Applying Evidence-Based Health Care to Musculoskeletal Patients as an Educational Strategy for Chiropractic Interns (A One-Group Pretest-Posttest Study)☆

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Abstract

Objective: To describe and measure the effectiveness of a problem-based educational strategy for teaching evidence-based health care (EBHC) to chiropractic interns, which focused on the development and appraisal of answerable clinical questions using actual musculoskeletal patients.

Methods: A 1-group pretest-posttest design (simple panel design) with investigator-blinded survey administration was used to measure effectiveness of educational activities using adult learning theory with a study population of interns (n=31) at a chiropractic college (Los Angeles College of Chiropractic, Southern California University of Health Sciences [LACC/SCUHS]) teaching clinic. Activities included 2 workshops on constructing clinical questions and critical appraisal of published research and independent patient-based EBHC assignments. A qualitative self-assessment survey was administered before and after a 6-week period of EBHC activities to measure their effectiveness. Sign tests and paired *t* tests were utilized to determine *P* values for significant difference of score results.

Results: Eighty-one percent of subjects completed the pretest-posttest surveys. All survey item responses showed an average increase in subjects' self-rating of skills and attitudes from pretest to posttest. There were statistically significant differences in interns' self-assessed ability to construct an answerable clinical question and appraise research articles and apply them to patient management, as well as their rating of importance of EBHC in patient decision making.

Conclusions: The results of this study suggest that having chiropractic interns apply EBHC to actual musculoskeletal patients along with attending EBHC workshops had a positive impact on interns' perceived ability to practice EBHC. (J Manipulative Physiol Ther 2004;27:253-61)

Key Indexing Terms: *Evidence-Based Medicine; Chiropractic; Education; Critical Appraisal*

Introduction

Evidence-based health care (EBHC), also known as evidence-based practice (EBP) or evidence-based medicine (EBM), is the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence-based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research.[1]

The term *evidence-based medicine* was coined at McMaster University Medical School in Canada in the 1980s to label a problem-based learning strategy introduced at that school in the 1960s.[2-4] In 1992, the Evidence-Based Medicine Working Group (EBMWG) emphasized balanced assessment of the strengths and weaknesses of research findings and their application to a particular patient or group.[5] In 1997, the textbook by Sackett et al,[6] *Evidence-Based Medicine: How to Practice and Teach EBM*, embedded critical appraisal in a wider package of physician skills, including clinical question development and research literature retrieval. Parkes et al[2] have outlined the development of critical appraisal and EBHC and noted that critical appraisal is a continually evolving entity. Milne

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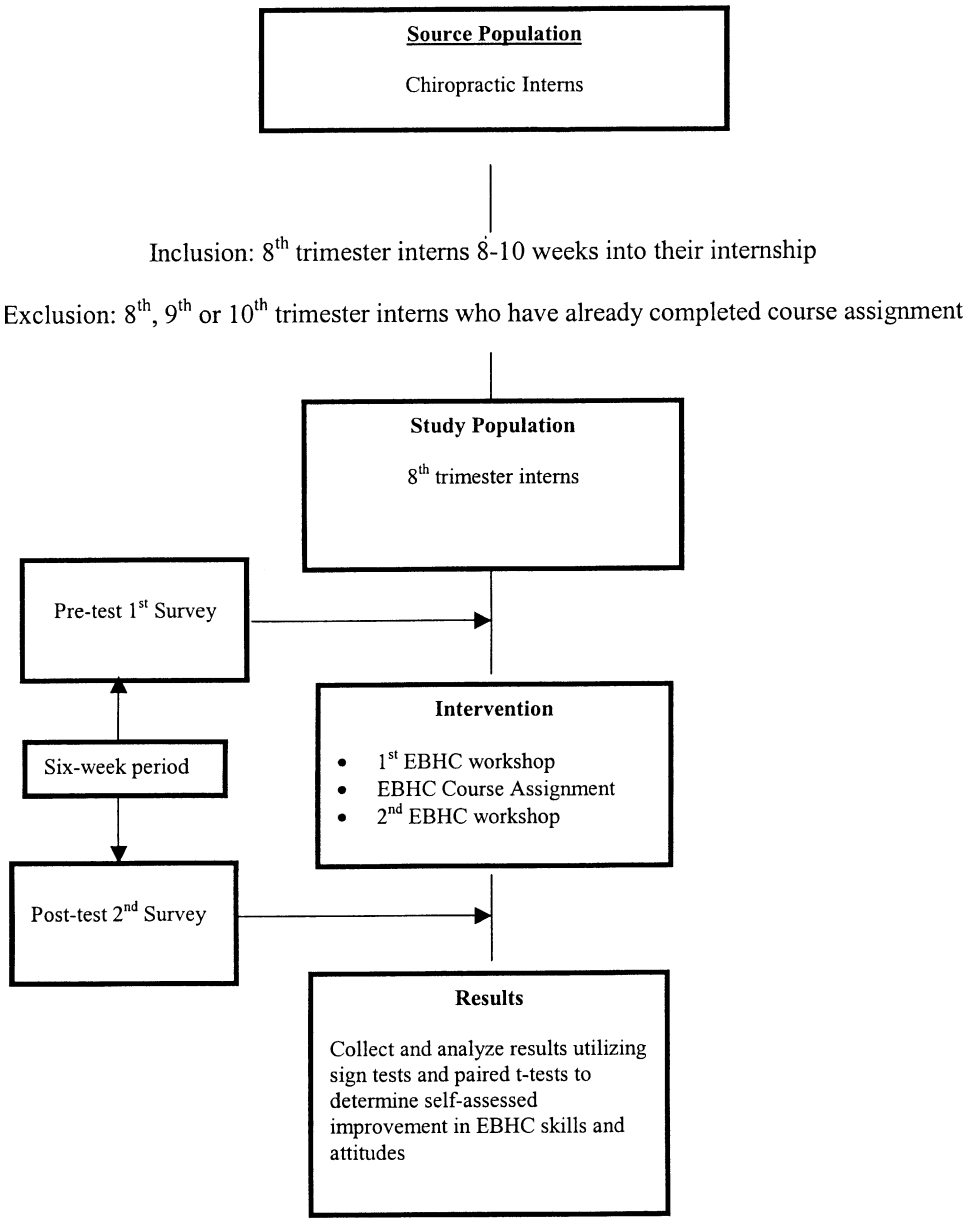

Fig 1. *Summary diagram of EBHC clinical teaching activities.*

et al[3] have discussed the value of this approach to those involved in making health care decisions.

EBHC is a process of self-directed problem-based learning where the clinician formulates an answerable question, accesses and evaluates evidence, utilizes appropriate evidence in patient decision making, and then evaluates self-performance. Problem-based learning is based on adult learning theory and principles that are important to consider when developing an EBHC curriculum. Adults need to know why they need to learn something before undertaking to learn it. Adult learners prefer responsibility for their decisions, desire to be viewed as capable of self-direction, and become ready to learn when it is necessary to cope effectively with real life situations. In contrast to children's subject-centered orientation to learning, adults are life centered (or task centered) and more responsive to internal than external motivators.[7-10]

The influence of evidence-based health care on chiropractors is increasing, due to recognition of the limitations and uncertainties of traditional clinical decision making. Evidence-based practice deals directly with these uncertainties and is transforming the education and practice of the next generation of chiropractic doctors. New skills required of evidence-based physicians include efficient literature searching, application of formal rules of evidence in evaluating the clinical literature, and integration of the best

evidence into patient care. An important goal of clinical chiropractic education should be to teach these specific skills to doctors.[11]

The skills and attitudes to adopt an evidence-based approach should now be an essential part of the curriculum in educating and training chiropractors.[12] Johnson and Green[13] reviewed the history of chiropractic education and concluded that the monocausal, authoritarian philosophy historically prevalent in the profession has hampered substantial growth in critical thinking. Recent literature suggests the profession may be on the brink of positive changes as the result of more chiropractors engaging in scholarship related to their field.[13]

A limited number of nonrandomized, noncontrolled studies using single-survey designs have addressed EBHC in chiropractic education. Green[14] described an innovative teaching strategy that included student-written letters to editors of peer-reviewed journals intended to develop critical thinking and professional communication skills in chiropractic students. This strategy produced a large percentage of students who felt that they had developed better critical appraisal and professional communication skills. In another study, Green and Johnson[15] evaluated student responses to a clinical epidemiology course focused on critical appraisal and professional communication. Students generally responded positively to active self-directed learning opportunities but expressed frustration if sufficient learning resources (such as individualized instructor contact) were lacking during course activities. Although both these studies were limited, they showed potential to change students' attitudes, professional communication, and critical appraisal skills.

A cross-sectional survey by Rose and Adams[16] studied the prevalence of EBHC teaching in chiropractic college clinics. Clinic administrators and directors were surveyed worldwide with a response rate of 78% (18 of 23 colleges). A majority of respondents required their interns to make oral case presentations (67%) and write case reports (65%), but few required their interns to routinely generate clinical/research questions or conduct literature searches (18%). None of the respondents required their interns to participate in journal clubs, and their students were more likely to rely on clinical faculty, preclinic course instruction, and textbooks for clinical decision making. It was apparent from this study that EBHC methods are not being widely taught in chiropractic college clinics worldwide. Clearly, there exists the need to further develop chiropractic curricula that focus on teaching critical appraisal and evidence-based health care in didactic and clinical settings.

Objectives

The objectives of this study were to describe an EBHC educational strategy focused on development of answerable clinical questions based on real patients with musculoskeletal conditions; to examine effectiveness of the strategy at improving chiropractic interns' self-assessed EBHC competencies and attitudes by use of pretest-posttest surveys; and to suggest future research directions.

Table 1. *Outline of first EBHC workshop*

Discussion on clinical case scenario and clinical decision making
Accuracy of diagnostic decision making / clinician-based factors
Accuracy of diagnostic decision making / external factors
Introduction to EBHC
Why should we use evidence-based methods?
How do I practice with evidence-based methods?
Which questions to answer this week?
Where clinical questions arise?
The 8 clinical tasks
Classify the question into a domain
Four elements of good clinical questions
A sample clinical question
Some common problems
Review and discuss EBHC assignment

EBHC, Evidence-based health care.

This project resulted from a review paper on EBHC previously published by the authors of the current study.[11] The question addressed in this study is: In teaching evidence-based health care to chiropractic interns, does the application of EBHC skills (ie, developing patient-centered clinical questions, on-line literature searching, appraisal of studies) to actual clinical patients result in improved EBHC skills and attitudes? This study was modeled, in part, after a previous study on internal medicine residents by Green and Ellis.[7] Few published studies were found in the literature regarding chiropractic interns' EBHC skills and attitudes. With the current study, we sought to develop basic strategies for teaching EBHC to chiropractic students, thereby better preparing them to be competent chiropractic practitioners and lifelong learners who inform themselves with the best available evidence to deliver quality health care.

Methods

A preliminary study was conducted with 94 subjects from 3 separate graduating classes over an 18-month period. They were similar to the subjects in this study in all other aspects. Pretest-posttest surveys (same instrument used in the present study, Appendix A) (Appendix A available online at *www.mosby.com/jmpt*) were administered and the data were collected and analyzed using the SAS statistical software (*t* test procedure) (SAS Institue Inc, Cary, NC). Pregroup and postgroup averages were compared with nonpaired *t* test on the data gathered before and after the curricular activities. There were increased group-averaged responses on all survey items, but only 1 (ability to construct a clinical question) showed a statistically significant difference. Post hoc statistical power analysis determined that use of paired *t* test and sign tests for noncontinuous data was required in a follow-up study to help determine if improved posttest responses were significant and not due to chance.

Table 2. *Outline of second EBHC workshop*

Review of first workshop
Rules of evidence: guides for selecting articles likely to provide valid results
Are the results of this therapeutic trial valid? Review article based on sample question
Are the results of this randomized trial important?
How do I learn to perform critical appraisal?
Critical appraisal example: Delaney and Hubka[40]
• Does McKenzie clinical assessment reliably differentiate discogenic from nondiscogenic lumbar pain?
• Study evaluated: Donelson et al.[41] A study of centralization of lumbar and referred pain; a predictor of symptomatic disks and annular competence.
End-range lumbar test motions
Pain centralization and peripheralization
2×2 contingency table for probability analysis
Specificity and sensitivity (SPins and SNouts)
The validity of McKenzie assessment compared with discography
The validity of McKenzie assessment compared with special imaging
Comparison of McKenzie assessment with diagnostic tests in AHCPR Guidelines
Usefulness of McKenzie clinical assessment for discogenic pain: Conclusions
The evidence spectrum
Conclusions

EBHC, Evidence-based health/care; *AHCPR*, Agency for Health Care Policy and Research.

A follow-up study of 1-group pretest-posttest design (simple panel design) was utilized to measure the effectiveness of educational activities with chiropractic interns (n=31) at a chiropractic college teaching clinic (Fig 1). These activities included 2 workshops on constructing clinical questions and analyzing research articles with rules of evidence, along with independent EBHC assignments given to interns. To measure effectiveness of these curricular activities, a qualitative self-assessment survey was administered before and after EBHC activities over the course of a 6-week period. Subjects were chiropractic interns (n=31) who had completed 8 to 10 weeks of their clinical internship. Excluded were interns who had already completed the assignment or attended the workshops.

The interns were invited to participate in this study by completing surveys on a voluntary and anonymous basis. A plain language statement describing this study was provided to 33 interns and 31 interns consented to complete the survey instrument. There was no separate control group used in this study. Subjects served as their own controls, as pretest-posttest surveys were administered (1-group pretest-posttest design). The study investigators were blinded to survey administration.

Survey Instrument

A survey instrument (Appendix A) (Appendix A available online at *www.mosby.com/jmpt*), which described interns' self-assessed behaviors, attitudes, and skills in the area of EBHC, was utilized as a measurement of effectiveness of the workshops and assignment. The items in this survey were rated on a 1 to 5 Likert scale and included self-assessment of computer on-line searching, constructing an answerable clinical question, appraisal and application of research studies to clinic patients, and rating the importance of EBHC in patient decision making. Criterion validity of our instrument was established by derivation from a self-assessment instrument found reliable and valid by Green and Ellis[7] when compared with a 17-point EBHC skills test. The face and content validity of our survey instrument was determined by using survey items addressing the domains of EBHC as described by Sackett et al.[6]

Table 3. *Pretest-posttest, mean values, SDs, minimums, and maximums*

Variable	N	Mean	SD	Minimum	Maximum
pre1	25	3.5200000	0.8225975	2.0000000	5.0000000
pre2	25	3.1600000	0.7461010	2.0000000	5.0000000
pre3	25	3.3200000	0.9000000	2.0000000	5.0000000
pre4	25	2.7200000	1.2423097	1.0000000	5.0000000
post1	25	3.7200000	0.7371115	2.0000000	5.0000000
post2	25	3.6800000	0.7483315	3.0000000	5.0000000
post3	25	3.7200000	0.7916228	2.0000000	5.0000000
post4	25	4.0800000	0.8124038	3.0000000	5.0000000

Procedure

The study proceeded by first administering the pretest survey, asking chiropractic interns to rate their skills (using the Likert scale) at computer on-line searching, constructing an answerable clinical question, and appraising and applying research studies to clinic patients and to rate the importance of EBHC in patient decision making. Blinded survey administration, without study investigators present, was provided by clinic staff members who issued numerical identification codes to students for use with surveys and EBHC assignments and provided and collected pretest surveys, posttest surveys, and EBHC assignments. Survey administration was blinded so that data were not directly submitted to study investigators but to "neutral" individuals, protecting respondent anonymity and minimizing response bias from student awareness of investigators' expectations and attitudes.

The pretest survey was administered prior to intern participation in the first EBHC workshop that focused on clinical question development, literature searching, and critical appraisal. This first workshop prepared interns to complete the EBHC assignment (Appendix B) (Appendix B available online at *www.mosby.com/jmpt*), which was provided at workshop conclusion. At the 4-week period, a second EBHC workshop was provided that emphasized in-depth critical appraisal and provided a forum for discussion of practical problems arising in application of EBHC to

Table 4. *Mean, SD, and SE of the posttest-pretest differences*

Variable	Mean	SD	SE
diff1	0.2000000	0.8164966	0.1632993
diff2	0.5200000	0.6531973	0.1306395
diff3	0.4000000	0.9574271	0.1914854
diff4	1.3600000	1.7530925	0.3506185

Table 5. *Results of sign tests and paired t tests*

Difference	DF	Sign tests	Paired *t* tests (*P* values)
post1 - pre1	24	0.4240	.2326
post2 - pre2	24	0.0010	.0006
post3 - pre3	24	0.0386	.0475
post4 - pre4	24	0.0007	.0007

interns' musculoskeletal patients. At the 6-week period, interns submitted the EBHC assignment and completed the posttest survey.

Data from pretest and posttest survey results were compiled on Microsoft (Redmond, Wash) Excel spreadsheets and were analyzed by an independent consultant utilizing SAS Software sign tests and paired *t* tests procedures to determine degree of improvement of self-assessed EBHC skills and attitudes.

Description of EBHC Assignment

This assignment (see Assignment Instrument in Appendix B) (Appendix B available online at *www.mosby.com/jmpt*) was largely derived from the book by Sackett et al,[6] *Evidence-Based Medicine: How to Practice and Teach EBM*. It was designed to be practical in nature and usable by interns and physicians to develop clinical questions based on their actual patients. The assignment instrument provided structure for development of a focused research question and required description of the literature search process (search terms, databases, and search engines/tools) for possible future reference. After articles pertinent to the clinical question were retrieved, interns critically appraised retrieved research by applying criteria for evidence (provided on the Assignment Instrument) appropriate for the specific type of study. Interns then wrote brief explanations to support their patient care decisions, based on the evidence retrieved, and obtained approval from their assigned supervising clinician for completion of the assignment within a 6-week period.

Description of First EBHC Workshop - EBHC and How To Ask Clinical Questions

Instructional methods derived from the text, *Evidence-Based Medicine: How to Practice and Teach EBM* [6] were utilized in the first workshop described below (Table 1). Emphasis was placed on student participation in clinical question development. Discussion included what constitutes evidence-based practice, identification of practical approaches, and barriers to applying EBHC. The perceived increased time demand on doctors was noted as a potential barrier, followed by discussion of how EBHC may facilitate time-efficient practicing by utilizing more effective diagnostic and therapeutic procedures. The use of real clinical cases was emphasized in the workshops. Other useful publications were utilized in the development of these instructional strategies.[5,17-19]

Description of Second EBHC Workshop – Critical Appraisal of Research Articles

This workshop focused on in-depth critical appraisal of research articles, demonstrating practical application of evidence related to its reliability and validity and discussion of what constitutes evidence (Table 2). Resources were provided to students for developing literature searching and critical appraisal skills. The Center for Evidence-Based Medicine maintains an internet site with teaching resources, including the EBM Toolbox and worksheets for critical appraisal in Microsoft Word format at http://cebm.jr2.ox.uk/docs/teaching.html. Haynes et al[20] discussed optimal search strategies for detecting clinically sound studies in MEDLINE and concluded that successful retrieval was greatly enhanced by carefully selecting combinations of indexing terms and key text words. Green and Ellis[7] noted that the most sensitive and specific literature search strategies may be found in a series of *ACP Journal Club* editorials.[21,22] Critical appraisal methods for prototypical clinical questions may be found in the EBM Working Group's series of articles, "User's Guides to the Medical Literature."[22-31]

Results

Out of the 31 chiropractic interns who participated in this study, 25 subjects completed the pretest-posttest surveys (81%). The survey data (Likert scale, range 1-5) were analyzed using the SAS software program sign tests and paired *t* tests. The results (Tables 3, 4, and 5) indicate an average increase in all posttest survey items, with 3 of 4 survey items (2, 3, and 4) showing a statistically significant difference ($\alpha = 0.05$) (Table 5).

Survey Items*

1. Computer on-line searching
2. Constructing an answerable clinical question
3. Appraisal and application of research studies to clinic patients
4. Rate the importance of EBHC in patient decision making

*See Appendix A online at *www.mosby.com/jmpt*.

Discussion

Adult learning theory applied in the clinical setting requires interns to take responsibility for their learning, exploit their experience as a resource, and take advantage of real life situations.[7] The practice of evidence-based health care utilizes adult learning theory and principles by requiring clinical problem solving and self-directed learning. A teaching strategy for chiropractic interns on applying EBHC to musculoskeletal patients was presented here. Results of this 1-group pretest-posttest study suggest a positive impact on the self-reported EBHC attitudes and skills of chiropractic interns. This was consistent with preliminary data collected by the authors on 94 subjects from 3 separate graduating classes (3 student cohorts) who were given identical pretest surveys, EBHC workshops and assignments, and posttest surveys over an 18-month period. In this preliminary study, group-averaged data from pretest and posttest surveys were compared utilizing nonpaired *t* tests. Results showed an increase in group-averaged response score on all 4 survey items, though only item 2 showed a statistically significant difference. Post hoc statistical power analysis determined that use of paired *t* test and sign tests for noncontinuous data were required in a follow-up study to help determine if improvement in group-averaged posttest responses were statistically significant and not due to chance.

A subsequent study utilizing sign tests and paired *t* tests, with a smaller sample size from 1 student cohort (1 graduating class), demonstrated a statistically significant increase in group-averaged responses to 3 out of 4 survey items.

Survey item 1 measured chiropractic interns' self-assessed skills in computer on-line searching. It showed nonstatistically significant improvement from a mean pretest score of 3.52 (Likert scale, 1-5) to a mean posttest score of 3.72. This was consistent with the Green and Ellis[7] study of internal medicine residents, which reported no significant change in a similar survey item, although their results might be explained by ceiling effect. The lack of statistically significant change in this item in our study may be due to interns' earlier training received in computer-based literature searching and retrieval. A greater posttest effect may have been measured if pretest measurements were taken earlier in interns' curriculum. Also, we assumed that interns only needed a review in this area and therefore did not emphasize it in EBHC workshops we provided.

Haynes et al[32] reported that searching from clinical settings affected clinical decisions and was feasible with brief training. They also noted that inexperienced searchers miss many relevant citations and search inefficiently. This may also partly explain subjects' response to survey item 1 in our study.

Survey item 2 asked interns to rate their competence in clinical question development. There was a statistically significant improvement from a mean pretest score of 3.16 to a mean posttest score of 3.68, perhaps because workshops and assignments emphasized question development using interns' actual patient cases. These results contrast those of Green and Ellis,[7] who reported that neither the intervention nor control groups significantly improved their abilities to pose a focused question. Again, this may be explained by ceiling effect, since both control and intervention groups scored high on the pretest in this competency in their study.

Survey item 3 required interns to rate their competency in appraisal and application of research studies to clinical patients. There was a statistically significant improvement from a mean pretest score of 3.32 to a mean posttest score of 3.72. Again, the application to real patients was emphasized in both EBHC workshops and assignment. Also, the assignment form that interns were required to complete provided a checklist of quality filters (evidence criteria) for appraising research articles. Green and Ellis[7] and other studies of less methodological rigor[33,34] have reported a significant change in critical appraisal skills following various teaching interventions. However, in the only randomized controlled trial conducted, which must be viewed as the strongest evidence, Linzer et al[35] did not report significant change in critical appraisal skills, but their study only used journal clubs without application of adult learning principles as described earlier. Seelig[34] reported significant change in this competency when journal clubs combined with adult learning theory were used in the teaching strategy.

Survey item 4 asked interns to rate the importance of EBHC in patient decision making. There was a statistically significant change from a mean pretest score of 2.72 to a mean posttest score of 4.08, a greater magnitude of increase than the other 3 survey items. Results regarding attitudes toward the process of EBHC were variable in the studies reviewed above, though some of these focused only on specific aspects such as literature searching, critical appraisal skills, and clinical knowledge.

Haynes et al[32] reported that most respondents acknowledged the value of on-line searching following training in its use. Pyne et al[36] reported that clinicians surveyed

Table 6. *Courses emphasizing EBHC at LACC/SCUHS*

Human biochemistry
Advanced clinical topics
Chiropractic procedures I and II
Specialized chiropractic procedures
Introduction to physical examination skills
Differential diagnosis I and II
Neuroscience
Human physiology
Philosphy and reasoning in chiropractic
Ethics in chiropractic
Scientific basis for chiropractic
Research methodology

EBHC, Evidence-based health care; *LACC/SCUHS*, Los Angeles College of Chiropractic, Southern California University of Health Sciences.

recognized the need to keep up-to-date with changes in their specialty and therefore frequently reviewed new research. The study by Tsafir[4] using survey questionnaires found significant correlation between respondents' preference for original research articles and their preferences for updating current professional knowledge, performing research, and writing for publication. The study by Rose and Adams[16] showed that EBHC is not being taught in the majority of chiropractic colleges, though studies by Green[14] and Green and Johnson[15] and our study indicate a positive response from chiropractic students following teaching interventions on critical appraisal, critical thinking, and professional communication.

Overview and Implications for Students Curriculum

Our project, though not a randomized controlled trial, demonstrated an effective strategy for teaching EBHC in both the preliminary (n=94) and subsequent (n=31) studies. This 1-group study with blinded survey administration demonstrated a positive pretest-posttest difference in all 4 survey items, with 3 out of 4 demonstrating a statistically significant increase in group-averaged responses. Survey item 1 showed a positive but not statistically significant increase in chiropractic interns' self-assessed skills in computer-based literature searching and retrieval. Based on this, we suggest that more instruction time be devoted to this area, especially to use of Boolean operators, appropriate search terms including medical subject headings (MeSH), and terms derived from well-constructed clinical questions. Various health sciences literature databases and search tools (eg, PubMed's Clinical Queries) should be explored and routinely used by students throughout the curriculum. Ongoing use of EBHC skills by participation in regular journal clubs emphasizing application to actual cases should develop students' skills, along with teaching interventions such as those described herein. Brynin and Farrar[37] described a detailed protocol for conducting journal clubs in a chiropractic educational setting.

Students have varied backgrounds before entering chiropractic college, which affect their self-assessed EBHC knowledge, skills, and attitudes. Many chiropractic colleges already incorporate dedicated strategies for improving students' professional and academic subject competencies, but relatively few colleges expressly teach evidence-based approaches that focus on individuals as self-directed learners throughout the entire curriculum. At SCUHS/LACC, students continue to participate in lectures and laboratories, but they spend substantial time in problem-based small-group tutorials where they learn using clinical case studies (see Table 6 for list of SCUHS/LACC courses emphasizing EBHC). With the current study, we sought to develop basic strategies for teaching EBHC during the clinical internship, to better prepare competent chiropractic practitioners and lifelong learners who inform themselves with the best available evidence to deliver quality health care. This assignment and other similar assignments may be useful in courses at other institutions.

Ideal Study Design

The weaknesses of this 1-group pretest-posttest study design include internal validity threats of history, maturation, and testing.[38]

History. Since the posttest observations are made after the pretest, the difference between them may be the result of historical events intervening during the period.

Maturation. During the course of the study, the individuals mature during their experience in a clinical setting and may change in ways that affect the outcome of the study.

Testing. If the pretest measurement of EBHC competency made individuals believe that they should be more competent, the pretesting alone could have produced higher scores on the posttest. Other limitations of this study include outcome measures that only include self-assessed skills and attitudes. Future studies may provide actual skills testing along with self-assessment. In addition, the dropout rate should ideally be lower. Sackett et al[6] describe 80% retention as the lowest acceptable for publication. This study retained only 81% of its study population, in part due to the increased number of weekly off-campus rotations in which interns participate, making them unavailable to complete both surveys. Finally, although the emphasis of this study was placed on the EBHC assignment, the EBHC workshops may also be considered as interventions or predictor variables. It is recommended that follow-up studies utilize a larger study population with control groups to account for the effects of this and other variables mentioned above.

In summary, future studies should require more rigorous trials, including outcomes utilizing EBHC skills testing, a larger sample size, use of a control group, follow-up, and multiple clinic involvement. A recent study by Taylor et al[39] was published after our data collection and analysis. They developed a questionnaire and measured its validity in evaluating the effectiveness of EBHC teaching. In comparing scores of "novices" with "experts" in both knowledge and attitude, they concluded that the questionnaire was a satisfactory tool. Future studies may also include specific skills testing in critical appraisal exercises and literature search outcomes and ultimately include valid clinical outcome measures to indicate an improvement or lack of improvement in patient care as a result of practicing EBHC.

Conclusion

There are few studies found in the literature that focus on chiropractic interns' EBHC knowledge, skills, and/or

attitudes. The results of this study suggest that having interns apply EBHC to actual musculoskeletal patients and participating in EBHC workshops has a positive impact on chiropractic interns' perceived ability to practice EBHC. Adult learning strategies in the clinical environment stress the importance of self-directed problem-based learning and the application of knowledge and skills to solve clinical problems. Developing an answerable clinical question about a patient is the starting point of the practice of EBHC. Previously published studies and our limited study indicate the ability of interns to competently practice EBHC is influenced by their skills at structuring clinical questions, searching health sciences literature, critically appraising literature for validity and clinical usefulness, and applying the results to actual patients. The evolution of an evidence-based chiropractic curriculum is, in part, contingent on developing measures of its effectiveness and utility. Teaching practical EBHC skills to chiropractic interns may better prepare them to be lifelong learners and competent practitioners in delivering quality chiropractic health care to patients with musculoskeletal conditions.

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