BIOGRAPHICAL SKETCH

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NAME: Edward H. Shortliffe

eRA COMMONS USER NAME (credential, e.g., agency login): ShortliffeE

POSITION TITLE: Clinical Professor and Senior Advisor to the Dean and Executive Vice Provost

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Harvard College, Cambridge, MA	A.B.	1970	Applied Mathematics & Computer Science
Stanford University, Stanford, CA	Ph.D.	1975	Medical Information Sciences
Stanford University School of Medicine, Stanford, CA	M.D.	1976	Medicine
Massachusetts General Hospital, Boston, MA	N/A	1976-77	Internship in Internal Medicine
Stanford Hospital, Stanford, CA	N/A	1977-79	Residency in Internal Medicine
State University of New York (SUNY) Downstate, Brooklyn, NY	D.Sc.	2014	Honorary Degree (Health-Related Professions)

A. PERSONAL STATEMENT

Dr. Shortliffe's background as a researcher, educator, and administrator is highly relevant to the current proposal. He is Professor of Biomedical Informatics and Senior Advisor to the Executive Vice Provost for Health Solutions at Arizona State University (part-time) while serving on the adjunct faculty at both Columbia University (Biomedical Informatics) and Weill Cornell Medical College (Division of Health Informatics in Healthcare Policy and Research). In 2012 he completed a 3-year term as President and Chief Executive Officer of the American Medical Informatics Association, based in Bethesda, MD and, until October 2011, was Professor in the School of Biomedical Informatics at the University of Texas Health Science Center in Houston, Texas. From 2007-2008 he was founding Dean of the University of Arizona College of Medicine – Phoenix. Before that, he was the Rolf A. Scholdager Professor and Chair of the Department of Biomedical Informatics at Columbia University's College of Physicians and Surgeons in New York City (2000-2007) and Professor of Medicine and of Computer Science at Stanford University (1979-2000).

During the early-1970s, he was principal developer of the medical expert system known as MYCIN. After a pause for internal medicine house-staff training at Massachusetts General Hospital and Stanford Hospital between 1976 and 1979, he joined the Stanford internal medicine faculty where he served as Chief of General Internal Medicine, Associate Chair of Medicine for Primary Care, and was director of an active research program in clinical information systems and decision support. He spearheaded the formation of a Stanford graduate degree program in biomedical informatics and divided his time between clinical medicine and biomedical informatics research. In January 2000 he assumed his post at Columbia University, where he was also Deputy Vice President (Columbia University Medical Center) and Senior Associate Dean (College of Physicians and Surgeons) for Strategic Information Resources, Professor of Medicine, Professor of Computer

Science, and Director of Medical Informatics Services for the NewYork-Presbyterian Hospital. In his current roles, he continues to be closely involved with medical education and biomedical informatics graduate training. His research interests include the broad range of issues related to integrated decision-support systems, their effective implementation, and the role of the Internet in health care.

It should be emphasized that Dr. Shortliffe is known as much for his dedication to informatics education as he is for his research accomplishments and leadership roles. He was Program Director for NLM-funded training programs at Stanford (1984-2000) and Columbia (2000-2007). Before leaving Arizona to assume his AMIA position, he served as training program designer and director at ASU from 2008-2009, bringing many of the lessons from the Stanford and Columbia programs to the new program at ASU. He authored the major textbook in biomedical informatics (1990) which is used worldwide and has been translated into many languages. It is now in its fourth edition (2014), with second and third editions in 2000 and 2006. The graduates of his training programs include many of the current generation of informatics leaders, and he is chairing AMIA's endowment fund raising effort for a new annual doctoral dissertation award.

B. POSITIONS AND HONORS

Professional Experience:

1979–2000 ***Assistant, Associate, and Full Professor of Medicine*** (General Internal Medicine), ***and of Computer Science***, Stanford University
1985–1997 ***Principal Investigator***, SUMEX-AIM & CAMIS Computing Resources, Stanford University
1988–1995 ***Chief***, Division of General Internal Medicine, Stanford University
1995–1999 ***Associate Dean for Information Resources and Technology***, Stanford University
2000–2007 ***Rolf H. Scholdager Professor and Chair***, Department of Biomedical Informatics, Columbia University
2000–2007 ***Director***, Medical Informatics Services, New York-Presbyterian Healthcare System, New York
2000–2007 ***Professor of Medicine and of Computer Science***, Columbia University
2000–2007 ***Deputy Vice President for Strategic Information Resources,*** Columbia University Medical Center
2007–2008 ***Dean of the Faulty***, University of Arizona College of Medicine – Phoenix, in Partnership with Arizona State University
2007–2009 ***Professor of Basic Medical Sciences*** and ***Professor of Medicine***, University of Arizona College of Medicine
2007– ***Adjunct Professor of Biomedical Informatics****,* College of Physicians and Surgeons, Columbia University
2007–2012 ***Professor of Biomedical Informatics***, Program in Biomedicine@ASU, Arizona State University
2009–2012 ***President and CEO***, American Medical Informatics Association, Bethesda, MD
2009–2011 ***Professor***, School of Biomedical Informatics, University of Texas Health Science Center, Houston, Texas
2012– ***Scholar in Residence***, New York Academy of Medicine, New York City
2012– ***Clinical Professor of Biomedical Informatics*** *(Part-time)*, College of Health Solutions, Arizona State University, Scottsdale, AZ
2012– ***Senior Advisor to the Dean & Executive Vice Provost*** *(Part-time)*, College of Health Solutions, Arizona State University, Phoenix, AZ
2014– ***Adjunct Professor of Healthcare Policy and Research*** *(Health Informatics)*, Weill Cornell Medical College, New York, NY

Professional Service (selected recent appointments):

Member, Executive Council, Institute of Medicine (now National Academy of Medicine).
Member, Committee on Science and Engineering Public Policy, National Academy of Sciences.
Member, Search Committee for the Editor-in-Chief, Annals of Internal Medicine; Member (2008-2012) and Chair (2013-2015), Journal Oversight Committee, American Medical Association.
Board of Trustees (Vice-Chair), New York Academy of Medicine.

Elected Professional Memberships (selected)

National Academy of Medicine (formerly Institute of Medicine), American Society for Clinical Investigation, American College of Medical Informatics (Fellow), American College of Physicians (Board of Regents and, subsequently, Master), Association of American Physicians, American Association for Artificial Intelligence (Fellow), American Clinical and Climatological Association.

Editorial Boards (current):

Journal of Biomedical Informatics (Editor-in-Chief), *Artificial Intelligence in Medicine*, *Information Systems Frontiers*

Honors:

2006	Morris F. Collen Award, American College of Medical Informatics (ACMI)
1979-1984	Research Career Development Award, National Library of Medicine
1983-1988	Henry J. Kaiser Family Foundation Faculty Scholar in General Internal Medicine
1977	Grace Murray Hopper Award, Association for Computing Machinery (ACM)
1971-1975	Medical Scientist Training Program (MD-PhD), Stanford University School of Medicine

C. CONTRIBUTIONS TO SCIENCE

1. *Rule-Based Expert Systems:* Dr. Shortliffe's doctoral dissertation introduced the notion of an "expert system" that separates knowledge of a domain from the underlying logical processing of that knowledge (the "inference engine"). The specific computer program, known as MYCIN, applied knowledge of severe infectious diseases (bacteremia and meningitis) to create and advisory tool regarding the selection of antibiotic treatment. The work led to R01-funded research in his advisor's laboratory and was ultimately inherited and pursued further when Dr. Shortliffe returned to Stanford from housestaff training.

a. Shortliffe EH, Axline SG, Buchanan BG, Merigan TC, and Cohen SN. An artificial intelligence program to advise physicians regarding antimicrobial therapy. *Comput Biomed Res* 1973;6:544–560.
b. Shortliffe EH and Buchanan BG. A model of inexact reasoning in medicine. *Math Biosci 1975;*23:351–359.
c. Shortliffe EH. *Computer-Based Medical Consultations: MYCIN*, New York: Elsevier/North Holland, 1976.
d. Duda RO, Shortliffe EH. Expert systems research. *Science* 1983;220(4594):261–268.
e. Buchanan BG, Shortliffe EH. *Rule-Based Expert Systems: The MYCIN Experiments of the Stanford Heuristic Programming Project*. Reading MA: Addison–Wesley, 1984.

2. *Integration of Decision Support Tools with Clinical Workflow:* In the 1980s much of Dr. Shortliffe's work addressed his recognition that decision support needed to be smoothly integrated with clinical workflow. He and his team developed methods for incorporating advisory tools directly into software used for clinical record keeping, illustrating the notions in a medical record system, ONCOCIN, that was designed to record data and provide advice in the context of cancer chemotherapy clinical trials. The work was later extended in the development of an experimental system for us in the outpatient management of HIV/AIDS.

a. Kent DL, Shortliffe EH, Carlson RW, Bischoff MB, Jacobs C. Improvements in data collection through physician use of a computer-based chemotherapy treatment consultant. *J Clin Onc* 1985;3:1409-1417.
b. Hickam DH, Shortliffe EH, Bischoff, M.B., Scott, A.C., Jacobs, C.D. A study of the treatment advice of a computer-based cancer chemotherapy protocol advisor. *Ann Intern Med* 1985;103:928-936.
c. Shortliffe EH. Artificial intelligence in management decisions: ONCOCIN, In *Frontiers of Medical Information Sciences* (R.L. Kuhn, ed), pp. 173-187, New York: Praeger Publishers, 1988.
d. Shortliffe EH, Hubbard SM. Information Systems in Oncolgy. In *Cancer: Principles and Practice of Oncology* (V.T. DeVita, S. Hellman, and S.A. Rosenberg, eds.), pp. 2403-2412, Philadelphia, PA: J.B. Lippincott Company, 1989.
e. Carlson RW, Tu SW, Lane NM, Lai TL, Kemper CA, Musen MA, Shortliffe EH. Computer-based screening of patients with HIV/AIDS for clinical-trial eligibility. *Online J Curr Clin Trials,* 1995 Mar 28; Doc No 179.

3. *Human-Computer Interaction in the Context of Clinical Decision Support and Graphical User Interfaces*: Dr. Shortliffe carried out some of the earliest work regarding graphical workstations and the use of intuitive

interfaces in designing medical records systems. Both ONCOCIN and T-HELPER were parts of this body of work, which marked a major departure from the earlier text-oriented EHR interfaces.

a. Tsuji S, Shortliffe EH. Graphical access to a medical expert system: I. Design of a knowledge engineer's interface. *Meth Info Med* 1986;25:62-70.
b. Lane CD, Walton JD, Shortliffe EH. Graphical access to a medical expert system: II. Design of an interface for physicians. *Meth Info Med* 1986;25:143-150.
c. Walton JD, Musen MA, Combs DM, Lane CD, Shortliffe EH, Fagan LM. Graphical access to medical expert systems: III. Design of a knowledge-acquisition environment. *Meth Info Med* 1987;26:78-88.
d. Wulfman CE, Rua M, Lane CD, Shortliffe EH, Fagan LM. Graphical access to medical expert systems: V. Speech input for use by physicians. *Meth Info Med* 1993;32:33-46.

4. *Characterizing the Field and Implications for Education of Health Professionals and Informatics Students*: In addition to his textbook, Dr. Shortliffe has authored many articles and editorials dealing with the nature of the field of biomedical informatics, its role in modern medicine, and assessments of curricula and training philosophy. He also offers popular "informatics civics" lectures to students that help them to learn about the field; its history, publications, and meetings; the role of funding agencies and how to write grants and participate as a grant reviewer; how to write scientific papers, create effective posters, and give engaging presentations; and the alternate career paths for those with informatics training.

a. Shortliffe EH, Fagan LM. Research training in medical informatics: The Stanford experience. *Academic Medicine*, 1989;64:575-578.
b. Greenes RA, Shortliffe EH. Medical informatics: an emerging academic discipline and institutional priority. *JAMA* 1990;263:1114-1120.
c. Shortliffe EH. Doctors, patients, and computers: Will information technology dehumanize healthcare delivery? *Proceedings of the American Philosophical Society* 1993;137(3):390-398.
d. Shortliffe EH. Medical informatics meets medical education. *JAMA* 1995;273(13):1061, 1064-1065.
e. Shortliffe EH. Medical informatics training at Stanford University School of Medicine. *1995 IMIA Yearbook*, pp 105-109, Stuttgart: Schattauer, 1995.
f. Shortliffe EH. Professionalism in medical informatics [editorial]. *Meth Info Med* 1996;35(3):155-156.
g. Shortliffe EH. Networking health: Learning from others, taking the lead. *Health Affairs* 2000;19(6):9-22.
h. Shortliffe EH, Garber AM. Training synergies between medical informatics and health services research: Successes and challenges. *J Am Med Inform Assoc* 2002;9(2):133-139.
i. Shortliffe EH. Strategic Action in Health Information Technology: Why the Obvious Has Taken So Long. *Health Affairs* 2005;24:1222-1233.
j. Greenes RA, Panchanathan S, Patel VL, Silverman H, Shortliffe EH. Biomedical informatics in the desert - A new and unique program at Arizona State University. Geissbuhler A, Kulikowski C, editors. *IMIA Yearbook of Medical Informatics 2008. Methods Inf Med* 2008; 47 Suppl 1: 138-143.
k. Greenes RA, Shortliffe EH. Informatics in Biomedicine and Health Care. *Acad Med* 2009:84(7);818-820.
l. Shortliffe EH. Biomedical informatics in the education of physicians. *J Am Med Assoc* 2010:304(11):1227-1228.
m. Stead WW, Searle JR, Fessler HE, Smith JW, Shortliffe EH. Biomedical informatics: Changing what physicians need to know and how they learn. *Acad Med* 2011;86:429-434
n. Kulikowski CA, Shortliffe EH, Currie LM, Elkin PL, Hunter LE, Johnson TR, Kalet IJ, Lenert LA, Musen MA, Ozbolt JG, Smith JW, Tarczy-Hornoch PZ, Williamson JJ. AMIA Board white paper; Definition of biomedical informatics and specification of core competencies for graduate education in the discipline. *J Am Med Inform Assoc* 2012;19:931–938.
o. Shortliffe EH. The future of biomedical informatics: a perspective from academia. *Stud Health Technol Inform*. 2012;180:19-24.

Additional areas of scholarly activity have included studies of uncertain reasoning, collaboration, cognitive factors in patient safety, and issues in the acceptance of technology by health professionals. A complete List of Medline-indexed work is available at http://www.ncbi.nlm.nih.gov/pubmed/?term=shortliffe+eh

D. Research Support

None in recent years. Extensive prior to 2007 (when he assumed a position as medical school dean and, subsequently, as President and CEO of the informatics professional society, AMIA)