

The Biomedical Informatics Short Course at Woods Hole/Georgia: Training to Support Institutional Change

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Abstract. The U.S. National Library of Medicine's Biomedical Informatics Short Course ran from 1992 to 2017, most of that time at the Marine Biological Laboratory in Woods Hole, Massachusetts. Its intention was to provide physicians, medical librarians and others engaged in health care with a basic understanding of the major topics in informatics so that they could return to their home institutions as "change agents". Over the years, the course provided week-long, intense, morning-to-night experiences for some 1,350 students, consisting of lectures and hands-on project development, taught by many luminaries in the field, not the least of which was Donald A.B. Lindberg M.D., who spoke on topics ranging from bioinformatics to national policy.

Keywords. U.S. National Library of Medicine, Donald A.B. Lindberg M.D, Biomedical Informatics Training, Marine Biological Laboratory

In memory of Catherine N. Norton M.S.I.S., 1941-2014.

Director, Marine Biological Laboratories/Woods Hole Oceanographic Institute Library

1. Introduction

Donald A.B. Lindberg M.D. firmly believed that the way to promote the adoption of informatics tools, resources and methods in the healthcare community was through outreach programs. Those programs exposed "change agents" from participating institutions to available informatics resources and applications and demonstrated what they could do. In 1990, Don learned of an informatics workshop that, despite being (in his opinion) of low quality, provided an inspiration for a new outreach mechanism.

This chapter describes the results of that inspiration – a short course on medical informatics, sponsored by the National Library Medicine. I will trace history of the development of the course, take a look at how the instructional topics changed over time, and try to give the reader a sense of why the course was such an exceptional experience for students and faculty who participated in it. While I cannot provide an in-depth analysis of the course's impact on the field of biomedical informatics, I reference some published work on the subject.

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In 1991, Don made a trip to the Marine Biological Laboratory (MBL), in Woods Hole, Massachusetts to learn more about MBL's research programs, Kent Smith M.A. (NLM Deputy Director) and Bradie Methany (a friend of Harlyn Halvorson Ph.D., MBL's director at the time) accompanied Don on the trip. While there, they met with Jane Fessenden, then acting director of the MBL Library (which also serves the Woods Hole Oceanographic Institute). Fessenden subsequently sent librarian and director of information services Catherine ("Cathy") Norton M.S.I.S. and biologist David Remsen Ph.D. to visit the National Library of Medicine. During that visit, Cathy got wind of Don's interest in hosting an informatics course. She suggested that Don should consider sponsoring a course at MBL [1].

The combination of the MBL's long history of biomedical education, hands-on laboratory and field work, and seaside setting struck a chord with Don. He had further conversations with Cathy, who wrote a proposal as principal investigator that led to the statement of work quoted below. The MBL hired David Stonehill Ph.D. as director the MBL/WHOI Library specifically to run the course [2]. The contract that followed was the first step in one of the NLM's longest-running and most popular outreach programs – one that ran for 23 years beyond the initially envisioned three.

"This 3-year project in Medical Information Outreach is designed to support the NLM's outreach efforts to the health professional community. The project consists of two phases. Phase I shall consist of three annual one-week sessions at the Contractor's site to train selected health professionals in the use of computer-assisted learning tools, accessing computerized databases, using communication networks, building and using knowledge bases for expert systems, and working with software for analyzing biologic sequence data. The potential audience for this program includes medical educators, members of the medical research community, graduate and postdoctoral students, health professionals from various disciplines, personnel in health agencies and associations, and staff of Regional Medical Libraries."

Professional Services in Support of NLM's Outreach Efforts to Encourage the Use of Computers and Information Science in Medicine – Statement of Work; December 17, 1991

2. Year One: 1992

2.1. History of the Woods Hole Marine Biological Laboratory

The MBL was established in 1885 as a research station for the US Bureau of Fisheries in Woods Hole, Massachusetts, a small fishing village at the time, located on the southwestern-most point of Cape Cod. Situated between the Gulf Stream, which brings southern marine fauna, and Cape Cod Bay, with its resident northern fauna, the MBL was ideally placed to harvest specimens for marine biologists across the country. The disadvantages of long-distance transportation of living specimens soon led biologists to come to the site of the specimens, especially in the summer when relieved of their teaching duties. Medical researchers became interested as well, when they learned of the practical advantages of studying marine organisms, such as squid (with their giant axons),

sea urchins (with their large ova) and horseshoe crabs (with their accessible optic neurons) as models for human biology. The scholarly community grew, as research faculty brought their trainees, and the MBL began offering courses, some of which have run for over 50 years. To understand the appeal the educational experience at the MBL, read Gerald Weissmann's collection of essays in *The Woods Hole Cantata* [3].

2.2. *Marine Biological Laboratory Facilities*

The MBL comprises a collection of buildings around Woods Hole's Eel Pond, a tidal pond in the center of town (Figure 1). The complex includes a highly rated, comfortable dormitory with a cafeteria and café. It also features classrooms and laboratories for research and training. What it did not have, in 1991, was anything like a computer laboratory. The original statement of work provided for establishment of such a lab (in Phase II alluded to above). Initially, the plan was simply to use wet-lab space. This entailed moving some lobster tanks and putting boards over lab sinks to accommodate desktop personal computers.



Figure 1. The Marine Biological Laboratory in Woods Hole, Massachusetts.

2.3. *MBL Short Course Faculty*

Don engaged Daniel R. Masys M.D., Director of NLM's Lister Hill National Center for Biomedical Communications, and David Lipman M.D., Chief of NLM's National Center for Biotechnology Information, as faculty. Don recruited Homer Warner M.D., Ph.D., Chair of the Department of Medical Informatics at the University of Utah, as course director. Homer, in turn, brought Peter Haug M.D., from Utah and Paul Clayton Ph.D., previously from Utah but then Director of the Center for Medical Informatics at Columbia University; Paul brought Robert Sideli M.D., from Columbia. Together, they provided good domain coverage for what were, at the time, the major themes in medical informatics: clinical information systems, decision support systems, library databases, and genetic sequencing.

2.4. *MBL Short Course Curriculum*

According to faculty involved in the initial course offering, very little advanced planning of the actual lectures had occurred (Figure 2). After an initial rocky start, the students were granted their request for a course syllabus, which became the guide for development of subsequent course materials [4]. Evaluations were generally good, with many

comments about the need for and appreciation of structured materials [5]. Afterward, the annual report provided this summary:

“The objective of the course is to train individuals in the applications of computer and information science in medicine. The training consists of computer-assisted learning, retrieving and organizing information from computerized databases, the application of medical informatics tools to the critical appraisal of literature and associated statistical software packages, hospital-and office-based information systems, and electronic communications. Students build and use a knowledge base for an expert system, and work with software for analysis of biological sequence data. Students also access the broad range of published scientific literature using NLM's Grateful Med. Lectures alternate with hands-on experience” [6].

Monday, June 1

Don Lindberg: Access to Medical Literature and Factual Databases; Grateful Med; COACH; Unified Medical Language System

Dan Masys: Computer Networks: Past, Present, Future; Computer Applications for Health Professions Education

Tuesday, June 2

David Lipman: Access to Protein and Genetic Databases

Dan Masys: Introduction to Database Design; Database Workshop

Wednesday, June 3

Paul Clayton: Integrated Academic Information Management Systems (IAIMS) Overview; Principles of Controlled Vocabulary

Robert Sideli: IAIMS Demonstration; Clinical Information Systems; Data Modeling; Database Design

Thursday, June 4

Homer Warner and Peter Haug: Demonstration and Experience of an Expert System; Analyze Patient Database for Statistics for an Expert System; Work with an Expert System

Friday, June 5

Homer Warner and Peter Haug: Use Skills Learned the Previous Day to Build an Expert System

Figure 2. Lectures for the first session of the course, June, 1992.

3. Early Years: 1993-1998

3.1. Evolution of the NLM Informatics Short Course

Don took the student evaluations to heart and tapped Dan Masys and NLM Computer Science Branch Chief Lawrence (“Larry”) C. Kingsland III Ph.D., to pull together reading materials on the course topics and assemble them into 30 black binders for the students. As a result, the second and subsequent years went much more smoothly. The course continued to be held in a classroom for didactic sessions and the wet lab for hands-on exercises. The lab had 15 personal computers, roughly half Macintoshes and half

Windows-based personal computers. Students were paired up – usually one librarian and one physician to each machine [7].

3.2. MBL Short Course Faculty Progression

Homer Warner continued as nominal course director, but the selection of lecturers and lecture topics was left to Dan Masys and Paul Clayton. Most faculty were re-invited each year. Few declined the opportunity to spend a week participating in lectures with fellow leaders in the field, socializing with informatics friends, and enjoying scenic Woods Hole. As word of the course spread, informaticians and former students alike began asking Homer, Dan, Paul and Don to invite them to be on the faculty. Dan retired from NLM in 1994 to move to the University of California-San Diego. He therefore became eligible to serve as course director; Don signed him on immediately.



Figure 3. Cathy Norton, Director of the Library at Marine Biological Laboratory and Woods Hole Oceanographic Institute.



Figure 4. David Remsen teaching squid neuroanatomy to students in the MBL Marine Resources Center.

While the faculty presented most of the lectures and hands-on tutorial sessions, it was the MBL staff who really made the course function coherently. Cathy Norton was quickly recognized as the key to the entire operation: smart, funny, engaging, and knowledgeable. All who knew her would agree that she was larger than life (Figure 3). Cathy also involved David Remsen, who helped teach technical classes and led tours of the Marine Resources Center, handing live squid, sea urchins and horseshoe crabs to the students (Figure 4) while he explained how studies of their biology had led to Nobel prizes for MBL researchers². Cathy's duties as a justice of the peace provided her with many stories with which to regale the students. She performed marriage ceremonies for several MBL short course faculty (myself included) and renewed vows for one of the students and his very surprised wife. Cathy was nevertheless a librarian at heart, and by

² Over the past 100 years, Nobel prizes have been awarded to 59 researchers with connection to the MBL.

1994 she had become the director of the MBL/WHOI Library. The informatics course was a pet project, to which she devoted enormous energy, personally seeing to the care and comfort of all faculty and students. She was the quintessential hostess and manager. The 900 MBL Short Course students she oversaw undoubtedly remember her well. She continued in her leadership role as Principal Investigator on the NLM Informatics Short Course grant until 2011, when she retired from the MBL. Sadly, she passed away in 2014. She has left indelible marks on the course and all who were involved in it.

Many other MBL staff contributed to the success of the course, ranging from travel and accommodation logistics to technical support and leading hands-on laboratory sessions, including Diane Rielinger M.S., M.L.I.S. (who took over as course principal investigator), John Furfey M.L.S. and Jennifer Walton M.L.I.S.

3.3. NLM Informatics Short Course Topics

The subject matter of the course evolved annually, based on contemporarily important and popular topics. Faculty were added to cover the additional topics, but there was no formal, longstanding syllabus. Rather, the NLM Informatics Short Course was a survey curriculum designed to expose students to general areas and provide sufficient depth to challenge them. It taught students that there was much more to know. As a way of providing some coherence, Dan Masys introduced the idea of a theme for the week and initially chose Alpha-1 Antitrypsin Deficiency, since it had known genetics (including a gene sequence), a serious but treatable clinical presentation, a good differential diagnosis, and easily accessible information in various databases and online resources [5]. Individual faculty embraced this guidance to varying degrees. As described below, the course content became more varied and more intense over the ensuing quarter-century.

Dr. Lindberg usually provided high-level context for the course, presiding over the welcome session, usually the evening before the first day of classes. His introductory comments encouraged students to interact with faculty and each other - in and out of class. He told them not to leave at the end of the week with any burning questions unanswered. He also provided lectures on various topics, ranging from bioinformatics to national policy. He usually presided over the closing session on the last day and made sure that all those questions did get answered. But most of all, he was available during the week to the students before, between and after classes, and at meals. Students were thrilled to share stories and pick the brain of someone who was a legend in his own time and Director of the National Library of Medicine.

4. 1999-2013

4.1. Doubling Down on the NLM Informatics Short Course

As popularity of the course grew, Don decided in 1999 to move from one session per year to two, each with 30 students. Dan Masys then asked for help with directing the course, and in the tradition of “see one, do one, teach one”, I was added to the faculty for the new fall course and became its director the following year. Dan continued as director of the spring course until 2005, when he moved to Vanderbilt University. I remained course director through 2015, with help in some years from Clement McDonald M.D.

(Lister Hill Center Director) and Joyce Mitchell Ph.D. (Chair of Biomedical Informatics at the University of Utah).

The shared workstations and paper-based materials gave way to individual laptops (Windows-based or Macs), and the class moved out of the lab to a large, airy room in a building called the Little Club, situated on Water Street, next to the WHOI pier. It was not unusual for class to be interrupted by large research vessels coming to dock in full view of the class. During inclement weather, waves added excitement, breaking on (but not through) the windows.

4.2. Continued Changes to MBL Short Course Contents

Lecture topics continued to evolve (see Figures 5 and 6). The disease-of-the-week changed to hereditary hemochromatosis, with an elaborate patient case that included medical history, family history, physical findings, laboratory results and medications, which many of the faculty worked into their lectures. Dan added a “Vanderbilt Day” to

Monday, June 1

Jim Cimino: What is Informatics?; Principles of Database Design

Joyce Mitchell: Bioinformatics

Stephen Phillips and Victor Cid: Disaster Informatics

MBL Team (Evening): Managing Data with Drupal; Twitter

Tuesday, June 2

Jim Cimino: Principles of Controlled Terminology

Mike Ackerman: Imaging Informatics; Telemedicine

MBL Team (Evening): Project Time

Wednesday, June 3

Ed Hammond: Clinical Information Systems I

Clem McDonald: Clinical Information Systems II

Kathy Canese: NCBI, Pubmed & More

MBL Team (Evening): Optional Project Time

Thursday, June 4

Rita Kukafka: Public Health Informatics

Alexa McCray: Consumer Informatics

Sue Bakken: Decision Analytic Methods for Evidence Based Practice

Kevin Johnson: Personal Health Records

MBL Team (Evening): Project Time

Friday, June 5

Chris Cimino: Education Informatics

Kevin Johnson: Computer-Based Physician Order Entry

Joan Ash: Evaluation

Larry Kingsland: The Internet: Reflections on What's Coming

Saturday, June 6

Don Lindberg: Current Issues

Students: Project Presentations

Figure 5. Lectures for the spring 2009 session of the course.

Monday, September 16**Joyce Mitchell:** What is Biomedical Informatics?**John Hurdle:** Major Biomedical Informatics Methods; Clinical Informatics**Joan Ash:** Unintended Consequences of Electronic Health Record (EHR) Adoption;
Evening workshop**Tuesday, September 17****Guilherme Del Fiol:** Vocabularies and Terminologies**Charlene Weir:** Human Computer Interactions and Issues**Les Lenert:** Meaningful use of EHRs**Marcelo Fiszman:** Natural Language processing at NLM and Semantic Medline;
Semantic Medline Evening workshop**Wednesday, September 18****Catherine Staes:** Population and Public Health Informatics**George Demiris:** Social media and Consumer health informatics**Guilherme Del Fiol:** Knowledge Management and Infobuttons**Thursday, September 19****Paul Harris:** Clinical and Translational Research informatics**George Demiris:** Telehealth and Mobile Devices**Joyce Mitchell:** Genetics and Genomics**Dmitry Kondrashov:** Mathematical Modeling; Mathematical Modeling Evening
Workshop**Friday, September 20****Kevin Johnson:** Biomedical Data Visualization and Interpretation**Ken Kawamoto:** Clinical Decision Support, Computer-Based Physician Order
entry and Quality**Faculty:** Ethics and Biomedical Informatics (lunch discussion)**Charlene Weir:** Evaluation Issues in Biomedical Informatics**Don Lindberg:** Disasters and Informatics**Saturday, September 21****Don Lindberg:** Research Issues in Biomedical Informatics**Figure 6.** Lectures for the fall 2013 session of the course.

the spring session that included informatics faculty from Vanderbilt to talk about end-to-end informatics development at the enterprise level. When Dan stepped down as course co-director and moved to Vanderbilt, he was able to return in the more relaxed role of faculty member when I continued the Vanderbilt Day tradition.

4.3. MBL Short Course Student Projects

The notion of hands-on laboratories continued to be a mainstay of the course. The admissions process became more formal, with applicants being evaluated for prior computing skills. Applicants were selected who seemed to have the basic skills needed to keep up with the laboratory exercises, and the exercises became more sophisticated. Where early students were learning about PowerPoint, Excel, and HTML, later students were learning about personal databases, publishing web sites, and integrating the two.

Students were grouped into teams to develop projects together, allowing less technically confident students to learn from more advanced users.

Eventually, the course began to schedule the didactic lectures during the day and the laboratory sessions as evening workshops. We began to integrate the daytime topics into the projects. In the spring of 2009, Steven Phillips M.D. (NLM Associate Director) joined the faculty. For several years, he gave a lecture on Disaster Informatics that included activities and research programs in the NLM's Disaster Information Management Research Center (DMIRC). This inspired the MBL staff to alter the evening project to be development of web sites for disaster management that made use of DIMIRC's tools, including patient locators and hospital capacity trackers. The "disaster" they chose to prepare for was the Zombie Apocalypse. MBL Staff enthusiasm gave way the final evening to them showing up as zombies to attack the class.

As fun as the zombie theme was, it was a little far afield of the daytime lecture themes. However, the disease-of-the-week case was a patient who acquired paralytic shellfish poisoning from eating at a local seafood restaurant, so we decided to use a red tide outbreak as our disaster. What we didn't know was that there was a small red tide outbreak on Cape Cod that week. When area residents started searching the web for information, they happened upon the students' websites. This caused quite a bit of consternation because the sites described a fictitious scenario in which hospitals were filling up with victims. Confusion ensued as people started calling news organizations to ask why they were covering up the outbreak, leading those organizations to contact MBL leadership who was, of course, totally unaware of our students' projects and unable to explain why MBL websites were publishing misleading information. It all got straightened out, with students' sites being placed behind the MBL firewall, but for a while it was reminiscent of Orson Welles's 1938 War of the Worlds radio broadcast.

4.4. MBL Short Course Social Events

No description of the course would be complete without commenting on the social aspects of the week. In addition to the opening reception and meals and break times, students and faculty alike often found the energy for some decompression time after the evening workshops. This usually entailed commandeering several of the large round tables at the Captain Kidd, a local watering hole that was literally a stone's throw from the Little Club. A common pattern was for there to be a small gathering of a few faculty and students early in the week, with growing numbers each evening, sometimes achieving perfect attendance by the last night. Another treat was a traditional New England clambake one evening. Very few actual clams were involved. Steamed Maine lobsters were the main attraction. Many students over the years added learning how to eat one to their list of educational experiences for the week. Although Don did not usually appear at the "The Kidd", he and Mary were reliable participants for other activities.

5. NLM Informatics Short Course 2014-2017

As the MBL's contract neared its end, the NLM was required to openly compete renewal bids. This timing coincided with a change in leadership at MBL. For reasons that were never made clear to NLM, the MBL decided not to submit a proposal for renewal. Several other organizations did, however. Michael J. Ackerman Ph.D. (Chief of NLM's Office of High Performance Computing and Communications), Kathel Dunn M.L.I.S., Ph.D.

(NLM's Associate Fellowship Program Coordinator) and I made several site visits to consider a replacement.

The clear winner was Augusta University, which offered its Brasstown Resort and Spa located in Young Harris, Georgia, as the site for the class. While a very different setting than Woods Hole, it lived up to its name in terms of comfort. All rooms were single occupancy, with televisions – luxuries not previously available at the MBL.

The real appeal, however, were the staff and educational facilities. Brenda Seago M.L.S., M.S., Ph.D. became the new contract Principal Investigator. She was (and, at the time of this writing, remains) Director of Libraries at Augusta University, serving ten colleges and schools with almost 10,000 students. She and her staff (including project leader Kathy Davies M.L.S.) had extensive experience with development of a number of training programs, making use of the latest educational methods and technologies. Added to this was the auditorium at the Brasstown Resort with comfortable chairs, generous desk space and excellent acoustics – all things not present in the Little Club.

Monday, September 11

Bill Hersh: What is Biomedical Informatics?

Hugo Campos: From Engagement to Autonomy: Leveraging Data and Technology

Daniel Fabbri: Security and Privacy

Paul Harris: Data Management; Data Management Implementation Using REDCap (Evening Session)

Tuesday, September 12

Don Lindberg: Genetics, Genomics, and Why We Care

Elmer Bernstam: Precision Medicine from an Informatics Perspective

Kathy Davies: NLM Resources

Eric Sayers: Practical Bioinformatics for the Clinic

Kathy Davies, Eric Sayers: Exercises in Knowledge Retrieval (Evening Session)

Wednesday, September 13

Rebecca Schnall: Consumer Health Informatics; mHealth Technology

Randy Miller: Ethical Issues Related to Research, Evaluation, Publication, and Implementation in Biomedical Informatics (Evening Session)

Thursday, September 14

Michael Ackerman: Imaging Informatics

Zhiyong Lu: Biomedical Data and Information Visualization

Karen Rheuban: Using Telehealth to Increase Multi-Disciplinary Collaboration and Improve Health Care Outcomes

Jessica Schwind: Public Health Informatics

Dmitry Kondrashov: Mathematical Modeling with Clinical Decision Support

Friday, September 15

Olivier Bodenreider: Controlled Vocabularies and Semantic Standards

Jeremy Warner: EHRs, APIs, and Apps

Dina Demner-Fushman: Natural Language Processing Support for Clinical Tasks

Kim Unertl: Organizational Issues in Biomedical Informatics

Saturday, September 16

Patti Brennan: Anticipating the 3rd Century of the National Library of Medicine

Figure 7. Lectures for the final session of the course in the fall of 2017.

After 17 years with the course, I stepped down as director after the Fall of 2015. Mike Ackerman took over in 2016 and Dina Demner-Fushman Ph.D. (an investigator in the Biomedical Informatics Branch, of NLM's Lister Hill Center) joined as co-director for the 2017 sessions. Although the structure of the course and many of the topics remained basically the same (minus the clambake), the faculty roster underwent major revision as many new, but nonetheless distinguished informaticians were brought in (Figure 7).

By this time, Don had retired from NLM but he and Mary continued to participate in the course. Don lectured on genomics and general research issues. Attendees were still thrilled to have him there, along with the new NLM director, Patti F. Brennan R.N., Ph.D.

A bigger change was to come, though. The "Georgia Course" as anyone not from Georgia came to call it, was undeniably a huge success. But the need to reach a broader audience and the advent of improved, inexpensive teleconferencing technologies, meant the days of intense, in-person training with a small student body (30) and a large faculty (20 or more), along with the attendant travel costs, were numbered. The NLM did not activate the final contract year of the course. It regrouped to consider how best to use limited resources to effect a broader impact [8].

6. "The Woods Hole Experience" in Print

Descriptions of the course have appeared in the peer-reviewed medical literature over the years. Some briefly mention its existence [9-11]. More details can be found in two evaluation reports of the fall 2000 course by A. Cimino (née Brummitt) and the spring 2005 course by Bridges and colleagues, respectively [12-13]. Correlating the descriptions herein with the descriptions from these two reports provides a clear picture of how the course evolved over time.

With regard to course evaluations, Bennett-McNew and Ragon reported their informal survey results from Fall 2005 participants [13]. They did not report numbers of respondents, but one can infer that nine librarians responded. The authors included anecdotal comments and in summary concluded that the course had a notable (presumably positive) impact on all respondents. Many reported a lasting influence on their careers.

Patel and colleagues conducted a more comprehensive evaluation, using quantitative and qualitative techniques [14]. Twenty-nine participants from the Spring 2002 course completed pre- and post-course surveys and participated in interviews. In addition, a randomly selected half of the 360 participants from the 1992-2001 courses received questionnaires by mail.

The course was highly rated by all survey respondents. They were especially impressed by the quality of the speakers, networking opportunities, the learning environment, and their ability to acquire specific knowledge. Interviews conducted four months after the course found that all students had become involved in new informatics activities. The mailed questionnaire results indicated that a high percentage of the 121 respondents had become involved in making strategic healthcare technology-related decisions. They had engaged in training others in the use of information technologies, and had recommended, specified or approved new information systems at their institutions. Respondents also reported a wide variety of long-acting positive influences on their knowledge of informatics. The survey authors summarized their findings thusly:

“The majority of the participants who responded to the questionnaire have since become effective agents of change in their institutions in the area of medical informatics, perhaps as a direct result of these positive experiences or as a result of a combination of other factors, in addition to the course” [14].

7. Discussion

In a way, the National Library of Medicine’s Biomedical Informatics Short Course was a metaphor for the larger academic field. Over time, the topics became more technical, more varied, increasingly drew on related fields, and encompassed greater breadth across the spectrum of translational science. The course employed increasingly sophisticated information technology, including teleconferencing and the resources of the World Wide Web. The faculty list reads like a Who’s Who of biomedical informatics. The diversity of the students was impressive - coming from all 50 U.S. states and many foreign nations. The scope reflected both intended users and beneficiaries of informatics.

Don Lindberg’s contributions to the course ranged from its highest to its lowest levels. He conceived the idea of NLM workshop sponsorship with the goal of reaching out to, and often creating anew informatics-related change agents. This encompassed all healthcare roles – not just patient care and librarianship, but policy makers, payors, and developers and vendors of EHRs and decision support systems. Dr. Lindberg constantly provided input in determining faculty participants, topics, and student admission criteria. He also contributed to the actual teaching in diverse ways, even stepping in to fill gaps due to a rare faculty absence. Finally, he was a key participant in the informal networking and interpersonal socializing among students, faculty and staff.

I would be remiss if I did not acknowledge Mary Lindberg’s contributions as well. She has probably sat through more informatics lectures than anyone in history, except for Don. She contributed greatly to discussions during and between classes, with her knowledge of informatics, informaticians, nursing and palliative care. When it came to networking and social aspects of the course, she participated equally with Don.

In the end, one cannot make a comprehensive accounting of the impact of the NLM Informatics Short Course project. Over the years, it brought together 1,350 students and close to 100 faculty who then collectively contributed to shaping the unique professional community that is biomedical informatics. The faculty learned as often as the students. They brought new experiences and ideas back to their home institutions. Doing so enhanced their own educational programs and further extended networks of collaborators.

The course was an intense experience for all who participated. Many students expressed a desire for a second course – until they were told what such a course would require tuition without NLM support. There is no question that the course was expensive and no question that its value justified NLM’s support. It is likely that the expense of the NLM Informatics Short Course has been paid back in terms of its impact on the field. The NLM Informatics Short Course led to more rapid and widespread adoption of informatics technologies and deeper investment of participants’ institutions in informatics infrastructure and offerings. The limited evidence from published papers and anecdotal experiences suggest that this has occurred.

8. Conclusion

The “Woods Hole Course” was an amazing experience for those fortunate enough to participate in it. We can all be grateful that Dr. Lindberg made it happen. Its faculty and students have been inspired to change their institutions and their field for the better. Many participants had their burning questions answered at Woods Hole and at Young Harris. They learned enough to go on to ask the next round of burning questions during their careers.

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