EVALUATION OF CURRENT CLINICAL INFORMATICS FELLOWSHIP TRAINING CONTENT FOR PHYSICIANS

By

Corneliu Antonescu

A CAPSTONE

Presented to the Department of Medical Informatics & Clinical Epidemiology
and the Oregon Health & Science University
School of Medicine
in partial fulfillment of the
requirements for the degree of

Master of Biomedical Informatics

May 2016

School of Medicine

Oregon Health & Science University

CERTIFICATE OF APPROVAL

_____

This is to certify that the Master's Capstone Project of

Corneliu C. Antonescu

"**Evaluation of current Clinical Informatics Fellowship training content for physicians**"

Has been approved

_____

Capstone Advisor: Vishnu Mohan, MD, MBI

Abstract:

Objectives: To evaluate the alignment of Clinical Informatics (CI) Fellowship curricula with the ACGME requirements and American Medical Informatics Association guidelines for fellowships in Medical Informatics, and to identify challenges in setting up and running a Clinical Informatics Fellowship for Physicians.

Methods: This research was conducted using mixed methods (qualitative and quantitative). Data was obtained through an online survey followed by an interview.

Results: The online survey was filled by 7 Program Directors (PDs) of ACGME accredited fellowships (53% of the 13 accredited programs at the time). Six PDs (38%) participated in a follow-up interview. On average, fellows spend most of their time in the first year in applied Clinical Informatics, for example participating in the design of EHR solutions like order sets, Clinical Decision Support (CDS) or planning and support of new implementations. In the second year most of the time is spent in Research. The programs typically consists of structured rotations and may vary in length even within the same program. Training in Inpatient/ED Clinical Informatics activities was predominant compared to Ambulatory Clinical Informatics activities (OR=2). Fellows spend on average between 4 and 10 hours per week in clinical activities. All programs have locally developed educational content in Clinical Informatics but three out of 7 (42.8%) also offer content developed by other organizations. When participating in projects fellows are more likely to be asked to be involved in projects involving designing EHR solutions and less likely to be involved in Telemedicine or Public Informatics projects. The most significant barriers in setting up and running a Clinical informatics fellowship are the financial challenges. Matching CI training to a rotation model similar to Clinical Medicine Fellowships is also a challenge. Participants suggested competencies for the CI fellowship programs need to be

more specific for Clinical Informatics and the didactic curriculum needs to place a higher emphasis on Data Analysis (Analytics).

Conclusions: While the newly created Clinical Informatics fellowships provide a diverse training and experience, identifying funding for these programs is challenging. Programs also have difficulty aligning the Clinical Informatics training opportunities with the ACGME requirements modeled after the requirements for fellowships in clinical subspecialties.

Keywords: Clinical Informatics, Fellowship, Training, Curriculum

1. Background and Significance

Clinical Informatics is a relatively new science. The specialists and experts come from various educational and professional backgrounds, including formal training as physicians. Clinical Informatics is now a recognized medical subspecialty and there are currently 20 ACGME accredited fellowship programs (thirteen at the time this study was conducted) that train physicians in clinical informatics.

A board certification process in Clinical Informatics by the American Board of Preventive Medicine was started in 2013. This board certification would confer the same level of professional recognition to physicians as certification in any other clinical subspecialty with respect to attesting the expertise of the certified individual. After an initial "grandfathering" period of 5 years, during which applicants may be certified as specialists in Clinical Informatics based on professional informatics experience and successfully passing an exam, the only pathway to certification will require the completion of a Fellowship Program. [1]

The American Medical Informatics Association (AMIA) Board of Directors approved the content requirements for fellowship training in 2008 [2] and the Accreditation Commission of

Graduate Medical Education (ACGME) adopted a set of requirements in 2009 which are periodically updated [3]. According to AMIA, the role of Clinical Informaticians is to assess the information needs, evaluate and improve clinical processes, design and implement clinical decision support and lead or participate in efforts throughout the lifecycle of clinical information systems.

The core content for fellowship programs is classified within four main categories: 1. Fundamentals, 2. Clinical Decision Making and Care Process Improvement, 3. Health Information Systems, 4. Leadership and Management of Change, and have been described in detail. [2]

Evaluations of the medical fellowships in medical specialties have been published before [4-6]. In an evaluation of Cardiology Fellowship Training published in 2012, four years after the Core Content requirements were published, Pack et al found that most cardiology training programs were not adhering to the core content guidelines in the field of preventive cardiology, citing "lack of time" and "lack of a developed curriculum" main obstacles.[5] An evaluation of a Pathology Informatics program was published and it found generally good alignment to the AMIA requirements for Clinical Informatics fellowships discussed above with some areas of discrepancy, mostly related to the fact that the AMIA requirements are not specific to Pathology Informatics but to Clinical Informatics.[7] We did not find any previous evaluation of Clinical Informatics Fellowship curriculums that has been published.

2. Objectives

Our objective was to evaluate how the Clinical Informatics Fellowship curricula align with the ACGME requirements and AMIA guidelines for fellowships in Medical Informatics. We also wanted to find out what some of the challenges in setting up and running a Clinical Informatics

Fellowship for Physicians were, and how programs have faced these challenges. This research is motivated on one hand by the need for rapid growth in this area of Health IT to fulfill the needs of healthcare, and on the other hand the difficulties inherent at the onset of any new process, in this case the Clinical Informatics fellowships for physicians.

3. Methods

In this mixed methods study, data was obtained from a quantitative online survey, and subsequently follow-up interviews were conducted using qualitative techniques.

An online survey was created on surveymonkey.com (SurveyMonkey, Inc., Palo Alto, California). The survey contained 25 questions about the structure of the program, the current fellows' background, the didactic curriculum topics mapped to the categories and subcategories from AMIA core content, foci of educational assignments from ACGME program requirements, the EHR platforms utilized at the institutions, and the barriers to the administration and running of fellowship in Clinical Informatics (Appendix1).

Three emails inviting participation were sent between March 15, 2016 and April 4, 2016. The survey closed on Apr. 10, 2016.

The online survey was completed by 7 Program Directors representing 7 ACGME accredited programs. Five of the respondents provided contact information and where contacted for a follow-up interview. Of the respondents who provided contact information four were scheduled for telephone interviews and one Program Director provided answers to the interview questions by email.

In addition to some clarifying questions about answers in the online survey, the interview consisted of questions about the most common issues and suggestions for improvement in running a Clinical Informatics Fellowship identified in the online survey (Appendix 2).

After conducting the interviews which were recorded, outlines of the themes expressed in the answers where written on index cards and the Card Sort method was applied to identify any prevalent concerns or solutions.

4. Results

Our data from the online survey includes responses from 7 program directors. Most respondents answered all the questions; however one participant only answered the questions that had pre-configured choices (checkboxes or radio buttons).

For the fellowships that were accredited, the number of positions approved ranged between 2 and 8 (total number, including both first and second year quotas). Some programs received initial accreditation for a specific number of fellows and then requested and received approval for increasing the number of trainees. Programs might also be initially approved for a specific number of positions but might not fill all their positions initially because of challenges setting up the program. The number of fellows currently in training ranged from zero to 3 (some of the programs that responded were gearing up to start training their first cohort of fellows in July 2016).

Clinical Informatics fellowships in this study have between 6 and 12 faculty. Between 0 and 3 affiliated faculty is paid by the program. There are between 2 and 10 faculty designated by programs as "key" (key faculty is defined as faculty spending at least 10h per week teaching supervising and evaluating fellows).

On average, during the first year fellows spend most of their time in applied clinical informatics projects (about 37% of their total training time). On the second year, the largest single chunk of their time is spent on research (about 32% of fellow time). Fellows spend 10% in data analytics in the first year and 7 % in data analytics in the 2nd year. There is little

difference between the time spent in didactic sessions (about 20% of the time), clinical activities or other activities between 1st and 2nd year of fellowship (13-14%), see Figure 1.

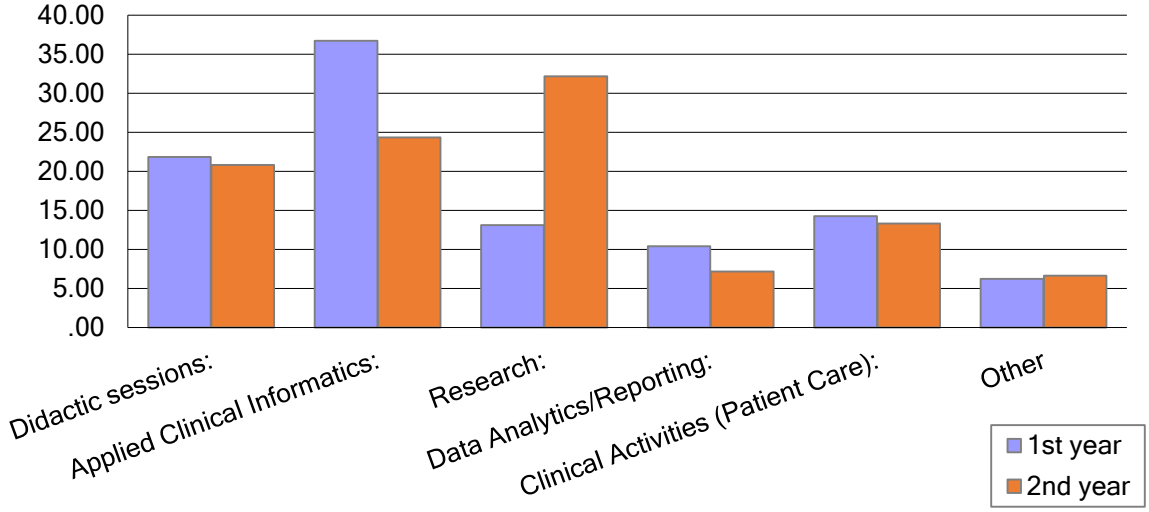

Figure 1. Time as a percentage that fellows spend in various activities in the CI Fellowship program in 1st year and the 2nd year.

Among the programs that participated in the survey, the training was organized utilizing more than one paradigm. All programs organized training in rotations, however the rotations vary in length between one and three months. When the rotations are fixed in length, fellows may also participate in longitudinal experiences that span multiple rotations. Rotations also may vary in length within the program. Rotations may be structured where the goal is to become exposed and learn one topic in one rotation or unstructured, where fellows follow a practicing informatician and participate in activities that relate to multiple topics.

When asked about whether the fellows activities are mostly in inpatient versus outpatient 3 programs (50% of respondent) reported a 1:1 ratio or close, however the other two programs that answered the question reported predominantly inpatient informatics, up to 100 % in one program.

For didactic sessions, Clinical Informatics fellowships may use locally developed content or content developed by another organization (such as Oregon Health and Science University). In some programs, attending the didactic curriculum also leads to a Master Degree. Most of the AMIA curriculum topics, based on the AMIA Core Content [2] are a required topic in all programs, as seen in Figure 2. Of the list of subcategories from the core content the least required topic is Human Factors Engineering. Other subcategories which are optional in more than one program are: Effective Interdisciplinary Teams, Effective Communications and Information System Lifecycle.

		Required	Optional	1 2 3 4 5 6 7
Fundamentals	Clinical Informatics	7	0	
	The Health System	6	1	
Clinical Decision Making and Care Process Improvement	Clinical Decision Support	7	0	
	Evidence-based Patient Care	6	1	
	Clinical Workflow Analysis, Process Redesign, and Quality Improvement	7	0	
Health Information Systems	Information Technology Systems	7	0	
	Human Factors Engineering	3	4	
	Health Information Systems and Applications	7	0	
	Clinical Data Standards	7	0	
	Information System Lifecycle	5	2	
Leading and Managing Change	Leadership Models, Processes, and Practices	7	0	
	Effective Interdisciplinary Teams	5	2	
	Effective Communications	5	2	
	Project Management	6	1	
	Strategic and Financial Planning for Clinical Information Systems	7	0	
	Change Management	7	0	

Figure 2. AMIA Core content and coverage in Clinical Informatics Fellowships

When fellows are involved in informatics projects, they are more likely to be asked to participate in designing EHR solutions, designing CDS related projects, projects involving user interface design and Information technology business strategy and least likely to be asked to participate in Remote systems/Telemedicine, Public Health Informatics and

Bioinformatics/Computational Biology Figure 3, however participation in project is also dependent upon what is available at a given time or based on fellow's interest. The categories in this section come from the ACGME focus for educational assignments.

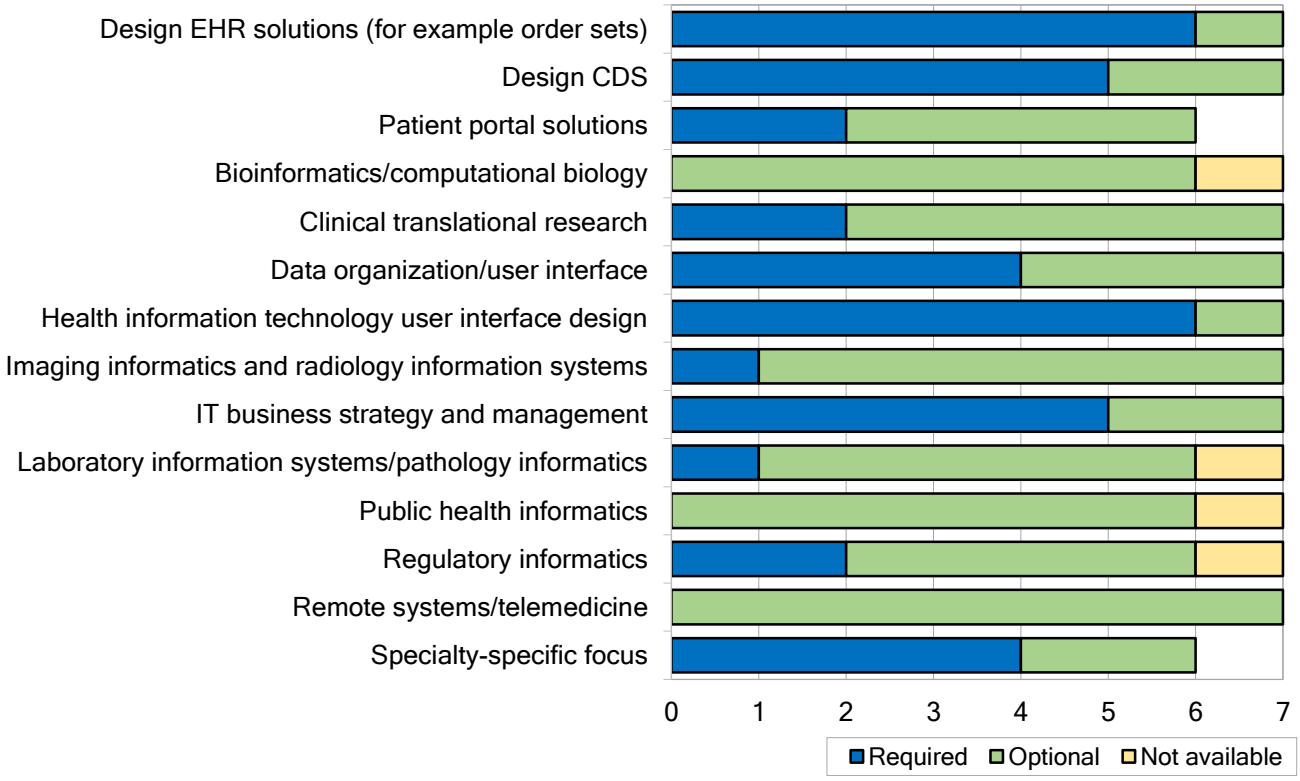

Figure 3. Types of project in Clinical informatics fellowships

In fellowships that answered our question about the availability of EHR's, fellows are exposed to the Epic EHR (5 fellowships) and Cerner EHR (3 sites). Two programs give fellows access to VistA, and fellows also get exposure to NextGen (1 program) and Allscripts (1 program).

All fellows can access both the front-end and the back-end of the EHR. Fellows also gain exposure to a range of analytic/database tools for reporting. This access may be direct, with the fellow receiving their own credentials, or indirectly by interacting with the respective team.

In our online survey, we asked participants what are the obstacles and barriers in the administration and delivery of the Clinical Informatics training and suggestions for improving Clinical Informatics. (Table 1)

Answer Options		Rating Average
Lack of developed curriculum		2.17
Lack of faculty expertise or interest		1.17
Financial Challenges setting up the fellowship		3.00
Other		3.33
Other (description)		
1	rotation model not conducive to informatics learning activities	
2	Internal politics of our institution	
3	"Round peg, square hole" of ACGME processes	

Table 1. Barriers in administration of Clinical Informatics Fellowships

Financial barriers represented the largest barrier for half of the programs that responded, followed by the lack of a developed curriculum. Participant's suggestions to improve Clinical Informatics training: (1) the need for creating a sustainable financial model, (2) decreased emphasis on the classical rotation model of training, (3) the ability to integrate Clinical Informatics as a track in other clinical fellowships, (4) the ability to update the program requirements and national milestones, (5) the need to be able to share the didactic curriculum, and (6) the ability to increase operational learning.

These themes were further examined by conducting interviews with Clinical informatics Program Directors. These interviews yielded significant insights.

Financial Challenges: Three interview respondents ranked the financial challenges as being the largest obstacle. Most of the programs struggle in this area. Current sources of funding include the hospitals programs are affiliated with, the Medical School they are part of, IT vendors or corporate sponsorship and donors; most programs use a combination of these sources. Four of the five PD's interviewed mentioned receiving funding from affiliated hospital(s). This

funding was sometimes tied to the fellows working shifts in the hospital, while other programs secured funding support from Clinical Departments. A medical school was less often mentioned as a source, although in one program it represents the main current source of funding. It is however important to notice that differences in the source of funding might also be due to different affiliations of the fellowship program: some fellowships might be affiliated with a Medical School and some other might be primarily affiliated with a Hospital system. Four out of five PDs also mentioned that they are worried about the sustainability of their current financial model they are continue to explore other sources of support.

Curricular challenges: Lack of a developed curriculum was the next largest barrier (Rating Average 2.17 out of 4). Finding a model of collaboration among programs to develop a shared didactic curriculum was suggested in the interviews.

With respect to the content of the curriculum, Program Directors suggested that topics related to change management are of significant importance for clinical informaticists who might become CMIO's. One PD suggested the need to increase emphasis on this topic. Conversely, two PDs suggested reducing the quantity of topics related to Management sciences within the curriculum, which they considered more important when implementing systems, as opposed to the current paradigm of focusing on maintenance and optimization of clinical information systems.

One PD suggested that their program tries to accommodate their fellow's preferences, resulting in an increased focus on the technical aspects of the EHR, particularly on technology like mobile health applications and interoperability. Four of the 5 PD's interviewed, independent of their suggestion for the direction of the changes in the "engineering/management ratio", suggested increasing emphasis on data analytics. There was also a perception that the curriculum

content, developed back in 2008-2009, might no longer satisfy the needs of this rapid changing field.

The rotation model in clinical informatics programs: Four of the five participants in the study elaborated on the idea that the Clinical Informatics fellowship training is dissimilar to the other clinical fellowships. Clinical Informatics training needs to allow more longitudinal experiences for the programs to utilize the opportunities that are available in their organizations for teaching and hands on experience. An apprenticeship model was suggested, where fellows would be matched with a practicing informatician for several months. Some programs are already implementing this to some extent, involving fellows in projects that transcend the typical rotations.

Barriers associated with clinical informatics competencies: Currently two sets of competencies exist, one developed by ACGME and one developed by one of the programs and these would need to be reconciled. Participants indicated that the ACGME requirements could be further revised to reduce references to patient care activities. It was suggested by the PD's we interviewed that the CI programs should suggest the changes, and ACGME should consider changing the competencies based on the suggestions.

Participation in the national match program: Currently Clinical Informatics does not participate in the match program because of the small number of active programs. This increases the risk to programs of unfilled positions, as well as creates a sub-optimal environment for candidates with respect to their choices. It is hoped that in the near future CI Fellowships will participate in the match program. However, because of current funding models, participation in the match program might pose new challenges.

5. Discussion

In this research we evaluated the content of Clinical Informatics fellowship training for physicians. We investigated how programs and training is structured, the content of the training, barriers faced by programs, and potential solutions to overcome these barriers. Some programs have already started training fellows, while others are in the process of initializing their training. Of note, the first programs in Clinical Informatics were approved by ACGME in 2014. In some cases, programs started with a smaller number of housestaff than the number of ACGME-approved positions, with the intent of gradually increasing the number of trainees.

There seems to be no difficulty in recruiting faculty to help train the fellows, even though only a minority of faculty receive reimbursement directly related to the fellowship activities.

Clinical Informatics training consists of a didactic curriculum (lectures) and practical activities (participation in projects and ongoing operations). In the first year of training, fellows spend most of their time in applied clinical informatics activities, while in the second year they spend most of their time in research. Data analytics activities took less than 10% of the training time on average for the 2 years of fellowship, however, most program directors believe that analytics should receive greater emphasis in the future in the fellowship training.

Time in patient care activities varies primarily depending on specialty. Depending on the program, time in clinical activities negotiated with clinical departments within the institution, or is considered “outside” of the CI program and thus classified as “moonlighting”.

To comply with ACGME requirements and tailored in the traditional clinical education model, clinical informatics fellowship training is structured as a series of rotations, however for many of the fellowships this structure is difficult to accommodate. Unlike fellowships in clinical subspecialties where the learning opportunities map to hospital encounters and daily or weekly

cycles of activities, in Clinical Informatics the learning opportunities map to projects that can last for extended periods of time. To resolve this issue some programs have rotations of different lengths, other programs have implemented unstructured rotations where the rotation length depends on what projects are being worked on and other programs have longer term experiences layered on top of the shorter term rotations. Some programs approach an apprenticeship model where the fellow is working closely in a one-on-one fashion with a practicing informaticist.

The didactic sessions that fellows receive are mapped to the curriculum originally developed in 2008 that became the AMIA Core Content for the Subspecialty of Clinical Informatics.[2] Smaller programs have found it difficult to quickly develop a curriculum for one or two fellows, while larger programs may find the curriculum too rigid. In two of the 7 programs in our sample the didactic curriculum is outsourced. In some programs, didactic learning results in a graduate certificate or Master's degree in Medical Informatics. Some Program Directors suggested the need for cooperation among programs in creating a shared didactic curriculum.

The fact that the clinical informatics curriculum was actually created more than 7 years ago raised some concerns of it being out-of-date. Most of the AMIA Core content topics are required in all programs, while a few are optional in a minority of the programs. One notable exception, Human Factors Engineering is optional in more programs than programs in which it is required.

While no consensus emerged of whether content that focuses on "management" aspects (that address business aspects, organizational behavior, working in teams) or "technological" considerations (that address engineering and programming aspects) should receive greater or lesser weight in the future, there was agreement among most of the programs that data analytics content should receive more emphasis.

For their practical experience, fellows from this sample of programs have access to frontend and backend of Epic (5 sites), Cerner (3 sites) and VistA (2 sites), Nextgen and Allscripsts (1 site each). Fellows are exposed to a wide range of projects (designing EHR solutions, designing CDS solutions, user interface design). However, two areas in which participation is considered optional by all of the programs, are "Remote systems/Telemedicine" and "Public Health Informatics". Telemedicine training might need to change in the future, based on the current expansion of the telemedicine field.[8] Public Health Information might need to gain more attention in training because of the increased attention it has been getting from the regulators.

The program directors we surveyed suggested that the competency requirements needed revising, in particular eliminating the areas that reference patient care activities. This, we think, is justified, because the focus of the Clinical Informatics fellowship is not patient care and that is not what the fellows are being trained on.

In our research, the largest problem identified by most of the programs was funding. The concern has been documented before in relation to Clinical informatics. Unlike fellowships for clinical subspecialties where all fellow activities at the bedside generate income (reimbursable as physician services), for clinical informatics fellowships the focus of the fellow activity is not directly generating revenue. Furthermore, teaching hospitals might find it difficult to bill for physician services at the attending level, since their predominant role is a fellow in informatics and not an attending [9]. While programs have found solutions for their financial needs, sufficient to be able to start and run a fellowship, all PD's are concerned with identifying a long term solution for the financial needs of the program.

Participation in the Match program is another topic brought up by the Program Directors. At the time of this writing the number of Clinical Informatics fellowships was too small for participation, however this would no longer be a problem in the future.

6. Conclusions

Our research shows that Clinical Informatics fellowship have a diverse portfolio of activities they use in training. In general, most of the AMIA Core content is required by most fellowships. One area, Human factors engineering is optional in most programs.

Of the challenges mentioned by the participants in the study, financial challenges were the most significant. Other challenges are related to the difficulty in aligning the programs with the current ACGME Program Requirements document, which is an adaptation of the curriculum written for medical and surgical subspecialties and has many areas that are applicable to patient care. Lastly, it is felt that participation in the Match program for resident and fellows would be a benefit to programs and fellows.

7. Clinical Relevance Statement. Our study approaches Clinical Informatics fellowship training for physicians. While our results do not directly impact patients, the indirect impact is significant. Improving the content and the functioning of the Clinical Informatics fellowships will improve the quality of the solutions that are being designed and implemented.

8. Conflict of Interest

No conflict of interest was identified.

9. Human Subjects Protections

The study was approved by two Institutional Review Boards: Oregon Health and Science University (where the principal investigator was a student, in the Biomedical Informatics

Master's Program at the time of the study) and Banner Health Institutional Review board (where the principal investigator was employed at the time of the study).

10. Acknowledgments: we would like to thank all the Program Directors who participated in this study for their time and their opinions.

11. References

1. Subspecialties [Internet]. Chicago, IL: American Board of Preventive Medicine; 2015 [cited 10/28/2015]. Available from: https://www.theabpm.org/subspecialties.cfm.

2. Gardner RM, Overhage JM, Steen EB, Munger BS, Holmes JH, Williamson JJ, et al. Core content for the subspecialty of clinical informatics. J Am Med Inform Assoc. 2009 Mar-Apr;16(2):153-7.

3. ACGME Program Requirements for Graduate Medical Education in Clinical Informatics [Internet].; 2015 [updated 09/27/2015;]. Available from: http://www.acgme.org/acgmeweb/Portals/0/PFAssets/ProgramRequirements/381_clinical_informatics_2016.pdf;.

4. Durning SJ, Hemmer P, Pangaro LN. The structure of program evaluation: an approach for evaluating a course, clerkship, or components of a residency or fellowship training program. Teach Learn Med. 2007 Summer;19(3):308-18.

5. Pack QR, Keteyian SJ, McBride PE, Weaver WD, Kim HE. Current status of preventive cardiology training among United States cardiology fellowships and comparison to training guidelines. Am J Cardiol. 2012 Jul 1;110(1):124-8.

6. Raman M, Shaffer E, Lockyear J. Gastroenterology fellowship training: approaches to curriculum assessment and evaluation. Can J Gastroenterol. 2008 Jun;22(6):559-64.

7. Gilbertson JR, McClintock DS, Lee RE, Onozato M, Kuo FC, Beckwith BA, et al. Clinical fellowship training in pathology informatics: A program description. J Pathol Inform. 2012;3:11,3539.93893. Epub 2012 Mar 16.

8. Eramo, Lisa A. Healthcare On Demand: An Expanding World of Telemedicine Raises New Questions for HIM Professionals *Journal of AHIMA* 85, no.9 (September 2014): 26-29.

9. Lehmann CU, Longhurst CA, Hersh W, Mohan V, Levy BP, Embi PJ, et al. Clinical Informatics Fellowship Programs: In Search of a Viable Financial Model: An open letter to the Centers for Medicare and Medicaid Services. Appl Clin Inform. 2015 Apr 15;6(2):267-70.

Appendix 1. Online Survey Questions:

1. How many Clinical Informatics fellows are in your program? (total, fellows in 1st year and second year).

2. How many Clinical Informatics faculty does your fellowship have?

3. How many of your Clinical Informatics faculty are volunteers and how many are in a paid position?

4. How many Key Clinical Informatics faculty does your fellowship have? (Key faculty spend 10 hr/wk throughout the year in teaching, supervising, and evaluating fellows.)

5. How do your Clinical Informatics fellows spend their time in the program during the first year? (enter percentage values, without the % sign; the values need to add up to 100)

   Didactic sessions: ___
   Applied Clinical Informatics: ___
   Research: ___
   Data Analytics/Reporting: ___
   Clinical Activities (Patient Care): ___
   Other ___

6. How do these fellows spend their time in the program during the second year? (enter percentage values, without the % sign; the values need to add up to 100)

   Didactic sessions: ___
   Applied Clinical Informatics: ___
   Research: ___
   Data Analytics/Reporting: ___
   Clinical Activities (Patient Care): ___
   Other ___

7. What previous training do your Clinical Informatics fellow(s) have? (Check all that apply.)

   DO ❑*, MD* ❑*, Clinical Informatics Graduate Certificate Degrees* ❑ *, MPH* ❑*, MBA* ❑
   Other Master's Degrees ❑ *(If fields are known please describe_____)*

8. What Clinical Residencies and Fellowships have your fellows completed prior to enrolling in your Clinical Informatics program?

❑ Emergency Medicine
❑ Family Practice
❑ Pediatrics
❑ Internal Medicine
❑ Surgery
❑ Ob-Gyn

Please enter below any other Residencies not enumerated above and Fellowships:

❑ _____

9. Since the ACGME accreditation, how many of the fellows you have trained or are currently enrolled, have had formal degrees in Computer Science? _____

10. What best describes the structure of your fellowship's training in Clinical Informatics? (For example: "we have 1 month rotations through each of the following subject: project management, performance improvement, healthcare quality, population health", "fellows spend two days with each of our affiliated organizations helping out with projects and attending meetings")._____

11. Are the fellows informatics activities Ambulatory or Inpatient/ED based, or both for their EHR environment? (enter percentage values, without the % sign; the values need to add up to 100)

    Inpatient/ED ___;
    Ambulatory ___;

12. Are the didactic sessions (lectures) offered locally or are they provided by a different institution? If different institution please specify institution name.

    Local ❑ ;
    Other Institution: _____

Which of the following topics are covered by lectures in your program? (Items 13-16)

13. Fundamentals: The basic knowledge that provides clinical informaticians with a common vocabulary and understanding of the environment in which they function.

Topic	Required	Optional
Clinical Informatics	❑	❑
The Health System	❑	❑

14. Clinical Decision Making and Care Process Improvement: The knowledge and skills that enable a clinical informatician to implement effective clinical decision making systems and participate in the development of clinical processes that support effective, efficient, safe, timely, equitable, and patient-centered care.

Topic	Required	Optional
Clinical Decision Support	❑	❑
Evidence-based Patient Care	❑	❑
Clinical Workflow Analysis, Process Redesign, and Quality Improvement	❑	❑

15. Health Information Systems: The knowledge and skills that enable a clinical informatician to participate in the development or selection of an information system for clinicians; prepare clinicians prior to implementation and support them during implementation and ongoing operation of a clinical information system; and evaluate the effectiveness of a system in meeting clinical needs.

Topic	Required	Optional
Information Technology Systems	❑	❑
Human Factors Engineering	❑	❑
Health Information Systems and Applications	❑	❑
Clinical Data Standards	❑	❑
Information System Lifecycle	❑	❑

16. Leading and Managing Change: The knowledge and skills that enable clinical informaticians to lead and manage changes associated with implementing clinical information systems and promoting adoption by health professionals.

Topic	Required	Optional
Leadership Models, Processes, and Practices	❑	❑
Effective Interdisciplinary Teams	❑	❑
Effective Communications	❑	❑
Project Management	❑	❑
Strategic and Financial Planning for Clinical Information Systems	❑	❑
Change Management	❑	❑

17. When fellows are engaged in clinical informatics projects, what kind of projects are they involved in?

Topic	Required	Optional
Design EHR solutions (for example order sets)	❑	❑
Design CDS	❑	❑
Patient portal solutions	❑	❑
Bioinformatics/computational biology	❑	❑
Clinical translational research	❑	❑
Data organization/user interface	❑	❑
Health information technology user interface design	❑	❑
Imaging informatics and radiology information systems	❑	❑
Information technology business strategy and management	❑	❑
Laboratory information systems/pathology informatics	❑	❑
Public health informatics	❑	❑
Regulatory informatics	❑	❑
Remote systems/telemedicine	❑	❑
Specialty-specific focus	❑	❑

Other (Please Specify): _____

18. How much protected time (hours) for clinical activities do the fellows have each week? _____

19. Which EHR platforms do your fellows get exposed to?

Allscripts ❑ ;
AthenaHealth ❑ ;
Centricity ❑ ;
Cerner ❑ ;
eClinicalWorks ❑ ;
Epic ❑ ;
Greenway ❑ ;
McKesson ❑ ;
Meditech ❑ ;
Nextgen ❑ ;
Practice Fusion ❑ ;
Vista ❑ ;
Other _____ ❑ ;
Other _____ ❑ ;
Other _____ ❑ ;
Other _____ ❑ ;

20. Do fellows have access to both frontend and backend (system building tools) ?
    Yes ❑ *No* ❑

21. Are fellows exposed to the following systems (if available) and what kind of access do they have ?

System	Yes, they have direct access	Yes, if they interact with the team	No	System not available
Business Intelligence Server	❑	❑	❑	❑
Clinical Reporting server	❑	❑	❑	❑
Databases for clinical reporting	❑	❑	❑	❑
Data warehouse	❑	❑	❑	❑

22. What were/are some of your institutions obstacles and barriers in administration of the Clinical Informatics program, and the delivery of Clinical Informatics training? Please rank order from 1 to 4, with 1 being the largest obstacle and 4the smallest.

    Lack of developed curriculum __
    Lack of faculty expertise or interest __
    Financial Challenges setting up the fellowship __
    Other __ Please Describe_____

23. In your opinion what is the biggest innovation you introduced in your Clinical Informatics program?

24. Please describe suggestions how could Clinical Informatics training be improved nationwide if you think this is necessary.

25. Would you be willing to participate in a brief phone interview? If agreeable, please enter a number where I can reach you from. _____

Appendix 2. Questions for the follow up interview:

1. How many students do you currently have in each year?
2. In terms of barriers to implementing and running a Clinical Informatics program, financial challenges ranked highest. How is your program facing those challenges?
3. Several responses to the online surveys mentioned the rotation model (adopted from fellowships in medical and surgical sciences) not being the best fit for a Clinical Informatics fellowship. What other possible structure would you envision for a Clinical Informatics Fellowship?
4. With regards to the Clinical Informatics Curriculum and ACGME requirements, which areas do you think are under-represented and should receive higher emphasis in the future revisions, and which areas do you think are over-represented and should receive lower emphasis in future revisions ?
5. Do you have any other comments related to Clinical Informatics Fellowship that you would like me to capture?