# The Evolution of Clinical Engineering Certification in Canada

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*Abstract*— **The evolution of clinical engineering certification in Canada started in 1980 with the development of a Canadian Board of Examiners, which used both written and oral examination methods to determine candidates' eligibility for certification. After an initial burst of activity, the number of applicants coming to the Board slowed down, to the point where the Board effectively ceased to function for an extended period. Renewed interest in the first decade of this century led to a fresh initiative to re-establish the Board. This time, it was decided to twin the activities of the Canadian Board with its United States counterpart, to the extent possible, to try to ensure the sustainability of the Canadian Board. Thanks to support from US colleagues, the new Canadian Board is in place, with a process that is closely aligned with that of the US. The main differences are the need to examine Canadian candidates on codes, standards and regulations that are Canada-specific, and the requirement in each Canadian province or territory for licensure as a professional engineer if the title engineer is to be used. The Canadian and US Boards are both accountable to the Healthcare Technology Certification Commission.**

*Keywords*— **Certification, clinical engineering, examination process, engineering licensure.**

## I. INTRODUCTION

As the field of clinical engineering started to develop in Canada, and hospitals and other institutions began to hire engineers to plan, implement and support health technologies in clinical care environments, those working in the profession recognized the desirability of introducing a certification process, to ensure that individuals claiming expertise in this area could demonstrate, and be recognized as possessing, overall competence.

In Canada, clinical engineering was originally defined as the work of engineers related to health technologies in both the hospital (acute care) setting and the rehabilitation setting. While it is unusual for clinical engineers in hospital settings to have any direct involvement in the patient treatment process, it is not unusual for rehabilitation engineers to have this direct contact, when working on devices such as speech aids and powered limb prosthetics, for example. In this sense, one can argue that rehabilitation engineers are perhaps the most clinically focused of all groups within the umbrella of clinical engineering. However, there are more clinical engineers working in Canada in hospital settings than in rehabilitation. It is important to keep this distinction in mind, since one of the sources of tension in the Canadian clinical engineering certification process has been this desire to include the work of hospital-based and rehabilitation-based clinical engineers in the certification process; a goal that has not always been realized in practice.

Under the laws of the Canadian provinces and territories, the use of the title "engineer" in a job description requires that the incumbent be licensed as a professional engineer in that jurisdiction. In contrast to some other countries, Canada has always taken the position that to be eligible to seek certification in clinical engineering, an applicant must first obtain licensure as a professional engineer. This process typically takes several years of engineering work experience post graduation from an engineering degree program in Canada. Immigrants to Canada who trained elsewhere are eligible to apply for recognition of equivalency of training which, if granted, means that they fulfill the academic training requirements for engineering licensure. The engineering work experience is conducted under the mentorship of a licensed professional engineer, and applicants are also required to sit exams on engineering laws and ethics. Once a person is licensed as a professional engineer and is working in the field of clinical engineering, or has developed competence in the field, then he or she can apply to the Canadian Board of Examiners for Clinical Engineering Certification.

## II. THE EARLY DAYS OF CERTIFICATION

The growing adoption of health technologies by Canadian hospitals from the late 1960's on resulted in a growing need for staff who understood how to purchase, commission and maintain these technologies, and ensure that they were used in safe and effective ways. The growing technical sophistication of intensive care, surgical and imaging environments led to very rapid increases in the complexity and volume of health technologies, and posed new challenges for those hired to support them. By 1980, it was recognized that engineers working in this role required a distinct but unrecognized body of knowledge to perform their tasks competently. Since there was no licensing process in place specifically for clinical engineering, thought leaders in Canada decided to



I. Lacković and D. Vasić (eds.), *6th European Conference of the International Federation for Medical and Biological Engineering*,
IFMBE Proceedings 45, DOI: 10.1007/978-3-319-11128-5_236

establish a certification process that would be administered by competent members of the profession.

In order to begin such an effort, discussions were held with colleagues in the United States who had undertaken a similar approach under the leadership of the Association for the Advancement for Medical Instrumentation (AAMI). Canadians with established track records working in the profession were grandfathered as certified, and established the first iteration of the Canadian Board of Examiners for Clinical Engineering Certification. They developed a series of multiple-choice questions for a written exam, covering topics such as engineering knowledge, human physiology, clinical instrumentation, technology management, and codes, regulations and standards. Applicants who wrote the exam and passed were then able to sit an oral exam, which consisted of a free-wheeling interview of the applicant by a team of two examiners, with special focus on any deficiencies shown by the candidate during their written exam. As it happens, this author was the first candidate to take the written and oral exams in Canada.

The original process of certification in Canada continued for a number of years. However, the initial rush of applicants dwindled, and the reasons for this were partly that the steady demand in Canada is not that high, coupled with the fact that most employers did not place much emphasis on the need for certification among their staff, and so it remained a voluntary activity with limited visibility amongst the health care community. Over time, the demand dropped to the point where the Board of Examiners found it hard to maintain their commitment to the process, especially the work of writing new exam questions and reorganizing the test each year. By the late 1990's, the work of the Board had effectively ceased, with very few applicants coming forward, and Board members unable or unwilling to commit the time required to sustain this activity.

In the United States, a somewhat different path was followed, with more applicants coming forward, and the ongoing commitment of their Board. However, as the process matured, it was recognized that the written and oral exam were set in rather ad hoc ways, and there was a growing desire to improve these processes and have them meet high standards of quality. A group of dedicated clinical engineers led by Frank Painter spent much time in the mid 2000's redesigning both the written and oral exam processes and putting in place more professional processes for the operations of the US Board and its exams.

## III. REVAMPING THE CERTIFICATION PROCESS IN CANADA

Meanwhile, there was a growing level of interest in certification again in Canada as younger engineers entered the profession and the need for skilled staff continued to grow. Members of the former Canadian Board were asked by the Canadian Medical and Biological Engineering Society (CMBES) [1], Canada's national biomedical engineering society, to resuscitate a Canadian certification process and bring it up to date.

It quickly became apparent that for Canada, with its small number of certification applicants and very limited financial resources, it would be difficult to launch and sustain a self-supporting certification process of high quality. There are many similarities in the practice of clinical engineering between Canada and the United States, and indeed with many other countries as well, as clinical engineering becomes more and more common around the globe. The Canadian team therefore decided to approach the US Board about the possibility of sharing aspects of the enhanced US exam process. This process includes the development of a large roster of exam questions, hosted by a professional testing company, with a fresh written exam prepared each year by the company, and administered in a formal manner at test houses in various locations in the US. The written exam questions are weighted each year, to ensure that an exam of comparable difficulty was maintained from year to year. Successful applicants then proceed to a three-question oral exam process where standard questions covering a range of relevant topics are posed. Each candidate is given a short period of time to prepare verbal responses to these three scenarios, and two examiners listen to the responses, looking for certain key issues to be covered. The key issues are identified through a prior process, involving certified clinical engineers, and cut scores are developed based on this process. Adding further credibility to the process, The US Board of Examiners are accountable to the Health Technology Certification Commission [2], which oversees the work of the Board and receives and ultimately decides on recommendations from the Board to certify individuals. For US-certified individuals, there is a self-reporting survey that must be completed every three years to maintain licensure. The purpose of the survey is to confirm that the person continues to be active in the field of clinical engineering. Points are awarded for participating in various clinical engineering-related activities, such as working in the profession, reading books and documents related to clinical engineering, attending conferences and publishing papers.

Discussions between the Canadian and US Boards went well, with good support and encouragement from US colleagues. The main issue of divergence of practice between Canadian and US clinical engineers relates to the country-specific codes, regulations and standards, an important but relatively small part of the written exam. In discussion, it was agreed that members of the Canadian Board would review the US written exam, to identify those questions

requiring specific knowledge of US codes, standards and regulations. Out of a full exam of 150 multiple-choice questions, the total number of exempted questions is typically no more than 30. Canadian examinees are marked out of the remaining questions, and the same percentage pass mark is used. To compensate for the lack of written exam questions on Canadian codes, standards and regulations (note that it was prohibitively expensive to add these questions to the US-based exam), it was decided to put an additional (fourth) question into the Canadian oral exam process, specifically on these topics. The Canadian Board agreed to develop such a question using exactly the same process as the US Board. In this way, Canadian candidates are examined through a slightly different but parallel process to their US counterparts.

Regarding process and administration, it was agreed that Canadian applicants would register and be administered by the Secretariat to the US Board, to avoid setting up a parallel office in Canada, and to ensure that candidates from both countries are tracked in one place. Fees to apply for and maintain certification are paid in US funds and sites are available in Canada to sit the written exam, which is made available in both countries on a single date and time each year, early in November. All policies and procedures are harmonized and the Canadian Board assists the US Board in the generation of new written and oral exam questions. Canadian applicants are directed to the application process via a webpage hosted by CMBES [3]. Members of the two Boards discuss their work on a regular basis, and the Chairs of each Board sit on the Healthcare Technology Certification Commission.

The harmonized process was established in 2010 and remains in place. There has been good communication between each Board, and a generally high level of support for this harmonized process.

## IV. Outcomes of the Redesigned Canadian Board Process

All in all, the Canadian Board is very happy with the aligned process with the US Board. Numbers of applicants for clinical engineering certification in Canada remain low (typically no more than two applicants per year), and so this harmonized approach has allowed Canada to offer a high quality certification process at a very reasonable cost to applicants. It is not unusual for Canadian and US clinical engineers to work for periods of time in each others' countries, and so the adoption of a unified certification process helps to ensure that a certified individuals meet a common standard, thus providing assurance of competence to prospective employers. Given that each group is examined only on codes, standards and regulations, it is important for clinical engineers moving from one country to the other to take the time to familiarize themselves with the codes, standards and regulations of their new place of work, and of course, this applies to any new country.

Note that the other significant difference between the Canadian process and US process is that the US Board does not require prior licensure as a professional engineer although some US applicants do hold such a licence. This is a difference that is based in Canadian law regarding the use of the title "engineer', as explained earlier.

The Canadian Board would like to boost the number of applicants applying for certification. This is a lengthy process, and the effort involved may act as a deterrent for some individuals, but the Board is convinced of the importance of sticking with a high-quality process. Most employers of clinical engineers in Canada still place relatively little emphasis on the need for certification during the hiring process, and the Canadian Board is currently debating how to increase the profile of certification. It is likely that this will remain a voluntary process in Canada, since there are no plans to legislate the need for certification of clinical engineers, and the current Canadian legal framework would make it difficult for such legislation to be introduced.

In sum, Canada has evolved a high-quality voluntary certification process for clinical engineering, working closely with, and benefitting from, the excellent work of the US Board of Examiners in establishing a certification process of high quality in that country. Rehabilitation engineers seeking certification are at a disadvantage, since the exam processes are oriented around clinical engineering duties in general clinical environments, and require broad knowledge in these areas that can be difficult for those working in rehabilitation to obtain. Training courses are offered on how to prepare for the certification process, and applicants are strongly encouraged to participate in these, to give them the best chance of success. Given the high degree of commonality of clinical engineering practice in many parts of the work, it is envisaged that this approach could potentially be expanded to include other interested countries. For regions where languages other than English are spoken, it would be necessary to arrange for translation of the written and oral questions to those languages. Canada is officially bilingual French/English, but to date, funds have not been identified to enable the translation of the exam materials into French, although the possibility of accomplishing this has been discussed by members of the Canadian profession.

## Conflict of Interest

The author declares that he has no conflict of interest to declare with regard to the work described in this paper. He was Chair of the Canadian Board of Examiners for Clinical

Engineering Certification during the transitional process described in this paper and is currently Past-Chair of the Board. The Canadian Board is currently chaired by William Gentles, PhD, PEng, CCE.

## REFERENCES

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