: Provide clear guidance and training on aligning research with policy-driven KT goals. **Collegial/peer community level**: Encourage collaboration among stakeholders for policy-informed research. **Institutional/organizational level**: Ensure funding aligns with the institutional and researcher goals for KT.
Montpetit-Tourangea, 2020 [39]	Physical and occupational rehabilitation therapy	-Lack of time and resources -Minimal stakeholder engagement -Lack of support for KT and dissemination efforts	-Collaborative partnerships between researchers, practitioners, and patients -Practical, and KT related, knowledge and skills of researchers and practitioners	**Individual level**: Improve practical KT knowledge and skills among researchers and practitioners. **Collegial/peer community level**: Foster collaborative partnerships between researchers, practitioners, and patients. **Institutional/organizational level**: Address the lack of time, resources, and support for KT and dissemination efforts.
Murphy, 2024[20]	Clinical care (neurorehabilitation)	-Steep learning curves for working with new technology -Lack of integration with existing clinical workflows	-Continuous training -Involving clinicians in the research and development process -Aligning research and development with clinical goals	**Individual level**: Improve KT knowledge and skills among clinicians. **Collegial/peer community level**: Foster collaborative partnerships between researchers, practitioners, and patients. **Institutional/organizational level**: Summarize how new research and technology can be integrated into existing workflows.
Mwendera, 2016 [8]	AIDS research	-Researchers lack of communication skills -Lack of research collaborations -Lack of platforms for researchers to engage with the public -Lack of funder-driven research -Unknown institutional policy positions -Lack of research repositories	-Collaboration efforts made by researchers, policy makers, and practitioners across disciplines	**Individual level**: Enhance communication skills among researchers. **Collegial/peer community level**: Improve research collaboration and public engagement platforms. **Institutional/organizational level**: Address the lack of funder-driven research and establish clear institutional policy positions.
Philipson, 2016 [19]	Dementia care	N/A	-Institutional provision of human and financial resources -Institutional recognition of KT work -Consideration of KT as a skill	**Institutional/organizational level**: Allocate resources and recognize KT work as a vital skill.
Presseau, 2022[21]	Inter-disciplinary		-Optimizing models/frameworks for quality care by tailoring them to KTA frameworks rather than creating new ones	**Individual level:** Develop skills to apply existing frameworks to various aspects of the KTA framework.

First author, year	Field	Barriers	Facilitators	Recommendations for KT strategies*
Roberge-Dao, 2019 [30]	Physical and occupational rehabilitation therapy	-Tensions within researcher-clinician interactions	-Physical proximity amongst practitioners, peers, and colleagues enabling collaboration -Technology allowing for virtual communication to collaborate -Mentorship and modeling for intergenerational learning that includes hands-on application of evidence to practice in supportive environments -Organizational support of communities of practice in specific geographical areas to provide opportunities for networking allowing practitioners and researchers alike to meet and share in substantive KT conversations improving morale and attitudes regarding KT -Clinician involvement at the start of project conceptualization and throughout the research process	**Individual level**: Tackle tensions within researcher-clinician interactions by facilitating better communication skills. **Collegial/peer community level**: Enhance physical proximity and use technology for collaboration. **Institutional/organizational level**: Support communities of practice for networking and morale improvement.
Szmaglinska, 2024 [22]	Clinical care	-Lack of formal training and education -Misconceptions of certain research -Time constraints	N/A	**Individual level**: Address narrow-sightedness through broader context training.
Tait, 2019 [32]	Policy	-Lack of education and training offered in methods and operationalizing KT -Limited confidence translating research to practice	-Focusing on developing capacity building, identifying knowledge-practice gaps, and research literacy skills -Close physical proximity amongst practitioners, peers, and colleagues enabling collaboration -Technology allowing for virtual communication to collaborate -Mentorship and modeling for intergenerational learning that includes hands-on application of evidence to practice in supportive environments -Organizational support of communities of practice in specific geographical areas to provide opportunities for networking allowing practitioners and researchers alike to meet and share in substantive KT conversations improving morale and attitudes regarding KT	**Individual level**: Focus on developing capacity building and identifying knowledge-practice gaps. **Collegial/peer community level**: Utilize technology for virtual collaboration and foster close physical proximity for effective teamwork.

First author, year	Field	Barriers	Facilitators	Recommendations for KT strategies*
Kengne Talla, 2023[23]	Rehabilitation	-Limited availability of researchers and clinicians -Limited budget and resources -Role confusion and overlap	-Organizational support through clinician release time for KT activities -Administrative support with expertise in KT -Close physical proximity between clinicians and researchers -Opportunities for networking with researchers	**Individual level**: Engage in networking events with researchers and other clinicians. Dedicate time to KT capacity building. **Collegial/peer community level**: Foster close physical proximity for effective teamwork. **Institutional/organizational level**: Provide resources, including human, and create environments conducive to KT. Provide release time for clinicians to engage in KT and opportunities for researchers and clinicians to network.
Thürliman, 2022 [24]	Nursing	N/A	-Mentorship -Understanding of role -Motivation and willingness to learn -Teamwork and commitment	**Individual level**: Engage in broad-context training to amplify motivation and willingness to learn. **Collegial/peer community level**: Foster collaboration and conversation among practitioners and researchers. Mentor those who may require it, or seek a mentor for translating evidence to practice.
Uzochukwu, 2016 [42]	Policy	-Distrust and lack of respect between researchers and policy makers	-Collaboration amongst all levels -Trust, mutual respect, and a shared understanding on the importance of evidence informed policy making among researchers and policy makers -Research findings presented in a way that is relevant and actionable for policy makers -Policy makers with skills and knowledge in understanding research	**Collegial/peer community level**: Foster collaboration, trust, and mutual respect between researchers and policymakers. **Institutional/organizational level**: Present research findings in actionable formats for policymakers.
Vaucher, 2016 [27]	Medicine	-Physicians' distrust of pharmaceutical firm influence in clinical research -Non-publication of negative results (publication bias) -Training gaps -Lack of sufficient methodological competences -Perceived mismatch between guideline recommendations and realities of patients' clinical circumstances	-Time and space -Personalized and interactive KT activities -Collegial and institutional support -Low-pressure, collaborative and supportive environments -Resources provided that are dedicated to ensuring RU in practice - Provision of pre-digested and trusted information and paid time in daily practice to systematically reading medical journals	**Individual level**: Address training gaps and methodological competencies through targeted education. **Collegial/peer community level**: Promote personalized and interactive KT activities to foster collegial support. **Institutional/organizational level**: Provide resources and create environments conducive to RU practice and systematic knowledge consumption.
Verville, 2021 [36]	Inter-disciplinary	-Narrow-sightedness on individual projects -Lack of context for researchers and practitioners on the end goal	-Collaboration and conversation among practitioners and researchers	**Individual level**: Address narrow-sightedness through broader context training. **Collegial/peer community level**: Foster collaboration and conversation among practitioners and researchers.

First author, year	Field	Barriers	Facilitators	Recommendations for KT strategies*
Wiss, 2024 [25]	Pharmacy and clinical	-Skepticism of evidence -Lack of awareness on scope of practice -Limited interdisciplinary collaboration	-Perceived benefits of the research/treatment/program -Economic incentives (research findings benefit clinician)	**Individual level**: Address narrow-sightedness through broader context training. **Collegial/peer community level**: Foster collaborative partnerships between researchers, practitioners, and patients. **Institutional/organizational level**: Summarize scope of practice for members. Summarize emerging research findings, and highlight how findings could benefit clinicians and/or patients.
Zych, 2019 [48]	Academic research	-Lack of funding -Funding with unclear goals or allocation	-Funding directly informed by and geared toward policy for KT -Funding that aligns with researcher and institutional goals -Research funders collaborating with other stakeholders	**Individual level**: Provide clear guidance and training on aligning research with policy-driven KT goals. **Collegial/peer community level**: Encourage collaboration among stakeholders for policy-informed research. **Institutional/organizational level**: Ensure funding aligns with the institutional and researcher goals for KT.

EBP = evidence-based practice; *KT* = knowledge translation; *IKT* = integrated knowledge translation; *N/A* = not applicable; *RU* = research utilization.

*Recommendations for strategies based on barriers/facilitators from included studies and consensus amongst authors

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When there is little or no research evidence: a clinical decision tool

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Despite advancements in research and guidelines of healthcare, there are still situations where clinicians may lack experience or face limited evidence to inform decision-making. In these situations, healthcare providers should provide care within their scope of practice considering all available evidence-based options, the patient's preferences, and the clinical context through a clinical expertise lens.

This decision-making tool serves as a guide for patient-centred clinical decision-making in chiropractic care. It integrates clinical expertise with the pillars of evidence-based practice, taking into account the best

Lorsqu'il y a peu ou pas de données de recherche: un outil de prise de décision clinique

Malgré les avancées dans la recherche et les lignes directrices en matière de soins de santé, il existe encore des situations où les cliniciens peuvent manquer d'expérience ou faire face à un manque de données probantes pour orienter la prise de décision. Dans ces situations, les professionnels de la santé devraient fournir des soins dans le cadre de leur champ d'exercice en tenant compte de toutes les options fondées sur des données probantes disponibles, des préférences du patient et du contexte clinique au moyen du prisme de l'expertise clinique.

Cet outil d'aide à la prise de décision sert de guide pour la prise de décision clinique axée sur le patient en soins chiropratiques. Il intègre l'expertise clinique avec les piliers de la pratique fondée sur des données

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available research evidence, patient preferences, and the clinical context. Examples are provided on using the tool within chiropractic care for conditions with large bodies of supporting evidence (e.g., low back pain), and conditions with little to no evidence (e.g., Parkinson's disease), to illustrate the broad applicability of how to use (and how not to use) this tool in the field of chiropractic care.

Author's Note: *This paper is one of seven in a series exploring contemporary perspectives on the application of the evidence-based framework in chiropractic care. The Evidence-Based Chiropractic Care (EBCC) initiative aims to support chiropractors in their delivery of optimal patient-centred care. We encourage readers to review all papers in the series.*

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probantes, en tenant compte des meilleures données probantes disponibles, des préférences des patients et du contexte clinique. Des exemples sont fournis sur l'usage de l'outil dans les soins chiropratiques pour des problèmes de santé ayant un grand nombre de données probantes (par exemple, la douleur lombaire) et des problèmes de santé avec peu ou pas de données probantes (par exemple, la maladie de Parkinson), afin d'illustrer la vaste applicabilité de la façon d'utiliser (et de ne pas utiliser) cet outil dans le domaine des soins chiropratiques.

Note de l'auteur: *Ce document fait partie d'une série de sept documents examinant les perspectives contemporaines sur la mise en œuvre du cadre fondé sur des données probantes pour les soins chiropratiques. L'initiative de soins chiropratiques fondés sur des données probantes (SCFDP) vise à soutenir les chiropraticiens dans la prestation de soins optimaux axés sur le patient. Nous encourageons les lecteurs à consulter tous les articles de la série.*

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MOTS CLÉS : chiropratique, outil de prise de décision clinique, pratique fondée sur des données probantes, prise de décision clinique

Introduction

"Evidence does not make decisions, people do" - R. Brian Haynes, PJ Devereaux and Gordan H Guyatt, 2002. (doi: https://doi.org/10.1136/bmj.324.7350.1350)[1]

Chiropractic care, including manual therapies, such as spinal manipulative therapy (SMT), has been found to be both safe and effective for treating back or neck pain and other musculoskeletal (MSK) or neuro-MSK (nMSK) conditions (e.g., cervicogenic headache).[2–5] As a conservative approach, chiropractic care has also been shown to be cost-effective in the treatment of these conditions,[6–8] though further research is needed[9,10]. Indeed, the evidence-base for chiropractic continues to evolve at an impressive pace, with recent years witnessing innovative and systematic research in previously under investigated areas (e.g., maintenance care),[11–13] as well as expansion of available tools such as evidence-based clinical practice guidelines (CPGs) through the work of organizations like the Canadian Chiropractic Guideline Initiative (CCGI). Nevertheless, there may still be instances in practice when clinicians are faced with scenarios in which they lack experience with managing particular aspects of a patient's presenting clinical complaint (e.g., diagnosis, etiology, therapy, prognosis). Further, in certain cases there may be contradictory evidence, or little or no high-quality clinical research evidence[i] available that is relevant to the patient's clinical state and circumstances to inform the shared management decision between the patient and clinician.[14,15] Importantly, little or no research evidence does not just include a lack of evidence in general, it also applies to situations where existing evidence

may not be obviously applicable to a specific patient. For example, previous research on a clinical topic may have been exclusively conducted on adults aged 18 to 65 years of age, but the specific patient is a youth or older adult, and guidance is needed on how to proceed.

When there is no clear research evidence that directly addresses a patient's particular situation, it may be possible to move forward with providing care,[16] as long as the proposed treatment is in line with the best available research evidence, is in the patient's best interest, falls within the chiropractic scope of practice, and adheres to the standards of practice, guidelines and policies set out by the regulatory body of the jurisdiction in which the chiropractor is practicing. To guide the systematic exercise of patient-centred clinical decision-making in cases where clarity is lacking, this paper introduces a clinical decision tool, which is a three-step decision algorithm.

Following the evidence-based medicine (EBM) model first proposed by Sackett *et al*. in 1996,[17] and later refined by Haynes, Devereaux and Guyatt in 2002,[18] we view clinical expertise as the lens through which the three pillars of evidence-based practice (EBP) are integrated: (1) best available research evidence, (2) the patient's preference and actions, and (3) the clinical state and circumstances[14]. When there is little or no high-quality evidence (e.g., from systematic reviews or randomized controlled trials [RCTs][14]) to inform decision-making for a particular patient circumstance such as a therapeutic intervention, the clinician must incorporate the remaining pillars of the evidence-based model, and perform a critical assessment of the evidence that does exist (e.g., cohort or case-control studies). The clinician must also incorporate the highest-quality evidence for related conditions (e.g., systematic review of RCTs supporting the treatment of a condition such as Tennis elbow to inform the management of a patient with Golfer's elbow), basic science studies, and generally accepted mechanisms to help inform biological plausibility. Biological plausibility is one of the nine criteria in epidemiology proposed by Bradford-Hill to help determine whether measured or observed associations are causal.[19] In the context of chiropractic treatment, biological plausibility would include consideration of whether there are known anatomical or physiological mechanisms which indicate that a given condition (e.g., cervicogenic headache) or set of symptoms (e.g., whiplash-associated disorder) might arise from MSK-related issues, and thus benefit from chiropractic treatment. We discuss biological plausibility in more depth below (see 'Biological Plausibility').

Decision tools are commonly used across healthcare disciplines to help people and organizations make effective and reliable evidence-based decisions, in contexts often characterized by a significant degree of complexity and uncertainty.[20,21] Such tools may be designed to support clinicians to make evidence-based diagnostic or treatment decisions,[22–24] or they may be targeted to organization level decision-making in areas such as service delivery, guideline development or health policy initiatives[25]. There are also numerous tools that have been developed to support patients' healthcare decisions[26] by providing patients with information about treatment or screening options that are available, as well as the benefits and harms associated with these options[27].

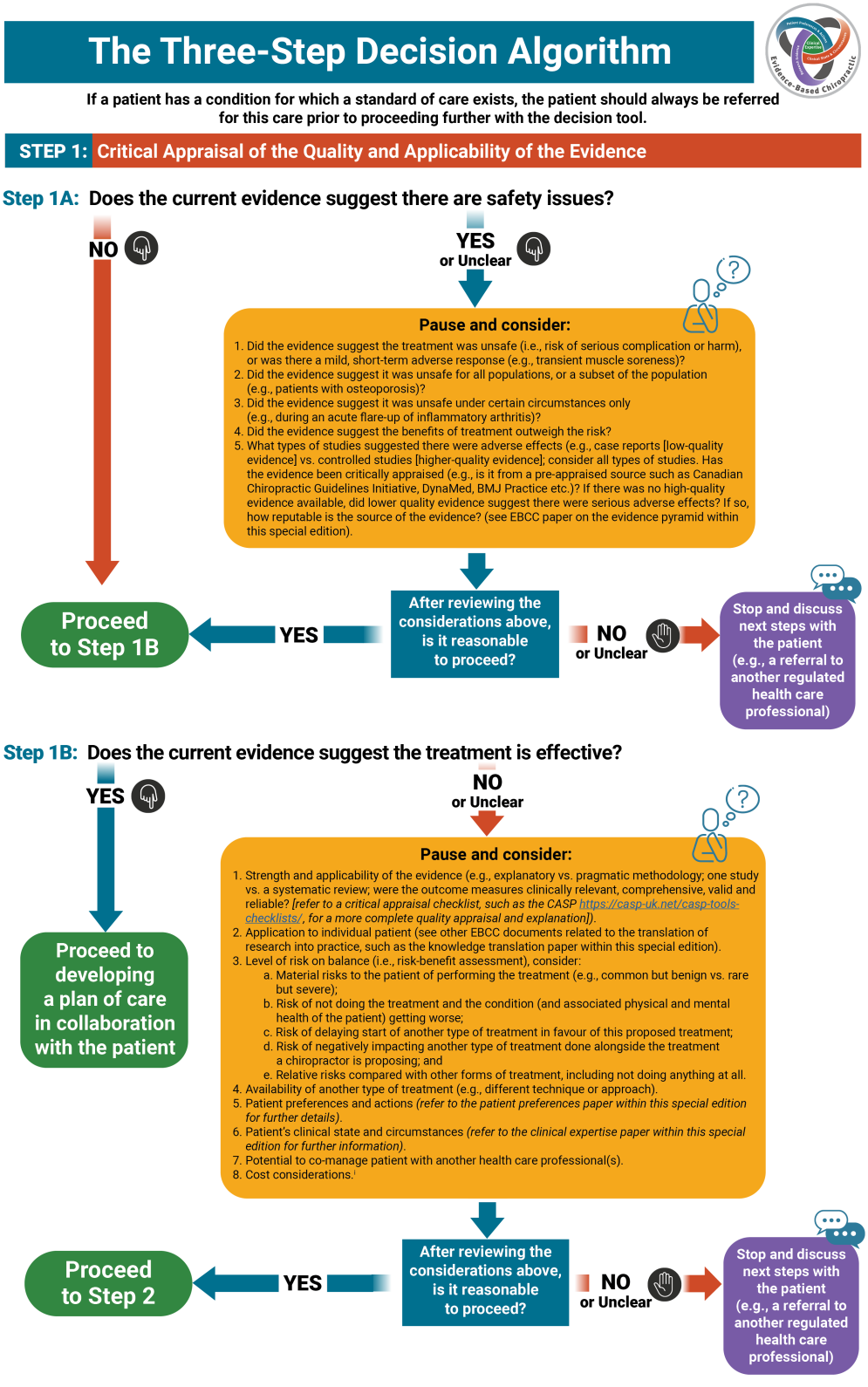
We searched three databases (Scopus, Web of Science and PubMed) for chiropractic or MSK-related clinical decision aids that were published in the past 10 years (since January 2012) and which were aimed specifically at supporting evidence-based clinical decision-making in instances where there is a paucity of research evidence. This search affirmed Leboeuf-Yde *et al*.'s[16] previous finding that most clinical tools are directed towards chiropractic care in specific domains[28–30]. To our knowledge no general guidance applicable to instances in which the research evidence base remains underdeveloped have since been published. Indeed, our search turned up only two tools which met our criteria for broad applicability[16,31] and only one which addressed the challenge of proceeding in an evidence-based manner when little research evidence is available[16].

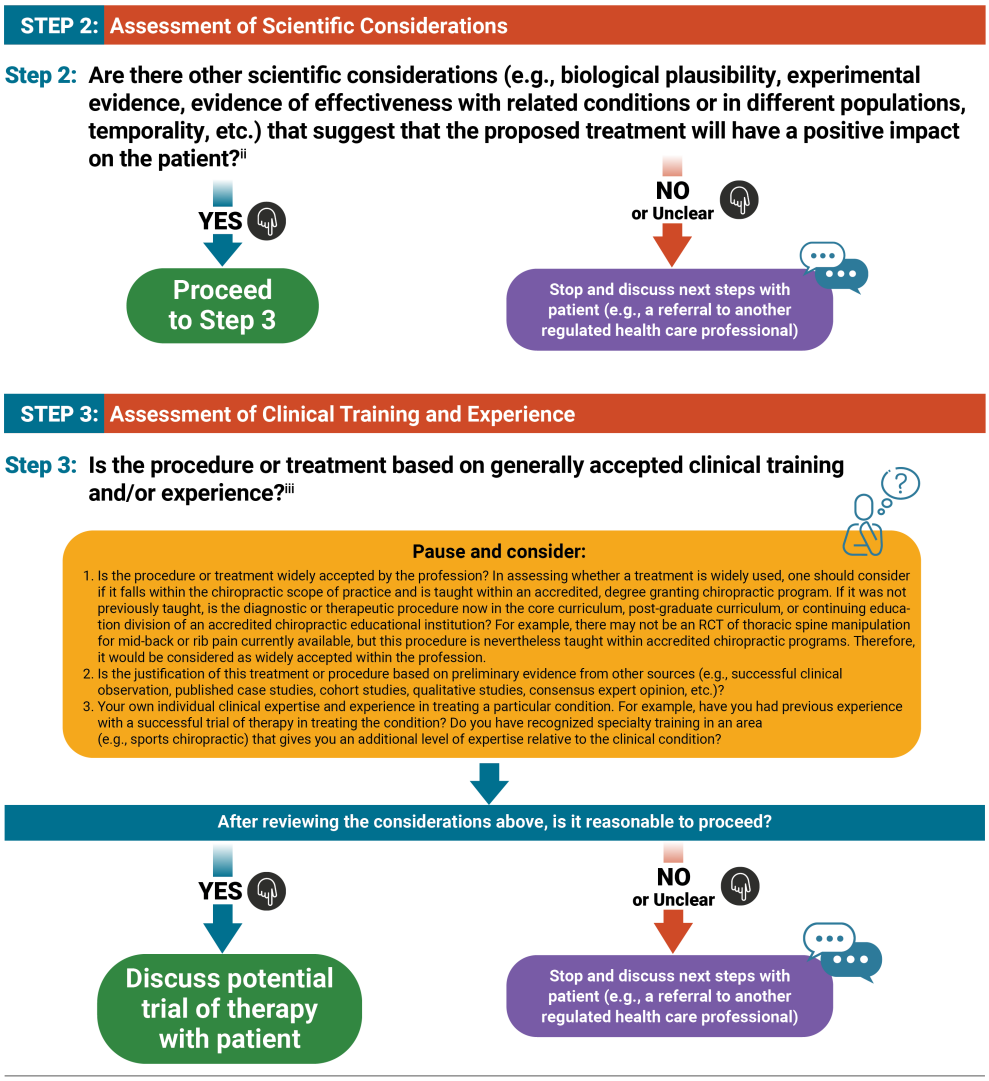
In 2016 Amorin-Woods and Losco[31] published a tool called "'PICO-D' Management" which provides a useful general framework for evidence-based clinical decision-making, in instances where there is an established evidence base. Originally developed as a pedagogical tool, it was published in the expectation that practitioners "may also find it useful for applying defensible evidence-based practice." (p. 1).[31] The model is based on making a decision to treat based on a comparison between chiropractic, "usual medical care" and/or "natural history" (e.g., do nothing). It includes within its broader framework a ranking of available evidence (syntheses such as systematic reviews and CPGs appearing at the top, followed by

strong, moderate, weak, or absent evidence) for both chiropractic and "usual medical care".[31] The tool may therefore be useful for supporting decision-making situations where one or more of these evidence bases is well developed. However, other than a reference to the "traffic light model" (p. 8) (discussed below) the tool is largely silent on what to do in situations where this is not the case.[31]

By contrast, the model developed by Leboeuf-Yde *et al*. in 2013 is expressly aimed at guiding clinical decision-making in the absence of high-quality research evidence.[16] The latter decision framework is called the "Traffic Light System", and is based on three questions that are designed to be applicable to most clinical situations, including and especially those for which research evidence is limited, absent or conflicting. The present decision-making tool therefore updates and expands upon this earlier model to include additional clinically oriented scientific considerations for the practitioner, as part of the evidence-based decision-making process. These additions are offered in the spirit of further enhancing the work of Leboeuf-Yde *et al*. to help guide clinicians in the delivery of evidence-based chiropractic care, particularly in instances where research evidence is absent or conflicting.[16]

The present tool is structured around a series of questions, organized into three steps. Figure 1 outlines this principle-based





[i] In looking at costs, there are several elements to consider: Are the outcomes of the chiropractic treatment better than alternatives? If the outcomes are similar (i.e., chiropractic care vs. alternative), is the cost of the chiropractic treatment lower (e.g., manual therapy vs. surgery)? What are the social costs associated chiropractic treatment versus the alternatives (e.g., manual therapy vs. pharmaceutical approach to pain management)? For instance, is there a risk of addiction with certain pharmaceuticals, such as opioids, in pain management? Does chiropractic treatment result in faster return to work or recovery time for patients? Are there additional psychosocial and emotional costs to consider? With any cost analysis or economic evaluation, the perspective (i.e., patient, institution, healthcare system, societal) and time horizon (e.g., 3 months, 1 year, 10 years, or lifetime) matters. In many cases, chiropractic care has the potential to represent lower cost and fewer risks than surgical or other invasive interventions (e.g., injections), while also having the benefit of keeping people active and productive.

[ii] Hill, AB. *The environment and disease: association or causation?* Proc R Soc Med. 1965;58:295–300.

[iii] It is important to keep in mind that the decision to move forward in Step 3 is based on the critical decision in Step 2 of whether there are other scientific considerations (e.g., biological plausibility, experimental evidence, evidence of effectiveness with related conditions and/or different populations, temporality, etc.) that suggest the proposed treatment may result in positive outcomes for the patient. We are aware that suggesting the proposed treatment should be widely accepted runs the risk of *argumentum ad populum* (i.e., a fallacious argument that concludes a proposition to be true because many or all people believe it; it alleges that "if many believe so, it is so"). However, on balance, we believe it is a reasonable consideration to make. At the same time, relying only on long-term and/or widely accepted treatments can limit the potential for clinicians to deliver care that may be beneficial to certain patients. For instance, a treatment that is not widely used may be uninvestigated because only a few people have undertaken the education and training to administer it. Similarly, conditions that are less prevalent may not yet be extensively researched, simply because there has not been a sufficient number of patients to conduct a formal, randomized controlled trial. In addition, there is oftentimes only limited funding available to conduct investigations on the clinical effectiveness of chiropractic care, and what funding that does exist tends to be prioritized towards studies on major morbidities such as low back and neck pain, rather than mid-back pain or other neuromusculoskeletal conditions. Furthermore, certain populations (e.g., seniors,) may not be included in the research.

Figure 1.
Proposed three step decision tool for use within chiropractic practice.

approach to designing a trial of therapy. Assessment of the research evidence relative to these steps will assist the chiropractor in deciding whether and when to stop and discuss other options, such as referral to a different healthcare professional, or proceed with an N of 1 clinical trial of therapy, tailored to the individual patient. In the latter case, as always, clinicians should initiate treatment and management with discretion. In addition to the tool, it is important to note that although it is challenging to master the skills of critical appraisal, learning and practicing critical appraisal of the literature is extremely valuable for practitioners. For example, a study may not have had an adequate control group, lacked an appropriate randomization strategy, or was unclear on inclusion criteria. These limitations could impact the outcome of the research, and hence the practitioner's trust in the study's conclusions. We refer readers to the Critical Appraisal Skills Program (CASP) for specific checklists and guidance on critically appraising different types of study designs (https://casp-uk.net/casp-tools-checklists/).

It should also be pointed out that dependent on the practitioner's expertise and/or patient preference, it is possible to reach different conclusions using the tool. For example, a chiropractor with advanced fellowship training may have knowledge and expertise that a colleague does not, enabling them to apply that expertise in a trial of care. Therefore, different clinical decisions are an acceptable outcome, as long as the full tool has been utilized and carefully evaluated at each step, and the individual patient's safety, best interests, their clinical state and cir-

cumstances, and the best available evidence, have been accounted for.

Biological plausibility

In line with Leboeuf-Yde *et al*.,[16] we define biological plausibility as the degree to which a concept, procedure, or treatment aligns with the chiropractic and scientific communities' understanding of biological or scientific principles. When the underlying rationale of a procedure or concept is biologically plausible, it means that it makes sense in the context of established scientific knowledge and principles. In such cases, if accredited educational institutions and the majority of clinicians also accept the concept, it is likely to be considered relatively acceptable.[16] However, if a concept or procedure is deemed biologically implausible, it means it contradicts or lacks support from scientific understanding. In such cases, clinical expertise alone is insufficient to justify its use and alternative options such as referral must be considered. This is because a biologically implausible concept is unlikely to be clinically valid, as it does not align with established scientific principles.

Biological plausibility may include conditions or symptoms in which plausibility is connected to the patient presentation and circumstance. For example, research suggests there is a link between the pathophysiology of myofascial trigger points (MTrPs) and central sensitization,[32] central sensitization and migraines,[33] and MTrPs and migraines[34–36]. An understanding of these mechanisms and relationships makes it biologically plausible that treating central sensitization (CS) through spinal manipulation may assist in treating MTrPs and migraines. Importantly, the incorporation of biological plausibility as a component of our decision tool is intended to eliminate clinicians proceeding with care in biologically implausible circumstances (see Supplemental File 3, chiropractic treatment of Parkinson's disease).

Considerations of risk

Risks must always be considered when making a clinical decision. Furthermore, the probability of risk should also be considered. For instance, a clinician should consider whether each of the risks outlined below are rare, low, or high. The risks to the patient to consider would be fivefold:[37]

1. Material risks to the patient of performing the treatment (e.g., common but benign vs. rare but severe),
2. Risk of not doing the treatment and the condition (and associated physical/mental health of the patient) getting worse,
3. Risk of delaying start of another type of treatment in favour of this proposed treatment,
4. Risk of negatively impacting another type of treatment done alongside the treatment a chiropractor is proposing, and
5. Relative risks compared with other forms of treatment, including not doing anything at all.

If a chiropractor is planning on proceeding with a treatment that has limited research evidence, the chiropractor must discuss with the patient, as part of the process of obtaining informed consent:

- The benefits of the proposed course of care,
- The potential risks of the proposed course of care, including the potential risk of delaying another type of treatment,
- The possibility that there may be risks that are not yet known, given that there is little or no clinical research evidence (e.g., if the patient is receiving concurrent treatment for a condition and possible interactions are not known) and,
- Whether the proposed treatment may interfere with any concomitant care the patient may be receiving.

This is the case even where new, and limited, evidence has been published, such as thrust manipulation for shoulder impingement, which is recommended in a recent systematic review and clinical practice guideline.[38,39]

In Canada, provincial legislation and standards of practice, guidelines and policies set out the minimum requirements for consent to treatment. For Ontario chiropractors, please see https://cco.on.ca/wp-content/uploads/2018/12/S-013.pdf.

If a decision is made to treat or co-manage the patient with another regulated healthcare professional/s, there are three types of care the chiropractor can provide: (i) acute care, (ii) care for chronic or recurrent conditions, including supportive care,[40] and (iii) preventive/maintenance care[41,42,ii]. If a referral to another regulated healthcare professional (e.g., orthopedic surgeon, neurologist, physio-

therapist, etc.) is required, the patient should be referred appropriately.

N of 1 trial of therapy

> *"In an era that promotes patient centred research, comparative effectiveness, and personalised medicine, N-of-1 trials allow clinicians and patients to evaluate health interventions in a rigorous fashion and to re-evaluate chronic therapies to ensure therapeutic effectiveness is still achieved. N-of-1 trials are a unique tool to elicit patient preferences and to facilitate shared decision-making, hence evidence-based medicine, in real clinical practice"*[43]
>
> – CONSORT extension for reporting N of 1 trial 2015 statement

An "N of 1" trial is a clinical research method that draws on key methodological elements of group RCTs, to assess the efficacy of a given treatment for a particular patient.[43] The methodological principles of an N of 1 trial can also be used outside of the research context to design a high quality, time limited trial of therapy that integrates available research evidence with the specific clinical circumstances, preferences and values of the patient.[44] The N of 1 trial design, first published by Guyatt, Sackett and colleagues in 1986, is a more rigorous method than the informal trials that were common in medicine prior to this, and provides a more reliable basis for inferring the effects of a treatment.[45,46]

N of 1 trials can be used to evaluate a range of conditions and interventions, including MSK and nMSK disorders and manual therapies commonly used by chiropractors.[43] Patients with rare MSK or nMSK conditions, as well as those with co-morbidities or who are undergoing concurrent treatments, may be especially likely to benefit from a trial of therapy.[43,47] In the case of rare MSK or nMSK conditions (e.g., complex regional pain syndrome) there may be little or no clinical research on which to base treatment decisions. Likewise, since patients with co-morbidities or who are receiving concurrent treatments are often excluded from fastidiously designed RCTs, further clinical investigation will be necessary, even where the high-quality evidence otherwise suggests that the treatment is safe and effective.[43]

Blinding and randomization are typical features of N of 1 trials conducted for research. Although these features reduce bias and confounding they are not necessary if the intention is solely to provide optimal patient care, and not to publish or disseminate the results of the trial.[44,iii]

Nevertheless, N of 1 trials are not appropriate to all conditions. As a form of controlled trial, confounding factors should still be minimized. N of 1 trials are therefore best suited to stable chronic conditions for which progress can be observed/tracked over time, and where the interventions are designed to address these conditions.[47] Where a concurrent treatment is present, this should also be stable throughout the trial.[43]

Due to the highly individualized nature of an N of 1 trial, the frequency and duration of treatment should not be determined *a priori* (e.g., an 'x amount of treatment' plan). Rather, these parameters should be determined on a case-by-case basis, and based on a patient's response to treatment as well as with regard to relevant legislation in the jurisdiction in which the clinician practices. A principles-based approach is outlined in the seven steps below, and emphasizes safety, patient preferences and input, and clinical judgement. As always, where information is relevant and available, clinicians should consult systematic reviews, CPGs and other forms of high-quality research to inform their clinical judgements.

When co-designing a trial of therapy with a patient, the following seven principles should be observed as part of the informed consent process, in compliance with the regulations set out by the regulatory body in the jurisdiction in which the clinician is practicing. Expanding on the general informed consent process described above, a well-designed N of 1 trial should be developed in partnership with the patient and include:

1. Discussion of risk, benefit, any potential side effects, and alternative treatments prior to commencing the trial;
2. Clearly defined, patient-centred outcome(s) (e.g., pain relief, physical and emotional functioning, patient satisfaction) defined at the outset. Outcomes should be relevant to the patient, and be targeted to the patient's chief complaints and goals with respect to those complaints;
3. Clearly defined time horizon, including frequency and duration of treatments agreed prior to commencement

of trial (e.g., see CPG for chiropractic care of low back pain by Whalen *et al*.[48]);
4. Regular, frequent re-evaluation to assess progress using objective and/or subjective tests and patient-reported outcome measures (e.g., numeric pain rating scale [NPRS], visual analogue scale, or functional capacity questionnaires such as the Bournemouth Questionnaire, Oswestry, or Neck Disability Index)[49], including if/when there is material change to the plan of management or a change in patient status that would materially change the risk-benefit profile;
5. Ongoing self-observation by the patient between clinical encounters to monitor symptoms (e.g., pain diary, MYMOP2 [Measure Yourself Medical Outcome Profile v.2]), and at regular intervals (e.g., daily or weekly) to minimize patient recall bias;
6. Investigation and documentation of the presence or absence of adverse events; and
7. Investigation and documentation of secondary benefits not directly related to the MSK or nMSK condition/goals (e.g., improved sleep quality).

If the patient is showing serious or persistent side effects, or not showing progress, the nature of the trial of therapy should be reconsidered and discussed with the patient. A trial of therapy should be ceased if/when any of the following occur:

- The agreed upon time limit is reached and there is no sign of improvement,
- The patient is getting worse,
- The patients' goals are achieved,
- The patient has a significant change in health status, whether related or unrelated to the condition for which they are receiving treatment, or
- There is a change to informed consent.

Guide to the supplemental files: using the decision-making framework with a patient's clinical state and circumstances

There are conditions which chiropractors see every day in practice for which there is no high-quality research evidence of direct treatment effectiveness; however, patients report improvements when chiropractors treat the MSK- or nMSK symptoms associated with these conditions rather than the underlying disease or condition itself. For example, a patient with post-traumatic stress disorder (PTSD), or someone who has cardiovascular disease and is on cholesterol lowering medication, might also suffer with chronic back or neck pain symptoms. A patient's therapeutic goal may not be to cure the PTSD condition, but rather to manage the MSK symptoms associated with the condition through supportive care or improving their activities of daily living. It may be that a chiropractor is co-managing the condition with other health professionals for whom the underlying disease or condition squarely falls within their respective scope of practice yet there exists an MSK or nMSK component related to the symptoms.

As such, we have developed a series of three supplementary files, which demonstrate how the tool might be used to answer three different clinical questions. The first is related to therapy for a specific nMSK condition (migraine headaches), the second is related to the concept of maintenance care, and the third is related to the treatment of a non-MSK condition. For this last example, we chose Parkinson's disease to illustrate how the tool prevents chiropractic treatment of non-MSK conditions but supports the co-management of MSK or nMSK symptoms associated with these conditions. Our goal in these files is to demonstrate how the tool can be used by clinicians to answer different types of clinical questions. Although we present three examples related to questions about therapy, the tool may also be useful for addressing other types of clinical questions (e.g., diagnosis, etiology, prevention, prognosis).

i The authors of this paper have operationally defined research evidence as scientific findings vetted through the scientific community (e.g., during either conferences attended by subject matter experts or by the peer-review journal process).

ii The three types of chiropractic care are: chiropractic care for acute conditions, chiropractic care for chronic/recurrent conditions, including supportive care and chiropractic care for prevention/maintenance.[40–42]

iii N of 1 trials are more reliable due to their prospective crossover design, which allows the clinician to compare the effects of two or more interventions.[45,47] This is commonly referred to as "ABAB" testing where "A" represents the tested intervention and "B" represents a comparator.[47]

Supplemental file 1. *Treatment question: treatment of patients with migraine headache*

Migraines are a condition commonly treated by chiropractors with varying levels of evidence and conclusions supporting the use of spinal manipulative therapy (SMT) for migraine treatment.[50–54] One of the challenges related to migraines is the large number of different types of headaches that may overlap with, or be confused with, migraines. Version 10 of the International Classification of Diseases (ICD) classifies migraine as a category of headache. However, even within the migraine classification there are 13 different codes that describe the variation and diagnosis of migraine headaches in greater detail.[55] Use of the decision tool for migraine via chiropractic care is discussed below, however, as an example of utilizing the decision tool in clinical practice, please refer to Figure 2 at the end of this section.

Patient profiles

Patient A:

- 37-year-old, Caucasian female suffering from migraine headaches and less intense headaches for over 20 years.
- The migraine headaches occur 2-3 times per month, and are associated with neck and jaw pain, photophobia, and cause nausea. They are triggered by stress, weather changes and commencement of her menstrual cycle.
- Her less intense headaches occur 1-2 times per week.
- She has been prescribed gabapentin, toradol (as needed) and naproxen (2X per week).
- She suffers from anxiety and has a stressful lifestyle.
- She has no other significant co-morbidities.

Patient B:

- 45-year-old, Caucasian female with a 30-year history of severe headaches and syncope.
- The headaches are debilitating and can cause nausea and vomiting. They are triggered by stress, certain chemical odours, red wine, and dark chocolate, and occur 2-3 times per month.
- Manual, chiropractic care provided significant relief 10 years ago, but was discontinued after moving to a different city.
- Syncope is triggered by very high stress or excitement and can last for 2-10 minutes. These attacks occur rarely.
- MRI within the last year demonstrated an aneurysm where the basilar artery bifurcates in the circle of Willis. The aneurysm is being monitored every 6 months.
- She is a single, yoga instructor with a low stress lifestyle.

The decision tool was used in the consideration of using high-velocity, low-amplitude, manual chiropractic manipulation as a treatment for Patient A and Patient B.

Step 1A. *Does the scientific evidence suggest the treatment is unsafe?*

Patient A: There is no evidence to suggest that chiropractic treatment of migraine headaches is unsafe. Therefore, move to Step 1B.

Patient B: While there is no evidence to suggest that chiropractic treatment of migraine headaches is unsafe, the presence of an aneurysm adds an additional risk factor. Therefore, proceeding with a high-velocity, low-amplitude, manual chiropractic manipulation as a treatment would be considered unsafe.

Options: refer to another healthcare professional *or* return to Step 1A to determine whether treatment with a low-force technique may be reasonable.

Step 1B. *Does the scientific evidence suggest the treatment is effective?*

Recent systematic reviews and randomized controlled trials have examined the evidence for chiropractic and manual therapy as a treatment for migraine. [5,51–53]

Key takeaways:

- There is evidence to support the effectiveness of chiropractic care for relief of migraine headache, but it is limited or of a low quality.[5,51] For example, one systematic review concluded that "SMT may be an effective therapeutic technique to reduce migraine days and pain intensity"; however, the authors acknowledged that there were methodological limitations in the studies that were included and that these results should be interpreted as preliminary.[5] Another systematic review found no evidence of an effect of SMT on migraine[53]; however, the number of included studies was limited. A response to this review indicated that none of the reviewed literature demonstrated a negative impact of

SMT on migraine patients, and that the evidence suggests more research in this area is warranted before any definitive conclusions can be drawn.[54] Due to the small number of studies, and the low grade of quality for some studies, any recommendations for treatment should be cautious. However, a trial of chiropractic care for migraine is justifiable, provided no contraindications for manual therapy are present.

Patient A: High-velocity, low-amplitude, manual chiropractic manipulation
- The research evidence about chiropractic treatment and migraine is inconclusive but evolving.
- Move to Step 2

Patient B: Low-force chiropractic technique
- The research evidence about chiropractic treatment and migraine is inconclusive but evolving.
- Move to Step 2

Step 2. *Are there other scientific considerations (e.g., biological plausibility, experimental evidence, evidence of effectiveness with related conditions or in different populations, temporality, etc.) which suggest that the proposed treatment will have a positive impact on the patient?*

Yes. Several laboratory-based studies (i.e., experimental evidence) suggest there is a link between central sensitization (CS) and migraine headaches.[33,36,56,57] The emerging research on CS and SMT, reviewed elsewhere in this collection,[58] is elucidating a possible physiologic mechanism responsible for the clinical presentation of migraines, among other conditions. Furthermore, research on CS is also advancing our understanding of the mechanism through which conservative techniques such as SMT, dry needling, and therapeutic ultrasound, may decrease the pain and disability experienced by migraine sufferers.[5,34,59,60] For example, deactivation of myofascial trigger points (MTrPs) has been shown to reduce both migraine pain and associated allodynia[34], while peripheral magnetic stimulation of MTrPs in the trapezius and deltoid muscles has also been shown to reduce migraine frequency[60]. Moreover, SMT has demonstrated potential in reducing migraine days and pain intensity, providing a plausible biological mechanism for chiropractic care in treating migraines, despite noting the dearth of research in this area rendering these conclusions preliminary.[5] Regardless, when considered safe, treatments targeting CS should therefore be considered for their clinical application in managing migraines.

Biological plausibility is one of the key considerations for establishing causality of disease or treatment effectiveness in epidemiology (i.e., the Bradford-Hill criteria).[19] These considerations include the strength, consistency, specificity, temporality, dose response, coherence, experimental evidence, and analogy of association. This research linking CS and migraine headaches,[33,36,56,57] as well as SMT and other conservative techniques with CS and migraines,[5,34,58–60] provides biological plausibility of chiropractic care in the safe, effective, and evidence-based management of migraine symptoms.

Patient A: High-velocity, low-amplitude, manual chiropractic manipulation
- There is growing evidence for biological plausibility between chiropractic care and migraine headache.
- Move to Step 3

Patient B: Low-force chiropractic technique
- There is growing evidence for biological plausibility between chiropractic care and migraine headache.
- Move to Step 3

Step 3. *Is the procedure or treatment based on generally accepted clinical training and/or experience?*

As noted above, migraines are a condition commonly treated by chiropractors. Knowledge about the treatment of migraines is gained through education and training in internationally recognized accredited chiropractic programs. This knowledge is also tested as part of official licensing examinations.[61]

In its 2020 national survey, the National Board of Chiropractic Examiners (NBCE) noted that chiropractors reported providing care nearly once a day to patients with headaches, making it the most common nMSK condition treated by U.S. chiropractors.[50] Over 75% of chiropractors also reported making the initial diagnosis of headaches for patients at least half the time.[50] Close to 25% reported co-managing headaches with other health professionals, while 70% reported treating the condition themselves.[50]

As identified in Note 3 within Figures 1 and 2, a treat-

The Three-Step Decision Algorithm

Chiropractic Care for Migraine

STEP 1: Critical Appraisal of the Quality and Applicability of the Evidence

Patient Profile

- 37-year-old, Caucasian female suffering from migraine headaches and less intense headaches for over 20 years.
- The migraine headaches occur 2-3 times per month, and are associated with neck and jaw pain, photophobia, and cause nausea. They are triggered by stress, weather changes and commencement of her menstrual cycle.
- Her less intense headaches occur 1-2 times per week.
- She has been prescribed gabapentin, toradol (as needed) and naproxen (2X per week).
- She suffers from anxiety and has a stressful lifestyle.
- She has no other significant co-morbidities.

Step 1A: Does the current evidence suggest there are safety issues?

NO

There is no evidence to suggest that chiropractic treatment of migraine headaches is unsafe. Therefore, move to Step 1B.

Step 1B: Does the current evidence suggest the treatment is effective?

NO or Unclear

Pause and consider:

1. Recent systematic reviews and randomized controlled trials have examined the evidence for chiropractic and manual therapy as a treatment for migraine.[5,51-53]

Key Takeaways:

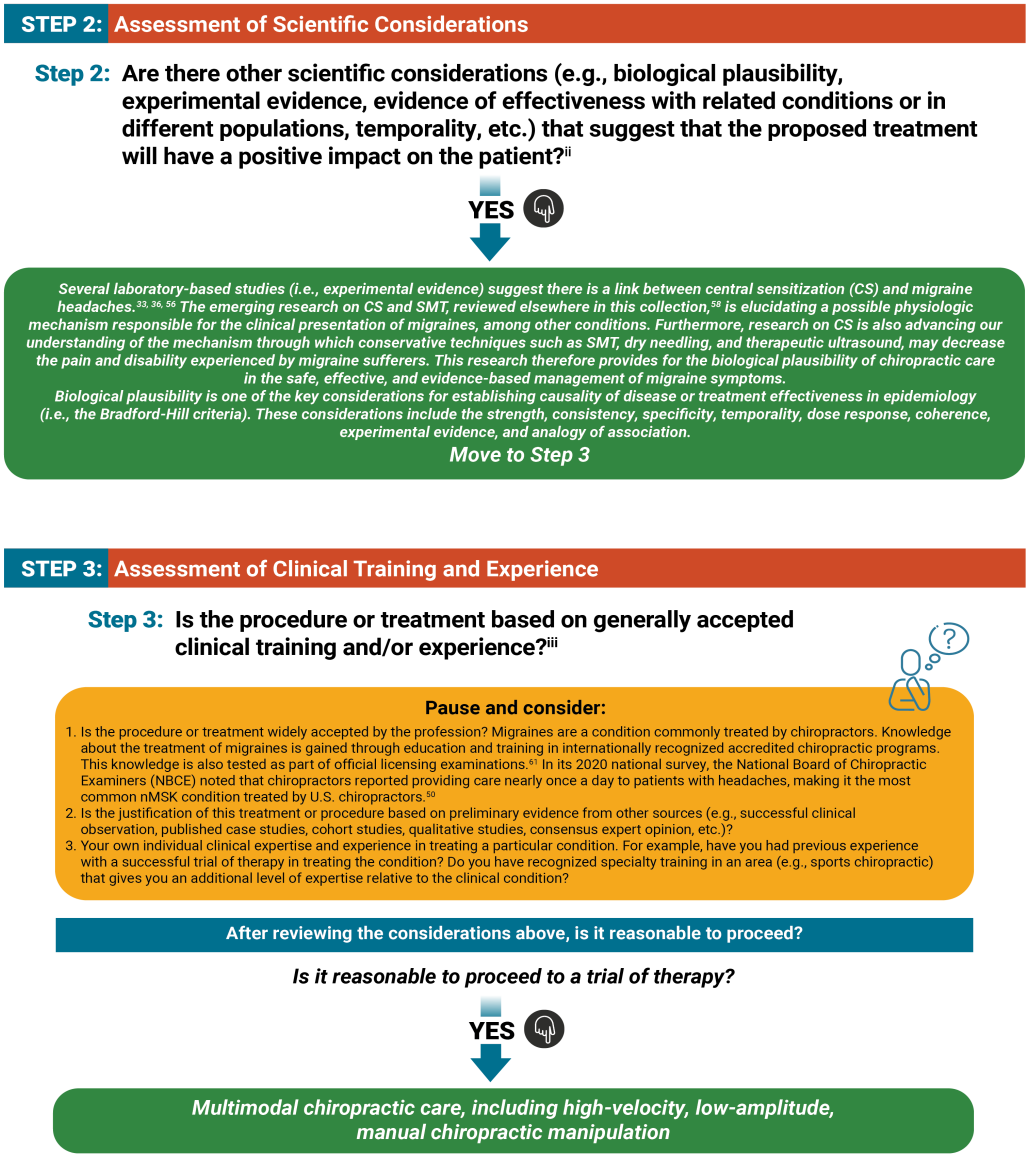
- There is evidence to support the effectiveness of chiropractic care for relief of migraine headache, but it is limited or of a low quality.[5, 51] For example, one systematic review concluded that "SMT may be an effective therapeutic technique to reduce migraine days and pain intensity"; however, the authors acknowledged that there were methodological limitations in the studies that were included and that these results should be interpreted as preliminary.[5] Another systematic review found no evidence of an effect of SMT on migraine[53]; however, the number of included studies was limited. A response to this review indicated that none of the reviewed literature demonstrated a negative impact of SMT on migraine patients, and that the evidence suggests more research in this area is warranted before any definitive conclusions can be drawn.[54]
- Due to the small number of studies, and the low grade of quality for some studies, any recommendations for treatment should be cautious.
- However, a trial of chiropractic care for migraine is justifiable, provided no contraindications for manual therapy are present.

2. Application to individual patient (see other EBCC documents related to the translation of research into practice, such as the knowledge translation paper within this special edition).
3. Level of risk on balance (i.e., risk-benefit assessment), consider:
   a. Material risks to the patient of performing the treatment (e.g., common but benign vs. rare but severe);
   b. Risk of not doing the treatment and the condition (and associated physical and mental health of the patient) getting worse;
   c. Risk of delaying start of another type of treatment in favour of this proposed treatment;
   d. Risk of negatively impacting another type of treatment done alongside the treatment a chiropractor is proposing; and
   e. Relative risks compared with other forms of treatment, including not doing anything at all.
4. Availability of another type of treatment (e.g., different technique or approach).
5. Patient preferences and actions *(refer to the patient preferences paper within this special edition for further details)*.
6. Patient's clinical state and circumstances *(refer to the clinical expertise paper within this special edition for further information)*.
7. Potential to co-manage patient with another health care professional(s).
8. Cost considerations.[1]

After reviewing the considerations above, is it reasonable to proceed?

YES

High-velocity, low-amplitude, manual chiropractic manipulation
The research evidence about chiropractic treatment and migraine is inconclusive but evolving.
Move to Step 2



i. In looking at costs, there are several elements to consider: Are the outcomes of the chiropractic treatment better than alternatives? If the outcomes are similar (i.e., chiropractic care vs. alternative), is the cost of the chiropractic treatment lower (e.g., manual therapy vs. surgery)? What are the social costs associated chiropractic treatment versus the alternatives (e.g., manual therapy vs. pharmaceutical approach to pain management)? For instance, is there a risk of addiction with certain pharmaceuticals, such as opioids, in pain management? Does chiropractic treatment result in faster return to work or recovery time for patients? Are there additional psychosocial and emotional costs to consider? With any cost analysis or economic evaluation, the perspective (i.e., patient, institution, healthcare system, societal) and time horizon (e.g., 3 months, 1 year, 10 years, or lifetime) matters. In many cases, chiropractic care has the potential to represent lower cost and fewer risks than surgical or other invasive interventions (e.g., injections), while also having the benefit of keeping people active and productive.

ii. Hill, AB. *The environment and disease: association or causation?* Proc R Soc Med. 1965;58:295–300.

iii. It is important to keep in mind that the decision to move forward in Step 3 is based on the critical decision in Step 2 of whether there are other scientific considerations (e.g., biological plausibility, experimental evidence, evidence of effectiveness with related conditions and/or different populations, temporality, etc.) that suggest the proposed treatment may result in positive outcomes for the patient. We are aware that suggesting the proposed treatment should be widely accepted runs the risk of *argumentum ad populum* (i.e., a fallacious argument that concludes a proposition to be true because many or all people believe it; it alleges that "if many believe so, it is so"). However, on balance, we believe it is a reasonable consideration to make. At the same time, relying only on long-term and/or widely accepted treatments can limit the potential for clinicians to deliver care that may be beneficial to certain patients. For instance, a treatment that is not widely used may be uninvestigated because only a few people have undertaken the education and training to administer it. Similarly, conditions that are less prevalent may not yet be extensively researched, simply because there has not been a sufficient number of patients to conduct a formal, randomized controlled trial. In addition, there is oftentimes only limited funding available to conduct investigations on the clinical effectiveness of chiropractic care, and what funding that does exist tends to be prioritized towards studies on major morbidities such as low back and neck pain, rather than mid-back pain or other neuromusculoskeletal conditions. Furthermore, certain populations (e.g., seniors,) may not be included in the research.

Figure 2:
Proposed three step decision tool for use within chiropractic practice

ment that is not widely used may be uninvestigated because the condition may be rare and there have been insufficient numbers of patients to conduct a formal, randomized controlled trial. The same concept applies to the current question of whether the proposed treatment is widely used. It may be that the treatment is so unique that only a few chiropractors have undertaken the education and training to perform it. This does not mean the patient cannot benefit from the treatment, but rather the clinician should consider whether this is the case when determining if a treatment is widely accepted. At all times, a chiropractor should consider the best available evidence and their own individual clinical expertise, related to treating the condition and the treatment plan being proposed, along with their patient's clinical state and circumstances.

If an informed decision is made by the patient to move forward with a trial of therapy the chiropractor and patient should agree on the desired outcomes being sought from the treatment as well as the length of the trial of therapy, prior to commencing treatment. This information should be thoroughly documented in the patient record. Ongoing reassessments of the patient's condition should also be conducted at regular, pre-determined intervals to assess whether a change in treatment approach or referral to another healthcare provider is necessary. See 'N of 1 trial of therapy' section above for further details on conducting a trial of therapy.

Patient A: Multi-modal chiropractic care, including high-velocity, low-amplitude, manual chiropractic manipulation

- It is reasonable to proceed to a trial of therapy.

Patient B: Multi-modal chiropractic care, emphasizing low-force chiropractic techniques

- It is reasonable to proceed to a trial of therapy.

Supplemental file 2. *Treatment question: maintenance care for patients with low back pain*

Maintenance care is a secondary or tertiary preventative healthcare strategy that is used by chiropractors to prevent future episodes and/or to manage persistent bothersome (activity-limiting) pain.[11,12,42] In this treatment approach patients are seen at regular, planned intervals rather than by timing treatments to respond to the (re)emergence of symptoms.

Low back pain is increasingly understood to be a persistent, recurring and often life-long condition. For this reason, effective management strategies are highly desirable for patients, employers, and healthcare payers alike.

A summary of the research regarding chiropractic maintenance care for low back pain is highlighted below in Step 1.

For further information about the different types of research designs that best answer different clinical questions (i.e., diagnosis, therapy, prognosis, etiology, prevention, or harm), please refer to our paper in this JCCA series on the evidence hierarchy.[15]

Patient profiles

Patient A:

- 42-year-old female, works full-time shift work as a personal support worker
- Recurring job-related low back pain
- Has experienced success with SMT for low back pain in the past; otherwise has good self-reported physical and mental health
- Has limited extended health coverage through workplace benefits, and limited discretionary funds for out-of-pocket healthcare services

Patient B:

- 82-year-old female with osteoporosis
- Lives independently and wishes to continue to do so, but has begun to experience episodes of low back pain which temporarily interfere with independence in daily living
- Has experienced positive outcomes from chiropractic care in the past
- Struggles periodically with depression and isolation
- Has excellent private health insurance coverage and financial means to pay out-of-pocket if necessary
- Is seeking a preventative strategy to avoid low back pain episodes and maintain independence in daily living

Step 1A. *Does the scientific evidence suggest the treatment is unsafe?*

Patient A:

- No, there is no evidence to suggest that chiropractic maintenance care is unsafe for this patient
- Move to Step 1B

Patient B:

- Yes, there is evidence and expert consensus that high-force, high-velocity treatments are unsafe for patients with osteoporosis
- No for lower force/velocity techniques
- Consider moving to Step 1B to assess the merits of a preventative maintenance care strategy of exercise, gentle manipulation/mobilization, and soft-tissue therapy

Step 1B. *Does the scientific evidence suggest the treatment is effective?*

The research on maintenance care is evolving. Pursuant to systematic reviews completed in 1996 and 2008 which concluded that evidence for this practice was lacking, a group of researchers in Northern Europe established a systematic research program, known as the "Nordic Maintenance Care Program".[42]

Considering the new research evidence generated through the Nordic Maintenance Care Program[11–13] as well as studies of maintenance care in the U.S., Canada and Egypt, a new systematic review was undertaken and published in 2019.[42] The review looked at a total of 14 qualitative and quantitative research articles published between 2007 and 2019, four of which were RCTs. Authors of the 2019 review include members of the Nordic research group, as well as those involved in previous reviews of maintenance care.

Key takeaways:

- Maintenance care can be considered an evidence-based method of secondary or tertiary prevention for patients with previous episodes of low back pain (LBP) who have responded well to treatment
- There is insufficient evidence to support the use of maintenance care on all patients who receive chiropractic care
- Further research is required to understand which patients respond best to maintenance care and which components of maintenance care are most valuable and for which patients
- The cost-effectiveness of maintenance care is unknown

Patient A:

- Yes, a recent systematic review (high-quality evidence) by the Nordic Maintenance Care group[42] suggests that maintenance care can be an effective therapeutic approach for patients with previous episodes of LBP who have responded favourably to treatment
- Consider that the patient has limited resources to offset the cost of this care, and the cost effectiveness of maintenance care is unknown

Patient B:

- Yes, a recent systematic review (high-quality evidence) by the Nordic Maintenance Care group[42] suggests that maintenance care can be an effective therapeutic approach for patients with previous episodes of LBP who have responded favourably to treatment
- Consider that the above-mentioned systematic review of the maintenance care literature suggests that maintenance care is typically understood to incorporate a range of treatment modalities (e.g., manual therapy, exercise prescriptions, advice on ergonomics, diet, weight loss, and stress management) and that sessions tend to "resemble ordinary consultations".[42]

Step 2. *Are there other scientific considerations (e.g., biological plausibility, experimental evidence, evidence of effectiveness with related conditions or in different populations, temporality, etc.) which suggest that the proposed treatment will have a positive impact on the patient?*

Other scientific considerations could include patient population, temporality, and biological plausibility, as they pertain to the patient's clinical state and circumstances. For example, clinicians might consider whether the patient has any risk factors associated with chronic or recurrent LBP, such as depression, obesity, or workplace risk factors.[12,13,42,62]

A recent secondary analysis[12] of previously published RCT data[11] looked at the differences in outcomes for patients across three different psychological subgroups, as classified by the West Haven-Yale Multidimensional Pain Inventory: adaptive copers, interpersonally distressed and dysfunctional. They found that patients who received maintenance care had "flat pain trajectories around each new treatment period and reported fewer days with pain compared to patients receiving the control intervention".[12] However, this entire effect was attributable to the patients in the group labeled with the "dysfunctional" psychological profile, defined as patients with high pain severity, marked interference with everyday life, high

affective distress, low perception of life control and low activity levels. The study concluded that "Understanding how subgroups of patients are likely to be affected by maintenance care may help align patients' and clinicians' expectations based on realistic outcomes".[12]

There is also emerging evidence that cortical reorganization and altered brain functional connectivity may predict the transition from acute/episodic to chronic pain.[62] This provides preliminary experimental evidence and biological plausibility on which a clinician could potentially identify individuals who are vulnerable to developing chronic pain. The clinician could then discuss a trial period of maintenance care with their patient, with the aim of slowing or arresting the transition to chronic pain.

There is also accumulating research suggesting CS is a key driver in the pathophysiology and clinical manifestation of broad profile chronic pain conditions, including LBP.[63–65] Further research suggests that SMT may achieve its therapeutic benefits by directly modulating CS.[66] Biological plausibility exists, therefore, to consider the role of SMT in a maintenance care plan for ongoing or persistent chronic pain conditions.[11,12,42] Please refer to Vazic *et al*. (2023)[58] in this JCCA collection for a detailed discussion on the mechanisms of SMT that suggest its role in an effective maintenance care program for persistent chronic pain.

Patient A:

- Consider that the patient does have workplace risk factors which may support the biological plausibility of maintenance care as an effective strategy in this instance
- Consider emerging research evidence to support the biological plausibility that SMT used as maintenance care may slow/prevent disability related to osteoarthritis[58]
- Consider that this patient does not match the psychological profile of the patient population which had the greatest impact on the outcome of the above discussed RCT
- Proceed to Step 3

Patient B:

- Consider the risk of the LBP becoming chronic
- Consider whether a patient who experiences depression and isolation may benefit from periodic check-ins to see if they are keeping up with exercises, etc.
- Consider whether it is biologically plausible that maintenance care could still be an effective secondary or tertiary prevention strategy in the absence of SMT

Step 3. *Is the procedure or treatment based on generally accepted clinical training and/or experience?*

Maintenance care is used by many chiropractors in the United States, Canada, Europe and the South Pacific.[12,42,67] For example, it has been reported that "About 98% of all chiropractors who are members of the Swedish Chiropractic Association consider a treatment strategy known as maintenance care (MC) to be clinically useful and beneficial for patients with recurrent and persistent MSK pain."[12] The United States National Board of Chiropractic Examiners 2019 survey also found that 65% of American chiropractors report providing care for "wellness and the maintenance of health".[50] Maintenance care is also taught in accredited chiropractic training programs.

If an informed decision is made by the patient to move forward with a trial of therapy the chiropractor and patient should agree on the desired outcomes being sought from the treatment as well as the length of the trial of therapy, prior to commencing treatment. This information should be thoroughly documented in the patient record. Ongoing reassessments of the patient's condition should also be conducted at regular, pre-determined intervals to assess whether a change in treatment approach or referral to another healthcare provider is necessary. See 'N of 1 trial of therapy' section above for further details on conducting a trial of therapy.

Patient A:

- A time-limited trial of therapy which includes consideration of the patients' financial circumstances in the balance of risks and benefits may be appropriate

Patient B:

- A time-limited trial of therapy appropriate to the clinician's level of skill and experience with this patient population may be appropriate

Supplemental file 3. *Treatment question: treatment of a patient with a non-musculoskeletal (non-MSK) condition – Parkinson's disease*

Parkinson's disease is a complex brain disorder characterized by slow neurodegeneration (i.e., the progressive loss

of structure and function of neurons in the basal ganglia). In the early stages of the disease, degeneration of the central nervous system presents chiefly as a loss of motor function, with symptoms including tremors, rigidity, and difficulty with walking, balance and co-ordination. Other symptoms may include depression, anxiety, and difficulty with sleep and sensory systems (e.g., a loss of smell). In more advanced stages of the disease, Parkinson's dementia also becomes common.[68–73]

The underlying cause of Parkinson's is dopamine deficit caused by the death of cells in the portion of the midbrain responsible for motor function. Dopamine is an organic chemical that plays a number of important roles, including as an inhibitory neurotransmitter which facilitates communication between the brain and the nervous system. Dopamine deficiency causes overexcitation of the motor cortex and is responsible for typical Parkinson's symptoms such as tremors and rigidity.[71,73] The ultimate cause of Parkinson's disease is unknown, but it is believed that heredity and environmental factors may both play a role.[71] It is also hypothesized that head and neck trauma may be a risk factor.[73]

There is no cure for Parkinson's. However, there are several pharmacological and non-pharmacological therapeutic interventions which may assist patients in managing symptoms and/or slowing the progression of the disease.[69,72] Pharmacological interventions are mainly focused on mitigating symptoms by temporarily replenishing or imitating dopamine (e.g., dopamine replacement therapy).[70,71,73] Dopamine replacement is helpful in reducing tremors and rigidity and is therefore associated with improved ability to carry out activities of daily living, quality of life, and mortality rates.[71,72]

Parkinson's disease medications are also associated with several side effects, including motor fluctuations and dyskinesia (e.g., involuntary, erratic, writhing movements of the face, arms, legs, or trunk), fatigue, osteoarthritis, and hallucinations.[70,72] Moreover, the efficacy of dopamine replacement therapy tends to wane over time[71,72] and to be less efficacious in treating gait and balance issues, pain, and sleep disorders among other symptoms.[70]

Other symptom management interventions include physical/manual therapy to assist with mobility and balance, exercise prescription to support functional abilities and recommendations for how to move safely, speech language pathology for the management of speech difficulties, and psychiatric or psychological care for the management of cognitive and emotional effects of the disease.[69,71,72]

Patient profiles

Patient A:

- 42-year-old Caucasian, male, physiotherapist who has been a patient for many years
- Has played intramural rugby since high school
- Over the past 10 years, the patient attended for acute episodes of neck and low back pain related to work and rugby
- Patient responds well to soft-tissue therapy, mobilizations, and spinal manipulative therapy
- Typically requires 10 treatments for his spinal pain to resolve
- Does not attend for treatments between acute episodes of back pain, despite your recommendations he do so
- Excellent overall health: non-smoker, social drinker, not on any medications and takes a multi-vitamin daily
- No history of significant falls, injuries, surgeries, or hospitalizations, but some fractured fingers and ankle strains related to rugby
- One year ago, patient was diagnosed with Parkinson's disease, after reporting to his medical doctor the onset of hand tremors at rest, occasional dizziness, and some gait disturbances unrelated to rugby
- Patient is under the care of a neurologist and has recently started taking Levodopa
- Patient has reduced how often he plays rugby in favour of swimming, weight training and walking and is considering career change to a less physical job
- Patient presents today with neck and low back pain related to his physical activity, in addition to the stress of having to cope with Parkinson's disease

Patient B:

- 71-year-old Caucasian male
- Retired teacher, self-reported excellent overall health
- Recently diagnosed with Parkinson's disease, is visibly upset and fearful of the future progression of the disease
- New patient, has never received chiropractic care previously
- Is seeking chiropractic care in the hope that it can slow

the progression of disease and therefore help to maintain independence by minimizing symptoms such as loss of balance

Step 1A. *Does the scientific evidence suggest the treatment is unsafe?*

Patient A:
- No. There is no evidence that the use of soft-tissue therapy, mobilizations, or spinal manipulation for treating spinal pain in a person with Parkinson's disease is contraindicated
- Move to step 1B

Patient B:
- Not applicable. There is no high-quality research on treating Parkinson's disease with chiropractic care.
  - There are some case studies (lower quality evidence) which suggest that chiropractic interventions, including SMT, have no added safety concerns for patients with Parkinson's disease.[70,71,73]
  - Regardless, these and other case reports constitute low-quality evidence. As such, when using this form of evidence to provide direction on proceeding with care, clinicians must proceed with caution. In this case, it is acceptable to proceed to Step 1B as there is no evidence of chiropractic treatment being unsafe for individuals with Parkinson's.
- Move to Step 1B

Step 1B. *Does the scientific evidence suggest the treatment is effective?*

Patient A:
- Yes, for spinal pain, no for treating signs and symptoms directly related to Parkinson's disease.
- Move to Step 2

Patient B:
- There is no high-quality research on treating Parkinson's disease with chiropractic care.
- There are some case studies (lower quality evidence) which suggest that chiropractic interventions, including SMT, may be successful in assisting in the management of MSK-related Parkinson's disease symptoms.[70,71,73] Consideration of this evidence would necessitate a reframing of the clinical/treatment question to ask whether chiropractic care may be useful in assisting a particular patient to manage the MSK symptoms associated with their Parkinson's diagnosis, such as in the scenario for 'Patient A'.
- For example, Anderson, Oakley, and Harrison reported improved mobility and quality of life through a chiropractic postural rehabilitation program[70]; and Elster provided upper cervical chiropractic care to a Parkinson's disease patient who had experienced substantial previous head and neck trauma, and recorded subjective and objective improvement in the patient's MSK-related Parkinson's disease symptoms.[73]
- Regardless, the limited evidence available should not be used on its own to justify the use of chiropractic treatment for slowing the progression of Parkinson's disease (i.e., the clinical question for this particular patient), which at this time is an incurable neurodegenerative disease. However, these and other reports can be used to inform chiropractic care to manage symptoms associated with Parkinson's, including MSK functional capacity (e.g., posture, balance and LBP).[62,63,65]
- Move to Step 2.

Step 2. *Are there other scientific considerations (e.g., biological plausibility, experimental evidence, evidence of effectiveness with related conditions or in different populations, temporality, etc.), which suggest that the proposed treatment will have a positive impact on the patient?*

Patient A:
- Yes. Patient has responded favourably to chiropractic care in the past for spinal pain (patient preference) and you have successfully treated many patients with spinal pain (clinical experience)
- There is no biological plausibility, experimental evidence, or evidence of effectiveness that chiropractic care can resolve his signs or symptoms of Parkinson's disease.
- Move to Step 3

Patient B:
- No. The underlying cause of Parkinson's disease is dopamine deficit caused by the death of cells in the portion of the midbrain responsible for movement.

- There is no current biologically plausible rationale to predict chiropractic intervention, broadly defined, would heal, or interrupt the progressive degeneration of a complex brain structure.
- Stop here and discuss next steps with the patient, including referral to another healthcare provider.

Step 3. *Is the procedure or treatment based on generally accepted clinical training and/or experience?*

Patient A:

- Yes. Proceeding to a trial of therapy is reasonable.
- Ensure that the patient understands that you are treating a person with spinal pain who also has Parkinson's disease but are not treating the disease itself.

Patient B:

- There is no cure for Parkinson's disease, and treatment of the neurodegenerative cause of the disease falls outside of the purview of generally accepted chiropractic training and experience.
- Stop here and discuss next steps with the patient, including referral to another healthcare provider.

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The pathophysiologic mechanisms of spinal manipulative therapy in the management of chronic musculoskeletal pain

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Chronic musculoskeletal (MSK) pain is a leading cause of disability affecting patients and healthcare systems worldwide. Its burden is expected to rise sharply due to the aging global population. Given that chronic MSK pain is the most common condition treated by chiropractors daily, chiropractic is ideally positioned to assume a unique leadership role in the future health delivery system of managing this growing clinical challenge. Central sensitization (CS) is linked to an increasing number of chronic pain conditions characterized by increased sensory, sympathetic, and motor excitability. Accumulating evidence suggests that spinal manipulation may achieve its therapeutic

Les mécanismes pathophysiologiques de la thérapie manuelle vertébrale dans la gestion de la douleur musculosquelettique chronique.

La douleur musculosquelettique chronique est une cause importante d'incapacité touchant les patients et les systèmes de santé dans le monde entier. On s'attend à ce que son fardeau augmente considérablement en raison du vieillissement de la population mondiale. Étant donné que la douleur musculosquelettique chronique est le problème de santé le plus courant traité par les chiropraticiens quotidiennement, la chiropratique est dans la position idéale pour assumer un rôle de leadership unique dans le futur système de prestation de soins de santé visant à gérer ce défi clinique croissant. La sensibilisation centrale (SC) est en lien avec un nombre croissant de problèmes de douleur chronique caractérisés par une excitabilité sensorielle, sympathique et motrice accrue. Les données probantes accumulées suggèrent que la manipulation vertébrale pourrait obtenir des bienfaits thérapeutiques en modulant la SC, ce qui en fait une approche potentiellement efficace et non invasive pour traiter

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benefits by modulating CS, thereby making it a potentially effective non-invasive approach to treating and managing chronic MSK pain. This review aims to provide a discussion of some of the scientific foundations underpinning the pathophysiologic mechanisms of chronic MSK pain and spinal manipulative therapy, as they relate to the contemporary neurophysiologic paradigm of chiropractic medicine and practice.

Author's Note: This paper is one of seven in a series exploring contemporary perspectives on the application of the evidence-based framework in chiropractic care. The Evidence Based Chiropractic Care (EBCC) initiative aims to support chiropractors in their delivery of optimal patient-centred care. We encourage readers to review all papers in the series.

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KEY WORDS: chiropractic, chronic musculoskeletal pain, central sensitization, spinal manipulative therapy

et gérer la douleur musculosquelettique chronique. Cette revue vise à offrir une discussion sur certains des fondements scientifiques sous-jacents aux mécanismes pathophysiologiques de la douleur musculosquelettique chronique et de la thérapie manuelle vertébrale, en relation avec le paradigme neurophysiologique contemporain de la médecine et de la pratique chiropratiques.

Note de l'auteur: Ce document fait partie d'une série de sept documents examinant les perspectives contemporaines sur la mise en œuvre du cadre fondé sur des données probantes pour les soins chiropratiques. L'initiative de soins chiropratiques fondés sur des données probantes (SCFDP) vise à soutenir les chiropraticiens dans la prestation de soins optimaux axés sur le patient. Nous encourageons les lecteurs à consulter tous les articles de la série.

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MOTS CLÉS : chiropratique, douleur musculosquelettique chronique, sensibilisation centrale, thérapie manuelle vertébrale

Introduction

Chronic musculoskeletal (MSK) pain, such as low back and neck pain, is a leading cause of disability affecting both patients and health delivery systems worldwide.[1,2] The International Association for the Study of Pain temporally defines chronic pain as pain persisting for longer than three months.[3] One in five Canadian adults live with chronic pain, 50% of which have lived with the condition for over ten years.[4] Those numbers are expected to rise worldwide due to the aging global demographic, placing significant economic burden on healthcare systems.[1,2,4] A recent Health Canada report revealed the total cost of chronic pain conditions, which includes both direct (healthcare) costs and indirect (lost production) costs, was between $38.2 and $40.3 billion in 2019 alone.[4] The growing burden of chronic MSK pain necessitates the advancement of effective and cost-efficient treatment strategies to help manage and mitigate the economic burden on healthcare systems.[1,4,5]

Despite its prevalence, the underlying mechanisms driving chronic MSK pain are still poorly understood. A growing body of research highlights the important role of central sensitization (CS) as a key underlying mechanism driving the pathophysiology and clinical manifestation of chronic MSK pain syndromes that are commonly managed by chiropractors, including chronic low back pain and osteoarthritis.[6–8] To this extent, understanding the physiological mechanisms of CS is relevant to chiropractors as it applies to the diagnosis and management of chronic MSK pain syndromes.[6]

Spinal manipulative therapy (SMT) is a cost-effective manual therapy technique utilized by chiropractors and a variety of healthcare practitioners.[9,10] Substantial evidence supports the use of SMT for the treatment of MSK disorders[11] and is recommended in guidelines for the treatment of chronic neck[12] and low back pain[13], two of the most prevalent conditions leading to disability[2]. Despite its widespread use, the underlying biological mech-

anisms mediating its therapeutic effects are still poorly understood. Previous literature suggests that SMT may achieve its therapeutic benefits via regional (segmental, heterosegmental) modulation of CS, making it an effective option in the ongoing management of chronic MSK pain.[5,14–16]

This literature review aims to explore the emerging evidence describing the pathophysiology and clinical manifestation of chronic MSK pain, and the evidence supporting the mechanistic role of SMT in the management of chronic MSK pain.

Physiological mechanisms of central sensitization

CS begins as a normal, activity-dependent and reversible increase in the input-response profile (windup) of dorsal horn neurons (DHN) in response to nociceptive input.[17] However, under persistent nociception, this process can lead to a long-term maladaptive change in the neuron, called CS, resulting in phenotypic changes in both spinal and supraspinal centers.[6,17,18] Acute pain is driven by nociceptive input originating from primary pathologies residing within somatic or visceral tissues, releasing glutamate into the dorsal horn where it acts on AMPA (α-amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid) receptors to trigger excitatory post-synaptic potentials (EPSP).[19] CS, however, typically arises from persistent nociceptive bombardment which can lead to the activation of voltage-dependent calcium (Ca^{2+}) NMDA (*N*-methyl-D-aspartate receptor) channels, increased intracellular calcium and a cascade of downstream biochemical changes promoting the further neuronal excitability and sensitization.[18,19] Persistent nociception may further increase the release of gamma-aminobutyric acid (GABA).[20,21] Although generally inhibitory, activation of GABA-A receptors can depolarize dorsal root ganglia (DRG) cells under conditions of persistent nociception (Primary Afferent Depolarization), leading to enhanced excitability of interneuronal circuits.[20] If allowed to persist, this enhanced excitability can ultimately trigger a response known as the dorsal root reflex.[20,21] During this response, pro-inflammatory neuropeptides (substance P (sP), Calcitonin Gene-Related Peptide (CGRP)) are antidromically released into peripheral tissues; there, they trigger a neurogenically mediated inflammatory response (neurogenic inflammation) contributing to inflammatory pain and potentially a region of secondary hyperalgesia.[19–22]

The Neurogenic Hypothesis proposes that neurogenic inflammation is a foundational mechanism driving the pathophysiology and clinical manifestation of chronic inflammatory muscle pain (myofascial pain).[23] This hypothesis challenges the current prevailing consensus (Integrated Hypothesis) that acute local mechanical injury to the myotendinous unit necessarily precipitates the pathophysiology of myofascial pain.[24] Importantly, this hypothesis provides biological plausibility for viscerosomatic and somatovisceral comorbidities commonly observed clinically, but not reconcilable using the local injury paradigm. Examples of this include the comorbidity of myofascial pain with an increasing number of primary visceral disorders including chronic pelvic pain,[25] prostatitis,[26] and cystitis[27] in the absence of muscle injury. This shift in thinking challenges the idea that the myofascial trigger point is the primary pathology driving chronic myofascial pain but, in fact, represents a secondary physical manifestation of an existing primary pathology elsewhere within the neuromeric field of the affected muscle(s).

The neurogenic paradigm of myofascial pain suggests that persistent nociceptive signalling leading to CS can also activate preganglionic sympathetic neurons within the intermediate horn via synchronized neuronal firing, glial cell activation and neuroactive substances[28,29], such as substance P, glutamate and brain-derived neurotrophic factor (BDNF).[30,31] Brainstem areas including the paraventricular nucleus, rostral ventrolateral medulla, and periaqueductal gray also directly influence the intermediolateral (IML) nucleus via descending inputs. Enhanced sympathetic nervous system activity leads to hemodynamic changes and sympathetic hyperinnervation commonly observed in chronic myofascial pain syndrome.[32–34] Similar interneuronal mechanisms may also be responsible for changes in excitability of the motor unit pool within the ventral horn, also commonly observed with conditions of chronic MSK pain such as myofascial pain and osteoarthritis.[35–38]

Dysfunction in descending inhibitory pathways is also commonly observed in chronic pain patients.[39,40] Persistent nociceptive input influences key supraspinal centers related to descending inhibition of nociception and reduced perception of pain, including the periaqueductal grey and the rostroventral medulla.[41,42] Persistent nocicep-

tive barrage of the somatosensory cortex has also been shown to alter sensorimotor integration.[43] Psychological factors associated with chronic pain such as fear avoidance behaviours, kinesiophobia, and depression further alter descending antinociceptive activity of the periaqueductal grey matter (PAG).[44] These collective mechanisms contribute to the pain processing integrity of peripheral nociceptive and non-nociceptive somatosensory signals at both the level of the spinal cord and supraspinal structures that contribute to the clinical manifestation of persistent MSK pain.[41]

Clinical manifestation of central sensitization

CS is a neuroadaptive phenomenon characterized by an "amplification of neural signalling within the CNS"[6] leading to enhanced responsiveness of neurons to noxious stimulation (hyperalgesia) and non-noxious stimuli (allodynia), as well as expansion of pain responsiveness beyond the primary injury site into unaffected tissues (secondary hyperalgesia).[6–8,17,23,37] These dysesthesias are commonly reported in patients across a broad spectrum of chronic MSK pain syndromes including chronic low back pain, osteoarthritis, whiplash-associated disorder, fibromyalgia, headache and persistent painful tendinopathies.[6–8,45–47]

Given its complex and heterogeneous presentation, reliably identifying the clinical presence of CS can be challenging to the clinician. To this extent, several authors have attempted to establish mechanism-based classifications of CS.[48,49] For instance, in patients experiencing low back and leg pain, a strong indicator of CS may include a "disproportionate, non-mechanical, unpredictable pattern of pain provocation in response to multiple/non-specific aggravating/easing factors".[48] Patients with CS often present with positive findings of primary and/or secondary hyperalgesia on physical examination and often report pain that is inconsistent with the magnitude of tissue damage and/or persists beyond reasonable tissue healing times. Altered interactions between physical movement, mechanical stimuli and pain perception may further point to the possibility of maladaptive changes within the CNS.[48] Additionally, the presence of neuropsychiatric findings including sleep disturbance, anxiety, depression and brain fog are all highly suggestive of CS.[48]

Another key indicator of CS is the presence of enhanced Temporal Summation of Second Pain (TSSP), defined as increased pain perception to a train of repetitive stimuli of peripheral C-fibers delivered at a frequency greater than 0.33Hz.[50] TSSP is considered the psychophysical manifestation of windup, a frequency-dependent facilitation of neuronal excitability that shares common mechanisms with CS.[17,50] To this extent, enhanced TSSP and TSSP-M (maintenance) have been reported in fibromyalgia patients presenting with chronic widespread pain[51], suggesting it may be a clinically-feasible outcome measure in the assessment of chronic MSK patients.

Supraspinal effects of central sensitization

Numerous investigations have been conducted to examine the influence of CS on supraspinal function, which contributes to altered pain processing and heightened responsiveness to pain (hypersensitivity). Neuroimaging studies have revealed alterations in grey matter in the brain's pain processing areas in chronic pain patients, such as the thalamus, periaqueductal grey, insula, cingulate, and somatosensory cortex.[52] Increased levels of excitatory neurotransmitters (glutamate) and lower levels of inhibitory neurotransmitters (GABA) in the insula have also been observed following sensitization.[53] Alterations in neuroimmune function have been associated with conditions of widespread pain hypersensitivity, such as fibromyalgia [54], while altered brain network activity between pro- and anti-nociceptive pathways is an additional finding with significant implications to chronic pain.[55–57] As a result of these maladaptations, cortical inhibition of pain is diminished[58,59], and a wide range of pain-processing regions in the brain, including those involved in the emotional and cognitive aspects of pain, become more sensitive to nociceptive stimuli.[60,61]

These adaptations may have implications that go beyond pain perception, however. Prior studies have utilised transcranial magnetic stimulation (TMS) to examine the impact of experimentally induced CS on sensorimotor integration (SMI) and motor cortex excitability in healthy participants.[62–65] Somatosensory Evoked Potential (SEP) peaks associated with cerebellar inputs (N18), outputs (N24), and sensory processing were found to be substantially altered by experimentally induced CS[64], indicating that CS may elicit central processing adaptations within the brain. Collectively, these findings highlight how CS may not only amplify pain perception but also disrupt the brain's sensory, motor, and emotional processing, under-

scoring its potential broad impact on overall neurological function.

Clinical assessment of central sensitization

Significant progress has been made in the clinical assessment of CS. The Pain Sensitivity Questionnaire (PSQ)[66,67] and McGill Pain Questionnaire (MPQ)[68,69] are patient self-report questionnaires that allow clinicians to effectively assess the various dimensions of pain, such as sensory, affective, and evaluative aspects. These questionnaires provide reliable information on pain location, character, intensity, as well as emotional and cognitive dimensions. The Central Sensitization Inventory (CSI) is an additional self-report screening instrument utilised to identify individuals who may present with Central Sensitivity Syndrome (CSS)[70], a group of conditions that are linked to CS and heightened sensitivity to both somatic and visceral pain (e.g., irritable bowel syndrome, fibromyalgia). However, evidence suggests that while the PSQ correlates more closely with neurophysiological changes in nociceptive sensitization, the CSI is more strongly associated with psychological constructs[71] such as depression[72] and anxiety.[73,74] This distinction underscores the complementary roles of these tools in assessing different facets of CS. The robust psychometric properties of the validated CSI enable it to reliably distinguish chronic pain from neuropathic and nociceptive conditions and to identify patients exhibiting symptoms of CS, despite its primary correlation with psychological constructs.[75,76]

Advancements in clinically feasible diagnostic techniques hold promise in the quantitative assessment of the various physiological manifestations of CS. One area of particular interest is the clinical application of Quantitative Sensory Testing (QST) to systematically assess the integrity of the various modalities (pain, mechanical, temperature) of the somatosensory system.[17,77,78] The Pain Pressure Threshold (PPT) is a widely employed, clinically-feasible technique used to quantify the sensitivity to pressure in chronic MSK pain patients. The PPT is a static measure of the minimum pressure necessary to evoke pain (pain threshold). It is highly responsive to CS and chronic pain, showing significant decreases (i.e., increased sensitivity) in a variety of chronic MSK pain conditions associated with CS such as fibromyalgia,[79] osteoarthritis,[80] and non-specific low back pain.[81] Incorporating PPT into routine clinical assessment, however, requires specialized algometry equipment with careful training and experience to ensure consistency, reliability and accuracy.

A key limitation to PPT technique is that it does not provide insight into the temporal dynamics of pain processing in CS. The Windup Ratio (WUR) technique is a dynamic measure of the increase in pain perception in response to a train of repeating noxious stimuli. The WUR better reflects the underlying dynamics of temporal summation, the psychophysical expression of windup, which is enhanced under sensitized conditions.[82] Similar to PPT, WUR assessments require technical proficiency and specialized equipment for delivering controlled noxious stimuli.

Conditioned Pain Modulation (CPM) reflects the body's endogenous capacity to modulate pain perception. It is measured by testing a patient's response (excitatory or inhibitory) to noxious stimuli after the application of painful stimuli to a remote area of the body.[83,84] The neural circuitry involved in CPM includes brainstem regions such as the subnucleus reticularis dorsalis (SRD), as well as higher cortical areas such as anterior- and mid- cingulate cortices, dorsolateral prefrontal cortex. These cortical regions directly communicate with the periaqueductal gray which influences descending noradrenergic, serotonergic and dopaminergic pathways involved in pain modulation.[85] Impaired CPM is commonly observed in chronic pain conditions associated with CS including chronic low back pain[86] and osteoarthritis.[87] Inhibition of CPM is also a strong predictor for the development of chronic pain as well as response to treatment.[88,89] Moreover, while some studies find correlations between CPM and other measures of CS (e.g., CSI, PPT),[90] others report no significant relationship.[91] Further research is needed to elucidate this relationship and the role of CPM in the assessment of chronic pain.

Nociplastic pain is defined as pain arising from altered nociception in the absence of clear evidence of tissue injury or pathology.[92] CS is considered a key driver of nociplastic pain,[93] emphasizing the nervous system's role in mediating this type of pain. The nociplastic pain grading system, introduced by the International Association for the Study of Pain (IASP), provides a framework for evaluating pain phenotypes dominated by CS.[92] This grading system highlights key diagnostic features, includ-

ing widespread non-localized pain, somatosensory hypersensitivity (e.g., allodynia, hyperalgesia), and comorbidities such as sleep disturbance, anxiety and depression, fatigue and cognitive difficulty. [94–96] Nociplastic pain has been reported in several chronic pain conditions including fibromyalgia,[94] myofascial pain,[97] and chronic fatigue syndrome.[96] The phenotype of nociplastic pain is predominantly characterized by widespread, non-localized pain, both in the presence or absence of these affective co-morbidities.[93–97] While individual presentations may vary in intensity, comorbidities, and specific symptoms, this widespread pain pattern remains a defining feature. Despite this heterogeneity, adopting and integrating these criteria into clinical practice equips clinicians with tools for improved pain phenotyping and targeted mechanism-based management.

Spinal manipulative therapy in the management of central sensitization and musculoskeletal pain and dysfunction

SMT is a widely recognized manual therapy technique utilized by a variety of healthcare practitioners including chiropractors and physiotherapists for the treatment of MSK pain.[9,10] It is recommended for use in the treatment of acute and chronic non-specific low back pain, disc herniation with radiculopathy[13], as well as acute and chronic neck pain[12], which are amongst the top causes of disability worldwide.[2] SMT involves a high-velocity, low-amplitude thrust delivered to spinal zygapophyseal joints in areas of dysfunctional segmental motion identified through palpation and motion assessment.[98] Despite its many beneficial applications, the precise mechanisms by which SMT achieves its therapeutic benefits are still poorly understood.

Although the underlying mechanisms and their interrelationships remain unclear, the physiologic effects of SMT are largely attributed to biomechanical and/or neurophysiological mechanisms.[98] The proposed biomechanical effects of SMT include release of trapped meniscoids, release of abnormal adhesions connecting tissues, decreased intervertebral disc distortion, and restoration of 'buckled' segments; each of these serves to reduce mechanical stress on soft and hard tissues to enable intersegmental motion.[98,99] Additionally, it is speculated that the neurophysiological effects of SMT are intrinsically associated with the modulation of CS[100], however, no study to date has investigated the causal relationship between SMT and CS in a clinical population.[41,42] Emerging evidence also suggests that stimulation of large myelinated fibers via manipulation may induce synaptic depression, synaptic structural changes and even modifications in gene expression.[14], as discussed below.

Neurosegmental effects of spinal manipulation

The growing body of research suggests that SMT exerts its therapeutic benefit(s) by influencing neurosegmental activity at the dorsal, intermediolateral and ventral horns of the spinal cord, as well as supraspinally at the PAG of the midbrain and the cerebral cortex.[41,101] Changes reported at the dorsal horn include attenuation of dorsal horn neuron (DHN) hyperexcitability, or long-term depression, are evoked through the activation of myelinated high threshold (Aδ) afferent fibers.[14,102] Various studies have measured the neurosegmental effect of SMT on nociceptive flexion reflex threshold, temporal summation of thermal pain sensitivity, and pain pressure thresholds.[5,16,103] These studies indicate that mechanoreceptor stimulation may induce a 'gating mechanism' that leads to reversal of long-term potentiation within DHNs.[14,104] Similar observations have also been documented in participants with and without pain.[5,16,102] Importantly, these effects occur in tissues that are neurologically linked to the manipulated region (segmental, heterosegmental), potentially underscoring a critical clinical factor in determining which segment(s) to apply the intervention to.[5]

There are also indications that ventral horn activity may be modulated by SMT.[101] A study comparing the effects of unilateral cervical, lumbar and both cervical and lumbar SMT on tibial H-reflex amplitudes in healthy asymptomatics demonstrated significant but temporary (60 seconds) decreases in motor unit pool activity post lumbar SMT compared to cervical SMT; no additional decreases were observed when cervical SMT was also administered.[105] These regional effects are mediated by afferent input from low and high threshold mechanoreceptors within lumbar spinal and paraspinal structures, which synapse onto inhibitory interneurons responsible for regulating motor neuron activity in the ventral horn.[105] Dishman and Burke subsequently evaluated regional variations in motor neuron pool activity following cervical and lumbar SMT.[106] They reported that SMT could reduce the excitability of motor neurons in neurologically linked muscles; however,

the effects were more pronounced and long-lasting after lumbar SMT than cervical SMT.[106] They further observed similar motor neuron activity inhibition in the gastrocnemius muscle following lumbar SMT in a symptomatic population with subacute low back pain.[107] It is postulated that the inhibition of motor neuron activity and muscle hypertonicity following manipulation may be achieved by "resetting" the excitability of motor neurons via gating mechanisms evoked subsequent to large Ia myelinated afferent fiber stimulation.[104] Other modalities such as transcutaneous electric nerve stimulation (TENS)[108] and dry needling likely exploit similar mechanisms to stimulate similar neurosegmentally arranged antinociceptive effects.[5,109]

Other effects of spinal manipulation

Prior research reveals that SMT can influence neuroimmunoendocrine function. This is evidenced by its ability to modulate the immunoregulatory cytokine interleukin-2 regulated biological response[110], reduce levels of pro-inflammatory interleukin-1 and TNFa[111], and lower immunoglobulin G levels.[112] While cervical SMT had no effect on cortisol levels, thoracic SMT was found to cause a rapid and statistically significant drop in salivary cortisol levels.[113] Given that the adrenal glands are innervated by the T9-T10 segments, this observation supports the purported segmental neuromodulatory mechanisms of SMT. Serum concentrations of neurotensin and oxytocin did, however, rise briefly in asymptomatic individuals following cervical and thoracic SMT. [113–115]

An increasing body of evidence also supports the role of SMT in regulating supra-segmental function. Prior research has documented alterations in motor output and cognitive processing following manipulation.[43] Furthermore, SMT is suggested to influence the excitability of the motor cortex[116], activity of the prefrontal cortex[117], perception of joint position[118], blood oxygenation in response to harmful stimuli[119], and the function of the cerebellum[120]. Collectively, these observations suggest that SMT may have systematic neuromodulatory effects on the CNS, which could hold important therapeutic implications in the management of CS, inflammation and motor control at both spinal and supraspinal levels. However, these findings remain preliminary, and further rigorous research is necessary to confirm their clinical relevance and establish evidence-based applications.

Clinical implications

While the collective literature indicates that SMT evokes robust systematic neuromodulatory effects on somatosensory and neuroimmunoendocrine functions, the overall volume of high quality studies is still lacking, and the studies that do exist are equivocal.[121,122] One of the most significant limitations of the current studies is the universally small sample sizes across the literature. Small sample sizes reduce the statistical power of studies, making it difficult to detect true effects when effect sizes are small, increasing the likelihood of false positives or negatives, and thereby limiting the generalizability of findings. Furthermore, evidence for SMT's long-term efficacy is still lacking and requires further investigation. Long-term efficacy refers to the sustained therapeutic benefits of an intervention over extended periods, encompassing the prevention of symptom recurrence, maintenance of functional improvement, and enhancement of quality of life. The heterogeneity in observed effects from SMT may be due to differences in cohort characteristics between studies, as well as variability in the SMT techniques used (e.g., Diversified, Gonstead) between practitioners, the anatomic location of spinal adjustments, and the frequency of treatment. These factors should all be considered during the informed consent process, and may make it difficult for clinicians to provide a balanced evidence-based analysis of treatment benefit versus risk to the patient.

As a result, clinicians should strive to continuously update their knowledge through self-directed and continuing education initiatives to stay abreast of evolving knowledge trends. Additionally, they should exercise caution when communicating with patients, ensuring that informed consent discussions emphasize the current state of evidence for SMT, including its benefits, limitations, and uncertainties. Clinicians should educate patients on appropriate use of SMT and explore alternative treatment options that may reflect the patient's unique clinical presentation and history. Furthermore, clinicians are encouraged to actively participate in the advancement of chiropractic science by engaging in collaborative research and educational initiatives with researchers and other clinicians to contribute to the growing body of knowledge informing future practice. These considerations are vital to support evidence-based care and maintain patient trust.

Future directions

Future research into the mechanisms and application of SMT should incorporate a variety of strategies aiming to enhance its therapeutic utility and benefits in the context of chronic pain management. Such strategies may include exploring optimal dosing, integrating SMT with multimodal approaches such as exercise or massage, and investigating patient-specific factors like biomechanical, neurophysiological, or psychosocial characteristics that predict treatment response. Additionally, long-term studies could examine SMT's sustained efficacy and its impact on quality of life and functional outcomes in diverse patient populations. The effectiveness of SMT in the treatment of specific conditions and/or populations is a pressing and pertinent question, as it could facilitate the development of more precise and individualised treatment strategies. Identifying patient subgroups or phenotypes that are most likely to respond to SMT is essential to developing more effective treatment approaches for chronic MSK pain – a focus that some researchers have already begun exploring.[123]

Another important and relevant area of study is the assessment of the dose-response effect of SMT. This line of research should determine the most effective frequency, duration, and type of SMT for use in patients presenting with CS. Frequency refers to how often SMT sessions are performed, duration describes the length of each treatment session or overall course of care, and dose encompasses the total amount of therapeutic intervention delivered, including intensity and number of treatments. Greater insight into the dose-response relationship for specific patient subtypes or other reliable clinical biomarkers could provide additional knowledge for the advancement of personalised treatment strategies. Determining the synergistic effects of SMT in conjunction with other modalities (such as pharmacological and cognitive-behavioural approaches) will provide valuable insights into the role of SMT within the context of a multimodal approach to the management of chronic pain. Finally, although unrelated to the mechanisms and applications of SMT, developing new methods for quantifying CS is perhaps the timeliest area of study. By developing novel diagnostic tools or improving existing ones (such as QST), the clinician can accurately measure changes in CS and systematically diagnose and monitor the therapeutic progress of the patient.

Conclusion

The increasing prevalence of chronic MSK pain in society presents a unique opportunity for chiropractic to assume a leading role in the management of chronic MSK pain. CS has been linked to a broad profile of chronic pain conditions including osteoarthritis, fibromyalgia and myofascial pain syndrome, that are commonly managed within a rehabilitation setting. While the growing body of research suggests that SMT may be a safe and effective treatment option in the management of a broad profile of chronic MSK pain conditions, the mechanisms are still poorly understood. This emerging body of research characterizing the physiologic mechanisms of SMT provides an important empirical foundation supporting the increased utilization of chiropractic treatment and SMT in the ongoing management of conditions of chronic pain sensitivity.

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