

# The chiropractic college admission test: a proposal for its development and use

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*A cardinal characteristic of any profession is self-regulation. It is argued in the present paper that chiropractic has now reached a level of professional maturity that indicates the need for the final aspect of self-regulation: a standardized selection approach into professional schools or colleges. Quality control of membership can then begin at the entry point into the profession. An admission test – the Chiropractic College Admission Test (CCAT) – is proposed and outlined for use for the selection of candidates into chiropractic colleges. Such a test would be beneficial for students applying to the colleges, regulatory and licensing boards, to the profession as a whole, to the chiropractic colleges, to other professions, and to government as well as the general public. The proposed CCAT contains elements that are general to many health professions such as knowledge of the biological and physical sciences, verbal and linguistic reasoning and visual perceptual ability. The test, however, is proposed to have elements that are unique to chiropractic. Based on the performance of other admission tests (e.g. Dental Admission Test, Medical College Admission Test), it is argued that the CCAT could be constructed and used to have the highest technical properties of validity and reliability. Such a test would become an integral tool in maintaining quality assurance, beginning at the earliest point of the profession.*

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KEY WORDS: chiropractic, education, admission tests, test validity.

*L'auto-réglementation est une caractéristique importante de toute profession. On explique dans cet article que la chiropratique a maintenant atteint un tel niveau de maturité professionnelle qu'il est nécessaire de passer au stade ultime de l'auto-réglementation en créant un moyen de sélection standard à l'entrée des écoles et les collèges. Le contrôle de la qualité des membres pourrait donc commencer au point d'entrée dans la profession. On suggère un test d'admission – le test d'admission du chiropratique college (CCAT) – qui serait utilisé pour sélectionner les candidats à l'entrée des collèges de chiropratique. Un tel test serait bénéfique pour les étudiants qui présentent leur candidature dans les collèges, pour les offices de réglementation et d'évaluation, pour la profession toute entière, pour les collèges de chiropratique, pour les autres professions, pour le gouvernement et pour le grand public. Le CCAT proposé contient des éléments communs à plusieurs professions de la santé (connaissance des sciences biologique et physique, raisonnement verbal et linguistique et capacités de perception visuelle). Toutefois, le test propose d'intégrer des éléments uniques à la chiropratique. En se basant sur les performances d'autres tests d'admission (p. ex., le Test d'admission dentaire, le Test d'admission au collège médical), le CCAT pourrait être conçu et utilisé de façon à intégrer les plus hautes propriétés techniques de validité et de fiabilité. Un tel test pourrait devenir un outil intégral permettant de maintenir l'assurance de la qualité, en commençant au point d'entrée de la profession.*

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MOTS CLÉS : chiropratique, éducation, tests d'admission, validité du test.

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## Introduction

A cardinal characteristic of any profession is self-regulation. Professions exercise self-regulation by determining the scope of practice and the selection of their membership. The latter is usually accomplished by licensing members who successfully pass post-professional school examinations developed and administered by the profession. Physicians in Canada, for example, must pass the Medical Council of Canada (MCC) Subjects Examinations after completion of the MD degree, while lawyers must pass provincial Bar examinations after earning the LLB degree. Similarly, chiropractors in Canada must pass the Canadian Chiropractic Examining Board (CCEB) examinations and the provincial clinical competency examinations in order to be granted a license to practice. All major professions in Canada, the United States and Europe, as well as elsewhere have similar procedures. These type of examinations, frequently called "high stakes" examinations (Klass, 1994),<sup>1</sup> are at the entry point into the profession, after completion of an appropriate degree.

In addition to post-degree examinations, however, most professions also exercise self-regulation through membership selection at the *entry point into professional schools or colleges* so that quality assurance into a profession can begin at the entry point into the college or school. Physicians do this with the Medical College Admission Test (MCAT – initiated in 1946), lawyers with the Law School Admission Test (LSAT – initiated in 1948), dentists with the Dental Admission Test (DAT – initiated in 1946), and optometrists with the Optometry Admission Test (OAT – initiated in 1971). Chiropractic – now officially more than 100 years old – has achieved a level of professional maturity that indicates the need for a standardized admission examination. The major purpose of the present paper is to propose such an admission test for chiropractic and to indicate how such a test may be developed, implemented and utilized.

## Benefits of admission tests

There are several benefits in utilizing admission tests to professional schools and colleges. First, these colleges are faced with admission decisions involving applicants from many different universities. It is well known that the grade averages of these applicants from different institutions are not directly comparable since standards can vary substantially across various educational institutions (Association

of American Medical Colleges, 1993).<sup>2</sup> An admission test such as the MCAT, however, provides a standardized metric on which all applicants can be judged equally. Accordingly, admission decisions based on such a standard metric provides a rational basis for decision making for the colleges (in combination with other information such as grade averages). Otherwise, college admission can only be based on information which does not have standard meaning across different applicants.

Second, applicants to the colleges are all judged on a fair basis for admission. To use a popular expression, these standardized admission tests provide a level playing field for all applicants. Irrespective of country of origin, ethnic minority, linguistic group, religious affiliation, gender, or institution of origin, each candidate has a fair opportunity to demonstrate achievement on the admission test and therefore be eligible for a position at the college. Without such a standard metric, college admission can be subject to a number of discriminatory practices that has no bearing on the potential to succeed in the relevant profession (Association of American Medical Colleges, 1993; Jolly, 1992; Xu, 1993).<sup>2,3,4</sup> Standardized admission tests, therefore, provide an egalitarian bases for all potential candidates for admission.

Third, all colleges have limited positions for students and finite resources for their education. Because of the necessity in the health professions to have laboratories, clinics, low ratios of instructor-to-students, and costly physical facilities, professional education can be very expensive. Accordingly, it is very wasteful and inefficient to admit unsuitable candidates to the colleges. Tests such as the MCAT, for example, can reduce these admission errors (Association of American Medical Colleges, 1993).<sup>2</sup>

Fourth, potential students accrue benefits since those who may be unsuited are not admitted to endure struggles, anguish and years of expense only to fail in the program. Even if such candidates were to ultimately receive a degree, they may never be able to successfully pass the licensing examinations and therefore, never practice in their desired profession. Such an outcome is wasteful for both the college and the student. This also raises an issue of the ethics of institutions that admit students who may never complete the program or if they do, never pass the licensing examinations. It is, therefore, *a propos* for colleges to minimize such admission errors (called false

positives) for they are harmful both to the student, institution, and the profession as a whole.

Fifth, professions that have standardized admission tests accrue status, legitimacy and prestige. Such admission tests clearly communicate to the profession itself, to other professions, to universities, to governments, and to the public in general that entry into the profession is rigorous, carefully considered, fair, and in keeping with the highest standards of professional self-determination.

Sixth, regulatory and licensing boards within a profession have a standard metric on which to judge the pre-professional scholastic achievement of candidates. Accordingly, these boards can exercise further quality control on the profession by setting standards and universal pre-professional school criteria. In short, they can require a minimum standard of performance on the admission test in order for candidates to subsequently qualify for the licensing examinations.

### **Challenges and resources in developing an admission test**

Although there are a number of benefits to a standardized admission test, there are some challenges and issues emerge from such examinations. First, it is necessary to establish an organization to develop, administer, score, maintain the test, and distribute the results to colleges and candidates. Such an organization requires resources and regulation by the profession, and substantial input from testing and psychometric experts. Second, there is an initial cost associated with admission tests. Except for the initial cost of developing the tests and organization, however, the cost is subsequently borne by the candidates who write the tests, as a fee is levied to cover the total costs of the admission tests. This is common practice with the MCAT, LSAT, DAT, OAT and other admission tests. Accordingly, the initial costs of test development and implementation can be readily recovered over the first few years of full test implementation. Third, there are both pecuniary costs and time involvement for the students who write the admission tests. Notwithstanding these challenges, the benefits derived from standardized admissions tests, clearly indicate that they are good for all involved.

### **The need for a chiropractic college admission test (CCAT)**

The foregoing discussion suggests that it is highly benefi-

cial both for a profession and the public in general to have a standardized admission test for entry to the colleges who supply the graduates for the profession. Indeed, mature and highly prestigious professions all have such admission tests for entry to their professional schools and colleges. We have already seen several examples in law, medicine, dentistry, and optometry. This then, is the final step in achieving professional maturity together with complete self-regulation and self-determination. Chiropractic in Canada today is poised to take this final step – developing and implementing a college admissions test – for achieving professional maturity and self-determination. In the following discussion, an admission test for chiropractic is proposed and how such a test may be developed, implemented and utilized is outlined.

There are a number of stakeholders that need to be consulted in the development and implementation of the CCAT as its success will depend on a broad base of support from the profession as a whole.

### **Stakeholders in the CCAT**

A number of groups, individuals, organizations and institutions have an interest in the CCAT and its development. First, the chiropractic colleges in Canada, the U.S.A. and elsewhere in the world have a stake in the CCAT. The colleges will be the primary beneficiary of the CCAT as it can be used for improving admission decisions at no cost to the college. Second, the Council on Chiropractic Education (CCE) has a stake in this test as it can equate pre-professional school achievement (on the CCAT) from students from many different colleges. Third, the provincial licensing boards in Canada and their counterparts in the U.S., Europe and elsewhere hold an interest in the CCAT. They can use it to establish pre-professional school standards for candidates who will ultimately take the licensing examinations. Fourth, the Canadian Chiropractic Association (CCA), an umbrella organization, has a clear stake in the CCAT since it has the interest of chiropractic as its major mandate.

There are several other indirect stakeholders in the CCAT. These include the students who will write the CCAT, government bodies who legislate regulations for professions, patients of chiropractors and the public in general. There are general benefits to most of the stakeholders in the use of the CCAT as we saw above. These are summarized in Table 1.

**Table 1**  
**Potential Benefits of the CCAT**

<b>Stakeholder</b>	<b>Benefit</b>
<b>Student</b>	Students will be provided with information regarding the status of their preparedness before entering a chiropractic program. Areas in need of remediation will be identified before students encounter difficulties in their professional training.
<b>Colleges</b>	College admission committees will have a standardized measure to help them assess the successful completion prospects of each candidate. This information will help maximize their completion rate and help minimize the difficulties associated with students unable to complete the academic requirements of the program.
<b>Council on Chiropractic Education</b>	The use of a standardized measure should assist the council in dealing with the various program variations which currently exist across colleges of chiropractic internationally. The CCAT should help the council more easily assert the standards they have established.
<b>Provincial Boards</b>	These boards may find it desirable to establish pre-professional school standards for candidates who will ultimately take their licensing exams.
<b>Canadian Chiropractic Examining Board (CCEB)</b>	The CCEB with a long history in candidate examination may wish to lend their expertise to the development and implementation of the CCAT. Moreover, the CCEB exams could serve as one of the criteria to help establish the validity of the CCAT.
<b>The Profession</b>	Professional school admission tests serve to increase the integrity and status of the profession in the eyes of the public, potential student candidates and other professions. The CCAT will enhance the visibility, status and credibility of the profession and should contribute to increasing the number of very able students entering the field of chiropractic.

### The validity of admission tests

There are generally two types of validities that are of principal concern for admission tests: (1) content validity, and (2) predictive validity. Content validity focuses on the adequacy with which the test samples the relevant content domain of professional school education and subsequent domain and scope of practice. Predictive validity refers to the extent to which the admission test can adequately predict performance on relevant future criteria such as academic achievement in college, performance on licensing examinations, and performance in clinical practice. These validity concerns are discussed below.

### Content validity

The content validity of admission tests is established by analyzing the relevant content of the program of study in the professional school and the scope of professional practice. The admission test should reflect both the content domain and the cognitive processes that are central to that educational program and professional practice. The general content domains and some critical features of three major admission tests (MCAT, DAT, OAT) in the health professions are summarized in Table 2. It is evident from this summary that there are common content domains in these tests such as biological sciences, physical sciences and linguistic or verbal comprehension and reasoning. The quantitative reasoning subtest of the MCAT was deleted from the "new" version (post 1991), although the DAT continues to have such a subtest. The proposed CCAT, then, will measure some of the similar content domains of these major health profession admission tests, although none of these tests as they exist would be acceptable for chiropractic college admission since they have not been developed specifically to sample the relevant domain and processes of chiropractic practice.

Both the DAT and the OAT have emphases on quantitative reasoning which have little relevance to the professional school curriculum in medicine (Glaser et al., 1992)<sup>5</sup> or chiropractic (Council of Chiropractic Education, 1988).<sup>6</sup> The MCAT similarly is geared towards sampling content relevant to basic medical sciences (anatomy, behavioural sciences, biochemistry, microbiology, pharmacology, physiology), clinical knowledge (internal medicine, obstetrics/gynaecology, pediatrics, psychiatry, public health, surgery), and clinical competency and patient management skills in residency programs and subse-

quent specialities. Much of the content sampled by the MCAT, therefore, is not relevant to chiropractic education and practice which is clearly different in emphasis, content, attitudes, and skills from medicine. So while there are some similarities among all health professional admission tests, content validity concerns requires that a CCAT be developed which is specifically content valid for chiropractic education and subsequent practice.

### Predictive validity

Research on the predictive validity of admission tests has now been conducted for nearly five decades (summarized below). Accordingly, extensive data has accumulated, and there is a great deal of evidence bearing on the predictive validity of admission tests.

The MCAT is one of the most widely researched admission tests. Many hundreds of studies have been conducted on this instrument. The criteria that have generally been employed to validate the MCAT include medical college grade averages (e.g. grade point average – GPA), national board exam scores written after earning the MD degree, clinical competency exams, residency performance scores, and performance on specialty boards exams. The general conclusion from these many hundreds of studies conducted over nearly fifty years and employing a variety of criteria, is that the MCAT has good predictive validity with validity coefficients generally exceeding .50 (Anderson and Brown, 1987; Association of American Medical Colleges, 1993; Elam and Johnson, 1994; Glaser et al., 1992; Hall and Beth, 1992; Mennin et al., 1993; Montague and Frei, 1993).<sup>8,2,9,5,10,11,12</sup>

These validity coefficients are usually Pearson product-moment correlation coefficients<sup>a</sup> ( $r$ ) that indicate the degree of linear relationship between two variables (a value of  $r = 0$  means that there is no relationship while  $r = 1.0$  means that there is a perfect relationship). A predictive validity coefficient of .50 or greater in the context of admission tests is regarded as very good (Anastasi, 1988; Cronbach, 1990; *Standards for Educational and Psychological Testing*, 1995).<sup>13,14,15</sup>

There are two important factors that tend to attenuate or reduce the predictive validity coefficients for admission tests: (1) the restriction of range of the candidates on one or more of the variables, and (2) the reliability of the criterion measure.<sup>b</sup> It is an elementary statistical principle that the correlation between two variables is reduced when

**Table 2**  
**Health Related Professional School Admission Tests**

<b>Test</b>	<b>Content</b>	<b>Scores</b>	<b>Use</b>
<p><b>MCAT</b></p> <p>Seven hours in length using both multiple choice and written response formats and administered twice a year.</p>	<p><b>Scientific Reasoning:</b> (Physical sciences) Physics and Inorganic Chemistry (Biological Sciences) Biology and Organic Chemistry</p> <p><b>Verbal Reasoning:</b> Reading Comprehension passages concerning the natural sciences, social sciences and humanities</p> <p><b>Writing Sample:</b> Two writing exercises each presenting a short statement you are asked to elaborate on e.g. "A government cannot enforce a law if its citizens oppose it"</p>	<p>4 Scores one each for Verbal Reasoning, Biological Sciences, Physical Sciences and one of the two writing samples</p>	<p>Actual use varies from program to program. However, the Association of American Medical Colleges states "MCAT scores are intended to be only one of several measures of applicant's qualification." Best predictive power results from combining MCAT scores with incoming GPA.</p>
<p><b>OAT</b></p> <p>Five hour multiple-choice test administered three times a year.</p>	<p><b>Natural Sciences</b> Biology, General Chemistry, Organic Chemistry, Total</p> <p><b>Reading Comprehension</b> <b>Quantitative Reasoning</b> <b>Physics</b> <b>Academic Average</b></p>	<p>One score for each of the eight sections of the test</p>	<p>To be used in combination with grades to enhance admission decisions.</p>
<p><b>DAT</b></p> <p>Four and one-half hour multiple choice exam administered twice a year.</p>	<p><b>Survey of Natural Sciences</b> Biology, general chemistry, organic chemistry <b>Perceptual Ability Test</b> Measures ability to conceptualize and estimate spatial and structural relationships <b>Reading Comprehension</b> Questions based on three reading passages related to dental, basic or clinical science <b>Quantitative Reasoning</b> Measures mastery of arithmetic, algebra, geometry and trigonometry</p>	<p>The DAT is scored on a scale of 1 to 30 with an average score of 15. Separate subscores reported for each section of the test.</p>	<p>Again, general consensus suggests to use DAT scores in combination with GPA and other relevant criteria to determine admission.</p>

the range of one or both variables is restricted. This is the case, for instance, when first year medical college GPA is correlated with MCAT scores. The range of GPA will necessarily be restricted because selection has been exercised for admission to medical school, thus reducing the standard deviation of GPA. The standard deviation of the MCAT scores of the admitted candidates is also restricted compared to the standard deviation of the total applicant pool. When the correlation between GPA and MCAT scores is corrected for attenuation<sup>c</sup> as is the reliability of the criterion<sup>d</sup> (GPA in this case), predictive validity coefficients can be as high as .60. When undergraduate GPA (UGPA) is combined with MCAT scores in multiple regression equations,<sup>e</sup> the validity coefficient can frequently exceed .70. The best prediction of performance in medical school is a combination of MCAT scores and UGPA. Individually, MCAT scores are better predictors than UGPA. This is also the case of other admission tests such as the LSAT (Linn and Hastings, 1984),<sup>16</sup> the OAT (Murphy et al., 1994),<sup>17</sup> and the DAT (Baldwin, 1992).<sup>18</sup>

The MCAT has been validated against several other criteria such as performance on National Board of Medical Examiners (NBME) examinations and the United States Medical Licensing Examinations (USMLE). The uncorrected correlations between MCAT scores and various subtests of the NBME and USMLE exams frequently exceed .50 (Elam and Johnson, 1994; Glaser et al., 1992; Mennin et al., 1993).<sup>9,5,11</sup> This is all the more remarkable considering that there was no correction for range restriction in the MCAT scores in the above studies, and that the exams had been written an average of 5 to 7 years apart. Somewhat smaller, but nevertheless significant validity coefficients, have been found between MCAT scores and medical residency performance and board medical specialty exams (Association of American Medical Colleges, 1993).<sup>2</sup>

In a factor analytic study, the new MCAT (post 1991) which consists of verbal reasoning, physical sciences, writing sample and biological sciences was evaluated by Li and Mitchell (1992)<sup>19</sup> for the cohesiveness of its factor structure. Based on a sample of more than 10,000 subjects who took the MCAT in the spring of 1991, the expected four factor structure was clearly replicated for the total sample as well as for various subsets (males, females, Asians, and Blacks). The factorial validity of the new

MCAT is high therefore, as it was in previous forms (e.g. Ebel, 1965).<sup>20</sup>

Finally, in a detailed study employing 1,628 physicians graduated from Jefferson Medical College between 1978 and 1985, Glaser et al. (1992)<sup>5</sup> evaluated the MCAT against the NBME subtests, Part I, II, and III. Part I covers the basic medical sciences (anatomy, behavioural sciences, biochemistry, microbiology, pharmacology, and physiology). Part II is designed to measure clinical knowledge base in internal medicine, obstetrics/gynaecology, pediatrics, psychiatry, public health, and surgery. Part III of the NBME is taken by most medical graduates at the end of their first year of residency training and is designed to measure certain components of clinical competence and patient management skills.

In this important study, Glaser et al. (1992)<sup>5</sup> followed a large group of physicians over time, and contrasted the importance of three skills as measured by the MCAT (science problem solving, reading, and quantitative) in predicting competence at three points in time (5 or more years after the admission test) as measured by the NBME subtests. They found that scores on the science problems subtest of the MCAT were better predictors of the basic science component of physician education (Part I of the NBME) than were reading scores. Both the science problems and reading skills predicted clinical science equally well (Part II of the NBME), but reading skills contributed more than science subtest scores to predicting scores on an examination of patient management skills (Part III of the NBME). Scores on the quantitative subtests do not contribute any predictive value to any of the NBME exams. These findings provide further support for the predictive validity of the MCAT generally, and particularly the importance of verbal skills in predicting clinical competency. Moreover, these findings support the changes made to the MCAT in 1991 and the de-emphasis on quantitative skills on the new MCAT.

Although not a health profession admission test, there has been extensive research on the predictive validity of the LSAT. In a meta-analysis<sup>f</sup> (a method for statistically integrating published studies and thus drawing conclusions from the accumulated evidence) of the validity of predictors of performance in law school, Linn and Hastings (1984)<sup>16</sup> integrated data from 154 law schools involving 259,640 applicants. They found that corrected for attenuation LSAT and law school GPA (LGPA) validity

coefficients had a median value of .55. The corrected validity coefficient for UGPA and LGPA was .50. Combined in multiple regression models, the validity coefficient of UGPA and LSAT to LPGA was in excess of .70 (Linn and Hastings, 1984).<sup>16</sup> The two general conclusions that emerge from this and other studies of the LSAT is that (1) the LSAT is a better predictor of law school performance than is undergraduate GPA, and (2) used in combination, LSAT scores and UGPA can result in impressive validity coefficients and thus help admission committees to improve their decisions.

Similar predictive validities have been found for other admission tests such as the OAT (Kegel-Flom, 1978)<sup>21</sup> and the DAT (Baldwin, 1992).<sup>18</sup> In all of these admission decisions, the best prediction is achieved by combining the admission test score (MCAT, LSAT, OAT, DAT), with undergraduate GPA (institutions frequently also use personal interviews, written submissions, extra-curricular activities, letters of reference, etc. though none of these have substantial predictive validities (Smith, 1991; Spafford, 1993, 1994).<sup>21,22,23</sup>

By way of summary, there is little doubt that extensive research over the last 40 years supports the predictive validity of admission tests, particularly of the MCAT and the LSAT. There is, therefore, every reason to believe that the proposed CCAT could achieve the same predictive validities of the admission tests reviewed above. The CCAT can be developed, constructed, and refined to achieve the highest technical standards (see below) as illustrated by the MCAT and LSAT. Ongoing refinement and research can help to create a CCAT that when combined with UGPA can achieve predictive validities in excess of .70.

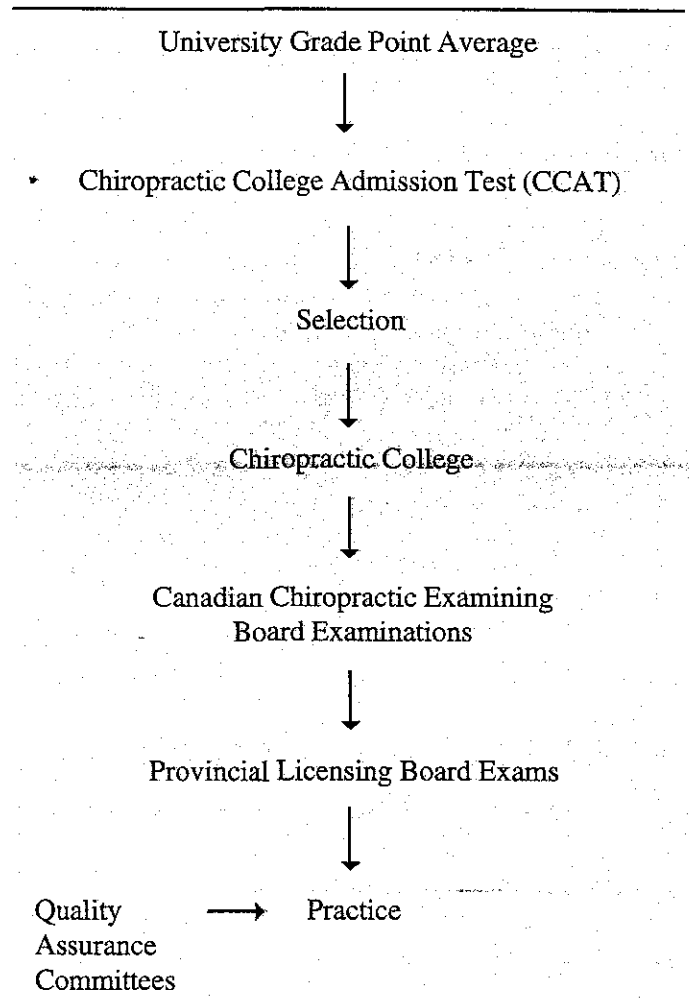
### Nature, development and implementation of the CCAT

This final section of this paper details the proposed nature, development and implementation of the CCAT. Its inter-relationship to other components of chiropractic is summarized in Figure 1. From this schematic it can be seen that the CCAT would be integrally related to all of the components of chiropractic education, testing, licensing and practice.

### Table of specifications of the CCAT

A table of specifications *specifies* both the content domain

**Figure 1**  
**Schemata showing the Interrelatedness**  
**of Various Components of**  
**Chiropractic for Quality Assurance**



and the cognitive processes to be assessed by a test. Table 3 is a summary of a hypothetical general table of specifications of the CCAT which we have developed based, in part, on the information in Table 2 and an analysis of the pre-requisites for entry into chiropractic colleges. It can be seen that the table of specifications in Table 3 includes some of the universal elements of domains relevant to health professions, as well as language and verbal based reasoning (in the natural and social sciences and the hu-



manities) which have been shown to be the best predictors of clinical competency and patient management in actual practice (Glaser et al., 1992).<sup>5</sup> As proposed in Table 3, the CCAT contains four sections, three of which are comprised of multiple choice questions (MCQ) and one constructed response (i.e., essay) question. The total testing time of five hours could be accomplished in a single day, three hours in the morning and two in the afternoon.

The table of specifications in Table 3 is a proposed beginning point and obviously requires much more development and detail. The final table of specifications will require input from the profession of chiropractic through focus groups, Delphi study as well as an analysis of chiropractic education programs. Another element that needs to be considered is a role delineation and scope of practice of chiropractors. The final table of specifications should reflect a broad consensus from the profession of the domain of the content of chiropractic education and the scope of practice of chiropractors.

#### **Developing the items for the CCAT**

Upon completion of the table of specifications, the task of constructing items for the CCAT can be undertaken. The key challenges in item construction involve the application of sound construction principles and content accuracy. This can be done by training a group of content area experts such as graduate students (MSc or PhD) or completed (PhD, MD, DC) experts in the sciences (e.g., anatomy, pathology, microbiology, neurology, physiology, chemistry, nutritional science, exercise physiology), and the humanities and social sciences.

Before constructing test items, content specialists, field doctors and academic chiropractors would receive formal instruction such as item construction workshops, during which time they are taught the procedures for sound test item construction. Following instruction, the item writers can be provided with feedback on their work and subsequently submit a set of well constructed and content accurate test questions. The items may receive a final review by testing experts and an exam construction committee. Using this technique, thousands of items can be constructed and refined relatively quickly.

#### **Piloting the items**

As the items are developed and subjected to review as a quality control, they will need to be piloted under real

testing conditions. The purpose of this is to obtain psychometric data for the items so that they can be edited, revised, and improved based on item analyses before they are finally admitted to the item bank where they will appear on versions of the CCAT. This piloting process is critical to developing a test of the highest technical standards. In this fashion the CCAT can achieve adequate reliability (alpha coefficients > .90) and predictive validity (validity coefficients > .50) expected from an admission test of this calibre.

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#### **Developing norms**

Norms – means, variance, standard deviations, z-scores, percentile ranks, etc. – will need to be developed before admission decisions are made based on CCAT scores. This means that after a complete version of the CCAT is administered under actual testing conditions with the appropriate norm group (applicants to the chiropractic colleges), there will be sufficient data to establish preliminary norms. As the data accumulate over the years with ongoing testing, the norms can be continuously refined and updated.

#### **Full implementation of the CCAT**

Once a sufficiently large item bank has been developed (e.g., 5,000 items), the scoring criteria have been established and refined for the constructed response subtest, and the norms have been developed and established, the CCAT can be fully implemented.

In order to conform to academic schedules and application deadlines at the colleges, two testing periods every year are proposed (Spring – March – and Fall – November). The testing can be implemented by currently existing structures. Most major universities in Canada and the United States have testing offices which administer such tests as the MCAT, LSAT, DAT, etc. This network can be used to administer the CCAT at several testing sites as needed. Such testing sites can be established in Canada and elsewhere as the need arises.

The operational headquarters for the CCAT can be established at some location. This is where the tests will be developed, printed and sent to the testing sites. All completed tests will be returned to the headquarters for scoring and processing. Results will be sent to the applicants who wrote the CCAT and to the chiropractic colleges of their choice. Only scores sent from the CCAT testing headquar-

**Table 3**  
**Hypothetical Table of Specifications for the CCAT**

<b>Content Area</b>	<b>Format</b>	<b>Number of Questions</b>	<b>Time (minutes)</b>
<b>Biological Sciences</b> General biological concepts Organic Chemistry	MCQ*	50	65
<b>Constructed Essay</b> Candidates will be asked to respond in essay form to a statement related to some aspect of health care. For example "Universal health care must be seen not as a privilege but as a right"	Written Response	1	45
<b>Physical Sciences</b> Inorganic Chemistry and Physics	MCQ	50	65
<b>Visual Perceptual Ability</b> The test will assess the candidate's ability to make visual spatial judgements.	MCQ	35	55
<b>Linguistic Reasoning</b> Reading Comprehension passages concerning the Humanities, Social Sciences and Natural Sciences	MCQ	50	65
*MCQ (Multiple Choice Question)			

ters and bearing an official seal will be regarded as official by the colleges. The colleges will receive percentile rankings for all subtests and an overall result for each applicant.

Based on the norms established, and employing multiple regression models, researchers at the CCAT headquarters can provide a regression equation which colleges may employ to make admission decisions. Ultimately, of course, each college has the prerogative and responsibility to make its own admission decisions, although research results from the CCAT will be very useful for this purpose.

### Summary and conclusions

Chiropractic – now officially more than 100 years old – has achieved a level of professional maturity that indicates the need for a standardized admission examination. Many other professions have had such admission examinations for several decades. Such admission tests not only provide a standardized metric on which to judge all applicants equally (combined with GPA and other criteria), but also introduce quality assurance at the entry point into the profession. A possible admission test, the CCAT, for chiropractic has been proposed and described in the present paper. Such a test provides a number of benefits to the chiropractic colleges, the applicants to these colleges, the regulatory and licensing boards within chiropractic, and the profession as a whole as well as the public in general.

Based on the nature, results and data from other major admission tests such as the MCAT, OAT and the DAT, the CCAT can be developed and constructed with substantial evidence for validity – both content and predictive. Accordingly, such a test may be useful for admission decisions, licensing control and general quality assurance for the profession, but is also likely to provide further legitimation and prestige to chiropractic as a whole.

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### Endnotes

- <sup>a</sup> Pearson correlation is based on the assumption of interval or quasi-interval scales. Virtually all admission test scales meet these assumptions as do the criteria against which they are evaluated. A negative  $r$  simply indicates the direction of relationship while the magnitude of the coefficient indicates the strength of the association.
- <sup>b</sup> If the criterion (e.g. GPA) has low reliability, the correlation between it and the admission test will necessarily be small only because of the high error of measurement in the criterion.
- <sup>c</sup> There are a number of methods for correcting for attenuation. A practical and very useful one is to use the ratio of the standard deviations of the applicant group to the

selected group. This ratio which is almost always greater than one, can then be used to adjust the derived coefficient. Lord and Novick (1968)<sup>22</sup> present another series of formulae for correction for attenuation.

- <sup>d</sup> As in the above, the correlation with a low reliability criterion can be corrected for attenuation assuming that the reliability was increased.
- <sup>e</sup> Multiple regression is a method of statistically combining predictor variables into an equation so that several predictors can be used. Using this procedure, the predictive value of each predictor can be determined. The equation, once derived from data can be used to predict individual scores on the criterion of interest. The validity coefficient derived in multiple regression models is the multiple correlation between the predictors and the criterion. A validity coefficient of .70 between the LSAT, UGPA, and LGPA, for example, is the multiple correlation between the predictors and LGPA.
- <sup>f</sup> Meta-analysis is a procedure developed in the 1970s to integrate published data so that they can be accumulated to provide stronger conclusions that can be derived from any individual study. This method is much superior to the traditional review paper that attempts to derive conclusions from subjective judgments.