

Self-reported attitudes, skills and use of evidence-based practice among Canadian doctors of chiropractic: a national survey

André E. Bussi eres, DC, PhD^{1,2}

Lauren Terhorst, PhD³

Matthew Leach, RN, BN (Hons), ND, PhD⁴

Kent Stuber, DC, MSc⁵

Roni Evans, DC, PhD⁶

Michael J. Schneider, DC, PhD⁷

Objectives: *To identify Canadian chiropractors' attitudes, skills and use of evidence based practice (EBP), as well as their level of awareness of previously published chiropractic clinical practice guidelines (CPGs).*

Methods: *7,200 members of the Canadian Chiropractic Association were invited by e-mail to complete an online version of the Evidence Based practice Attitude & utilisation SurvEy (EBASE); a valid and reliable measure of participant attitudes, skills and use of EBP.*

Results: *Questionnaires were completed by 554 respondents. Most respondents (>75%) held positive*

Objectifs: *Cerner les comportements, les comp etences et la mise en  uvre de la pratique factuelle (pratique fond ee sur des donn ees probantes) des chiropraticiens canadiens, ainsi que leur niveau de connaissance des guides de pratique clinique chiropratiques pr ec edemment publi es.*

M ethodes: *7 200 membres de l'Association chiropratique canadienne ont  et e invit es par courriel pour remplir une version en ligne du sondage sur l'utilisation et le comportement associ es  a la pratique factuelle; une  evaluation valable et fiable des comportements, des comp etences et de la mise en  uvre de la pratique factuelle par les participants.*

R esultats: *Les questionnaires ont  et e remplis par 554 r epondants. La plupart des r epondants (> 75 %)*

¹ Assistant Professor, School of Physical and Occupational Therapy, McGill University

² Professor, D epartement Chiropratique, Universit e du Qu ebec  a Trois-Rivi eres

³ Associate Professor, Department of Occupational Therapy and Health and Community Systems, University of Pittsburgh

⁴ Senior Research Fellow, School of Nursing & Midwifery, University of South Australia

⁵ Division of Graduate Education and Research, Canadian Memorial Chiropractic College

⁶ Associate Professor, Center for Spirituality & Healing, Academic Health Center, University of Minnesota

⁷ Associate Professor, Department of Physical Therapy and Clinical and Translational Science Institute, University of Pittsburgh

Corresponding author:

Andre Bussi eres DC, PhD

School of Physical and Occupational Therapy, Faculty of Medicine

McGill University, 3630 Promenade Sir-William-Osler

Hosmer House, Room 205 Montreal, Quebec, Canada H3G 1Y5

E-mail: andre.bussieres@mcgill.ca

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attitudes toward EBP. Over half indicated a high level of self-reported skills in EBP, and over 90% expressed an interest in improving these skills. A majority of respondents (65%) reported over half of their practice was based on evidence from clinical research, and only half (52%) agreed that chiropractic CPGs significantly impacted on their practice.

Conclusions: While most Canadian chiropractors held positive attitudes towards EBP, believed EBP was useful, and were interested in improving their skills in EBP, many did not use research evidence or CPGs to guide clinical decision making. Our findings should be interpreted cautiously due to the low response rate.

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KEY WORDS: chiropractic; complementary and alternative medicine; evidence-based practice; survey

Introduction

Evidence-based practice (EBP) refers to ‘the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients’¹. Essentially, EBP involves the integration of three key components: 1) the use of the best available research evidence, 2) knowledge arising from one’s clinical expertise/clinical reasoning, and 3) patients’ preferences and values.¹

Evidence-based practice is associated with improved clinical decision-making and patient care.^{2,3} Since the establishment of evidence-based medicine at McMaster University in the 1980s, EBP principles have been embraced in other health disciplines, including nursing^{4,5}, occupational therapy and physical therapy.⁶ Complementary and alternative medicine (CAM) professionals, including

ont révélé des comportements positifs vis-à-vis de la pratique factuelle. Plus de la moitié d’entre eux ont rapporté un niveau élevé d’aptitudes autodéclarées en matière de pratique factuelle, et plus de 90 % d’entre eux ont fait part de leur intérêt à améliorer ces compétences. La majorité des répondants (65 %) a indiqué que plus de la moitié de leur pratique était fondée sur des données probantes issues de la recherche clinique, et seulement la moitié de ces derniers (52 %) a reconnu que les guides de pratique clinique chiropratiques avaient des répercussions importantes sur leur pratique.

Conclusions: Si la plupart des chiropraticiens canadiens ont révélé des comportements positifs vis-à-vis de la pratique factuelle, pensaient que celle-ci était utile et étaient intéressés à l’idée d’améliorer leurs compétences en la matière, un grand nombre d’entre eux n’utilisaient pas les données probantes issues de la recherche ou les guides de pratique clinique pour orienter leurs prises de décisions cliniques. Nos conclusions doivent être interprétées avec précaution en raison du faible taux de réponse.

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MOTS-CLÉS : chiropratique, médecine parallèle et médecine douce, pratique factuelle, sondage

Doctors of Chiropractic (DC), are increasingly expected to use EBP principles to guide clinical decision making.⁷

A number of indicators suggest a possible shift toward the adoption of EBP in chiropractic, including the relatively recent creation of evidence-based clinical practice guidelines (CPGs) in chiropractic⁸⁻¹², EBP educational programs¹³⁻¹⁶, and the adoption of an ‘Evidence-Informed Practice statement’ by nine out of ten Canadian provincial associations and eight of ten provincial regulatory boards (status pending in three organizations). (www.chiroguidelines.org). The statement reads as follows:

“Canadian chiropractors adopt evidence-informed practice principles to guide clinical decision making by integrating their clinical expertise, patient’s preferences and values, and the best available scientific evidence.”

However, the impact of these important initiatives is dependent on whether or not EBP principles and tools such as CPGs are routinely applied in clinical practice. Despite the growing awareness of EBP in the chiropractic profession, there still remains a large gap between the appreciation of EBP and the actual application of EBP.¹⁷ The challenges in reducing the research-practice gap have not been restricted to certain health conditions, health professions, context (primary vs. specialized care) or settings (developed vs. underdeveloped countries).¹⁸⁻²⁰ A landmark report, 'Bridging the quality chasm', published by the Institute of Medicine in the early 1990's drew attention to the gap between 'what we know' and 'what we do'.²¹ The nature of the problem is described as one of overuse, misuse and underuse of health care services. In essence, the health care delivery system has fallen far short in its ability to translate research into practice and policy, and to apply new technology safely and appropriately.²¹ A major implication from this observation is that patients do not always receive safe and effective healthcare.

Understanding how EBP is perceived and implemented across health disciplines can identify educational needs and outcomes, and predict where new research evidence is more likely to be implemented.²² This is accomplished by examining healthcare providers' knowledge, attitudes, and application of EBP, as well as practitioners' EBP behaviours in the clinical setting.²³

Significant predictors of self-reported use of research evidence among physical and occupational therapists, mental health care providers and dietitians include factors such as educational degree or academic qualification, involvement in research or EBP-related activities, and practitioners' perceptions, attitudes and beliefs about research and EBP.¹⁷ Previous surveys and interviews of chiropractors in Australia, USA, Germany and the UK generally report favorable attitudes toward EBP²⁴⁻²⁷, with respondents indicating that research is important in establishing chiropractic as a legitimate profession^{26,27}. However, in spite of their favorable inclination towards EBP, many respondents did not use CPGs or research evidence to guide clinical decision making.^{24,25,28} Lack of time, lack of clinical evidence in CAM, and lack of incentive to participate in EBP were the most commonly reported barriers to practicing EBP. Learning needs appeared to vary according to the type of profession, years

in practice, and prior research experience.²⁹ Further, accessibility to research, insufficient skills for locating, interpreting, critically appraising, and applying research findings to clinical practice were poor amongst chiropractors and other CAM providers.^{25,29-31} However, given the small and specialized samples in these studies, the generalizability of these findings is somewhat limited. Consequently, the factors associated with the uptake of EBP by the chiropractic profession in Canada still remain poorly understood.

The primary objective of this study was to investigate Canadian chiropractors' attitudes, skills and use of research evidence in clinical practice, and to identify the barriers to and facilitators of EBP uptake. A secondary objective was to explore the level of awareness and agreement with three chiropractic clinical practice guidelines (CPGs) published in the last decade on the management of adult neck pain³², whiplash-associated disorders¹⁰ and headaches³³.

Methods

Study Design & Setting

This descriptive cross-sectional survey was conducted online between December 13, 2013 and June 5, 2014. The survey was administered electronically through the University of Pittsburgh (U Pitt), Pennsylvania, using the U Pitt web platform.

Context

This study replicates the first phase of a federally-funded study of DCs in the United-States (R21 AT007547-01: Distance Education Online Intervention for Evidence-Based Practice Literacy [DELIVER]), which was designed to evaluate the effectiveness of an online EBP educational program on chiropractor attitudes, skills, and use of EBP.³⁴ The first phase of the DELIVER study was an online EBP survey of US chiropractors, which provided an opportunity to contrast the attitudes, skills, and use of research evidence between chiropractors.

Participants & Recruitment

The survey was open to all practicing Doctors of Chiropractic in Canada who had internet access and a valid email address and were members of the Canadian Chiropractic Association (CCA). A convenience sample of DCs

was recruited from a potential pool of 7,200 DCs, with the support of the CCA and all ten provincial chiropractic associations.

The above mentioned organizations provided email-forwarding services through their respective membership lists. The forwarded email and follow-up emails described a unique opportunity to participate in an online survey. Preliminary notification of the study and published advertisements in a national chiropractic publication (The Journal of the Canadian Chiropractic Association) and quarterly newsletters of the CCA and provincial associations (December 2013) provided an overview of the study and invited readers to participate in the online survey.

Questionnaire and Outcomes

The Evidence-Based practice Attitude and utilization Survey (EBASE) is a self-administered multi-dimensional instrument designed to measure CAM providers' attitudes, skills and use of EBP.³⁵ The instrument has demonstrated good internal consistency (Cronbach's alpha = 0.84), content validity (CVI = 0.899), and acceptable test-retest reliability (ICC = 0.578–0.986).^{35,36} Minor modification of the EBASE was required to ensure the language was appropriate for use with American³⁴ and Canadian chiropractors. These changes were made in consultation with the survey developer (ML) and recent administrator of the survey (MS) to ensure the structure and intent of the modified questions did not alter the validity of the original survey. Some additional questions were added to the online survey in order to explore DCs' awareness of Canadian chiropractic clinical practice guidelines (CPGs) released in the past decade. The demographics section of the survey was revised to ensure it was relevant to the Canadian chiropractor population. Modifications to the demographics section did not affect the internal validity of the other parts of the EBASE, which were not modified. The modified-EBASE was then translated into French using a forward-backward translation approach.

The modified version of the EBASE contained 76 items and was divided into seven parts (Parts A-G); Parts A-F each address a different EBP construct (i.e. Attitudes, skill, use, training & education, barriers, and facilitators), and Part G contains demographic items only. Three parts of the EBASE generate sub-scores: Parts A (Attitudes), B (Skill), and D (Use). The survey was accompanied by an

additional 12 items that examined participant awareness of prior chiropractic guidelines. The completion time of the online EBASE was approximately 20 minutes (see additional file 1 for a copy of the modified-EBASE and the scoring rubric for calculating the three sub-scores).

Survey Administration & Data Collection

DCs interested in participating in the survey were invited to follow a link to the UPitt website (<http://www.chirostudy.pitt.edu>), where they could obtain detailed information about the study procedures and register for the study by submitting an email address. Participants were subsequently emailed a password in order to enter the survey site; an effort aimed at preventing multiple responses from the same individual. To encourage honest and transparent responses, anonymity was insured by assigning a unique identification number to each registered DC, which was used to identify the individual's survey data. As participants completed the survey in the language of their choice, responses were captured through a secure data capturing feature/system, Web Data Xpress, an interface used by UPitt that allows for direct entry and storage of data within a designated SQL Server database (<http://www.wpic.pitt.edu/research/wdx/>). This method of data capture is resource-efficient and minimizes human error by avoiding the need for manual data entry.

Data Analysis

Data were analyzed using SPSS version 22 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were calculated for each item in Parts A, B, D, E, F and G (response frequencies and means), Part C and the additional items on the awareness of CPGs (response frequencies). The attitudes, skills, and use sub-scores were calculated using the scoring rubric (see additional file 1) developed for the original EBASE. This involves summing the first eight items of Part A (response range 1-5; total score range of 8-40), all 13 items of Part B (response range 1-5; total score range of 13-65), and the first 6 items of Part D (response range 0-4; total score range of 0-24). Frequency distributions for the group sub-score means for Parts A, B and D were also calculated. Higher sub-scores indicate higher self-reported attitude (Part A), skill level (Part B) and use (Part D) of EBP. We also explored possible associations between certain demographic variables and the attitudes, skills and use sub-scores.

Table 1.
Baseline demographics of the 554 Canadian chiropractors who completed the online survey.

Variable		n (%)	National (%) (CCRD) ¹
Gender	Male	363 (65.5)	67.1
	Female	191 (34.5)	32.9
Age	Mean=42.1 yrs (SD=11.4) Range=24-80 yrs		
Year in Practice	Mean=15.8 yrs (SD=11.4) Range=1-49 yrs		Mean = 14.7 yrs (SD=11.1)
Highest Education Level	High School	102 (18.4)	
	Associate Degree/Some college	36 (6.5)	
	Bachelor's Degree	352 (63.5)	
	Master's Degree/Some grad work	53 (9.6)	
	Doctorate	11 (2.0)	
Primary Language	English	482 (87.0)	
	French	72 (13.0)	
Region of Practice	Alberta	68 (12.3)	14.6
	British Columbia	70 (12.7)	14.5
	Manitoba	29 (5.3)	3.5
	Atlantic provinces	23 (4.0)	3.9
	Ontario	242 (43.7)	47.9
	Quebec	104 (18.8)	13.1
	Saskatchewan	18 (3.2)	2.8
Geographic Setting	City	337 (60.8)	
	Suburban	137 (24.7)	
	Rural	80 (14.4)	
Patients Seen Daily	0-10	130 (23.5)	
	11-20	149 (26.9)	
	21-30	131 (23.6)	
	31-40	68 (12.3)	
	41-50	36 (6.5)	
	51 or more	40 (7.2)	
Focus	Musculoskeletal Focus	367 (66.1)	
	Spine and extremities	330 (59.6)	
	Spine	7 (1.4)	
	Sports	30 (5.2)	
	Non-musculoskeletal focus	177 (31.9)	
	Pediatrics	8 (1.3)	
	Family care	77 (13.9)	
	Wellness/Prevention	48 (8.7)	
	Non-musculoskeletal care	1 (0.2)	
Subluxation-based	43 (7.8)		
Other	10 (2.0)		
Onsite Imaging	Yes	132 (23.8)	
	No	422 (76.2)	
% Patients who get Radiographs	25% or less	428 (77.3)	
	26%-50%	40 (7.2)	
	51-75%	39 (7.0)	
	Over 75%	47 (8.5)	
X-rays useful for diagnosis of acute low back pain	Strongly Disagree	132 (23.8)	
	Disagree	184 (33.2)	
	Neutral	126 (22.7)	
	Agree	76 (13.7)	
	Strongly Agree	36 (6.5)	

¹ Canadian Chiropractic Resources Databank (CCRD). National Report, The Canadian Chiropractic Association. Canada. 2011.

Ethics

Ethical approval (A07-E62-13A) for this study was obtained through McGill University’s institutional review board in July 2013. Informed consent was obtained from all subjects via the homepage of the study website, prior to participation in the survey.

Results

Participant Characteristics

Demographics

A total of 554 Canadian chiropractors responded to the survey, providing a response rate of approximately 8%. The sample was predominantly male (65.5%) with a mean age of 42 (SD 11.4) years (Table 1). The majority of respondents practiced in urban (60.8%) or suburban settings (24.7%), saw on average fewer than 30 patients daily (74%), and indicated that the main focus of their practice was musculoskeletal care (66.5%). The mean number of years in practice was 15.8 years (range: 1 to 49 years).

Self-reported use of radiography

Less than a quarter of the participants (23.8%) indicated they had access to onsite radiography, and a large majority (77.3%) reported that 25% or fewer of their patients undergo spine radiographs each week (either in their clinic or at imaging centers). Nonetheless, over 20% of respondents agreed or strongly agreed that x-rays of the lumbar spine are useful in the diagnostic work up of patients with acute (< 1 month) low back pain, and a further 22.7% indicated that they neither agreed nor disagreed (i.e., felt neutral) with this statement (Table 1).

Attitudes toward EBP

Participants generally held favorable attitudes (Part A) toward EBP, with a mean attitudes sub-score of 32 (5.5), (range 10-40); while the median (IQR) sub-score 33.0 (7.0) was close to the mean (Fig 1). The majority (>75%) of participants “agreed” or “strongly agreed” with the attitudinal statements on EBP (Table 2). A smaller proportion of the respondents agreed with statements: 1) “EBP takes into account a patient’s preference for treatment” (47.4% agree/strongly agree); and 2) “EBP takes into account my clinical experience when making clinical decisions” (70.7% agree/strongly agree). A large majority of

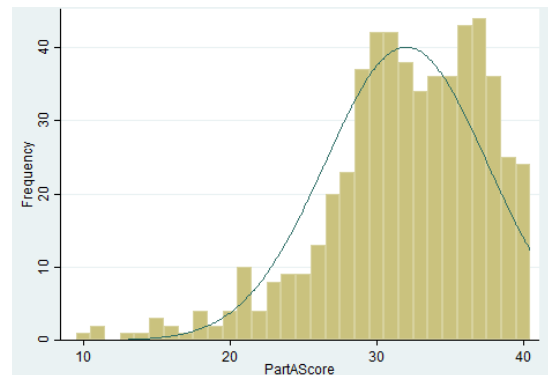


Figure 1:
Part A (attitudes) sub-scores. Mean(SD)=32.0(5.5), Range=10-40; Median(IQR)=33.0 (7.0).

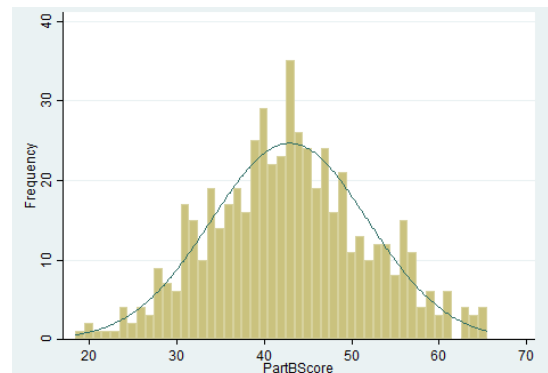


Figure 2:
Part B (skills) sub-scores. Mean(SD)=42.9 (8.9), Range=19-65; Median(IQR) =43.0 (12.0).

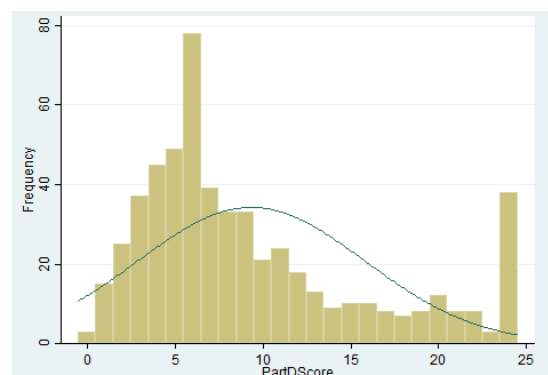


Figure 3:
Part D (use) sub-scores. Mean(SD)=9.3(6.5), Range=0-24; Median(IQR)= 8.0 (8.0).

Table 2.

Response frequency and means of Attitudes toward EBP items (Part A of E-BASE). These are responses to the question “On a scale ranging from strongly disagree to strongly agree, how would you rate your opinion on the following statements?”

Part A	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Mean Range=1-5
*Evidence based practice (EBP) is necessary in the practice of chiropractic	0.6%	3.3%	3.0%	34.7%	58.3%	4.5
*I am interested in learning or improving the skills necessary to incorporate EBP into my practice	0.9%	2.4%	7.3%	45.6%	43.8%	4.3
*EBP improves the quality of my patient’s care	0.9%	3.3%	9.4%	36.9%	49.5%	4.3
*EBP assists me in making decisions about patient care	0.9%	3.3%	7.3%	40.2%	48.3%	4.3
Prioritizing EBP within chiropractic practice is fundamental to the advancement of the profession	2.4%	5.7%	9.7%	38.4%	43.8%	4.2
*Professional literature (i.e. journals & textbooks) and research findings are useful in my day-to-day practice	0.6%	4.2%	11.5%	53.2%	30.5%	4.1
*EBP takes into account my clinical experience when making clinical decisions	2.4%	10.0%	16.9%	42.0%	28.7%	3.8
*The adoption of EBP places an unreasonable demand on my practice	21.8%	52.6%	18.4%	3.6%	3.6%	3.9
*EBP takes into account a patient’s preference for treatment	3.0%	20.8%	28.7%	29.0%	18.4%	3.4
There is a lack of evidence from clinical trials to support most of the treatments I use in my practice	10.3%	47.7%	17.8%	19.9%	4.2%	2.6

*The sum of the 8 items with asterisks comprises the “Attitudes” sub-score, which ranges from 8-40. See Figure 1 for frequency distribution graph of attitudes sub-scores.

the sample (89.4%) agreed or strongly agreed with the statement “I am interested in learning or improving the skills necessary to incorporate EBP into my practice”.

Skills in EBP

For self-reported skills in EBP (Part B), the mean and median (IQR) sub-score were respectively 42.9 (8.9), (range 19-65) and 43.0 (12.0) (Fig 2). For the majority of the skill items, more than half of respondents indicated a high level (‘4’ or ‘5’) of self-reported skill in EBP (Table 3); Nonetheless, nearly a third of respondents rated their skills in the mid-range (‘3’ on a 1-5 scale) for 11 of the 13 skill items. Two items were rated as having poor self-reported skills: 1) “conducting clinical research” (73.7%

of respondents), and 2) “conducting systematic reviews” (59.2% of respondents).

Level of EBP training/education

One third or less of respondents indicated that the following topics were major parts of their chiropractic education: coursework about EBP (34.7%), applying research evidence to clinical practice (28.1%), and critical thinking/analysis (27.8%) (Table 4). Ten percent of the sample indicated they never had any training in critical thinking/analysis included in their chiropractic education. A large portion of the sample reported that they had never received any education/training on clinical research (27.2%) or on conducting systematic reviews (40.2%).

Table 3.
Response frequency and means of Skills in EBP items (Part B of E-BASE). These are responses to the question “On a scale from 1 to 5, with 1 being poor and 5 being advanced, how would you rate your skills in the following areas?”

PART B	Poor (1)	(2)	(3)	(4)	Advanced (5)	Mean Range=1-5
Identifying answerable clinical questions	0.0%	1.2%	20.8%	55.3%	22.7%	4.0
Locating professional literature	0.9%	4.5%	26.9%	43.5%	24.2%	3.9
Identifying knowledge gaps in practice	0.3%	1.5%	29.3%	54.7%	14.2%	3.8
Applying research evidence to patient cases	0.6%	5.7%	22.4%	58.3%	13.0%	3.8
Using findings from clinical research	1.5%	5.4%	26.3%	52.9%	13.9%	3.7
Online database searching	4.5%	12.4%	26.3%	34.7%	22.1%	3.6
Retrieving evidence	1.5%	12.1%	28.4%	39.3%	18.7%	3.6
Critical appraisal of evidence	0.6%	13.9%	30.5%	40.8%	14.2%	3.5
Synthesis of research evidence	2.1%	15.1%	38.1%	31.1%	13.6%	3.4
Sharing evidence with colleagues	3.6%	14.8%	31.7%	37.5%	12.4%	3.4
Using findings from systematic reviews	4.2%	12.4%	32.6%	36.6%	14.2%	3.4
Conducting systematic reviews	28.7%	30.5%	20.8%	15.1%	4.8%	2.4
Conducting clinical research	40.8%	32.9%	15.1%	7.6%	3.6%	2.0

The sum of all 13 items comprises the “skills” sub-score, which ranges from 19-65. See Figure 2 for frequency distribution graph of skills sub-scores.

Table 4.
Response frequency of Training/Education items (Part C of E-BASE). These are responses to the question “Please indicate the highest level of training/ education you have received in the following areas”.

PART C	None	Seminars or short specific courses	Minor part of chiropractic education	Major part of chiropractic education	Part of diplomate education	Informal personal study
Evidence-based clinical practice/ evidence-based chiropractic	1.8%	17.8%	24.5%	34.7%	9.3%	6.6%
Applying research evidence to clinical practice	5.4%	19.6%	24.5%	28.1%	8.7%	8.5%
Conducting clinical research	27.2%	10.2%	41.7%	2.1%	8.7%	3.9%
Conducting systematic reviews or meta-analysis	40.2%	15.0%	26.0%	1.5%	7.8%	4.5%
Critical thinking / critical analysis	10.0%	16.8%	18.4%	27.8%	13.9%	6.6%

There is no sub-score associated with this part of the survey.

Table 5.
 Response frequency and means of Use of EBP items (Part D of E-BASE). These are responses to the question
 “Indicate how often you have performed the following activities over the last month”.

PART D	None or very Small (0-25%) (1)	Small (26-50%) (2)	Moderate (51-75%) (3)	Large (76-99%) (4)	All (100%) (5)	Mean Range=1-5
What percentage of your practice do you estimate is based on clinical research evidence (i.e. evidence from clinical trials)?	11.5%	22.1%	35.7%	29.0%	1.8%	2.9
	0 times (1)	1-5 times (2)	6-10 times (3)	11-15 times (4)	16+ times (5)	Mean Range=1-5
*I have read/reviewed professional literature (i.e. professional journals & textbooks) related to my practice	3.3%	46.5%	20.9%	10.3%	19.0%	2.0
*I have used an online search engine to search for practice related literature or research	7.9%	42.9%	21.2%	8.8%	19.3%	1.9
*I have read/reviewed clinical research findings related to my practice	10.0%	48.3%	14.8%	7.9%	19.0%	1.8
*I have used professional literature or research findings to assist my clinical decision making	13.9%	49.9%	16.0%	5.7%	14.5%	1.6
*I have used an online database to search for practice related literature or research	34.1%	33.2%	9.1%	7.6%	16.0%	1.4
*I have used professional literature or research findings to change my clinical practice	24.8%	50.8%	8.8%	3.9%	11.8%	1.3
I have consulted a colleague or industry expert to assist my clinical decision making	24.2%	51.1%	13.0%	3.0%	8.8%	1.2
I have referred to magazines, layperson / self-help books, or non-government/non-education institution websites to assist my clinical decision making	47.7%	37.8%	6.0%	3.0%	5.4%	0.8

*The sum of the 6 items with asterisks comprises the “Use” sub-score, which ranges from 0-24. See Figure 3 for frequency distribution graph of the “use” sub-scores.

Use of EBP

The mean sub-score for the use of EBP (Part D) was 9.3 (6.5), (range of 0-24) while the median (IQR) sub-score 8.0 (8.0) was higher than the mean (Fig 3). Nearly two thirds of the sample (64.7%) indicated that over half of their practice was based on evidence from clinical research. Nonetheless, 34% did not use an online database to search for practice-based literature or research findings, and 24.8% reported not using professional literature or research findings to change their clinical practice (Table 5).

Barriers and Facilitators to EBP Uptake

Participants perceived the following factors to be moderate or major barriers to EBP uptake in clinical practice

(Part E): 1) lack of clinical evidence about CAM (44.1%); 2) lack of time (40.8%); and 3) lack of industry support (e.g., professional organizations) (31.2%) (Table 6). Approximately one quarter of respondents cited lack of incentive (23.2%) and insufficient skills to critically appraise (24.1%) and to interpret research (24.1%) as being moderate or major barriers to EBP uptake.

Conversely, over 70% of respondents indicated all 10 facilitator items were either “moderately useful” or “very useful” in facilitating the uptake of EBP (Part F) (Table 7). Items most frequently reported as “very useful” were: access to online education materials related to evidence-based practice (92.5%), access to the internet (92.2%), access to free online databases (87.3%), and ac-

Table 6.
Response frequency and means of Barriers to EBP uptake items (Part E of E-BASE).
 These are responses to the question “On a scale ranging from ‘not a barrier’ to ‘major barrier’,
 to what extent do the following factors prevent you from participating in EBP?”

Part E	Not a barrier (1)	Minor barrier (2)	Moderate barrier (3)	Major barrier (4)	Mean Range=1-4
Lack of clinical evidence in complementary and alternative medicine	23.6%	32.3%	32.6%	11.5%	2.3
Lack of time	27.2%	32.0%	30.2%	10.6%	2.2
Lack of industry support for EBP	37.8%	31.1%	23.0%	8.2%	2.0
Insufficient skills to critically appraise / evaluate the literature	34.4%	41.4%	19.3%	4.8%	1.9
Insufficient skills for interpreting research	36.9%	39.0%	19.0%	5.1%	1.9
Lack of incentive to participate in EBP	48.3%	28.4%	16.3%	6.9%	1.8
Patient preference for treatment	39.9%	42.0%	16.3%	1.8%	1.8
Insufficient skills for locating research	41.4%	41.4%	13.0%	4.2%	1.8
Insufficient skills to apply research findings to clinical practice	45.0%	40.5%	11.8%	2.7%	1.7
Lack of relevance to chiropractic practice	55.3%	26.3%	11.2%	7.3%	1.7
Lack of colleague support for EBP	51.1%	31.1%	12.1%	5.7%	1.7
Lack of resources (i.e. access to a computer, the internet or online databases)	55.6%	29.9%	10.6%	3.9%	1.6
Lack of interest in EBP	65.6%	24.2%	6.9%	3.3%	1.5

These items are focused on barriers to the uptake of EBP. However, there is no sub-score associated with this part of the survey.

Table 7.
Response frequency and means of Facilitators of EBP uptake items (Part F of E-BASE).
 These are responses to the question “On a scale ranging from ‘not useful’ to ‘very useful’,
 to what extent would the following strategies assist you in participating in EBP?”

Part F	Not useful (1)	Slightly useful (2)	Moderately useful (3)	Very useful (4)	Mean Range=1-4
Access to the Internet in your workplace	3.0%	5.7%	15.4%	75.8%	3.6
Ability to download full-text / full-length journal articles	2.1%	10.9%	16.3%	70.7%	3.6
Access to online education materials related to evidence based practice	0.9%	6.6%	24.5%	68.0%	3.6
Access to free online databases in the workplace, such as Cochrane and Pubmed	1.2%	11.5%	19.0%	68.3%	3.5
Access to critical reviews of research evidence relevant to your field (these are critical reviews of multiple research papers addressing a single topic)	0.9%	11.8%	28.1%	59.2%	3.5
Access to critically appraised topics relevant to your field (these are critical appraisals of single research papers)	1.2%	15.4%	33.8%	49.5%	3.3
Free access to online databases that usually require license fees, such as DynaMed and CINAHL	6.9%	15.7%	20.2%	57.1%	3.3
Access to tools used to assist the critical appraisal / evaluation of research evidence	2.7%	23.3%	36.6%	37.5%	3.1
Access to research rating tools that facilitate critical appraisal of single research papers	4.2%	20.8%	35.3%	39.6%	3.1
Access to online tools that assist you to conduct your own critical appraisals of multiple research papers related to a single topic	8.8%	23.3%	32.9%	35.0%	2.9

These items are focused on facilitators to the uptake of EBP. However, there is no sub-score associated with this part of the survey.

Table 8.

Response frequency and means of Awareness of previous CCA-CFCEAB Clinical Practice Guidelines. These are responses to the question “On a scale ranging from ‘Strongly disagree’ to ‘Strongly agree’ how would you rate your opinion about your knowledge and the impact of the guidelines?”

Awareness of previous clinical practice guidelines	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	Mean Range=1-5
Adult Neck Pain Not Due to Whiplash guideline (2005)						
I am familiar with most of the recommendations	0.0%	0.0%	15.7%	68.3%	16.0%	4.0
Overall, this guideline is representative of the evidence	0.9%	2.7%	19.9%	59.8%	16.6%	3.9
Recommendations have significantly impacted how I manage patients	3.3%	8.8%	41.1%	39.6%	7.3%	3.9
Whiplash-associated Disorders in Adults (2010)						
I am familiar with most of the recommendations	0.0%	0.0%	12.1%	67.1%	20.9%	4.1
Overall, this guideline is representative of the evidence	0.9%	2.1%	20.2%	60.4%	16.3%	3.9
Recommendations have significantly impacted how I manage patients	2.7%	9.4%	32.3%	46.8%	8.8%	3.5
Management of Headache Disorders in Adults (2011)						
I am familiar with most of the recommendations	0.0%	0.0%	18.1%	63.1%	18.7%	4.0
Overall, this guideline is representative of the evidence	0.6%	2.1%	25.1%	56.2%	16.0%	3.9
Recommendations have significantly impacted how I manage patients	2.4%	9.4%	35.1%	42.3%	10.9%	3.1

These items are focused on awareness and uptake of prior chiropractic CPGs produced in Canada. However, there is no sub-score associated with this part of the survey.

cess to critical reviews of relevant research evidence (i.e. critical reviews of multiple research papers addressing a single topic) (87.3%). In contrast, items most frequently reported as “not useful” or “slightly useful” related to the access to tools to assist clinicians in conducting their own critical appraisal of the research evidence (26%), and for evaluating single (28%) or multiple research papers (32.1%).

Awareness of past clinical practice guidelines

Table 8 presents respondents’ levels of awareness and agreement with three chiropractic clinical practice guidelines (CPGs) developed by the Canadian Chiropractic Association and the Federation. All respondents were aware of the three CPGs published between 2005 and 2011, and a large majority (over 80%) indicated that they were familiar or very familiar with most of the recommendations issued in these CPGs. Although over 70% of participants felt that the guidelines were representative of the best available evidence, only half of the respondents (51.7%) agreed or strongly agreed that these guidelines

had significantly impacted on how they managed their patients.

Associations between demographic variables and Attitude, Skills and Use Sub-scores.

DCs with a musculoskeletal focus had a more favorable attitude toward EBP ($r = .406, p < .001$) and a higher level of skill in EBP ($r = .153, p < .001$) relative to those with a non-musculoskeletal focus. Similarly, as education level increased (i.e. from associate degree, to MSc and PhD), attitudes ($r = .191, p < .001$), skills ($r = .296, p < .001$), and use ($r = .146, p = .001$) sub-scores increased. In contrast, DC’s who reported a busier practice had a less favorable attitude toward EBP ($r = -.297, p < .001$) and lower level of skill in EBP ($r = -.150, p < .001$) than those who saw fewer than 20 patients per day.

DCs who reported having onsite imaging equipment had less favorable attitudes ($r = -.235, p < .001$) and lower EBP skills ($r = -.118, p = .005$) than their counterparts. Furthermore, DC’s who reported ordering more radiography had lower attitude sub-scores ($r = -.292, p < .001$).

Similarly, those believing that lumbar spine x-ray is useful for diagnosing patients with acute LBP had less favorable attitudes ($r = -.377$, $p < .001$), skills ($r = -.128$, $p = .003$) and use ($r = -.107$, $p = .012$) sub-scores.

Discussion

Summary of findings

Understanding chiropractors' attitudes, skills and use of EBP and the potential barriers and facilitators of EBP use is a critical step in advancing EBP and increasing the uptake of research into chiropractic clinical practice. Our results suggest that Canadian chiropractors generally have moderate to strong positive attitudes about EBP and report moderate to high level skills in acquiring research evidence, but that much improvement can be made in the application of research evidence in clinical practice. These results are in line with those reported by Suter³⁰ among DCs and massage therapists in Canada; although, that sample was restricted to one province (Alberta) and did not use a standardized questionnaire.

While attitudes toward EBP were generally favorable in our sample, misconceptions regarding the importance of integrating the three pillars of EBP to guide clinical decision making (i.e. use of the best evidence, clinical expertise, and patient's preferences and values)¹ appear to persist. A large proportion of survey respondents (between 30% and 50%) were unsure or disagreed that EBP takes into account clinical experience and patient preference. These results are not surprising given that approximately half (44%) of our sample received their chiropractic training greater than 15 years ago, with many of our participants reporting no, minimal, or minor chiropractic foundational training in EBP (Table 2). Also, contrasting beliefs and approaches in chiropractic (experiential vs. EBP) are well documented and remain a source of ongoing debate in the profession.³⁷⁻⁴⁰ While chiropractors seem to recognize the 'push' towards EBP, and a growing segment of the profession appear to embrace its principles with nearly 90% of participants interested in learning or improving their EBP skills, uptake of scientific evidence is slow.⁴¹ Gaining a better understanding of chiropractors' clinical experiences, beliefs and apparent dissonance with research evidence may help to improve the translation of research into practice as well as patient care.⁴²

Between 50% and 70% of the sample reported a high

level of skill in EBP, particularly in relation to identifying answerable clinical questions, identifying knowledge gaps in practice, and literature searching. However, nearly one third of respondents rated themselves only in the mid-range on nearly all of the EBP skill items. Importantly, 40% reported poor to moderate skills in using the findings from systematic reviews, which is a common finding among many health professions.⁴³ This is worthy of attention given the value of systematic reviews to provide efficient access to potentially large volumes of research data through the synthesis of primary research studies using systematic, explicit and reproducible methods.⁴⁴ As such, well-conducted systematic reviews have replaced randomized controlled trials as the gold standard of evidence and further, are presented in a format that can facilitate the use of the best available evidence by both students and practitioners.

Over one-third of respondents estimated that only a small or very small percentage of their practice was based on clinical research evidence. Furthermore, over half reported never or rarely using an online database to search for practice-based literature or research, professional literature and research findings to change their clinical practice, or consulting a colleague or industry expert to assist their clinical decision making. Such findings are troublesome and likely result in important knowledge-practice discrepancies in chiropractic. Important gaps have also been identified in other health disciplines, with nearly 30-40% of medical patients not receiving optimal care, and a further 20-25% receiving care that is unnecessary or potentially harmful.^{45,46} While robust estimates of knowledge-practice gaps in chiropractic are lacking, we postulate that it is unlikely to be any better considering our findings. Further, cultural shifts are often slow and require concerted efforts from professional leaders to move research agendas forward and to accelerate the uptake and application of EBP to improve patient health outcomes.³⁹

Exploratory analyses suggest that DCs with a main focus on non-musculoskeletal care, reporting busier practices and with lower levels of education demonstrated poorer attitudes and lower skill levels with respect to EBP. These findings are consistent with a recent US study that found provider and practice characteristics influence chiropractic practice behaviour.³⁴ Further, poorer attitudes toward, skill levels in, and utilisation of EBP were associated with beliefs that lumbar spine x-ray is useful for

diagnosing patients with acute LBP, a practice inconsistent with the best available evidence.⁴⁷ While educational interventions may be effective in improving professional practice⁴⁸ and possibly reducing the perceived need for plain radiography in acute LBP among chiropractors⁴⁹, more active strategies will likely be required to change professional behaviours^{20,50}.

In the current study, a majority of respondents (77%) reported that 25% or fewer of their patients undergo spine radiographs each week. This is in line with figures from a national survey of Canadian DCs suggesting that the percentage of chiropractic patients who are x-rayed at least once per episode has gradually declined from 48% in 1997 to 35% in 2011.⁵¹ Furthermore, our data indicate that about 20% of respondents agreed or strongly agreed that x-rays of the lumbar spine are useful in the diagnostic work up of patients with acute (< 1 month) low back pain. This represents an important reduction from about half of respondents in an Ontario study a decade ago who agreed or strongly agreed with this same statement.⁴⁹ Such a downward trend has been observed over the past two decades among chiropractors in North America⁵²⁻⁵⁶, UK⁵⁷ and Switzerland⁵⁸.

Barriers to applying research findings in practice are numerous.^{19,59,60} For Canadian DCs, the key barriers to EBP uptake were a lack of clinical evidence about CAM, a lack of time and incentive, and a lack of support from professional chiropractic organizations. Similar factors were identified by Lawrence (2008) among professional chiropractic leaders in the US.⁶¹ In contrast, a number of facilitators were identified, including access to online education materials related to EBP, access to free online databases and access to critical reviews of relevant research evidence. This emphasizes the need for high quality continuing education programs on EBP to better meet the needs of the chiropractic profession.

Awareness of Canadian chiropractic CPGs published between 2005 and 2011 was very high, with over 80% of respondents indicating that they were familiar or very familiar with most of the recommendations. However, only half of the respondents agreed or strongly agreed that these guidelines had significantly impacted on how they managed their patients. Different reasons can explain these findings, including: compliance with recommended practice was already high among respondents; the proposed guidelines were not deemed to be of suf-

ficient quality to be implemented, or individual barriers to guideline uptake prevailed. Two recent qualitative studies focusing on chiropractors' views about barriers to using CPGs and best practice identified common theoretical domains likely to influence compliance with recommended care among DCs in North America.^{62,63} These barriers included: conflicting beliefs about the potential consequences of applying recommended care in practice (beliefs about consequences), concerns over perceived threats to professional autonomy, professional credibility, lack of standardization, and agreement with guidelines (social/professional role & identity), the influence of formal training, colleagues and patients (social influences), and guideline awareness and agreement (knowledge). Level of awareness of best practice was thought to be influenced by geographical isolation and negative views toward guidelines among US chiropractic leaders.⁶¹ These factors were thought to be relevant for Canadian DCs as well.⁶⁴ Ongoing efforts to identify these modifiable determinants of clinicians' guideline adherence are needed to design tailored knowledge translation strategies to encourage evidence-based practice.

Geographical variations

When comparing our results with those from a similar study of American chiropractors³⁴ striking similarities were observed in terms of the average scores on the attitudes, skills, and use subscales. The American study found average attitudes subscale scores of 31.4 compared with our average of 32.0. American average skills subscale scores were 44.3, compared to 43.0 for Canadian respondents. Finally, the average American and Canadian use subscale scores were equal at 10.3. Our findings are also similar to studies conducted in Australia, USA, Germany and the UK where chiropractors report favourable attitudes toward EBP^{24,27}, but many fail to routinely use EBP to inform clinical decision making^{24,25}. Failure to translate clinical and health services research into practice and policy is not limited to chiropractic, however; it is an issue spanning the wider health care system.¹⁸

Implications for education and guideline implementation

The passive dissemination of CPGs results only in small practice changes.⁶⁵ Our results suggest that educational emphasis should be focused on improving the skills of DCs

with respect to the appraisal and application of research evidence to clinical practice. This may be facilitated by providing access to EBP tools (e.g., a central repository of CPGs and best practices relevant to the scope of practice), and by offering online and face-to-face training.⁶⁶ Understanding barriers to professional behaviour change is an important component of successful dissemination and implementation efforts.⁶⁷ We are currently in the process of evaluating the feasibility of implementing a theory-based knowledge translation strategy designed to overcome previously identified barriers in the chiropractic setting.⁶³ This multifaceted strategy includes a webinar series, clinical vignettes, and online learning modules.

Study limitations

Strengths of this study include the use of a validated and reliable measure of EBP attitudes, skills and use. Nonetheless, this project has several important limitations. First, while attempts were made to maximize the response rate by using the principles of the Dillman method⁶⁸ (including pre-announcement in this journal, and sending out invitations and multiple reminders to participate by national and provincial associations), we are unable to determine the generalizability of our findings to the total population of Canadian chiropractors; this is partly because our sample was a convenience sample of members of the CCA limited to those with email addresses who did not previously opt-out from receiving these. Notwithstanding, although the response rate was low, study participants were generally representative of the target population in terms of gender, years in practice and geographical location.^{50,67} Survey respondents also had similar ages, number of patients seen daily, levels of education, and focus of practice; indicating that our sample was likely to be representative of Canadian DCs.^{51,69} Still, we cannot exclude the possibility of response bias and should be cautious about generalizing results. For example, it is possible that the 'attitudes' sub-scores were skewed toward higher values because participants were already positively biased in favour of an evidence-based practice paradigm prior to taking part in the survey. Second, as with most survey designs, there was a reliance on self-reported information, which has its own limitations. For example, the 'skills' sub-score was based on the participants' self-perceived level of skill; we did not formally test participant knowledge or skills with respect to EBP. Future evalua-

tion of DC skills, knowledge and actual behaviours related to EBP would provide an improved understanding of the chiropractic profession's needs and better inform the design of targeted EBP interventions. Also, while our exploratory analyses yielded interesting and potentially important findings regarding the relationships between practitioner characteristics and EBP attitudes, skills and behaviours, the significant findings were based upon only weak to moderate correlations. Thus, these results should be interpreted with caution and explored further in future research.

Conclusions

The results of this survey have provided additional insights into the attitudes, skills and use of EBP among Canadian chiropractors. Chiropractors generally had moderate to strong positive attitudes about EBP and moderate to high level skills in acquiring research evidence. However, the application of research evidence in clinical practice remains challenging. Results from this survey provide a baseline measure and can inform the design of future theory-based knowledge translation interventions to help improve chiropractors' level of EBP literacy and use of evidence in clinical practice.

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