

# Certification of Clinical Engineers in Sweden

P. Ask<sup>1</sup>, N-E. Pettersson<sup>2</sup> and B Wändel<sup>3</sup>

<sup>1</sup>Department of Biomedical Engineering, Linköping University, Linköping, Sweden

<sup>2</sup>Erikstorp Biomedical Engineering, Örebro, Sweden

<sup>3</sup>Department of Biomedical Engineering, Gävle sjukhus, Gävle, Sweden

**Summary— The Swedish Society for Biomedical Engineering and Physics has certified clinical engineers since 1994. The certification is performed at two levels: Master of Science and Bachelor of Science. We have in total received had 695 applications and certified 391 engineers. We have also developed a system to certify Specialists in Clinical engineering.**

**Keywords— Clinical engineer, certification, patient safety**

## I. INTRODUCTION

The importance of patient safety has to an increasing degree been emphasized by the national and international communities. In the industrial countries, we now know that 10% of the patients do not get the correct treatment due to inadequacies in the patient safety systems. Most of the problems are caused by failures in the procedures of the diagnostic or therapeutic process. The most common problem concerns mistakes in the routines performed by the medical personal.

Clinical engineers have been pioneers in patient safety matters. They have mainly been dealing with technical safety, where work has been ongoing for more than 30 years. Clinical engineers will normally have training in electrical safety, gas safety, radiation safety, risk analysis, quality assurance and organizational matters. During the last decades, the extensive introduction of information technology systems has put new challenges to the technical safety in health care. One reason for this is that the information technology now is getting integrated into medical equipments and systems. Computer systems that used to be administrative only, now, in many cases, have to fulfill requirements put on medical equipment.

To improve the safe use of medical equipment, it is important that the responsible clinical engineers have the necessary competence. One way to address this, is the availability of a certification procedure of the clinical engineers to ensure that they have the necessary education and training.

In Sweden, this is performed by the Swedish Society for Biomedical Engineering and Physics.

## II. HOW THE CERTIFICATION IS PERFORMED

The Swedish Society for Biomedical Engineering and Physics started already in 1956 and has today about 800 members who are active in health care, academia and industry. The Society formed a working group in the early 1990:s that developed guidelines that were presented and approved at the annual meeting of the Society in 1993. The Certification of clinical engineers started in 1994.

The certification is performed at two levels:

1. At an exam corresponding to approximately the level of a Bachelor 's degree in engineering (the Swedish "Högskoleingenjör").
2. At an exam corresponding to approximately the level of a Master's degree in engineering (the Swedish "Civilingenjör").

Applications can be sent to the Society twice a year. They are judged by a Certification Committee that has a mandate to review the applications from the Board of the Society. The Certification Committee consists of a Chairman who preferably is a lawyer from a governmental health care organization or a health care provider. There are two university professors in biomedical engineering, and two experienced certified clinical engineers. There are also deputy members who are certified clinical engineer. The committee has two meetings yearly.

The requirements besides the exam, are courses in biomedical or clinical engineering, medicine and related subjects corresponding to at least 30 credit points. The European Credit Transfer and Accumulation System ECTS is used as a reference. The courses can be university courses or courses given by other organizations or by companies. Credit points are assigned to each course by the Committee.

Different types of courses can be approved. One type is courses in medicine or biomedical engineering, and the credit points from such courses should be at least 15 points. The certified engineer should also have at least 8 credit points in specific clinical engineering subjects such as technical safety in health care, clinical engineering management, quality assurance or risk analysis.

One could also have continuing education in engineering subjects with direct relevance for the work as a clinical engineer. This can correspond to computer science courses, electronics, fluid mechanics, measurement science etc.

Fifteen credit points in biomedical or clinical engineering can come from courses included in the basic exam. Furthermore, at least 15 credit points should be part of post exam continuing education.

To become a certified clinical engineer, the person should have at least three years work experience as a clinical engineer in a hospital supervised by an experienced and preferably certified clinical engineer.

The reason for choosing the Bachelor of engineering as the lower level of certification, was that in 1989, a Swedish law came into force, that said that to work with clinical engineering, a person should preferably have at least this level of education. At the time, there were many engineers working at the clinical engineering departments in the hospitals who did not have the Bachelor's degree but an older degree from a polytechnic institute ("Gymnasieingenjör"). These engineers were accepted for certification if the degree was from 1989 or earlier. However, they should have at least 6 years instead of 3 years work experience.

### III. CERTIFIED CLINICAL ENGINEERS

Since 1994 we have received a total of 695 applications, 124 at the Master's level and 571 at the Bachelor's level. We have certified a total of 391 persons of whom 87 are at the Master's level and 304 at the Bachelor's level.

### IV. NEW LEVEL UNDER INTRODUCTION

We have also (2014) developed a program to certify specialists in clinical engineering.

To become a certified specialist in clinical engineering, you should have at least two years in specialist training supervised by an experienced and certified specialist in clinical engineering. First of all, you should make an agreement with the supervisor of the clinical engineering department to receive a training program for at least two years. The specialist training program consists of courses corresponding to a Continuing Professional Education. It is the Certification Committee that classifies the courses for the specialists. The certified specialist should have at least 30 credit points during the specialist training years.

The specialist certification is also performed at two levels (a Bachelor's degree and Master's degree in engineering, respectively).

To keep the role of a specialist you should continue to develop your professionalism as a Clinical engineer by ongoing training and education.

We are developing specialist programs for a number of different types of medical functions. Examples of Specialist programs are Medical Imaging, Dialysis, Intensive Care, Computers in health care, Responsibility and management.

### V. HARMONIZING EDUCATION PROGRAMS

For the future, we have started a discussion with the universities that have education programs in biomedical engineering. The purpose is to harmonize relevant courses in the programs of medical bioengineering available at the different universities and to meet the expectation from Clinical engineering departments in the health care sector.

### VI. DISCUSSION

We are pleased to note that through the years many engineers have applied for a certification. Many of those have also obtained one. The number of applications was very large when the certification started but has decreased after some years. One reason is that after some years, most of the engineers that can be certified already have got the certification. Another reason is that at the time, it became harder to recruit engineers to the health care sector since there was a high demand from industry. The health care employer stopped to put "certified clinical engineer" as a desired

qualification in the advertisement which reduced the focus on the importance of being certified. This request is still lacking in many advertisements for clinical engineering positions, but this is an issue that is being raised by the Swedish Society for Biomedical Engineering and Physics.

By making a connection between the certification system and the engineering programs at the universities we hope it will be more interesting for students to choose programs of Biomedical Engineering and that it will facilitate starting a career as a Clinical Engineer.

We also plan to discuss with the National Board of Health and Welfare about the possibilities to classify Clinical engi-

neer (the Swedish: “Medicinsk ingenjör/-civilingenjör”) as a protected title that may be used only by those who hold a license to practice as Clinical engineers.