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A Passion and a Calling

My interest in biomedical and health informatics goes back to my high school days in the northern suburbs of Chicago in the early 1970s. I was introduced to computers when my school acquired a Hewlett-Packard 9830A, which was the size of a suitcase and had a built-in single-line LED display, thermal printer on top, and cassette tape storage unit. I learned how to program it in BASIC. I was also a cross-country and track runner in high school, which led to my interest in health and medicine. Running also taught me self-discipline, which helped me achieve goals later in life.

I went off to college at the University of Illinois Champaign-Urbana, where I intended to major in computer science (CS). However, I found CS to be very different in college than in high school. My first courses using punch cards and the PL/1 programming language did not excite me. I did, however, enjoy working with PLATO, a networked system with (primitive, by today's standards) bit-mapped graphics. Two years into college, I left CS to pursue a medical career. My interest in health and preventive medicine, together with youthful rebellion, provided the foundation for my interest in evidence-based medicine.

In medical school, also at University of Illinois, I met my first informatics faculty member, Dr. Allan Levy, who nurtured my interests. Of all my education, medical school was the least enjoyable. I did not like the massive amount of rote memorization, which contributed to my later attraction to informatics. In my third year of medical school in 1983, I purchased my first computer, a Commodore 64: I hooked it up to my television as a monitor and to my phone via a 300-baud modem, and connected to Compuserve, which had a medical bulletin board called MedSIG. There I met Col. Gordon Black, who encouraged a number of us early informaticians, including long-time colleague, Rob McClure.

The reigniting of my interest in computers continued to grow as I started an internal medicine residency in 1984 at University of Illinois Hospital in Chicago. During my residency, it became apparent to me that I wanted to combine medicine and computers in my career. I came to learn about a field called "informatics," but without Google or other search engines, there was no easy way to find more information. This led me to write letters and make phone calls to people like Ted Shortliffe, Bob Greenes, Clem McDonald, Perry Miller, and Scott Blois. I ultimately learned about National Library of Medicine (NLM)–funded informatics fellowships and chose to pursue one in the Harvard program under Bob Greenes at Brigham and Women's Hospital in Boston. In 1987, after having lived my whole life in Illinois, I headed off with my wife to start my informatics fellowship. It was quite a change for me, with my previous daytime focus on medicine and intermittent nights-and-weekends focus on computing now flipped. In the fellowship, I could do computing almost all the time and practice medicine on the allowed one day

per week. During this fellowship, it quickly became clear that informatics would become my life's calling.

Like many working in informatics in the 1980s, I initially tried to find a research interest and niche in artificial intelligence (AI) systems of the day. One early attraction was knowledge representation, and this led to Bob involving me in his work on the Unified Medical Language System (UMLS) project that had been launched by the NLM in 1986. But the progress of the first generation of AI was sputtering by then, and almost by accident I came across a report on the topic of information retrieval (IR) authored by Bruce Croft, a computer science professor at the University of Massachusetts at Amherst. There was very little research going on in IR in medical informatics, and the main work emanated from the development of MEDLINE (although Mark Frisse had done some important work during that time in applying IR to the emerging world of hypertext). Croft's report steered me to the most prolific researcher and author in the IR field, Gerard Salton. Many current senior leaders in IR trained as PhD students under Salton, and I was also profoundly influenced by his work. I had the chance to meet Salton when he came to give a talk at Harvard. He was intrigued by my interest in IR applied in the medical domain. I have always thought it was most unfortunate that Salton never lived to see the wide reach and impact of his ideas and work in modern search engines, as he passed away in 1995.

My clinical background dampened my enthusiasm for the relatively clunky and time-consuming AI systems of the 1980s and heightened it for IR. I was intrigued by the idea of physicians and others being able to access knowledge at the point of care. My perception of IR systems at the time was that they were limited, with systems doing just word-based searching on text or requiring complex Boolean queries over human-assigned indexing terms. My interest in IR, combined with the advancing UMLS project, led me to pursue a line of research that combined concept-based automated indexing to enhance retrieval that applied the statistical approaches developed by Salton and others. This led to me to develop and implement a system called SAPHIRE, which was the focus of my early research.

During my fellowship, I was also briefly involved with a project that would later become a highly successful commercial product. Bob had been visited by Burton Rose, a nephrologist at Brigham and Women's who was enamored with a new tool that shipped with the Mac called Hypercard. He believed that small chunks of information on each "card" in a Hypercard "stack" could be highly useful to physicians. But as the quantity of information grew, he needed a search capability that was better than that which shipped with Hypercard. I programmed the search capability for the first version of what would later be called UpToDate, which ultimately achieved great commercial success. At the end of my fellowship, I handed this project off to another fellow, Joseph Rush, who continued to work on UpToDate for many years.

As my fellowship was ending, I knew that I wanted to pursue a career in academic medical informatics. One person I came to know was Bob Beck, who at the time was heading the informatics program at Dartmouth College. By the fall of my last year of fellowship, Bob had moved to Oregon Health Sciences University (OHSU) to start a new program there funded by the NLM IAIMS program, bringing with him another faculty member, Kent Spackman.

While I had some other job possibilities, my wife and I, now with a one-year-old daughter, packed up and moved to Portland in July 1990. My first activity in the new job was to submit an NIH R29 proposal that I had been working on in the latter months of my fellowship. Also called a FIRST Award, this type of grant was a common pathway

for new researchers to launch their careers. Several months later, I was notified that it would be funded, which jump-started my academic career.

In 1990, Oregon voters passed a property tax limitation measure which ultimately led to Bob Beck losing resources and leaving in 1992. This left behind a very junior faculty, led by Kent, but as Kent wasn't interested in building a program, he devolved the leadership to me. By 1996, our young academic group was starting to achieve sustained success. This led the Dean of the OHSU School of Medicine at the time, Joseph Bloom, to encourage our unit to become more visible on campus. The usual way of doing this at OHSU was establishing a so-called free-standing division, which was the path to establishing a department. This also provided me a seat at the table of clinical department chairs, which I maintain to this day.

I was interested in teaching from the beginning of my faculty career, and when Kent asked me to organize the introductory informatics course—something I still teach to this day—it led to many others, like the one I teach in the 10x10 program. When I started my fellowship, and then my faculty position at OHSU, I never realized how much of a passion teaching would become for me. I always enjoyed teaching because it gave me a chance to learn as well as develop a coherent organization for various topics. My path down the road to my current leadership in education was also greatly influenced by those I taught. In particular, while I assumed that our educational program would be small and aim to produce researchers like myself, there were a number of students who were interested in more varied careers, such as the small but growing number of professional positions in healthcare settings or industry. This resulted in our new Master of Science program taking on a more practical orientation. But that was fine, as the research of many of our faculty, such as Paul Gorman and Joan Ash, was motivated by real-world concerns in the application of informatics.

Even with my growing interest in education and my leadership responsibilities in our emerging program, I still maintained my interest in research. While it became more difficult to develop new IR systems when giants like Google and PubMed emerged, my interest in evaluating how well people used IR systems for health and medical reasons became the main focus of my research. In 1996, I published the first edition of my book, *Information Retrieval: A Health Care Perspective*.

By 1999, as I was contemplating ways to expand our educational program, a number of people had asked if we planned to offer our courses via distance learning. I decided to offer my now-mature introductory course in this manner, which was quite successful. There was an untapped market for distance learning in informatics, and the success of my initial course led me to convince the faculty to add this format to the program. This foray into distance learning distracted us from another goal we had in the late 1990s, which was to establish a PhD program. We finally accomplished this when our NLM training grant was renewed in 2002. At this point I became PI of the training grant.

Another pivotal career event for me came when Charlie Safran was President of AMIA (back in the days when the AMIA President was an elected position). He was convinced that the US needed more professionals, especially physicians and nurses, trained in informatics. Charlie believed the US needed at least one physician and one nurse trained in informatics in each of the nearly 6000 hospitals in the US. Also at this time, AMIA was looking to develop some sort of introductory course in biomedical informatics. However, the prices quoted to them by vendors were beyond their means. As I already had my introductory course from our graduate program, I proposed to AMIA that we repackage my online course. I came up with a name, 10x10 (pronounced "ten by ten"), based on Charlie's one physician and nurse in 5000+ hospitals, and set a goal for

doing so by 2010. Because the course already existed, we were able to put in place a Memorandum of Understanding between OHSU and AMIA and launch the first offering of the course in just a few months. The next President of AMIA, Don Detmer, called 10x10 one of the association's most successful programs ever.

My interest in education and training spurred my interest in workforce development for the field. In 2006, I was invited to organize the surprise retirement event for long-time academic leader, originally from Germany and later from Victoria, Canada, Jochen Moehr. I gave a talk entitled *Who are the Informaticians, What We Know and Should Know*, which I later published in JAMIA. This interest was fortuitous, since the US economy would soon enter freefall, leading to the American Recovery and Reinvestment Act (ARRA), the economic stimulus bill that included the Health Information Technology for Economic and Clinical Health (HITECH) Act. While HITECH was best known for its $30 billion "meaningful use" program of incentives for EHR adoption, it also included $118 million for workforce development, motivated in part by some research I published showing a need for more informatics professionals. I played a large role in the grants that were competitively awarded by the HITECH Workforce Development Program, including being funded as the National Coordination and Dissemination Center for the health IT curriculum that was funded through the program.

During and after HITECH, I continued to provide leadership for informatics education and its relationship to other careers in the field. I was also a leader in the new clinical informatics physician subspecialty, being appointed by AMIA to direct the Clinical Informatics Board Review Course (CIBRC), which was offered in time for the first board examination in 2013. The next year I laid the groundwork at OHSU to establish one of the first four Accreditation Council for Graduate Medical Education (ACGME)–accredited fellowships for the new subspecialty, which launched in 2015. Around this time, I also had the opportunity to develop informatics education for non-informaticians, namely medical students. Along with colleagues at OHSU, we began to implement informatics education in the MD curriculum (just in time for my younger daughter to become a medical student!).

I have now been at OHSU for nearly 30 years, where I have had the opportunity to continue my research and teaching, and lead my department. Another critical activity of mine now is to mentor young faculty, who one day will sustain and lead our program.