

**Stanley Finkelstein, Ph.D.**

Narrator

**Dominique A. Tobbell, Ph.D.**

Interviewer

**INSTITUTE FOR HEALTH INFORMATICS  
HISTORY PROJECT**

**UNIVERSITY OF MINNESOTA**

# **INSTITUTE FOR HEALTH INFORMATICS HISTORY PROJECT**

In 2015, the Institute for Health Informatics (IHI) celebrates the 50<sup>th</sup> anniversary of health informatics at the University of Minnesota. Early institutional markers serve as the formal beginnings of the emergent discipline of health informatics at the University of Minnesota, designating the University of Minnesota as one of the first academic institutions to support and subsequently anchor the development of the new discipline. In 1965, the National Institute of Health (NIH) Division of Research Resources awarded the University of Minnesota's College of Medical Sciences a grant to establish a Biomedical Data Processing Unit at the University. Two years later, the Hill Family Foundation awarded a ten-year grant to Professor Eugene Ackerman to initiate a graduate research and training program in Biomedical Computing. In 1968, the College of Medical Sciences established the Division of Health Computer Sciences, which would serve as the administrative home for the NIH research resources grant, housed within the Department of Laboratory Medicine. The Division provided interdisciplinary training to pre-doctoral and post-doctoral students applying health computer sciences technology to health services research. In 1974, the University of Minnesota was awarded the prestigious National Library of Medicine Grant for Training in Health Computer Sciences, which formally established the Graduate Program in Health Informatics at the University of Minnesota. The Division and its institutional successor, the Institute for Health Informatics (created in 2006), received continuous training grants from the National Library of Medicine until 2009. For fifty years, the University of Minnesota has been one of the preeminent health informatics institutions in the United States.

The Institute for Health Informatics History Project captures, analyzes, and records the history of health informatics at the University of Minnesota. Through oral history interviews, the Project preserves the personal stories of faculty members and National Library of Medicine administrators who were involved in the early history of the field and have keen insights into the history of health informatics at the University of Minnesota.

## **Biographical Sketch**

Stanley Finkelstein received his B.S. in Electrical Engineering (1962), M.S. in Electrical Engineering (1964), and Ph.D. in Electrical Engineering, Systems Science, and Bioengineering (1969) from the Polytechnic Institute of Brooklyn in Brooklyn, New York. From 1968 to 1977, Dr. Finkelstein served as an assistant and then associate professor of Bioengineering, Operations Research and Systems Analysis at the Polytechnic Institute of Brooklyn. In 1977, Dr. Finkelstein moved to the University of Minnesota, where he joined the faculty of the Division of Health Computer Sciences in the Department of Laboratory Medicine and Pathology. Since 1977, Dr. Finkelstein has been a member of the graduate faculty in Health Informatics and in Biomedical Engineering, and since 1983 in Biophysical Sciences and Medical Physics. From 1986 to 1997, Dr. Finkelstein served as director of graduate studies in health informatics; from 1996 to 2000, as director of graduate studies in biomedical engineering; and from 2000 to 2001, as interim director of the Division of Health Informatics.

## **Interview Abstract**

Stanley Finkelstein begins by discussing his educational background and his arrival at the University of Minnesota. He describes at length his research in the field of home monitoring and telehealth, including his research with Jay N. Cohn on the development of a device to measure and monitor arteriovascular compliance in order to diagnose and monitor hypertension and congestive heart failure; his research with Warren Warwick and the development of the first home monitoring system for cystic fibrosis patients; and the subsequent development of home monitoring of lung transplant patients in collaboration with Marshall Hertz. Dr. Finkelstein goes on to discuss the NLM training grant program; the lack of institutional support provided to the Division of Health Computer Sciences; the development of the Institute for Health Informatics; the leadership of Eugene Ackerman and Laël Gatewood; the number of women in the field of biomedical engineering and health informatics; the relationship between the Division of Health Computer Sciences and the Biomedical Library; the collaborative relationship between the University of Minnesota and the Mayo Clinic; and the development of the Masters in Health Informatics.

**Interview with Doctor Stanley M. Finkelstein**

**Interviewed by Dominique Tobbell, Oral Historian**

**Interviewed for the Academic Health Center, University of Minnesota  
Oral History Project**

**Interviewed in Doctor Finkelstein's Office, 793 Mayo  
University of Minnesota Campus, Saint Paul, Minnesota**

**Interviewed on July 23, 2014**

Stanley Finkelstein - SF  
Dominique Tobbell - DT

DT: This is Dominique Tobbell. I'm here with Doctor Stan Finkelstein. We're in Doctor Finkelstein's office, 793 Mayo on the University of Minnesota campus. It is July 23, 2014.

To get us started, I wonder if you could tell me about your educational background.

SF: Do you want me to go back to elementary school?

DT: You can start with college and, perhaps, how you got into electrical engineering in the first instance.

SF: Actually, I did all my degrees at the Polytechnic Institute of Brooklyn [New York], which, at that time, was considered, at least in electrical engineering, within the top five or six programs in the country. It was a large engineering school, but relatively small in terms of universities. It's gone through several changes. It currently doesn't exist in that form. It's currently called the Polytechnic School of Engineering of New York University [NYU]. So it's now, actually, a full standing division at NYU. I have my undergraduate degree in electrical engineering there. If I recall correctly, I was in the electrical engineering honors program. There were fifteen, sixteen of us that, basically, stuck together for the last two years.

Part of that was doing a research project. I ended up doing a research project which turned out to be sort of biomedical engineering oriented with a professor there who was one of the early pioneers in developing graduate level biomedical engineering curriculum. But at that time there were no biomed engineering programs available.

DT: Hmmm.

SF: He wrote one of the first systems engineering type books in biomedical engineering.

So when I graduated, I had some choices to consider in terms of graduate school. I received a National Defense Education Act Fellowship; it was a federal grant that provided, basically, full support and a stipend for a period of time to do graduate study. So I stayed at Brooklyn Poly and continued with the master's degree in electrical engineering, where I did another project which was biomedical engineering oriented with the same guy.

DT: What's the name of this professor?

ST: [William B.] Bill Blesser.

When I moved on to my Ph.D. work, the Ph.D. work was still in electrical engineering but it was electrical engineering/system science, at the time. The work I did was to develop a model that was dealing with diabetes. We did several studies. The model was based on collecting data in dogs. I did that. Again, Bill was on my committee but my advisor at that time was Jesse Crump, who was sort of the medical director of this fledgling biomedical engineering activity. At that time, I don't think there were any universities that were giving degrees in biomedical engineering. When I graduated, I continued there on the faculty for a number of years, and we actually developed a graduate program in biomedical engineering.

So that was my education.

DT: Your entrée into biomedical engineering, is it because you had an interest or was it because you worked with Bill Blesser?

SF: When I started as an undergraduate, I didn't know about biomedical engineering. It wasn't widely considered as a separate discipline. These days, biomedical engineering is probably one of the most popular undergraduate engineering curricula at any university. As I say, I was in the honors program, and Bill was involved to a certain extent, so I started working with him and it sort of just happened. He had some ideas as to what might be an interesting project. We ended up doing some. I really don't remember what the project was, other than it involved probably some instrumentation to be used to make some relatively straightforward simple physiologic measurements. So that was sort of my introduction.

DT: Can you explain what systems science is? You said that was your Ph.D. area. I don't have a good sense and for the audience that ends up reading...

SF: I probably can't give you a good definition of system science. It has evolved over the period.

DT: Sure.

SF: At that time, it was, basically, the generalization of engineering principles, the things I did, electrical engineering ideas, generalizing them into other physical or biological systems.

DT: Okay. That's what I presumed it was. It's always good to have a definition from that time.

With the work you were doing in biomedical engineering at the Polytechnic Institute of Brooklyn, did you have any relations with the biological scientists that were at the Institute?

SF: Yes. Actually, there were very few biological scientists, because, basically, it was an engineering school. At that time, there wasn't this sense that there really should be a link between engineering and biology. One of the promoters of such a linkage was this new generation of biomedical engineering practice, which really depended on having this kind of linkage.

My work was with Jesse Crump, who was an M.D. I'm trying to think of the various connections. He had an appointment at one of the local hospitals in Brooklyn, and we developed some graduate courses, and we used some of the activities or the facilities of the hospital to introduce physiological lab work and some animal studies. But I did my Ph.D. research at Mount Sinai Hospital in Manhattan working with some people in the Department of Surgery. That was, again, this linkage with Bill Blesser. I don't think it was a formally funded program. He had started to work with one of the leaders in the Department of Surgery there to develop some introduction to biomedical engineering principles for surgical residents. So I ended up working there in the Department of Surgery with several surgical residents on my thesis work. So that's where I collected the data that I, then, used to develop the models that we were working with.

DT: What led you to move to Minnesota?

SF: Perceived opportunities. I thought it would be important to be working in an institution that actually had a medical school available. One of the attractions was that the appointment that I would have would be in the Medical School. So I would have easier access and ability to work with the fine colleagues. I was interested in what they were doing; they weren't necessarily interested in what I was doing but we saw some ways to come together. Over the years, I think it worked out pretty well.

DT: You arrived here in 1977?

SF: Nineteen seventy-eight, 1979, I think, something like that.

DT: What was the culture of the Division of Health Computer Sciences like when you arrived?

SF: I liked it.

[chuckles]

SF: It wasn't huge. There were four or five people in it at that time. [Eugene] Gene Ackerman was the director. Laë'l Gatewood was, I guess at that time, the associate director. They were the ones that actually put the whole thing together. It was interesting that it ended up being a full division, small but full division, in Laboratory Medicine and Pathology. I think that was probably largely due to the interests of Ellis Benson, who was the chair of Lab Medicine, to help support something like that. It was called the Division of Health Computer Sciences and I guess it made sense because back then, one of the larger activities using computers was in the clinical laboratory's unit, so that was sort of a natural place.

As it turned out, the Health Computer Science folks were physically located in Laboratory Medicine, but the graduate program was a joint program called Biometry and Health Information Systems [B-HIS]. The biometry part was sort of the biostatistics piece. The faculty that were responsible for the health computer science track, if you will, were the four or five of us in Lab Medicine and the faculty responsible for the biometry biostatistics piece were in the School of Public Health. That seemed to work well. It was an interesting way of putting things together. Graduate students would come into the program and they would have to decide which one of these tracks they wanted. Some first year courses, everybody took. So the biostat people had to learn a little bit about health computer sciences and the HIS people had a sequence of required biostatistical courses. That went on for a number of years.

DT: Did you teach courses within the HIS track?

SF: Yes.

DT: Do you remember which ones you were teaching?

SF: Again, at that time, I was on the graduate faculty for Health Computer Sciences, well for the HIS, actually, and, also, for biomedical engineering. There was no undergraduate, but a graduate program in biomedical engineering that was, basically, homeless.

DT: [chuckles]

SF: It resided in a department in the Institute of Technology or the Medical School, depending to which college the director of graduate studies belonged.

DT: Okay.

SF: Of the original people that started the biomedical engineering program, the two that I remember distinctly were [Kenneth H.] Ken Keller, who went on to become the chair of

Chemical Engineering and, then, dean of the Graduate School, and, then, president of the University, and Perry [L.] Blackshear, who was a professor in Mechanical Engineering.

I ended up getting involved with the Biomedical Engineering program, as well as Health Information Systems program at the time. The coursework that I did in Health Computer Sciences involved systems approaches or engineering approaches, some modeling kinds of things to physiologic systems. Since then, it was kind of a continuation of what I had been doing. I was never, actually, what has now come to be known as an informaticist. My informatics stuff was based on the engineering kinds of work that I was doing and it always had an informatics flavor to it because we were always collecting and using physiological and clinical data. The work I did in terms of biomedical engineering was always involving direct patient application. So it started as patient application and, then, remote monitoring, which involved a fair amount of information exchange and, then, moving into the whole area of telemedicine and home telehealth. So, again, I wasn't as much interested in early telemedicine applications, which involved discussions between an expert here and an expert here, as I was in utilizing the growing capability of the technology to bring the patient into the loop. We were always interested in getting things into the patient's home and having them become an integral part of the whole process.

DT: So, for example, like a heart monitor into the home or other monitoring devices and, then, having the patient be able to report back what they're seeing? Is that what you mean?

SF: That's basically what's going on in home monitoring.

There were two principal people I worked with when I first started here. One was Jay [N.] Cohn, who was a professor of medicine and head of the Cardiovascular Division. He was always interested in hypertension and congestive heart failure. We were looking at some different ways of monitoring things and ended up looking at something very simple, which was the blood pressure waveform, not the blood pressure itself. If you take a cuff measurement, you get just two numbers.

DT: Sure.

SF: We were interested in the wave shape and looking at the wave shape, we were able from an engineering perspective to identify what we thought were important characteristics. We actually ended up developing a process to measure, almost non-invasively, what we called arteriovascular compliance, which cardiovascular people talked about but never really measured directly. We ended up generating about a dozen patents involving this and were two of the four founders of a company that developed our idea into an actual instrument that was used in clinical research studies. The company never made money.

DT: [chuckles] What's the name of it?

SF: It was called Hypertension Diagnostics, Inc. [HDI]. It was located in the Twin Cities and probably existed for about fifteen years. To a larger extent, it supported research studies—not here because we were involved, and there’s a conflict of interest or would have been a conflict of interest. It provided equipment (the primary device was the CV Profiler) and expertise to other cardiovascular researchers here in this country and around the world, mainly in Europe and in Asia. There were probably several hundreds of papers that were generated using that equipment. There are still papers being generated from various trials that are using it. It has always been controversial in terms of the interpretation. But the researchers that have been using it have found it to be a very useful and predictive way of identifying potential cardiovascular problems. That was one chapter. Again, that was developing instrumentation. This device was actually used in a clinical setting. A future version, if it ever existed, might easily have been converted to a home monitoring type device.

At the same time, I was working with Warren [J.] Warwick. Warren was a professor in Pediatrics and the director of Cystic Fibrosis [CF] Center at the University, which was one of the largest and probably more successful... Take out “more successful.” That’s my own interpretation.

DT: [chuckles]

SF: It was probably one of the largest and early well respected CF Centers in North America. A lot of competition was with Toronto kid’s [University of Toronto Children’s Hospital].

Warren had commented many times, frequently when his CF patients would come to see him—and they were coming on a regular schedule—that they thought they were doing really well, but when they went through a full examination, he found that they really weren’t. Was there some way of getting a handle on their condition without them coming in? So we sat down and actually did, what we call today, a home monitoring program. At that time—this was probably the very early 1980s—technology was sort of on the cusp of really expanding. What we were interested in was how could we monitor the patient with a pulmonary function? There weren’t any really good ways. So we ended up using what they use in hospitals after surgery, sort of an incentive spirometer. What happens after surgery is they want to keep the airways open, so you have this little plastic tubing, basically, and the patient will be asked to take a deep breath against this device, so it provided some resistance. The advantage of that was it was real cheap, and it was very easy to use. One of the disadvantages was that it didn’t have any automatic links to anything else. We provided that.

We ended up with a large NIH [National Institutes of Health] grant. It was called the SCOR [Specialized Center of Research] grant, at that time. Our particular SCOR grant was focused on cystic fibrosis. My piece of it was focused on the home monitoring. We would have our subjects record on a paper diary a set of about a half a dozen different measurements that they could make at home, including exercising spirometer volume. They would do it on a paper diary. They were asked to send the diary in to us by mail

every week, and we would have one of our students do the data entry. Then, we put together some data response forms so that the docs could look at it and have it when the patients came to clinic. The idea was could we use this ongoing sort of weekly sets of data to develop some sort of a predictor or decision rule so that when we got the data and ran it through the decision rule, we could identify those kids that might be more at risk than others and if they were at risk to call them in. At the conclusion of the SCOR we (our research team) would sort of drop out, and it became a clinical mission. That ran for a number of years and we actually developed two different decision system approaches that seemed to be working pretty well. As happens in many research studies when the grant money runs out, and we couldn't get anybody to pick up the cost of running the program, the program, basically, stopped; although, different pieces of it ended up getting picked up. We followed this research effort with an NIH funded Demonstration Education Research (DER) grant that investigated psycho-social interventions for CF.

We used that expertise to develop a home monitoring system for lung transplant patients. At about that time (early 1990s), the instrumentation that was used for monitoring pulmonary function was typically an electro-mechanical kind of a system that was used in the pulmonary function lab, not at all practical for patients to use at home. People started to develop electronic versions of that. There was a local company, and one of our contacts here knew somebody there, which is one of the nice things about this area in terms of the proximity of fine medical instrumentation kind of possibilities. Anyway, we met with them.

To back up for a moment... When we decided to move into sort of the transplant realm, I started working with Marshall [I.] Hertz, who is a pulmonologist. At that time, I think he was medical director of the lung transplant program. We put together what we thought would be a reasonable way of doing home monitoring. We identified this company that was making electronic spirometers, they weren't making them for home. They were making them to be used, to a large extent, for respiratory therapy. We got in touch with those folks and sat down and said, "Your device looks like it's probably what we would use, but we need it to do these particular things." They said, "Oh, sure. That's easy." But everybody says that.

DT: [laughter]

SF: You know past history, you'd expect they'd go away and you'd never hear from them again. These guys actually came back in a month with a prototype pretty much doing everything we wanted it to do. We ended up incorporating it in our study and that became the basic instrumentation of the home monitoring program. It was a device that patients were able to use at home, at least, we thought they could. The big issue was to convince the clinical folks to rely on the patient's ability to do these kinds of things. The device monitored respiratory function and it, also, had the capability of...it consisted of sort of a diary component. So after they did the spirometry, it would come up with a series of questions, and they would answer the questions. The answers were typically numeric answers so we would be able to do some coding. It was set up so that they would be able to connect it to their telephone system and just dial the data center and

download the data. We asked them to do that, basically, once a week, download it every Saturday.

Then, of course, there were two major issues. One was whether or not they were willing to do it and could do it, and the other was whether or not the stuff that they sent us had any clinical use at all. We had an NIH grant basically to do a pilot study, at the time. I think it was a two-year study where we were able to look at the home data that was sent in and, also, look at the data from these patients when they came to clinic. Typically, they'd come to clinic several times a year. If you plotted the two of them, they weren't exactly the same, because their particular conditions in a lab that followed and is directed by a trained respiratory person whereas the others are sent from the patient's home. So one of the issues was how do you replicate that at home without sending a therapist home with it. So we compared the two. We had home data for every day. We only had clinic data four or five times a year. At the points in time when we had clinic data, the home data was pretty close to it. If you followed the pattern of the clinic data, the home data followed the exact same pattern. It was just off by a little bit. Since we weren't using it particularly for diagnostic purposes, the actual number was not all that important. We were interested in how things changed. The idea was to identify early changes in the transplant patient's condition. If you could pick up the change early enough before it became a more serious thing, you might be able to have them come in for a more thorough workup and try to alleviate the problem or, if you couldn't get rid of the problem, at least to slow it down.

I think we had NIH support for probably a twenty-year period as we got more and more successes with it.

We found that patients could do it and we were able to convince the skeptical people...

[chuckles]

SF: ...that the numbers were actually good enough to use for making some decisions. We, also, showed that, as one might expect, for those people that did home monitoring on a regular basis, they typically had more clinic visits than those that either didn't do it at all or did it only sporadically. One would say that's an added expense. But that same group had fewer hospitalizations, which is what we had predicted would happen, because if you can successfully identify a problem before it becomes more serious, you'd call them in to come to clinic and try to work on it and you might be able to prevent hospitalization. Hospitalization is really expensive and a clinic visit was not cheap, but it was a lot less expensive. So that was a plus, also.

I don't remember the year, but sometime during that series of studies, CMS, [Center for] Medicare and Medicaid [Services], came out with a provision to provide reimbursement for home spirometry for asthma and lung transplant patients. I recall that they cited some of our papers for the decision. I tried for a long time to go back and see where I could find that in the federal register.

DT: [chuckles]

SF: At the time that was nice, but I didn't record it anywhere. I've never been successful in tracking it down. But that was sort of a plus.

During this time frame I organized and directed the Schmitt Center for Home Telehealth, locally funded by the Schmitt Biomemetric Foundation, established by the estate of Otto Schmitt an internationally recognized scholar on the U of M faculty. The Center was an educational and information resource for folks interested in telemedicine from the patient's home.

At the end of one of our grants, Marshall was able to convince Fairview University Hospital to implement a part of this as part of regular clinical practice, which we considered to be a real plus.

DT: Hmmm.

SF: That wouldn't have happened without the reimbursement possibility; although, it turned out the amount of the reimbursements was always less than what it cost to collect the data.

[chuckles]

SF: That went on for a number of years until the economy started to bottom out and the hospital started looking around to see which is a profit center and which is a cost center. Clearly, this was a cost center, so they ended up dropping that. I'm not sure if it has continued or not.

We went on and had one or two more NIH grants focused on lung transplant home monitoring. The last one which ended about three years ago was in terms of lung function. It was developed because the concern was if you really have a successful home monitoring program so that patients actually collect data on a regular basis and lots and lots of people are doing it, it doesn't become a research study. It becomes part of regular clinical practice. So they send the data in. Who's going to look at it? Somebody's got to review it and decide if there's a potential problem or not. Given the lack of increased manpower... When we first started this back probably in the very early 1990s, there were, I think, four nurses in the lung transplant program, and it had just started then. When we ended several years ago, the University probably had 600 or somewhere closer to 1,000 lung transplants, but there were still I think six nurses. So...

DT: Yes.

SF: ...people power didn't coincide with the increased clinical load.

We ended up trying to develop, again, an automated decision system that would look at the data as it came in and decide whether or not a particular patient looked like they were

in trouble. If they were identified, for a warning, for example, that information would be sent to the clinical team and they would decide what they could do. So it was no longer on engineering but the decision system problem became really a clinical problem. We ended up doing a clinical trial where all of the subjects get home monitoring, but half of them had their data reviewed by a nurse in the traditional way and half was reviewed by our decision system. It turned out at the end of the study that it didn't make any difference, which we thought was an indication of the success of the decision system. We weren't necessarily saying it was going to do better than the nurse.

DT: Yes.

SF: What we didn't want it to do was have it do worse. There were a whole bunch of papers published on this work. That ended, as I said, about three years ago.

Over that period of time, Stuart Speedie... You have spoken to or will be speaking to him?

DT: I will be speaking to, yes.

SF: We were co-P.I.s [principal investigators] on a couple of studies supported by the Department of Commerce, of all places.

DT: Yes. [laughter]

SF: They were interested, at that time, about finding health-related applications for new technology. That's what we were doing.

Just backing up for a moment... At the time when we started the lung transplant work, it was sort of the beginning of the era of small electronic devices for monitoring. It also turned out to be the beginning of the new telecommunications era. People didn't all have smart phones at the time, but they were moving in that direction. It did turn out that communication systems were improving, so we were able to have all the patients just download data from their devices. These days everything would probably be on the smart phone, and we wouldn't need all these intermediate steps.

Several years ago, I started working with one of the docs (Anne Kelly) in Pediatrics on a question that she had. We used to sort of meet in the hall every now and then. What her clinic did was provide care coordination for kids with special healthcare needs. So we started to consider that and see if we could generate some sort of funding to develop that concept. We ended up doing that and submitted an NIH grant, which was approved but not funded. So, yes. There were some questions that had to be addressed to sort of make it a little stronger. Over that period of time, her clinic was closed down—again, because it was a money-crunch time, and you didn't get reimbursed for care coordination. You got, basically, reimbursed for doing procedures. Her clinic and her concept were not based on procedures. She felt she could do a much better job helping the patient if you coordinated their care to a greater extent. So we ended up searching around, and we

ended up, again, through some contacts working with a group in the special needs program at Saint Paul Children's. It's part of Children's Hospital and Clinics of Minnesota, but it was the Saint Paul campus people that we were working with. We ended up finally getting an NIH grant approved and funded (TeleFamilies) to do this. That's actually ending after 5 years. We're sort of at the tail end of a no-cost extension, which will be ending in another couple of months. The idea there was to improve care coordination for kids with special healthcare needs. We ended up with three arms in this particular study. One was the controls which got their care coordination in the standard usual way, which was more of a triage system than a care coordination system. Then, we had two intervention groups, both of which were directed by an advanced practice registered nurse. An advanced practice nurse is able to prescribe medication and make other kinds of clinical decisions. One of the intervention groups interacted with our advanced practice nurse basically through the telephone.

DT: Hmm.

SF: The same nurse had a second intervention group which used both the telephone and video conferencing. The idea was if a nurse or the parent thought the video would be helpful in coordinating care, she would ask the parent to turn on the video, and she would have it on our system and they'd be able to do a video consult. Again, these days, that would probably all be done on smart phone, but four or five years ago, that wasn't the case.

Video conferencing became an issue because we're dealing with patients' data so the video conferencing software had to be HIPPA [Health Insurance Portability and Accountability Act] compliant and there weren't too many. There was one relatively moderately priced system that could be used at home that was HIPPA compliant. Stuart and I had used it in one of our previous studies so we had some familiarity with it. But it became an issue going through the various firewalls at the Hospital. We did it, but it was an issue. It turned out that we were just into the study but not that far when one of my graduate students ran into a former graduate student that was now out at the University of Washington who was doing home monitoring kinds of things. He had just started working with a small company—I think it was in Iowa—that had a web-based video conferencing protocol that was HIPPA compliant, and we ended up using that. Once we installed that, we never had a problem with it again. Patients easily did it. So that was a success.

Now that we have finally collected all our data, we're in the process of looking to see whether or not either the telephone and/or the video intervention actually turn out to be an improvement over typical triage.

DT: Does the telehealth relate to...? I know in the 1970s when there were concerns about shortages of rural physicians, one of the innovations was to set up telemedicine. I think it was possible for patients to call a physician at a different site and talk about their symptoms, and, also—I think you mentioned this earlier—have clinicians talk to clinicians, one here and one there.

SF: Typically, when one spoke about telemedicine in the earlier days, it was frequently institution to institution, so it was expert to expert in some sense. Later on, it became more recognized that, gee, maybe we need to bring patients into it, as well. Back in the 1970s, they, basically, telephoned.

DT: Yes.

SF: It's only in the last few years where it's progressed into the patient's home and, to a large extent, that's not necessarily been driven by the clinical folks, but it's been driven by the Nike's of the world—right?—...

DT: [chuckles] Yes.

SF: ...and the fad of exercise people having to know every number about everything that they do. Now, you can buy various instruments that will automatically link to a phone.

DT: There's currently an iPhone commercial about all the health-related apps [applications] that monitor every single number whether it's exercise- or health-related.

SF: Yes. It, basically, indicates that things are now caught up to the popular culture. Whether or not the clinical folks, or us, could capitalize on that in some way remains to be seen.

DT: All of this research, aside from the Department of Commerce funding, has all been funded through the NIH?

SF: All of my studies have been funded from NIH. This goes back to the early ones with the arteriovascular compliance through the CF, the lung transplants, and the nursing ones now. The earlier ones were funded by the [NIH] Heart, Lung, and Blood Institute. Those, I think, were for the vascular compliance ones and the CF ones. The latter ones, which now span many, many years, or decades, for the lung transplant home monitoring and the nursing have been funded by the National Institute of Nursing Research, which is one of the smaller institutes at NIH. It's an institute that has a real interest in clinical application, not so much sort of wet lab kinds of things. The sort of things we're doing are not basic research really...well, sort of applied research. What we try to do is use what's available or try to get somebody to modify what's available to serve our purposes. We're not really developing instruments themselves. What we are developing are systems that use all of these things to help us better understand the clinical picture. We were probably ahead of the times doing what is now referred to as translational research, moving from the lab to beyond the bedside, into patients' homes.

DT: That is very much what nursing research is focused on: clinical application.

SF: Right, right.

DT: Your own research program was exceedingly well funded by the NIH and its various institutes. Then, at the same time, the Division of Health Computer Sciences got a lot of National Library of Medicine [NLM] funding. I wonder if you are able to speak about the various training grants that the Division had.

SF: Well, the training grants were all part of the same program from the National Library of Medicine. They'd be funded for a five-year period. Then, they had to be renewed regularly. Typically, NLM would sort of change their particular goals, which makes sense. They don't want to for thirty years just do the same thing. We were always sort of at the cutting edge. There weren't, probably, more than six or ten universities around the country that had the same longevity as we did in terms of training grants. Again, I think as happens very often, we were much more highly recognized and regarded off campus, at other institutions and other places, than on campus. Even though we probably had one of the largest and longest training grants around here, I don't think there was anybody who knew it...

DT: [chuckles]

SF: ...except the people that were most intimately involved. Over the years, frequently the students in a training grant program would end up doing some research with me if they were interested in the kinds of things I was doing. They would end up being graduate students, and they were funded by the training grant, which was really nice. In some cases, once the training grant funding ran out for them, if I had funding, I would pick it up. It was a nice way of getting an interested student involved in an interesting project. What we were doing was not necessarily considered to be the core of informatics, at the time. At that time, the trainees were typically former undergraduate engineers or computer science people. Sometimes, they were psych [psychology] or they were clinical folks, docs or nurses or, sometimes, pharmacy people.

One of the important aspects of the training grant was to get these two different cultures to talk to each other and to work with each other and understand what they were doing. In a sense, that was really the same thing that one would face in biomedical engineering. At that time, there were no undergraduate programs in biomedical engineering, so the graduate students would either have an engineering background or a biology background. Usually, the biologists, to a large extent, avoided engineering kinds of undergraduate things and undergraduate engineers managed to avoid biology. All of a sudden, they're together in this graduate program. One of the functions of some of the early, first year courses was to get these folks to talk to each other and to understand each other's language. That was similar in Biomedical Engineering and it was similar in Health Computer Sciences.

DT: Was that challenging to get the biologists up to speed on the engineering and computer side of things and the engineers up to speed on the biological sciences?

SF: I think in the early days, it was probably easier to get the physical science people up to speed on the biology than the other way around. But as biology became a lot more

complex, that has probably evened out, or has changed. It becomes, I think, more and more difficult to get an engineering student that doesn't have any undergraduate biology background up to speed quickly. So many things have changed.

DT: Yes. [whispered]

Aside from your tenure at the Polytechnic Institute of Brooklyn, do you have any sense of the ways in which Minnesota's training graduate program was maybe different from the training programs at the other institutions that were preparing health informaticians?

SF: I wasn't involved with health informatics at Brooklyn Poly.

DT: Yes...at least the kinds of students you were preparing?

SF: Certainly at Brooklyn Poly, there were no health informatics programs, at the time. I became more familiar with health informatics programs once I was here and when I was able to meet with other people from training programs. But, I think, to a large extent, all of those, the reason they even existed was because NLM provided funding for them and people don't like to turn down potential funding. One of the issues involved with all of that is at some point when the training grant runs out—I think we were particularly fortunate that NLM continued this for all of those years—is how do you sustain a program if you're not getting outside support for it. Usually, you can sustain part of it by tuition but that's not going to pay the way. Is there any institutional support? I think one of the problems we had here—I don't know about other places—is we didn't have any institutional support. So we, finally, ran out of training grant money.

Again, we had four or five faculty and they were all tenured faculty, so they were here. They were all really dedicated to keeping this whole idea going. One thing to say is it was a small and pretty cohesive group all with different kinds of backgrounds, and all, I think, really felt strongly about keeping this going. Then, at times when myself and other colleagues that were well and heavily supported in research and in other places probably would have been able to buy out their time so they didn't have to teach. But the way the situation was here, if we didn't teach, nobody would have done it, so the program would have slowly disappeared. People, I think, did both: they had a heavy research load and a heavy teaching load. It wasn't every semester, every quarter at the time, but it was an issue over the years.

There was a gap of time and, then, the NIH came out with the CTSA [Clinical and Translational Science Award] initiative. One would have thought that the University of Minnesota would have been a shoo-in at the beginning—and we weren't. I don't know how many cycles we went through. We never got funded. I think part of that was because of the lack of insight from higher up administrative levels at the University to actually know and/or appreciate what informatics was. The folks at NIH, they know what's going on. I think they can sense pretty well whether or not an institution is really serious about this. I don't know what the reasons were, necessarily, for not getting the funding. Frequently, with regular research funding, there may be some sense by the

funding agency that the institution is not really into this. If they get it, that's fine; if they don't get it, it's fine. I think that was one of the reasons; there may have been others, as well.

One other reason might have been that we didn't have a formal director once the Institute of Health Informatics (IHI) was launched. It certainly got to the point where the University, I think, finally, did realize that if they were going to do anything further... This was after bioinformatics became a widely accepted and known discipline. So I think in many cases, the perception at that level was what we're all doing is bioinformatics. Point of fact, only one or two of our faculty was actually involved in bioinformatics. Other faculty were involved in various other aspects of clinical health informatics. They (the University administration) ended up putting together the Institute of Health Informatics, which was a fine idea. Moving the graduate program from Lab Medicine to the Institute actually made some sense, because it gave it the possibility of a much wider knowledge base, basically, amongst the University itself that such a thing actually exists. It's difficult to put something together and not have a director.

DT: Yes.

SF: I think the faculty have always been sufficiently self-guided and experienced researchers. To a great extent, they were able to function on their own, but didn't see any particular advantage...and we've been going along now for five or six or seven years without a director. I think that does become an issue. I'm not sure how it's going to be resolved. We've had a couple of people that we've interviewed that were really very good and for one reason or another decided not to pursue it. I think there are some people in the pipeline now, so we'll see what happens.

DT: You mentioned about the lack of institutional support. It sounds like the Department of Laboratory Medicine was supportive. I read in some of the material I found in the Archives that there was really no option to get any more tenure lines. You mentioned that it remained a small faculty. Can you speak to that at all beyond what you've already said?

SF: I think in the early years, probably even before I was here, Ellis Benson was a strong supporter and when I got here, he seemed to be also a strong supporter. But as the overall direction of Health Computer Sciences sort of expanded, there was a general feeling—I think it was more greatly expanded when Leo [T.] Furcht became the chairman of the Department—that the core of Health Informatics was not necessarily a clinical laboratory. It was in lots of other things. His statements have always been that he thought that Health Informatics was an important discipline, should be supported, but he thought it was a much broader thing than just Laboratory Medicine. Over the years, he was never able to convince his colleagues of that. He continued to support the program. Over the years, even before Leo, there were ups and downs. There were times where the continued existence was pretty shaky.

DT: Yes.

SF: We always managed to work it out. Leo continued to provide this minimal level of support, but again, we were not able to hire anybody to increase the level of activity and the breadth of potential research resources. So that became an issue. If the program is not allowed to grow, it's not going to go anywhere.

DT: Yes.

SF: When the Institute was formed, that might have been a plus. I think from Lab Medicine's point of view, the fact that the graduate program was moving out was a plus but faculty is still here. Even though the core faculty in the Institute is fairly large, the primary movers and players in it are the old Health Informatics people and/or some of their former students. That's going to have to change, because most of the former Health Informatics people are going to be retiring, if they haven't already retired.

DT: Right.

SF: We'll have to see where all of that goes.

DT: One of the other major grants it seems that the Division had was the NIH's simulation pre-resource for stochastic population models.

SF: Right.

DT: Could you talk about that and whether you were involved with that at all?

SF: I can't talk about it, because I wasn't involved with it.

DT: Okay. [chuckles]

I wonder if you could say a little about Gene Ackerman's role as director and maybe what his leadership style was.

SF: If Gene were not here and were not able to convince people—again, this is before I was here, so I don't know the exact details—my assumption is that he was able to convince Ellis that this was a good idea to promote it. So probably without his vision and his leadership, there would not have been a Division of Health Computer Sciences. He was certainly nationally, probably internationally, respected researcher and investigator. A lot of the early things that I remember reading that he and Laël were involved with were in terms of developing models for physiologic systems. Again, that's sort of part of the genesis of Health Informatics. I was doing some of that as a Ph.D. student and subsequent to it, but I didn't know that was called Health Informatics or Health Information Systems, at the time

[chuckles]

SF: From an electrical engineering point of view, that's a mouthful. I think Gene was really instrumental in getting this going and keeping it going. Sometimes, he could be difficult to deal with, but I think, generally, he listened. Although, he didn't always appear to agree with you, I think he thought about it and, sometimes, would come back. He, also, wasn't one of these super charismatics. He was an interesting person or character in his own right, but he wasn't one of these people that was charismatic and could sort of talk to anybody and say, "Gee, let's jump on the bandwagon"—not that those folks are not thoughtful. He was much more involved in sort of the details and the science and less involved in building or continuing the growth.

When he retired, Laël took over and we sort of continued on that path, but, by that time, it became more and more difficult. Ellis was either retired or close to retirement at the time, so situations were changing and funding was changing, getting more and more difficult.

DT: Would you say her leadership style was different from Ackerman's?

SF: I think Laël is a very highly respected investigative person in the field and, basically, works tirelessly at it and, sometimes, it's hard to tell where she gets all the energy to do that. We always have lacked a charismatic leader to be able to sort of jump-start this thing and get to the next level. It turns out that out of our small core of faculty, nobody was like that.

DT: [chuckles]

SF: I think we had a core faculty that really was good and energetic and smart, good researchers, and were able to get their things done, but they weren't necessarily empire builders. If you look around, the places that have really jumped ahead had somebody like that that was able to get the ear of some high-up vice president or whoever it is where some of the decisions are really made. We tended to work, to a large extent, through the department structure and the department head who, sometimes, well I won't say sometimes, but would have to work through the dean and the whole structure there. I think to a great extent, there was a lack of knowledge and appreciation of what informatics is or could be—until now when everybody talks about informatics as though it's sort of this discipline that's going to solve everything.

DT: [laughter] Ironically.

SF: I remember when I was presenting our new Health Informatics program at a Graduate School committee, after the split between Biometry and Health Information Systems. I don't remember who this was but at some meeting of the Graduate School, we were talking about proposing the program and somebody sort of...“What's informatics? How did they come up with such a weird name like that?”

[chuckles]

SF: But the Graduate School was willing to approve the program. But that was sort of an indication of the fact that it really wasn't widely known, or widely accepted, or appreciated.

DT: I see that you were associate director of Health Informatics for almost twenty years.

SF: For a long time.

DT: What were your responsibilities as associate director?

SF: I guess I was associate director when Laël became director. I was, basically, working with her to maintain the graduate program. It was largely to maintain and keep the graduate program going, to modify some of the coursework to keep up with changes in the field, and to try to work with her to convince *upstairs* to provide additional support, but we were not ever successful.

DT: [chuckles]

SF: Again, I was part of the same model of all the other folks in the Division. I think any one of us could have been the associate director and probably didn't have the personality to build an empire. It's disappointing, but I think we were reasonably satisfied that for a good number of those years, we kept renewing the training grant and we had a fairly decent number of students, and some interesting research going on. Probably the biggest thing within the Division, other than the training program, was the micropopulation resource. That was primarily Gene and Laël and Mike Altman at the time who we had hoped to become one of our regular faculty. It never happened. The other folks were involved with some collaboration amongst us with their own research studies. I think those were going along. We didn't have \$20 million grants, but we had reasonably sized grants for the time. The thing that brought everybody together was the graduate program.

DT: One of the things I noticed about the history of Health Computer Sciences here is that there were a relatively high number of female students and faculty members here relative to other sciences in Minnesota and elsewhere. I wonder if you have any sense of why that might be.

SF: The fact is, the faculty...that was sort of the way it was when I got here. In one sense, we could say, "Well, we weren't able to grow so we sort of stayed at about that same level." I think, to some extent probably, in terms of the student base, it was a somewhat technical science that attracted people's biological backgrounds. I think there were a lot more women that were graduating with degrees in biology than there were men, at the time. That may have contributed to it. It may have been because when they looked around at the faculty, there were a fairly large number of women on the faculty and maybe that was a draw. I don't recall that there was any particular stated goal to have a certain percentage. As far as I can tell, it just happened.

DT: It's interesting given that on the student side of engineering, one thinks of engineering as being more male certainly at that time.

SF: When I was an undergraduate engineer, I think there was one female in the entire engineering school. Yes. It wasn't a huge engineering school. It was a reasonable size, probably 6,000, 7,000 students. There was a thing there. Again, my opinion and it's not backed up with any fact necessarily, but I don't think there was any particularly stated goal to *not* accept women; although, it was clear, and I could see it from friends of ours and even sort of now to a lesser extent with my grandkids, that as young kids, there was really no particular distinction between the fact that the females were less interested in the sciences or engineering than the males. But, somehow, as I went through high school, things changed. I don't know why. I think that's changing. I think there's a greater recognition that things have to change. I think there are more and more women now. Again, when I was involved with Biomedical Engineering here, it was a graduate program and not a department. Then, it became a department. I have had much less day-to-day interaction with it. But I think the numbers of women now might be half and half. I don't know if that's true in other engineering disciplines, but, again, it may be because of this linking of the physical sciences and the biological sciences.

DT: It seems that the Division of Health Computer Sciences has had an important relationship with the Biomedical Library and the fact that the Institute is located within the Biomedical Library. I wonder if you have any thoughts to share on that relationship.

SF: Going back for many, many years, there was always a close...not always a linking, but a relationship. Certainly, our training grant was supported by the National Library of Medicine which had a major input and influence on the Biomedical Library, so it was sort of natural. Quite often the director of the Biomedical Library was interested in informatics, obviously information systems, and, in many cases, was among the people that were encouraged by NLM to be supportive of proposed closer linking with educational programs like that. The last couple of directors of the Biomedical Library were particularly close in that regard. I don't know how the deal was worked out to get space in the Biomedical Library, but it turned out to be a fortunate one. It might have been something that the Library people sort of saw that as things became more and more electronic it would be harder to justify utilizing all of that space. Space is always an issue around here. This was always a continuing a link with informatics in a real positive way. I think it's worked out very nicely.

DT: From what I can tell from the documents I read, the teaching computer lab has always been in that space in the Biomedical Library since, I see it, since the Health Sciences Instructional Computer Laboratory set up in 1981. So there's been this history of there being this space.

SF: Lynda [Ellis] probably knows that better than I do.

DT: Yes, she was running it. [chuckles]

SF: She was running it, right. For many, many years, it was down in the basement in the Moos [Tower] over there or one of those buildings.

DT: Yes.

SF: There's still a sign on the door on that level that points to it.

DT: That's what she said, yes.

SF: It was there for many, many years. I don't recall that that was necessarily Biomedical Library space.

DT: Yes, I guess it's a little unclear in the documents.

SF: It's only since the IHI [Institute for Health Informatics] was established and moved into the Biomedical Library that we have that lab space there. I think over the years, the library administration has always been pretty supportive of what we needed. Unlike lots of other programs in the Medical School, for example, in terms of lab space, we don't need an awful lot. We basically need an empty room and a bunch of desks.

[chuckles]

SF: We don't need all kinds of hoods and wet equipment and things like that. So it's a relatively inexpensive program to support.

DT: Yes.

How about the relationship with the Mayo Clinic? I know it predates your arrival here, but it also extends...

SF: It predates because Gene and Laël were at the Mayo Clinic before they came here.

DT: Yes.

SF: Mayo has always had a strong relationship between one of the biophysical science programs down there and the folks here. I remember there was, periodically, a bus trip down there to meet people there and see what was going on. That was my first real contact. Over the years, I haven't had any really strong direct relationship. I've known [Christopher G.] Chris Chute a long time because he has for many, many years been involved with our training program. So we sort of knew each other that way and he sort of knew what was going on here—probably more than we knew what was going on there.

DT: [chuckles]

SF: For the latter number of years when we had a training program, it was a joint training program: Mayo and the University of Minnesota. That, also, for the most part,

ran pretty smoothly, but it had its ups and downs and disagreements, as, I assume, most programs between two major institutions would in the same way. But I haven't had any direct research relationship with Mayo.

[Donald P.] Don Connelly...I don't know if you're going to...

DT: Yes, I'm going to interview him in a couple of weeks.

SF: Okay. He actually was one of the recipients of this Mayo/University research program. I think he was one of the first grantees, so he will probably know more about that. But Laël is probably the best resource for that kind of information.

DT: We've had a meeting and we're going to actually have an interview, at least the first interview in a couple weeks time, too.

I just have two more questions... I wonder if you could speak to the establishment of the [MHI] Master in Health Informatics in 2005 and what influence that has had.

SF: That, I think, was, basically, spurred on by Stuart, at the time. I've lost track of the different dates. He became DGS [Director of Graduate Studies] after I was DGS. It was sometime around then...

DT: [chuckles]

SF: The idea was, initially, to come up with a professional degree. I think we had looked around and there were several other programs on campus that had special professional degrees which were not really under the auspices of the Graduate School and, therefore, were not tied to the rules of the Graduate School in terms of tuition. So some of them really have escalated their tuition for that particular degree because they were focused on particular potential students. Anyway, I think we investigated that, and it turned out that that was not going to work. We thought that it might be, I don't know if it was to bring any more students in because it was designed to have less of a time requirement than the traditional master's degree. I think the idea was that if the student did it fulltime, they could finish like in a year and a summer, whereas, a regular master's student took like two years or more. So we moved in that direction. We instituted that in addition to our other degrees. I don't remember the numbers, but I don't think it was particularly successful to begin with. I think it became much more of a draw once the Institute was formed.

Julie Jacko, to give her credit for that, brought in another kind of a training grant to, basically, get computer-related health professionals in to get certified in the area of health informatics. She had support for people, particularly in the MHI program; so, suddenly, the number of MHI students really grew. It grew because there was financial support. Again, one of the difficulties that we've had in the past...when we had a training grant, we had support, but when the training grant disappeared, we didn't have any general support. There was a little bit of support from the Graduate School, which was not

available on a regular basis. It was really a hit or miss. Other than that, there were maybe a couple of very specialized cases, but there wasn't any general support. I supported some of our students as graduate research students, assistants, on my grant and other people did the same. But we didn't have this vast research empire. So you couldn't support all that many students. It wasn't until Julie brought in that training program that was able to provide a reasonable amount of support for a broad number of students. Now, that that's over, I don't know what the MHI numbers are going to be like. I'm still more of a strong proponent of a traditional master's program and Ph.D. program than the MHI.

DT: I guess without an undergraduate program you don't have teaching assistants [TAs]. Then, you'd get teaching revenue.

SF: Right. The departments in the Engineering School have large enrollments, and they have TAs depending on the number of undergraduate students. We never had that.

DT: Yes.

SF: Leo did actually provide support for one TA, basically out of Lab Medicine money, again, which was a plus. He didn't have to do it. Although, he frequently was interested in farming out the program or getting it more widely supported, he did maintain it. It didn't allow ours to really grow but it allowed us to at least keep that at an even level.

DT: It's clear from your research that you have collaborated widely with clinicians. I'm curious within the Division—you've already mentioned several collaborators—what collaborative relationships were like with other units within the Academic Health Center. Did they work with the Nursing School, other units within the Medical School? I know with Biometry and Health Information Systems, obviously the School of Public Health...

SF: Right. I think, to a large extent, the relationships were built on research relationships, not necessarily teaching or academic relationships. Early on, I remember some of the first-year courses, Laël and I would co-teach. At one point, students in Epidemiology were required to take one of these courses, so we had some Epi students. There were always a couple of Nursing students that were involved. Early on, we had some ongoing relationship with one of the divisions in Surgery, so there were always one or two surgical fellows, because a fellowship requirement was they had to do a certain amount of research and part of that research was collecting data. At some point after collecting data, you have to figure out something to do with it, what to do with it and how to present it. So they found, I think, some of the informatics work to be useful. Over the years, as leadership in some of these other places change and particular focus and direction changes, and since none of this has ever been institutionalized, it sort of comes and goes. As most collaborations, they're really based on individual personal contacts, not institution. By institution, I don't mean the University but college to college or even department to department.

DT: Well, do you have anything else that you'd like to share about the history of Health Computer Sciences or your own experiences here?

SF: Not particularly. From a research point of view, I think I really enjoyed things and found really good collaborators and we did some interesting and important things. From the educational point of view, when I was more involved in it, I think we put together a good program and we had some really good students who, eventually, went on to do other good, important work.

A disappointment was the fact that we could never get past the level that we were at. We have to take part of the blame because we didn't have either the perseverance or the leadership or the ability to do that. But I think, to a large extent, if we had had more aware and visionary leaders at a higher University level that could have seen what was going on nationally and, also, seen what they had in their own backyard, we could have really been at the very forefront over all of these years. Because of a lack of that, we continued to sort of slip. I think we're going to continue to slip until somebody finally decides we're going to bring in a permanent director and provide the resources needed to actually do something. If you make available resources just to stay even, you're not going to go anywhere. If anything, you're going to fall further behind. As in many other places, it takes some visionaries and some good leadership at the decision-making level. Unfortunately, I think we have not had that all of the years. We have had some good people, some people that saw things and tried to move ahead, but never quite succeeded.

DT: Well, thank you. I really appreciate your time. You've given me some great information, so thank you.

SF: Okay.

[End of the Interview]

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