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ORIGINAL ARTICLE

An investigation into chiropractic intern adherence to radiographic guidelines in clinical decisions with a descriptive comparison to clinical practitioners

David N. Taylor, DC, and Cheryl Hawk, DC, LMT, PhD

ABSTRACT

Objective: The purpose of this study was to assess chiropractic interns' knowledge and adherence to radiographic clinical practice guidelines (CPGs) and compare their clinical decisions to previous surveys of established practitioners in Canada and Australia.

Methods: A clinical decision-making survey was administered to 88 interns. The survey contained clinical scenarios and vignettes with inquiries regarding indications for radiographic referral, the likelihood of referral, and the application of CPGs.

Results: Forty-four percent (43.75%) of the interns were aware of CPGs, 38.75% were unsure, and 17.5% were not aware. When asked specific questions about the appropriateness of diagnostic imaging, the interns' responses were similar to those of practitioners in Canada and Australia. When interns evaluated a clinical vignette, there was lower compliance with CPGs.

Conclusion: The interns' clinical decisions regarding the use of diagnostic radiography did not significantly differ from those of practitioners who were surveyed in other related studies. Interns were inconsistent in applying their decision making in clinical cases. Notwithstanding the similarities with practitioners, some deviation from the guidelines indicates the need for further intern education to improve the implementation of CPGs for optimal cost-effective and clinically appropriate care.

Key Indexing Terms: Practice Guideline; Diagnostic Imaging; Low-Back Pain; Clinical Decision Making; X-Rays; Internship.

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INTRODUCTION

The prevalence of low-back pain (LBP) in numerous countries, including the United States, has been reported to range from 15% to 20% of adults in a single year, with an estimated 50% to 80% of adults experiencing LBP at some point in their life. More than 50% of US adults have received chiropractic care at some time in their life, and 30% of patients with spinal pain in the United States have sought out chiropractic care.[1,2]

Costs per episode of acute LBP are not the same among types of practitioners. Findings from a 2009 study were as follows: $369 for standard medical care only, $560 for chiropractic care only, $579 for chiropractic care with physical modalities, and $760 for medical care with physical therapy.[3,4] In 2006, the total costs associated with LBP in the United States were more than $100 billion per year, inclusive of health care, lost wages, and decreased productivity.[5] Another study reported that as much as $238 billion is spent every year in the United States for direct and indirect health care costs.[6] In 2013, neck and back pain accounted for the 3rd largest portion of total national health spending, after diabetes and ischemic heart disease.[7] The continued rise in the use of technology for assessments is expected to increase the cost of services. This is especially noteworthy since US health care spending has continued to increase for many years and accounted for 17% of the US economy in 2016[7] and 17.7% in 2020.[8]

Inappropriate diagnostic imaging contributes to the increasing costs of spinal health care and may expose patients to unnecessary radiation, depending on the diagnostic imaging procedure performed.[9,10] It has been reported that diagnostic imaging (on initial evaluation) does not usually provide a benefit to patients with LBP, and most clinical practice guidelines (CPGs) do not

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recommend it unless there are red flags.[6,11] A meta-analysis revealed that there was no difference in short- or long-term outcome measures reported between patients who received immediate lumbar imaging and usual care and patients who did not receive immediate imaging for LBP.[12] Low-quality evidence indicates that performing radiography or magnetic resonance imaging is associated with an increase in overall health care utilization and costs. It has been suggested that adherence to CPGs could help reduce health care utilization and costs.[6] Despite the lack of documented benefit, imaging is performed in 21.7% to 28.8% of the patients with acute LBP in the United States in the 1st 4 to 6 weeks of care, with radiography performed on 12% to 32% of the total patients with acute LBP.[13]

The Centers for Medicare & Medicaid Services (CMS) of the US government noted that utilization management has been an integral part of all public and private health insurance plans since 1991.[14] CMS reported that utilization management had a limited impact on controlling health care costs and expected the process would be improved with the development of CPGs.[15] CMS expenditure projections for 2018 to 2027 indicate a likelihood that prices for services will grow even faster during this period.[16] Initial utilization management was often performed by claims reviewers based more on cost than a substantiation of medical necessity. The conflict between utilization management and the clinician necessitated the research, creation, evaluation, and implementation of chiropractic CPGs. This resulted in professional associations and specialty organizations sponsoring a CPG-generation process. After a systematic review and Delphi panel recommendations, recent CPGs have recommended ordering or referring radiographic examination based on CPG criteria.[14,17] Chiropractic clinical decision making was investigated by De Carvalho et al[18] and Jenkins.[19] Their studies looked at the use of radiographic CPGs in the clinical decision-making process of established chiropractic practitioners. Clinical vignettes revealed that 75% of the practitioners followed CPGs.[18]

Current relevant US CPGs for LBP diagnosis and treatment, including imaging, have been codified by the Clinical Compass Evidence Center.[20] A recently published rapid literature review found that no relevant studies assessed the clinical utility of routine or repeat spinal radiographs to assess function or structure in the absence of red flags. There was no evidence that routine or repeat radiographs improved clinical outcomes or benefited patients.[21] Current CPG recommendations for lumbar radiographs with LBP patients were also codified by the American College of Radiology Appropriateness Criteria. The use of lumbar radiographs for uncomplicated LBP (variant 1 or 2) was categorized as usually not appropriate in the absence of red flags.[11]

Chiropractic students are trained in evidence-based practice. In 2018, the World Federation of Chiropractic and Association of Chiropractic Colleges issued a set of consensus statements from attendees at the 2018 Education Conference. One of these statements was that chiropractic education programs should support an evidence-based teaching and learning environment.[22,23] Texas Chiropractic College's (TCC's) mission is to promote education in quality evidence-based practice.[24] The Grand Rounds at TCC has 1 hour of intern radiology guideline education to cover the TCC clinic radiology guidelines. These clinic guidelines comply with fulfilling the CCE Meta-Competency No. 6 – Information and Technology Literacy.[25] These guidelines are reinforced throughout the intern's education.

This study aimed to assess the level of knowledge of radiographic CPGs by chiropractic interns and their potential use in clinical practice. A secondary objective was to compare interns' CPG knowledge and adherence to published estimates of utilization by established practitioners in other countries.

METHODS

Survey Design

The survey was modeled after those previously used in Australia[19,26] and Canada[18] to investigate CPG use by established practitioners, with adaptations made for applicability to interns. Walker et al[26] stated that the survey was "tested in a cluster randomized controlled trial of 880 chiropractors." However, De Carvalho et al[18] and Jenkins[19] used the survey without conducting any tests to assess the validity of the survey prior to implementation. Since the survey was already tested and only insignificant changes were made to reflect the earlier stage of the careers of interns, no validity or pilot testing was performed.

The survey included a demographic section, a section on knowledge, a section on implementation during an internship, and an opinion on the future use of radiologic imaging. Additional questions addressed their awareness and belief system regarding CPGs. Clinical vignettes were used to assess the likelihood of intern adherence and utilization of radiology CPGs for LBP. The vignettes were modeled after those used in past studies.[18,19,26] Some questions were added or adapted to be applicable to interns (rather than practitioners). Otherwise, the vignettes were the same as those published previously. The study was determined to be exempt under 45CFR 46.101 (b) by the Texas Chiropractic College institutional review board.

Study Design

This was a cross-sectional descriptive survey. It was provided to all 7th- through 10th-trimester interns in a 10-trimester chiropractic degree program at Texas Chiropractic College (Appendix A). It was administered in 2 iterations. The 1st iteration was conducted in April 2021 and the 2nd in August 2021. Students were advised not to complete it a 2nd time to ensure that responses were unique. The administration of the survey was performed online via SurveyMonkey (Momentive Inc, San Mateo, CA, USA) at a clinical rounds meeting. Participation was voluntary and anonymous. The 1st survey question asked for permission to use the responses for research purposes. A descriptive statistical analysis was performed by downloading the survey results to SPSS Statistics software (IBM Inc, Armonk, NY, USA).

Table 1 - Awareness of Guidelines

Guideline	*n* (%)
Classroom	46 (58)
CCGPP[20]	24 (30)
ACR[11]	12 (15)
NICE[29]	7 (9)
Bussieres[27]	7 (9)
ACP-2009[12]	3 (4)
ACP2-2011[11,30]	4 (5)
Other[a]	4 (5)
Do not use any guidelines	6 (6)

Total respondents = 80. Many participants were aware of more than 1 guideline. ACP, American College of Physicians (2009); ACP2, American College of Physicians (2011); ACR, American College of Radiology; Bussieres, 2008 Guideline publication[30]; CCGPP, Council of Chiropractic Guidelines and Practice Parameters; NICE, National Institute of Health and Care Excellence.
[a] Official Disability Guidelines & other various guidelines.

Analysis

Descriptive statistics were used to calculate the percentage of correct responses to each question and vignette, in concordance with the common published CPGs.[18,19,26–28] The data were compared with practitioner information from previous studies.[18,19,26]

Open comments were grouped and categorized by content with common themes and accounted for in an Excel datasheet (Microsoft Corp, Redmond, WA, USA) as a percentage of the total surveyed. The results of the clinical vignettes provided more quantitative data on the percentage of appropriate radiology orders for a clinical case. The results were compared with previously published studies that focused on established practitioners' adherence to CPGs. This was tabulated and similarly analyzed.

RESULTS

Demographics

Eighty of 88 students responded (91% response rate). Twenty-five percent ($n = 20$) were in the 7th trimester 55% ($n = 44$) in the 8th, 11% ($n = 9$) in the 9th, and 9% ($n = 7$) were in the 10th trimester. Their clinical experience was likewise variable, with 16% of interns having had >200 patient encounters, 25% with 101 to 200 encounters, 28% with 51 to 100 encounters, 26% with 11 to 50 encounters, and 5% with 6 to 10 patient encounters. All interns had received instruction about CPGs in earlier trimesters.

Awareness of Guidelines

There were 9 response options for awareness, including the classroom guideline, "other," "do not use," and 6 specific CPGs.[11,12,20,27,29,30] Although all interns attended the same doctoral program, their awareness of CPGs differed (Table 1). Notably, 17.5% stated that they were not aware of guidelines. Sixty-seven percent of the 9th-trimester interns reported that they were aware of the guidelines, but that was out of a total of 6 interns. The largest participation was among the 8th-trimester interns, among whom 37% ($n = 46$) reported awareness of guidelines. Most of the students stated that they rely on what is taught in the classroom (58%). Thirty percent of the students were aware of the Council of Chiropractic Guidelines and Practice Parameters guidelines.[31] Only 15% were aware of the American College of Radiology guidelines.[32] There was minimal awareness of other guidelines.

Comments included familiarity with some guidelines and knowledge of where to find them for reference. There was also mention of the familiarity with the "Official Disability Guidelines," which were not included in the survey. The limited experience of the interns was indicated by the degree of opportunity for these interns to make a clinical decision on imaging. This was evenly split, with 53% stating that they have not yet had the opportunity to make a clinical decision about ordering imaging.

Table 2 - Types of Images Ordered for Each Vignette

Case No.	None, *n* (%)	Lumbosacral Radiography, *n* (%)	Full-Spine Radiography, *n* (%)	Total, *n* (%)
1	46 (82)	9 (16)	1 (2)	56 (100)
2	36 (60)	16 (27)	8 (13)	60 (100)
3	16 (28)	35 (61)	6 (11)	57 (100)
4	1 (2)	33 (53)	28 (45)	62 (100)

Adherence to Guidelines Based on Clinical Case Vignettes

Four LBP clinical case vignettes were provided to the interns to allow them to make a clinical decision about the need to order lumbosacral radiographs, full-spine radiographs, or imaging not being medically necessary. The 1st 3 cases did not indicate any medical necessity for imaging, but it would have been appropriate in the 4th case vignette (a 67-year-old woman with risk of osteoporosis and fracture).

Clinical Case Vignette 1

This case was an acute LBP without radiculopathy in a 48-year-old office worker with a nontraumatic soft-tissue injury in which the patient requested "X-rays." Despite the patient's request, 82% of respondents correctly did not order imaging on this patient (Table 2). There were 106 different comments. Reasons to not order imaging included the following: no trauma ($n = 19$), no red flags ($n = 5$), no neurologic signs or symptoms ($n = 23$), perform an initial period of trial therapy before ordering imaging ($n = 24$), no indications of pathology ($n = 10$), guidelines do not indicate the need ($n = 4$), and case diagnosis of a soft-tissue lesion ($n = 21$). There were 4 reasons to order radiographs: differential diagnosis, ruling out disc herniation, responding to a patient request for fear of losing the patient, and ruling out a possible pathology.

Clinical Case Vignette 2

This was a case of chronic LBP in a 57-year-old office worker without radiculopathy. The patient had comorbidities and a family history of diabetes but no history of trauma, and the pain was dull, mild, and of 8 weeks'

Table 3 - Reason to Refer for Lumbar Radiographs

Reason	Always, *n* (%)	Very Often, *n* (%)	Occasionally, *n* (%)	Never, *n* (%)	On New Patients, *n* (%)	Missing Responses, *n* (%)	Total, *n* (%)
1. How often do you refer for an X-ray of the lumbar spine	0 (0)	6 (7.5)	52 (65.0)[a]	11 (13.8)	4 (5.0)	7 (8.8)	80 (100)
2. Clinical suspicion of traumatic injury	25 (31.3)[b]	38 (47.5)[c]	16 (20.0)	0 (0)	0 (0)	1 (1.3)	80 (100)
3. Suspicion of red flags	62 (77.5)[a]	14 (17.5)	1 (1.3)	1 (1.3)	2 (2.5)	0	80 (100)
4. Clinical suspicion of arthritis	33 (41.3)[a]	28 (35)	17 (21.3)	0 (0)	2 (2.5)	0	80 (100)
5. Clinical suspicion of biomechanical pathology	18 (22.5)	19 (23.8)	39 (48.8)[a]	1 (1.3)	3 (3.8)	0	80 (100)
6. To perform biomechanical analysis	3 (3.8)	4 (5.1)	34 (43.0)	35 (44.3)[b]	3 (3.8)	0	79 (100)
7. Screen for subclinical contraindications	6 (7.6)	8 (10.1)	46 (58.2)[c]	15 (19.0)[b]	4 (5.1)	0	79 (100)
8. As a component full-spine series, even without low-back pain	1 (1.3)	2 (2.5)	21 (26.3)	51 (63.7)[a]	4 (5.0)	1 (1.3)	80 (100)
9. For patient reassurance	3 (3.8)	6 (7.5)	36 (45.0)[c]	32 (40.0)[b]	2 (2.5)	1 (1.3)	80 (100)

[a] Correct as per clinical practice guidelines and chosen by the majority.
[b] Correct as per clinical practice guidelines.
[c] Majority of respondents.

duration. The patient had anxiety about severe underlying pathology and requested "X-rays." Despite the anxiety and requests for "X-rays," only 36% of respondents found imaging medically unnecessary, leaving 64% ordering clinically unnecessary radiographs. The reasons for ordering were similar to those in vignette 1. Most gave the reason that the patient requested it ($n = 20$), and others gave age as a reason ($n = 11$). Still, others provided the reasons for prolonged duration of symptoms, overweight, and family history of diabetes. Reasons for not ordering the radiographs consisted of no trauma ($n = 26$), no red flags ($n = 3$), no neurologic signs or symptoms ($n = 11$), performing a treatment trial first ($n = 11$), no indications of pathology ($n = 7$), and a diagnosis of soft-tissue lesion ($n = 3$). One respondent noted that radiographs would not change the outcome of the care, which correlates with the guidance of CPGs.

Clinical Case Vignette 3

This was a subacute moderate LBP of 6 weeks' duration in a 36-year-old real estate agent without radiculopathy following a heavy-lifting activity. The patient was under an existing nonacute care program (more akin to maintenance care) over the previous 4 weeks. The patient never received acute relief care and requested a referral for further workup. Seventy-two percent of respondents would improperly order imaging. The major reason given for ordering the imaging was that there was no improvement over 6 weeks ($n = 50$) and patient request ($n = 6$).

Clinical Case Vignette 4

This case consisted of acute LBP in a 67-year-old woman with a risk of osteoporosis and fracture, which was traumatic in onset. The patient was a senior citizen, and the pain was constant and of immediate onset after a fall. Interns would have complied with CPGs and ordered radiographs on this patient in 98% of respondents. Reasons (total = 166) given for the medical necessity of radiographs included trauma ($n = 57$), suspicion of fracture ($n = 43$), suspected osteopenia/osteoporosis ($n = 9$), and age ($n = 55$), and 2 respondents mentioned CPG. Interestingly, when imaging was recommended, the types of imaging ordered included 43 full-spine radiographs, contrary to all CPGs.

Utilization of Lumbar Spine Imaging

To investigate referral patterns, the intern survey questioned their likelihood of referring for low-back radiographs in different clinical presentations (Table 3). Respondents referred for lumbar spine radiographs occasionally (65%) and rarely referred on new patients, unless there was clinical suspicion of a traumatic injury (79% referral rate) or red flags (95%). The interns would refer when there was suspicion of arthritis. Fewer than half of interns would use radiographs to regularly assess for biomechanical pathology. Most interns would refer for radiographs to screen for subclinical contraindications. There is lack of agreement of the ordering of radiographs for patient reassurance (Table 3).

The final section of the survey was a 5-point Likert scale to investigate how strongly the interns disagreed or agreed with indications in clinical situations that are common in practice (Table 4). Many interns (72.5%) did not agree with the necessity of routine radiographs before administration of spinal manipulative therapy, but a minority (21.3%) were unsure. Most interns (72.5%) did not agree that radiographs were indicated for biomechanical analysis. Fifty-five percent did not agree that there was a role for the use of lumbar spine radiographs as part of the evaluation of acute LBP in the absence of red flags, although 46.3% did feel there was a role for radiographs in chronic LBP even without any red flags. Following 4 weeks of nonresponsive conservative treatment of LBP, 75% agreed that they would order radiographs. Respondents

Table 4 - Agreement With Radiographic Indication Statements (*n*/%)

Statement	Agree, *n* (%)	Neither, *n* (%)	Disagree, *n* (%)	No Response, *n* (%)	Total, *n* (%)
1. Lumbar spine X-rays are indicated when a patient is nonresponsive to 4 weeks of conservative treatment for low-back pain.	60 (75)[a]	14 (17.5)	6 (7.5)	0	80 (100)
2. Routine X-rays of the lumbar spine are recommended prior to initiating spinal manipulative therapy (adjustments).	5 (6.3)	17 (21.3)	58 (72.5)[a]	0	80 (100)
3. Lumbar spine X-rays are indicated to perform radiographic biomechanical analysis to assess spinal misalignments (subluxations) and obtain spinal listings or other biomechanical information to direct treatment.	6 (7.5)	16 (20)	58 (72.5)[a]	0	80 (100)
4. There is a role for the use of lumbar spine X-rays in the evaluation of patients with acute low-back pain (less than 1-month duration), even in the absence of red flags for serious disease.	15 (18.8)	20 (25)	44 (55)[a]	1 (1.3)	80 (100)
5. There is a role for the use of lumbar spine X-rays in the evaluation of patients with chronic low-back pain (greater than 3 months' duration), even in the absence of red flags for serious disease.	37 (46.3)[a]	27 (33.8)	16 (20)	0	80 (100)
6. There is a role for full spinal X-rays in chiropractic practice (other than for patients with scoliosis).	29 (36.3)[b]	26 (32.5)	25 (31.3)[c]	0	80 (100)
7. There is overutilization of plain film X-rays in chiropractic practice in our community.	7 (8.8)	25 (31.3)	48 (60)[a]	0	80 (100)
8. There is a role for X-rays of the lumbar spine when there are neurologic signs associated with low-back pain.	59 (73.8)[a]	12 (15)	8 (10)	0	80 (100)
9. X-rays of the lumbar spine are useful in the diagnostic workup of patients with sciatica.	21 (26.3)	23 (28.7)	36 (45)[a]	0	80 (100)
10. X-rays of the lumbar spine are useful in the diagnostic workup of patients with suspected pathology.	64 (80)[a]	15 (18.8)	1 (1.3)	0	80 (100)
11. X-rays of the lumbar spine are useful to confirm the diagnosis and to direct appropriate treatment of low-back pain.	31 (38.8)	32 (40)[b]	17 (21.3)[c]	0	80 (100)
12. There is a role for the use of X-rays as a screening tool to find contraindications to manipulation in patients with low-back pain.	32 (40)[b]	30 (37.5)	18 (22.5)[c]	0	80 (100)
13. I am likely to refer low-back pain patients for X-rays of the lumbar spine because patients often expect me to do so.	4 (5)	17 (21.3)	59 (73.8)[a]	0	80 (100)

[a] Correct as per clinical practice guidelines and chosen by the majority.
[b] Majority of respondents.
[c] Correct as per clinical practice guidelines.

were evenly split in their opinion regarding a role for full-spine radiographs. This is despite the fact that the full-spine radiographs are not taught in the Texas Chiropractic College's curriculum. Most interns did not judge that there was overutilization of radiographs in the chiropractic intern program. There was a more definitive agreement with guidelines regarding the role of radiographs of the lumbar spine when neurologic signs were presented with the LBP, as 73.8% of all interns would order radiographs when the patient showed neurologic signs, but only 26.3% surmised that they were necessary for sciatica and 45% would not order radiographs for sciatica patients. When there was a suspected pathology, 80% would order lumbar spinal radiographs. Utilization of radiographs for a screening tool to confirm a diagnosis to direct treatment or for contraindication to spinal manipulative therapy did not have general agreement. When patients expected the doctor to perform radiographic imaging, 73.8% would still

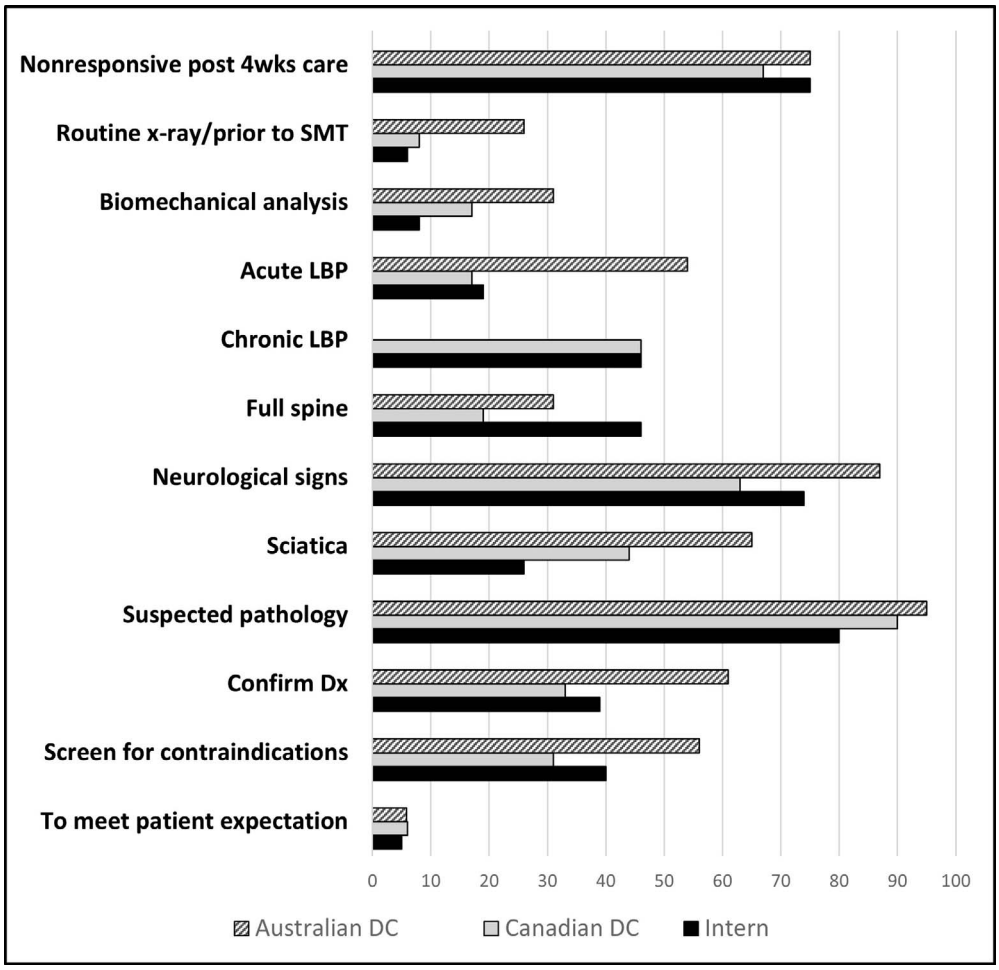

Figure 1 - Radiographic medical necessity: responses of interns compared with previously published responses of practitioners.

decline and not order them based on those patient expectations alone.

Intern responses to imaging necessity were compared with the data from practitioners in other studies (Fig. 1). The results indicated a strong comparison to the clinical decisions of Australian and Canadian chiropractic practitioners.

DISCUSSION

This study was intended to assess the radiographic clinical decision making of interns and to compare their decisions to field practitioners (as reported in the literature) and to the reported CPGs. The 1st 3 clinical vignettes presented cases in which imaging was medically unnecessary. In case 1, only 15.5% of interns complied with the CPG, while De Carvalho et al[18] found 88% compliance in practitioners and Walker et al[26] found 37% compliance (Table 5). This would suggest that the interns' lack of experience and confidence may result in patients convincing the intern to order unnecessary imaging. This is supported by the 2nd case, in which the anxious patient convinces 64% of the interns to unnecessarily order a radiograph, with only 36% complying with CPGs. Interestingly, the practitioners in Canada were more compliant (75%) with CPGs, whereas the Australian practitioners had even lower compliance than the interns did (16%). In the 3rd case, the interns complied with CPGs (70%) more than the practitioners did in the other 2 studies (38% and 39%). It is possible that the patient's direct request was more evident to the interns than in the other cases. In the 4th case, which involved trauma to an older patient with comorbidities, medical necessity may have been more evident to the experienced practitioners (71% and 95% compliance) than to the interns (48% compliance).

The overall average intern case compliance to CPG was 42.3% as compared with 68% of the Canadian practitioners[18] and 46.8% of the Australian practitioners[26] or an average of 57.4% compliance of practitioners. The interns' radiology ordering criteria in specific situations revealed many similarities between the interns and practitioners (Fig. 1). They agreed with the CPG more often than not and were very similar to the agreement rate of Canadian doctors of chiropractic. The interns' reasoning for imaging to refer in the 4 vignettes was similar to the CPGs for 7 out of the 9 reasons presented. However, the interns would benefit from further education regarding subclinical

Table 5 - Intern vs Practitioner Case Compliance With Clinical Practice Guidelines (CPGs)

Case No.	Intern CPG Compliance, %	Canadian DC CPG Compliance, %[18]	Australian DC CPG Compliance, %[26]
Vignette 1 (imaging medically unnecessary)	15.5	88	37
Vignette 2 (imaging medically unnecessary)	36.3	75	16
Vignette 3 (imaging medically unnecessary)	70	38	39
Vignette 4 (Lumbosacral plain X-ray imaging medically necessary)	47.5	71	95
Mean compliance with CPG	42.32	68.00	46.75

Interns' mean vignette compliance with CPG = 42.32%. Practitioner combined mean vignette compliance with CPG = 57.38%.

contraindications and especially about communication with patients to provide indications and contraindications. The interns scored well on the radiographic indication statements. They followed the CPG in 10 of 13 clinical situations presented (Table 4). The interns' overall case compliance (with vignettes) was 42% as compared with 57% compliance by the practitioners, indicating a need for education for both groups.

Further education is needed regarding the utilization of full-spine radiographs and the use of radiographs as a screening tool for contraindications or to confirm a LBP diagnosis. The interns have gained most of their knowledge through the integration of the CPG recommendations into the classroom curriculum. Implementation of the CPG needs to be further reinforced by specifically addressing the different CPGs, similarities and differences, and applying to cases during the clinical internship to provide a carryover into practice and improve care.[33]

Limitations

This study is limited in its validity due to a small sample, and it is the first time the questionnaire was used on this sample base. The questionnaire replicated past questionnaires from other studies for ease of comparison. However, the questionnaire needs updating. Because of the sample of participants all being students of 1 college, a direct correlation to practitioners or extending conclusions to other chiropractic college students cannot be made beyond the comparison. Although no survey validity testing was performed in this study, it was performed in previous studies. Comparisons of interns were made in a secondary manner by comparing their responses to data from previous studies.

CONCLUSION

Although some differences were apparent, the overall level of intern knowledge and their adherence to radiographic CPG were comparable with that of practitioners in previous studies when presented with specific clinical reasons but differed when evaluating a full case presentation. Still, there is a need to increase interns' knowledge level to ensure clinically effective and cost-effective compliance with CPGs. Reinforcement is needed throughout the internship to improve the clinical decisions of current and future practitioners. The didactic educational content may need to focus more on the current CPG, integrate it into cases and testing, and reinforce it throughout the internship experience.

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About the Authors

David N. Taylor (corresponding author) is a professor in the Clinical Sciences Department at Texas Chiropractic College (5912 Spencer Hwy, Pasadena, TX 77505; dtaylor@txchiro.edu). Cheryl Hawk is a professor in the Research Department at Texas Chiropractic College (5912 Spencer Hwy, Pasadena, TX 77505; chawk@txchiro.edu).

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