Chapter 4
Clinical Informatics Subspecialty Certification and Training

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Abstract Although the clinical informatics subspecialty is new, the term "clinical informatics" first appeared in the informatics literature in 1983 in an article in the Proceedings of the American Association for Medical Systems and Informatics (AAMSI) Congress by Michael A. Jenkin entitled "Clinical specialty systems as an introduction to Clinical Informatics." Over the succeeding years there has been a great deal of research and development in clinical informatics, and at least a decade of effort to form the subspecialty. Finally, in 2011 the discipline was first recognized as a subspecialty by the American Board of Medical Specialties and the first specialty board certification examination was in 2013. This chapter describes the background about the development of the subspecialty as well as the core content and training requirements.

History and Background of Clinical Informatics

The term "clinical informatics" first appeared in the literature in the Proceedings of the American Association for Medical Systems and Informatics (AAMSI) Congress in 1983 in an article by Michael A. Jenkin entitled *Clinical specialty systems as an introduction to* ***Clinical Informatics*** [1]. Jenkin also published a second article; ***Clinical Informatics***: *a strategy for the use of information in the clinical setting*

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which appeared in 1984 [2]. The field of clinical informatics was not new and had been evolving for at least a century. Perhaps the first clinical informatician was Florence Nightingale who introduced classification to field injury during the Crimean War in 1854. Herman Hollerith developed and received his PhD from Columbia University in 1889 with a dissertation entitled "An Electric Tabulating System" which used the punched card. The system was a key technology used to assist in taking the 1890 census.

In 1959 Robert S. Ledley and Lee B. Lusted published a key article in Science entitled, "*Reasoning foundations of medical diagnosis*; *symbolic logic*, *probability*, *and value theory aid our understanding of how physicians reason*" which became a cornerstone of computerized medical reasoning [3]. In the 1960s, in the United States, several medical investigators made use of computers to improve the practice of medicine. Homer R. Warner [4, 5] and colleagues at LDS Hospital in Salt Lake City developed mathematical approaches for medical diagnosis as well as a clinical information system called HELP [6]. Donald A. B. Lindberg developed the first automated clinical laboratory system [7]. Morris F. Collen developed automated multiphasic screening at Kaiser-Permanente in northern California [8]. G. Octo Barnett [9], Robert A. Greenes [10], and colleagues at the Massachusetts General Hospital developed the MUMPS (**M**assachusetts General Hospital **U**tility **M**ulti-**P**rogramming **S**ystem – also known as **M**) computer programming language and used mini-computers to develop the COSTAR patient care system. Warner V. Slack developed a computer-based history taking system [11] and his life-long colleague Howard L. Bleich developed methods for interpreting acid–base disorders [12]. These two physicians and their colleagues then went on to develop a multitude of clinical computer applications at Harvard and Beth-Israel Hospital in Boston.

In the 1970s a large group of individuals and clinical systems were developed. Donald W. Simborg added another medical history taking system [13]. El Camino Hospital in California developed automated medical records [14]. William W. Stead and W. Edward Hammond developed clinical computing systems at Duke University [15]. Edward H. Shortliffe developed the MYCIN computer-based infectious disease consulting system at Stanford University [16]. Clement J. McDonald used protocol-based computer reminders to improve the quality of patient care and compensate for the "non-perfectibility of man" [17]. In 1974, Francois Gremy coined the term "medical informatics" to encompass these types of activities [18, 19].

The success of these early pioneers led to funding of individual clinical computing systems, development of clinical computing research laboratories, and eventually to the National Library of Medicine funding training programs in the growing field which eventually became a much broader field known as "Biomedical Informatics." Biomedical Informatics includes clinical informatics, bioinformatics, public health informatics and other topics [20]. The training focus and curricula of each of these academic programs varied, but a next generation of informaticians was minted who were instrumental in further developing these seminal systems and in starting new clinical computing systems development (See also Chap. 3 for more details on the NLM training programs).

The past few decades have been exciting and challenging times for the clinical informatics field. After a gestation period of over 50 years, the Electronic Health Record (EHR) has become a reality in many healthcare facilities in the United States [20]. Clinicians, technologists and politicians have jointly decided that it is inevitable that widespread adoption of the EHR will improve caregivers' decisions and patients' outcomes [21]. In 2004, the Office of the National Coordinator (ONC) for Health Information Technology was created within the U. S. Department of Health and Human Services (DHHS). The primary focus of ONC is to facilitate the implementation and use of Health Information Technology (HIT) to improve the efficiency and quality of Healthcare. Based on efforts of the ONC, the U.S. Congress and the Obama Administration in 2009 enacted the Health Information and Technology for Economic and Clinical Health (HITECH) Act [21–23]. HITECH calls for the Secretary of DHHS to develop specific "*meaningful use*" objectives for EHRs and have the EHRs certified. The primary intent of having an EHR which meets "meaningful use" objectives is to improve care quality [21]. Already Stage 1 and Stage 2 "meaningful use" objectives have been developed and promulgated.

Development of Clinical Informatics Specialty Board Certification for Physicians

There are over 750,000 physicians in the United States as well as millions of nurses and pharmacists who will be using EHR systems. In 1995, the American Nursing Association (ANA) recognized nursing informatics as an important area of clinical specialization and established a method for nursing informatics certification [24–26]. As part of the process, in 1995, ANA published a document entitled *Nursing Informatics*: *Practice Scope and Standards of Practice*. The latest revision of that document describing certification of nursing informatics was published in 2007 [27].

In 2003 the Institute of Medicine issued a report *Health Professions Education*: *A Bridge to Quality* [28]. This report called for health professionals to be trained to use informatics and related tools to "reduce errors, manage knowledge and information, make decisions and communicate more effectively than had been the case in the past."

In 2004, then President George W. Bush set a national goal that the majority of people in the United States should have their health information in Electronic Health Records (EHRs) by 2014. In response, Charles Safran, then Chairman of the Board of Directors of the American Medical Informatics Association (AMIA), called for the training of one physician and one nurse for each of the nearly 6,000 hospitals in the United States to help implement EHRs [29]. During 2005, AMIA along with the American Health Information Management Association (AHIMA) convened a policy summit meeting to examine the workforce implications of then President Bush's

directive [30]. Participants in the summit identified three key success factors for achieving the presidential directive:

1. The need to invest in people to use technology wisely and well
2. The need for a core of health information specialists who were academically prepared
3. The need for new educational curricula and learning environments

The AMIA/AHIMA summit participants estimated that over 50,000 healthcare professionals would need some level of informatics training to support the proposed national health information infrastructure. Not only were there physicians and nurses who needed training but also other health information management professionals (medical records and office management staff) who would need to enhance their clinical informatics skills.

An informal survey of National Library of Medicine biomedical informatics training program directors revealed that almost none of their training programs had the capacity to help meet the perceived huge physician and other healthcare professional workforce deficit. However, Dr. William Hersh, at Oregon Health Sciences University (OHSU), had developed capabilities for distance education for his graduate education program and suggested that this approach could be used to address workforce development [31]. In consultation with Don E. Detmer, President of AMIA and Charles Safran, Chairman of the AMIA Board of Directors, AMIA initiated its 10×10 program with the goal of training 10,000 physicians and nurses by 2010 with OHSU being the first AMIA 10×10 site.

The intent of the AMIA 10×10 programs was to initiate clinical informatics training with a one semester graduate level introduction of the application of informatics to clinical healthcare. The program was open to all students and health professionals interested in an introduction to information and communication technologies in healthcare. AMIA hoped that some of the 10×10 participants would go on to obtain more formal training in the field of informatics (see also Chap. 8 for more information on AMIA 10×10).

During AMIA's fall meeting in 2004, Detmer and Safran convened a "Town Hall" meeting to discuss AMIA's role in workforce training in clinical informatics. The Town Hall discussion reached three important conclusions:

1. Informatics as a discipline is broader than clinical informatics.
2. Clinical informatics is an inter-professional domain that helps to integrate health professions.
3. Sufficient social value in clinical informatics exists to ensure benefit from formal training and certification.

The AMIA Board of Directors subsequently adopted a formal policy and approved an effort to obtain funding to undertake formal development of clinical informatics certification for clinical professionals beginning with physicians.

In March 2007, the Robert Wood Johnson Foundation awarded a grant to AMIA to support the development of the documents required by the American Board of Medical Specialties (ABMS) to create a new medical subspecialty in clinical informatics [32, 33].

Creating the Medical Subspecialty of Clinical Informatics

The American Board of Medical Specialties was established in 1933 and is a non-profit organization of "Member Boards", representing 24 broad areas of specialty medicine. ABMS is the largest physician-led specialty certification organization in the United States. ABMS Member Boards maintain a rigorous process for the evaluation and Board Certification of medical specialists. They certify specialists in more than 150 medical specialties and subspecialties. More than 80 % of practicing physicians in the United States have achieved Board Certification by one or more of the ABMS Member Boards. The Member Boards of ABMS also support lifelong learning by physicians through the ABMS Maintenance of Certification (MOC) program [34, 35].

The two documents required by the ABMS for review to determine whether clinical informatics was indeed a new medical specialty were – the **Core Content** of the curriculum and the **Clinical Training** Program. AMIA established two working teams to provide the needed documents. AMIA also hired a consultant (Benson S. Munger) who had recently completed the submission of similar documents required for another clinical field. A professional Editor (Elaine B. Steen) prepared documents and agendas for both teams. The Core Content team met three times between August 2007 and January 2008 [36]. The Clinical Training team met three times between January 2008 and August 2008 [37]. In addition to these face-to-face meetings, there were multiple Email conversations and telephone conference calls to establish consensus in the required documents.

Development of the Core Content

The core content working team consisted of professionals who had been working in the field of "clinical informatics" and included physicians, computer scientists, engineers, nurses and other technologists. The Core Content for a medical subspecialty defined the boundaries of the discipline and helped inform clinical informatics fellowship training program requirements. Under the leadership of Reed M. Gardner, an engineer/clinical informatician as Chair and J. Marc Overhage an internist and clinical informatician as vice-Chair, a team of 11 experts established that clinical informatics encompassed three spheres of activity [36]:

1. Clinical care
2. The healthcare system and
3. Information and communication technology.

The Core Content team decided both what the discipline should be called and what the discipline encompassed. Initially the team considered naming the subspecialty "applied clinical informatics" . However after a lengthy discussion, the team decided that the term "applied" was redundant and that the discipline should be called clinical informatics. The team defined what clinical informaticians

do as: *Clinical informaticians transform healthcare by analyzing*, *designing*, *implementing*, *and evaluating information and communication systems that enhance individual and population health outcomes*, *improve patient care*, *and strengthen the clinician-patient relationship*. *Clinical informaticians use their knowledge of patient care combined with their understanding of informatics concepts*, *methods*, *and tools to*:

1. *Assess information and knowledge needs of healthcare professionals and patients*,
2. *Characterize*, *evaluate*, *and refine clinical processes*,
3. *Develop*, *implement*, *and refine clinical decision support systems*, *and*
4. *Lead or participate in the procurement*, *customization*, *development*, *implementation*, *management*, *evaluation*, *and continuous improvement of clinical information systems* [36].

The key concepts were that physicians who are clinical informaticians must measurably improve care or care processes and that they must have the skills to collaborate with a wide array of disciplines and health professionals. In practical terms a clinical informatician should be able to lead an implementation of an Electronic Health Record (EHR). Sometimes this type of clinician is called a Chief Medical Information Officer (CMIO) although depending on the organization, a CMIO might have other responsibilities as well [38].

Table 4.1 summarizes the four main topic areas described by the CORE CONTENT team. Each of these topic areas had several sub-topics – in fact a total of 177 subtopics are outlined in the final document [36].

The Core Content team did not specify the relative importance for each of the main content areas but did elucidate subtopics, although the depth of details was not consistent. For instance, there were 32 subcategories for fundamentals and 69 for health information systems. Moreover, the level of specificity also varied. For instance, there were 30 subcategories of information systems with 10 related to data (not even including eight subcategories on data standards) while there were only five subcategories for effective communication. In total, the team identified 177 items in defining the core content. These different levels of detail presented some challenges for the test writing committee who needed to determine the weighting of the different content domains. Based on information provided by the American Board of Preventive Medicine's "Study Guide Materials Examination Content Outline" Website, the percentage of each of the four content areas is indicated in Table 4.1 [39].

Development of Clinical Training Program Criteria

The Clinical Training team consisted of primarily physicians, computer scientists and other professionals who had worked at establishing operational clinical systems and who had participated in clinical training programs. After completion of the

Table 4.1 Four topic areas describing the CORE CONTENT of clinical informatics [36]

Content [% of items on Board Exam]	Core content	Number of topics
1. Fundamentals [10 %]		**32**
Clinical informatics	1.1	13
Health systems	1.2	19
2. Clinical decision making and care process improvement [30 %]		**35**
Clinical decision support	2.1	23
Evidence-based patient care	2.2	8
Clinical workflow analysis	2.3	4
3. Health information systems [40 %]		**69**
Information technology systems	3.1	31
Human factors engineering	3.2	5
HIS applications	3.3	5
Clinical data standards	3.4	8
Information systems lifecycle	3.5	20
4. Leadership and management change [20 %]		**41**
Leadership models	4.1	8
Effective interdisciplinary teams	4.2	6
Effective communications	4.3	5
Project management	4.4	9
Strategic and financial planning	4.5	8
Change management	4.6	5
	Grand total	**177**

Core Content document, the Clinical Training team began its deliberations with Dr. Charles Safran, an internist and clinical informatician as Chair with Dr. M. Michael Shabot, a surgeon and clinical informatician as vice-Chair. The assignment of the second team of 12 experts was to determine how the "Core Content" of clinical informatics should be taught in a two-year fellowship training program [37, 40]. The team had to grapple with which of the 177 items of core content could be learned best by didactic instruction and which required experiential learning. Also the team realized that most of the existing training programs in biomedical informatics, which were designed to produce system developers and researchers, did not cover all of these content areas. The Clinical Training team concluded that each training program should be able to certify that a trained clinical informatician could demonstrate the competencies shown in Table 4.2.

To accomplish meeting the above noted goals the team determined that training programs should:

(a) Develop a curriculum with clear learning goals.
(b) Ensure fellow participation in scholarly activities that "advance fellows' knowledge of the basic principles of research, including how such research is conducted, evaluated, explained to patients, and applied to patient care."
(c) Provide didactic sessions to assure all "core content" is covered during a 2-year fellowship.

Table 4.2 Informatics competencies to be demonstrated at the end of training

1. Search and appraise the literature relevant to clinical informatics;
2. Demonstrate fundamental programming, database design, and user interface design skills;
3. Develop and evaluate evidence-based clinical guidelines and represent them in an actionable way. All clinical informaticians should be able to represent such guidelines in a logical way, while others would be able to program them into computer code;
4. Identify changes needed in organizational processes and clinician practices to optimize health system operational effectiveness;
5. Analyze patient care workflow and processes to identify information system features that would support improved quality, efficiency, effectiveness, and safety of clinical services;
6. Assess user needs for a clinical information or telecommunication system or application and produce a requirement specification document;
7. Design or develop a clinical or telecommunication application or system;
8. Evaluate vendor proposals from the perspectives of meeting clinical needs and the costs of the proposed information solutions;
9. Develop an implementation plan that addresses the sociotechnical components of system adoption for a clinical or telecommunication system or application;
10. Evaluate the impact of information system implementation and use on patient care and users;
11. Develop, analyze, and report effectively (verbally and in writing) about key informatics processes.

(d) Provide "rotations [that] are experiential assignments, of finite duration … designed to provide fellows with exposure to different types of clinical and health information systems, in a range of settings that includes inpatient, ambulatory, and remote applications" [37]. These rotations should comprise 15 % of the two-year training experience.
(e) Provide a long term assignment for each fellow of at least 12 months on a project team.
(f) Fellows must conceive, develop, implement, and evaluate a substantive, applied Clinical Informatics project and present the results of the evaluation in a peer-reviewed setting.

In addition to public presentations of the two documents, more than 80 people participated in developing and reviewing the Core Content [36] and the Training Requirements for Fellowship Education in the Subspecialty of Clinical Informatics [37].

American Board of Medical Specialties Approval of Clinical Informatics as a Subspecialty

It was decided that clinical informatics was best pursued as a subspecialty. Clinical informatics cuts across many of the other medical specialties, and on a practical level, a subspecialty was more feasible to establish. Leaders of AMIA contacted member boards of ABMS to find which of the 24 Boards might be willing to take the lead in creating the new subspecialty of clinical informatics. The American Board of Preventive Medicine (ABPM) became the lead board and won approval for

creating the subspecialty of clinical informatics. ABPM was then joined by the American Board of Pathology (ABP) to create the certifying process and examination for clinical informatics. All of the 24 member boards of ABMS allow their members to sit for the clinical informatics subspecialty examination, and it is likely in the future that many boards will adopt clinical informatics as a formal subspecialty within their specialty. The ABMS granted final approval of clinical informatics as a board-certified medical subspecialty in September 2011 [41].

The American Board of Preventive Medicine and the American Board of Pathology have become the primary sponsors of the subspecialty board certification. Physicians who are board certified in any of the 24 ABMS boards are eligible to become board certified in clinical informatics. All except those physicians who are board certified in pathology must apply for clinical informatics subspecialty certification through the American Board of Preventive Medicine. Those physicians board certified by the American Board of Pathology must apply through the American Board of Pathology [42].

To be eligible to take the first examination for board certification in the subspecialty of clinical informatics (October 7–18, 2013), the following requirements must be met [39]. Application completed from March 1 to June 1, 2013, AND

1. Have current certification by at least one of the member boards of ABMS; AND
2. Medical school or osteopathic school graduation; AND
3. Current license(s) in the USA or Canada; AND
4. Completion of one of the two Pathways noted below:

   (a) Practice Pathway – "Grandfather Path" – three years of practice in clinical informatics, significant clinical informatics responsibility, verified time of at least three years in clinical informatics for the five years prior to application, OR, for those who have completed a non-accredited fellowship training program of less than 24 months, curriculum and evidence of completion of the practice pathway are required
   (b) Fellowship Training Pathway – Completion of a fellowship program of at least 24 months in duration that is acceptable to the ABPM is required. Initially, a mix of Practice Pathway AND Fellowship Training Pathway will also be reviewed by ABPM. Starting in 2018, only programs that are accredited by the Accreditation Council for Graduate Medical Education (ACGME) will be eligible [40].

Developing the Board Certification Examination for the Clinical Informatics Subspecialty

The ABMS, in approving clinical informatics as a subspecialty, adopted the documents provided by the two teams [36, 37]. These documents are literally the foundation of the clinical informatics subspecialty. The ABPM and ABP, with guidance from AMIA, assembled an examination committee of 16 experts to develop a bank

of over 300 questions for the online certification examination. The development of the examination for board certification adheres to the outline provided by the Core Content team, but since the core content team did not establish the level of importance of each of the content areas nor did they specify at what level of detail a clinical informatician should demonstrate their competency, these decisions were made by the examination committee.

From 2011 to 2013 the group of 16 experts met four times. Both Charles Safran, Chair of the Clinical Informatics Fellowship team and Reed M. Gardner, Chair of the Core Content team are members of the certification examination test development committee. The examination is a one-day, multiple choice question examination administered by Pearson VUE Professional Centers throughout the United States and at several international sites [39].

Because the actual examination questions and content are "confidential" for obvious reasons, only a broad overview of the methodology used is presented here. Standard test development procedures were followed. Questions writers with different areas of expertise prepared the initial questions and then each question was reviewed by the entire group of experts. Broad ground rules for developing the multiple-choice questions and answers were:

1. Questions should focus on the practice of clinical informatics, not the history of the field.
2. Questions should have one correct answer and about three distractors; True/False questions were not permitted.
3. Each question required an appropriate reference supporting the correct answer.

Because many members of the test committee were academic experts, the members are, of course, required to keep the test content confidential and cannot share the detailed content with their students, with their colleagues, and cannot "teach to the test" in their own programs.

The process of preparing questions and vetting each of them with the group of experts is complex and difficult. While the members of the Core Content team had a sense their work was historic, none of the team members understood how literally the core content outline would guide the construction of the Board Exam. For instance, we were quite detailed about "information systems" but less so about "clinical decision support." While clinical workflow was only briefly mentioned in the outline, that did not reflect its importance.

Moreover, important subjects like "workflow" or "governance" are barely mentioned in many of the classic or current textbooks on informatics. Most textbooks cover some, but not all of the needed content areas [20, 43–53]. The ABPM lists texts and journals that would be helpful for the examination, but these are likely to change over time, especially because the current texts do not cover all of the needed content. Certainly the academic and subspecialty field of clinical informatics is new and under development. As a consequence it should come as no surprise that few textbooks and formal training materials are currently available. In addition, as was mentioned earlier, many of the informatics training programs were designed to produce developers and researchers, not the applied clinical informatics practitioners

for whom the certification is designed. Consequently, questions on content not covered in many current textbooks will be a challenge for physicians who want to use a textbook to study for the first examinations. New texts and training materials that are relevant to the new subspecialty clearly need to be developed. The American College of Pathologists has recently published a text *Pathology Informatics: Theory & Practice* which is broader than earlier texts in the field [51].

Accreditation of Training Programs in Clinical Informatics

Over the coming months and years, the American Board of Preventive Medicine will take on the responsibility for accrediting training programs in clinical informatics. Initial requirements for such accreditation were described by the Clinical Training team [37].

Clinical and academic programs at universities and healthcare organizations will need to organize and establish such training programs much as they have for Medicine and Surgery. However, it is likely that special efforts will need to be taken since several of the academic Biomedical Informatics education programs do not have close operational affiliations with clinical centers. While the AMIA 10×10 programs have functioned well for providing basic informatics education, clinical informatics requires that Fellows work in the clinical setting which is a much more challenging program to establish and run. Currently curricula for training in the field of Biomedical Informatics have a wide diversity of program content [54]. However, the content of clinical informatics fellowships has very specific and detailed requirements [37].

Challenges and Opportunities for Clinical Informatics

The next 5–10 years will present challenges and opportunities for clinical informaticians. Hopefully a large number of clinical informaticians who are "grandfathered" into exam eligibility will take the exam and become board certified. Such board certification will add credibility to the field and provide an excellent method for making the discipline of clinical informatics more professional. In addition, there will likely be new and innovative programs in clinical informatics that develop in the United States and Canada. The recognition of clinical informatics as a medical subspecialty with board certification will also have worldwide implications for healthcare education.

Since subspecialties in medicine no longer have "lifetime" tenure, those who are board certified in clinical informatics will be required to maintain their certification through a process of Maintenance of Certification (MOC). AMIA and other professional organizations will have the opportunity to offer courses and share successful clinical informatics experiences which will enhance the field.

Summary

While changes in healthcare delivery have made the need for clinical informatics specialists more obvious in today's world, the field has been evolving for over 50 years. Multiple experts in the field donated their time and effort to make the field of clinical informatics a reality. Those who donated their time, and those who will in the future, are what will make the field of clinical informatics a success and provide a significant impact on healthcare.

With greater maturity and visibility of the profession of clinical informatics, there has been a greater recognition of the need for specialty certification. Developing the clinical informatics subspecialty took hard work, excellent leadership and external funding. It was almost a decade since the initial efforts were initiated until the first certification examination was conducted. With nurses and physicians being able to be board certified, it is now essential that other healthcare informatics professionals have the opportunity to gain certification – computer scientists, computer engineers, pharmacists, and other medical technologists.

For the subspecialty to grow, hospitals and ambulatory sites must recognize the credentials reflected in the board certification, and must allow clinical informaticians to be involved and encourage them to participate in executive level activities – not keep them relegated to "off to the side geeks." This will be important for training programs as well. Strong training programs will be required to prepare physicians for the board examination and to certify the candidate's experience. Training of clinical informaticians will require both didactic learning that can be tested in a board examination and experiential training similar to all medical specialists. Although remote and web based training are becoming ubiquitous in medicine and other fields, clinical informatics will require a "live clinical laboratory". Training programs are developing and there will likely need to be accreditation of those training programs in the future.

Once the certification and accompanying training process becomes operational, it will be essential to evaluate the utility and effectiveness of board certification in clinical informatics. Clearly, there is still much work to be done. We have only begun on a long and changing journey to implement training programs, evaluate them, improve them and make continuous progress in the field of clinical informatics.

Lessons Learned

- External experts, who had gone through the process of getting board certification, were essential in developing clinical informatics board certification. As noted earlier, Dr. Benson S. Munger had recent experience with another Board at getting certification, and his help was invaluable.

- Obtaining professional consensus was essential and at times difficult. With highly competent individuals on both teams, there were several instances where strong feelings and values were held and these situations had to be resolved so that a workable consensus was reached.
- The initial documents guiding the Core Content and Training were a key reference for the examination committee and assumed more importance than the experts who created the documents realized.
- Because multiple choice tests are not routinely used in testing informatics trainees, there was a learning curve for the test committee to learn to write effective test questions for the examination.
- Many areas of expertise that clinical informaticians must acquire such as leadership and management skills are challenging to test in multiple choice formats.
- The process of Board Certification is a "living" process – which is continually changing and improving over time. Establishing "grandfathered rules" for the first board certification process was difficult and the rules may need revision over time. In addition, information that was essential 20 years ago may be obsolete today.
- Required interaction with other professional organizations was essential, productive and healthy.
- Because the competencies of the clinical informatician span academic and operational areas, there must be cooperation between several clinical, computer science, engineering, leadership training, business and management centers to provide optimal training and professional development.
- The recent Institute of Medicine Report about safe IT systems [55] provides support for the timeliness and importance of assessing the complex sociotechnical concepts that clinical informaticians will have to master.
- There are currently many texts about clinical informatics topics. However, none of them have been designed to fill the core requirements as outlined for the subspecialty of clinical informatics.
- The subspecialty of clinical informatics is a rapidly changing field as illustrated by the fact that the ABPM clinical informatics exam writing committee had to reject questions that were originally accepted during its first round of question preparation.

Key Take-Away Points

- Changes in the healthcare environment have created a need for clinical informaticians.
- Clinical informatics has been evolving as a discipline for over 50 years
- Subspecialty training and specialty board certification can add to the professionalism of the discipline.
- Creating an examination and training programs for an evolving field is challenging.

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