The SIIM History Committee Presents

An Interview with Joseph N. Gitlin, DPH

Fellow of SIIM
Associate Professor of Radiology
Johns Hopkins Medical Institutions

Interviewed by
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From the SIIM History Committee:

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Steve Horii: I'm here today with Dr. Joseph N. Gitlin who is currently an Associate Professor of Radiology at the Johns Hopkins Medical Institutions. Dr. Gitlin and I have known each other for a number of years; and I'm Steven Horii, a radiologist and member of SIIM. And we're here to get a little bit of personal history from Dr. Gitlin; and because Dr. Gitlin and I have known each other for so long, please don't think it presumptuous if I refer to him as Joe. So, I think as a way of getting some background about your personal history, can you give us a little bit of an idea of sort of how you got started in this, a personal background, where you were born, something about where you grew up, and your family history?

Joseph Gitlin: Yes, I was born in 1927 in Scranton, Pennsylvania, a town that was well known for its anthracite coal mines and trains that took the coal out of the city. I lived through the Great Depression and was concerned about lung disease because of family members who worked in the coal mines. I was very much aware of silicosis morbidity and mortality associated with the miners. I was very active in Boy Scouts, which gave me a sense of both indoor and outdoor activities and I was especially interested in first aid and completed several courses. This, in turn, led to my interest in medicine at the time and I was able to ask our family physician many questions about his philosophy and his practice of medicine.

Steve Horii: Did you have any interesting jobs as a youth?

Joseph Gitlin: Oh, yes, I worked in the family gas station where I was a grease monkey and I learned how to change oil and repair tires. If I may tell a brief story, gasoline at that time was 10 cents a gallon and for a dollar you could fill up your car. I pumped a lot of gasoline for customers and tried carefully not to spill any because for those days it was very expensive.

Steve Horii: Would you think that your early conversations with Dr. Severson, your family physician, influenced the direction you wound up going in?

Joseph Gitlin: Definitely. Probably one of the most memorable encounters was when my father developed an infection in his leg. In those days it was very serious because there were no antibiotics and I became a caretaker for my father and saw Dr. Severson almost every day for three weeks. With his wonderful kindness and treatment, my father pulled through and managed to live a long life.

Steve Horii: Can you tell us a bit about your educational history - where you went to school, the kinds of undergraduate and graduate education you had? And what I'm interested in is if there were any salient events during those times that you would like to let us know more about?

Joseph Gitlin: Well, after I graduated from high school in Yeadon, Pennsylvania, I was able to spend one year at the University of Pennsylvania, where I was accepted in the Naval Reserve Officer Training program and specialized in medical training. With one year of college and Navy training behind me, I was called to active duty. My first assignment was on a Navy destroyer escort, a relatively small ship, and interestingly, because it had a crew of less than 100, I was designated the ship's "doctor." I tried to stay within my limited knowledge and didn't lose any patients. When I was released from active duty, I returned to Penn and got a BA in economics, which at that time was taught by Nobel Prize winner Simon Kuznetz, who developed the national income approach to the U.S. economic system. I also had an opportunity to learn about punch card systems and ENIAC, the first computer that was at the University of Pennsylvania. I was intrigued by its large size and speed that computer people today think is rather strange. It was able to calculate 2 plus 1, 10,000 times in a second, which was absolutely unheard of, and it occupied about a square block of space. I began to understand there were such things as computers at that time.

Following graduation at Pennsylvania, I was accepted in the U.S. Public Health Service (PHS) and continued my education in the Washington area majoring in bio-statistics. That began to pull together in a formal way my interest in medicine and, in those days, data processing. Additional educational activities while I was still with the Public Health Service included a Masters of Public Health degree at Johns Hopkins in 1966. Because of my interest in radiology at the time, I did some preliminary studies of how radiology might benefit from applying computer technology to departmental operations. The studies were accepted as a thesis subject for the Doctor of Public Health degree, which I was awarded in 1970.

Steve Horii: …Never let your schooling interfere with your education. What about your subsequent work? I understand that you certainly worked for the Public Health Service and also had some experience with the Air Force, if I'm not mistaken.

Joseph Gitlin: Yes, and a lot of different uniforms. When I was accepted in the Public Health Service in 1950, my first assignment was with the Division of Tuberculosis when a national screening program was underway to make an attempt to eliminate tuberculosis in the United States. The technique that was developed included a photofluorographic unit that recorded chest x-ray examination images on 70 mm square film. Coincidentally, on that point, since we are sitting here in Rockville, Maryland, the Public Health Service had a laboratory about a mile away from here on Stone Street known as "Murphy's Lab." That's where the new photofluorographic x-ray unit was tested under the direction of Dr. Russell Morgan, who was active in the development of the test procedures. At the time, Dr. Morgan was the Chairman of the Department of Radiology at Johns Hopkins and a consultant to the Public Health Service.

The work resulted in 60 mobile units being built, each of which was equipped with the photofluorographic x-ray equipment. Over the next three years of operation, there were 2 million chest x-ray examinations done throughout the country. It was a free program, highly publicized and very well attended. A large number of cases of previously unknown tuberculosis were found that were treatable because isoniazid was available. Instead of sending patients with active disease off to sanitaria, the treatment was usually performed at home. During this assignment, I participated in designing a punch card system that recorded the fact that an individual had participated in the screening program, and provided names and addresses, so that if a 70 mm reading was positive, follow-up could be performed. The punch cards also were used to produce program statistics. A professor of statistics at the University in California analyzed the data and we noticed that there were relatively high positive rates of readings by the young radiologists who were interpreting the 70 mm films. As a result, we got permission and funding to change the single reading of the 70 mm films to independent double reading. That pretty much solved the problem of "over reading" and it greatly reduced the follow-up costs because every positive reading on the small films resulted in the individual going to a hospital or clinic and having a 14 x 17 film exam done to confirm the positive screening result.

Steve Horii: This was certainly before the days of anything digital. So, I presume that an optical device of some kind was used to enlarge those images for reading?

Joseph Gitlin: The only thing digital we knew about in those days was that you used your hands and your fingers to punch the holes in the cards. Yes, a special reader was developed to hold the 70 mm films that were on a roll of 500 and magnify them to get a better view without changing the image proportions. But there was a tendency, because of the screening program and single reading, that if the reader saw anything that was abnormal it was recorded as positive and that resulted in calling the patient back for the 14 x 17.

That was my first assignment in Public Health. I was then transferred to a very interesting second assignment in '52, the Venereal Disease program. I shouldn't be humorous about these things, but the nurses who were part of the Venereal Disease program congratulated me saying, you have left that coughing and spitting disease to something more romantic. It was a memorable assignment both in terms of public health and medical care. Penicillin was then available and the positive cases that we found were treated quite successfully – even advanced syphilis responded to treatment by penicillin. Even though I had had quite a bit of experience in World War II with ships and sailors and sending them off on leave, the venereal disease contact follow-up program in

Atlanta, Georgia, was successful and I learned a great deal about how "land lubbers" behaved. It was professional public health in the finest tradition.

My next move was to the Chronic Disease Program concerned with the early diagnosis of diabetes and the monitoring of the disease, which at that time was in its infancy. It was difficult for patients to do their own monitoring and treatment at home, which resulted in many visits to hospitals and clinics. Dr. Buck Rickli, with whom I worked, was instrumental in developing a new hemo-dialysis unit that we evaluated for about six months and found that it could be used in a very effective way outside of hospitals. Treatment at small clinics and some home use was developed at that time, which increased effectiveness and reduced costs. Another development that occurred in the early '50s was UNIVAC, that was the first commercial computer sold to the U.S. Government in 1951. It was programmed for the 1960 census and over the next eight years, individuals from different agencies were trained in its use. It certainly was enlightening to me to recognize that we were going to use real computers that didn't occupy a full block. UNIVAC only occupied about a quarter of a block and its speed was dramatically faster than the earlier ENIAC. The 1960 census was quite successful using UNIVAC and about 50 of them were produced, several of them in medical applications and public health.

Steve Horii: How did you manage to go from blue water to blue air to go to the Air Force?

Joseph Gitlin: I mentioned earlier that I took courses in Washington, DC, while I was on my first Public Health assignment and got a Masters in Bio-statistics. While I was still a reserve Naval Officer in 1954, I got a call from Navy personnel asking if I would volunteer to serve in the U.S. Air Force. At that time I was speaking to a Lieutenant Commander and I said, "Commander, as a Navy man you know you are never supposed to volunteer for anything." He said, "Well, I've been authorized to offer you a very choice assignment. On the other hand, if you choose not to volunteer to transfer to the Air Force, I'm also authorized to call you back to active duty in the North Korean Sea," which I knew very well was not the most pleasant assignment. And so, I asked him where I might be assigned and he said, "It's classified information" and I said I'm cleared for top secret. He said, "Well, I can tell you the APO is 633." This was a post office code used by the military to send mail to people on active duty and I had the code book to translate it as Wiesbaden, Germany, where the command headquarters of U.S. Air Forces in Europe was located. The position they were looking to fill was the Command Biometrician. Navy personnel had records on me to show that I had gotten some advanced degrees and had participated in health care programs. So I volunteered and I received orders to head to Europe. I had been courting my wife for the previous two years in the Washington area. When I got my orders, I called her to say, "I'm being sent to Europe. Do you want to go with me?" She had a Masters degree in Biology and was doing a long-term cardiovascular study at NIH, and you can imagine she had to have a sense of humor to be associated with me. So she said, "As your wife?" and I said, "If there is no other way, yes." We were married between the time I got the orders to leave and arrive in Wiesbaden. This was rather disruptive to the families but everybody hurried up. I went over to Wiesbaden first until her project at NIH reached the point where she could leave. She joined me three months later and that got me into the wearing of the Air Force uniform and a very interesting assignment for three years in Europe.

The principal duty of the Command Biometrician in Europe was to review medical records from each of the Air Force hospitals throughout Europe. The definition of Europe in those days included North Africa and the Middle East, so in effect, all of the medical care facilities operated by the U.S. military from Oslo, Norway, to Dhahran, Saudi Arabia, were included in that geography. Based upon reviews of medical records for public health implications, it was clear that there were high rates of active tuberculosis in Europe. This was primarily in the indigenous personnel that worked on our bases, and the exposure to the disease by American dependents and military who were on the same bases resulted in relatively high incidence as well. I reported the findings to General Armstrong, who was then the Air Force Surgeon General in Europe, and he wrote to the Surgeon General of the Public Health Service, who confirmed that I had been active with the Tuberculosis Case Finding Program in the U.S. General

Armstrong then talked to the Commanding Officer of USAFE and obtained a budget to set up a tuberculosis case finding program in Europe. There I was again talking to the Siemens Corporation in Erlangen, having them produce four photo-fluorographic 70 mm chest x-ray units. One of them was installed in a van that would fit in a C130 so that we could fly the unit across the Mediterranean and operate it in North Africa. It was a very exciting, complicated program that included Army military personnel and dependents. We obtained Army medical corp participation to increase the number of film readers and not depend only on Air Force radiologists to do all the initial readings. So, I did not escape my early experience with tuberculosis case finding but applied it in Europe, where we found advanced cases that were no longer seen in the U.S. An important aspect was agreements with other governments that we would screen the indigenous workers on the bases and see that they got proper treatment. Again, isoniazid was available and that was very helpful.

Steve Horii: When did you come back to the U.S.?

Joseph Gitlin: Oh excuse me, I forgot another interesting point. One of my assignments was to be a Public Health Officer on the development of the status of Forces Agreement, which replaced the formal occupation of Germany. In Wiesbaden, this involved meeting with the architects who designed new water and sewer systems and better roads so that military personnel and civilians could travel faster in the area. Soviet Union forces were only 36 miles away from Wiesbaden, which is on the east side of the Rhine River and the only bridge across to the west was 20 minutes away. So drawing up the plans for the water and sewer lines in the State of Hesse, which is where Wiesbaden is located, got to be very interesting. Two of the old Roman roads were there with the original cobblestones and the Germans, who had a great feeling for tradition and history, insisted that every cobblestone be labeled to be replaced in the same position. After the ditches were dug, and the new lines put in and covered, that’s what they did. I couldn’t believe it, but as a souvenir, I brought one of the cobblestones back. I also have one from the Berlin Wall. I returned to the U.S. from Wiesbaden in 1956 with my wife Jane and the two children who were born there. Before we left Wiesbaden, we bought a used 1953 Volkswagen that cost $500 and was shipped back.

I rejoined the Public Health Service Accident Prevention Program at the request of Dr. James Goddard, who was well known in Public Health. He became the director of the Food and Drug Administration (FDA) for several years, and then was the medical director of the construction program at Dulles Airport. He was instrumental in making sure that accident prevention measures and medical care facilities were established for passengers in the "people movers" from the main area out to where the planes were. In 1955, he was appointed the Director of a new Accident Prevention Program in Public Health and one of his key projects was the Cornell Crash Injury Program. When we returned from Wiesbaden, he asked me to coordinate data from the Program, which showed the value of seat belts when an accident occurs and how it affects the injury rate and mortality. The Cornell Crash Injury Program report indicated, beyond doubt, that if people in automobiles wore seatbelts and were in an accident, their injuries were fewer and less severe and there was a factor of almost 19:1 that the probability of survival was increased. The Public Health Service people and the Cornell University researchers were sure that this finding, which was widely publicized, would be very well accepted by the general population and by health care facilities and the manufacturers. There were only three of them then, Chrysler, Ford and GM. Dr. Goddard and members of the Attorney General's office of the Federal Government called a meeting with the three manufacturers and formally presented the research results, and said that we would like to encourage them to equip the new models with proper chassis and promote the idea of making available seat belts for people who bought the new cars. The companies objected strenuously because their marketing plans for the next couple of years emphasized power and speed and not safety. We had a raging battle on our hands, and despite all kinds of pressure from interested agencies, the three manufacturers resisted any emphasis on seat belts. So President Johnson asked the GSA, the Government Services Administration, how many vehicles the federal government bought each year. It turned out to be 150,000, and he said, write in the request that every one of those be properly equipped for seat belts. The three manufacturers said, if we have to do that for 150,000, we may as well do it for all the cars. That really started the seat belt program in the United States.

Another interesting finding in the accident program involved my good friend Pat Iskrant, who was a renowned bio-statistician at the time in the PHS. He was then looking at accident prevention cases and was studying osteoporosis, which affects middle aged and elderly women primarily, and it was generally accepted by health care providers that older women with osteoporosis had a tendency to fall and break their hips. This is a very serious problem and a rather costly one as well. Pat Iskrant collected a large number of cases and found that it was not true that older women "fell and broke their hips," they "broke their hips and fell." The osteoporosis caused the break and then they fell to the ground. This finding started a public health program to prevent osteoporosis and to develop dietary activities and exercises that are associated with it. It is a great story and an interesting example of how informatics, gathering data and interpreting them properly, can provide the right answers.

Steve Horii: Now I was a youth in the mid to late '50s and certainly grew up during that time when radiation was a major concern to the populous because of nuclear testing and radioactive fallout. And I'm sure that had some effect on the course that the Public Health Service took or certainly people interested in public health?

Joseph Gitlin: President Eisenhower issued an executive order in 1957 that removed the Health and Safety regulatory authority from the Atomic Energy Commission, which was the successor to the Manhattan Project. The Atomic Energy Commission had the responsibility for promoting the use of radionuclides and radiation activities including energy production, and they spent 90 percent of their time promoting it rather than giving priority to health and safety. At that time, we were testing weapons in the atmosphere and there was a great deal of concern about fallout and dietary ingestion that contained a variety of radionuclides. When President Eisenhower transferred that responsibility to the Public Health Service, that, in effect, became the beginning of the organization of the Center for Radiological Health. I was assigned to the new Radiological Health

Laboratory in Rockville two miles south of here. We built a building away from everybody else because we had information posters on radioactivity that was in the building and alerted people who might visit us.

We set up a regular monitoring program with a Public Health Service "Air Force" made up of four planes based in Las Vegas and many monitoring devices that collected an enormous amount of data. Initially, we used punch cards to record the data but it was clear that better data processing methods were needed. I was successful in arranging with IBM to install their model 1620 computer, which in effect was the first solid state mid-sized unit available. It was a scientific high speed unit that we installed in the Rockville laboratory to process all the data that we collected from 1960 to 1963, the period when atmospheric testing of weapons was still conducted. The use of the digital computer for data processing provided reports very quickly because of its speed and the programs written by our capable staff. The data collection and processing effort placed special emphasis on strontium 90, which was of great public health concern because of infants and children drinking milk and possibly ingesting strontium 90. The program had a lot of important publicity attached to it and people followed the weekly reports very, very carefully. The atmospheric weapons testing ban was signed by President Kennedy in 1963, several months before he was assassinated. The ban halted the testing by the U.S. and other countries that had signed the treaty. The monitoring program continued for almost two years afterwards just to be sure nothing else was happening.

The monitoring program that provided measurements of radioactivity in the food chain to estimate what the U.S. population was ingesting from their diet was a collaborative effort with the Department of Agriculture (USDA), the National Office of Vital Statistics, and the Center for Radiological Health. The design included household interview surveys from a representative sample of the population, in which the woman of the house usually provided information about the food consumed during the previous week. The staff of the PHS, USDA and GSA in selected areas of the country bought the reported food items in the specified localities and made them available to our four laboratories, where they were burned and then analyzed for radioactivity. On several occasions the local

Rockville, Maryland, Environmental Health Office would come to visit me because we had three 18-wheeler freezer-type trailers holding a large amount of food for analysis. There often was some odor from the trailers and the environmental office received complaints from nearby residents about it, even though everything was frozen. But the program worked quite well and we saw a downward change in the radioactive measurements over the four-year period of the food collection program. This clearly showed that the atmospheric weapons testing ban had, in fact, achieved its goal. There were many humorous stories about the analytical program, for example, we had a connoisseur of liquors as the manager of our Rockville Lab, and he logged in each weekly shipment that we received. This included liquor when it was reported in the survey, and he said it broke his heart to see Johnny Walker burned and analyzed.

Steve Horii: Well this whole idea, though, of being concerned about environmental radiation certainly raised the consciousness of the population about radiation exposure and that certainly would include medical x-rays?

Joseph Gitlin: Yes it did. The work that we did in household interview surveying gave rise to the idea that we could produce estimates of population exposure to x-ray examinations by asking people in households if they had any x-ray exams including dental during a specified period of time. A serious statistical problem was associated with picking the time period. If people were asked about x-ray examinations in the past year, the responses provided relatively large numbers of procedures, but because of the memory factor, there were many false positives and negatives. If the time period was the past month, the result was relatively few exams with few false positives and negatives. We compromised by choosing a three-month time period that was tested in a pilot study of the protocol in Berks County and Reading, Pennsylvania, best known for its beers and pretzels. The county health officer there was an old friend of mine and he encouraged residents to participate in the household interview and the follow-up phases of the study. In addition to showing that residents were able to report that they had medical and dental x-ray examinations, we developed an x-ray film pack to obtain radiation exposure data on each exam reported in the household interview phase. Patients provided permission for a follow-up visit by a public health service officer to the clinic, hospital, or physician who did the exam to verify the report and perform an exact replica of the procedure using the film pack as the object. After the film pack was exposed, it was sent back to Rockville, where it was processed, and estimated exposure to various organs were recorded. These data were translated later into dose estimates using a computer program at Johns Hopkins, where I worked with Dr. Russell Morgan and a staff of experts. The results of the x-ray exposure study were very well received by physicians, scientists, and public health officers.

The findings facilitated improvements in the training of technicians and the education of interpreting physicians. We found that one of the most important problems with x-ray examinations in those days was that the size of the x-ray beam used was often far larger than the organs of interest and was exposing much more of the patient's anatomy than was necessary. This led to the development of beam limiting devices by the manufacturers, which were installed on all types of x-ray machines. It was especially interesting to two members of our staff who were dentists, Jim Miller and George Crocker, who showed that ordinary lead washers of a proper thickness and diameter could be attached to the pointer cones used on dental x-ray machines to limit the x-ray beam. The PHS dental officers obtained the cooperation of the American Dental Association that sponsored presentations at meetings and encouraged the use of the lead washers in practice, and manufacturers of dental x-ray machines modified their equipment.

A sidebar on the x-ray exposure study concerns fluoroscopic shoe fitting machines. Some of you may not remember when your mother took you to the shoe store in the '30s, '40s, '50s, kids enjoyed trying on their new shoes, walking over to the shoe fluoroscopy unit, putting their feet in and watching their toes wiggle. Mothers were interested in getting the right size shoes for the kids with space so they could last another six months. The position of the fluoro unit could produce gonadal exposure as well as foot images. In 1958 we banned shoe fluoroscopy in the United States, but in 1964, when we conducted the national study, we soon had people in the household survey report x-ray exams as being done at a shoe store that was not aware of the ban. The Surgeon General wrote a letter to the state health officers indicating that any shoe store that had a fluoro unit but collaborated by providing data in the study would not be prosecuted if it stopped using the unit. One day in 1964, I received a call from the regional representative in North Dakota saying, “we have a shoe store operating a shoe fluoroscopy unit, what should we do?” And I said, “Well, read the letter from the Surgeon General and tell the owner that he is exempt from prosecution if he stops using it, and if the owner of the store offered to donate the unit to the Rad Health Museum in Rockville, we would pay the freight.” He made the offer, and the last known shoe fluoroscopy unit in the country is on display.

Steve Horii: Joe, from your educational history, I note that you picked up your graduate education in about 1966; and I’d like you to elaborate a little about what you did for your degrees and what kinds of work you were doing at that time?

Joseph Gitlin: In 1966, I was still with the Public Health Service, participating at Johns Hopkins with the conversion of the exposure data from the national x-ray study to produce organ dose estimates. As I mentioned earlier, Dr. Russell Morgan and the computer staff at Hopkins were very cooperative in writing the programs and developing the conversion tables. When that was finished, we tested the validity of the organ dose tables in cooperation with Dr. Richard Chamberlain at the University of Pennsylvania to estimate dose from selected x-ray exams in certain organs. When it was feasible to measure dose during examinations with the patient’s permission, we compared the measurements with the estimates produced by conversion tables developed at Hopkins. When we were satisfied that the computer programs worked well, I began to think about what should be done next. The staff in Rockville wanted to write two papers related to the 1964 national study and I agreed. We produced a report on x-ray examinations during pregnancy as a subset of what we learned about the general population in ’64, and a report on the dose estimates based upon the ’64 exposure data and the conversion tables.

At Hopkins, we began to recognize the potential for using data processing systems in radiology in the day-to-day operations. Dr. John Dorst, Director of Pediatric Radiology, had set up a punch card system to record each examination that was done in his section to expedite the searching of the film library for specific exams. The interesting cases were noted for the medical students, residents, and fellows to search the literature on those cases and update the teaching program. When I learned about the use of the punch card system, with Dr. Morgan's approval, we began to record data on a punch card for every x-ray examination that was done in the department during 1966. An analysis of the exam data on the punch cards helped settle an argument between the comptroller's office of the hospital and the radiology department regarding the number of exams performed. The comptroller's office always seemed to underestimate the income derived from radiology, which was a factor in determining what the budget for next year would be. And so, in his usual fashion, Dr. Morgan said, "we ought to have a verification process." He asked me to participate in expanding the initial punch card system to cover the entire department and as it turned out, we had 6 percent more examinations based on the punch card system than the comptroller had from the paper process of several layers to produce financial reports. Dr. Morgan was very pleased with the additional dollars in next year's budget and we began looking at other areas of radiology that might benefit from computer applications.

A preliminary study of departmental activities was conducted at Hopkins. It included radiologists at Hopkins and several members of the PHS radiological health program in Rockville. Data were collected on each of the recurring activities at Hopkins, and similar baseline studies were conducted at other institutions to determine where computers could help radiology departments become more efficient. The activities included scheduling patients and exam rooms, film library management, the reporting of interpretations of films that often took three-four days when they were dictated and transcribed, and support for teaching and research activities from records on interesting cases. In almost every instance, the baseline studies at Hopkins and other institutions that used similar protocols identified the same kinds of problems and suggestions that computers could help in these areas, and this was before we could actually do it but the concepts were defined.

At that time, Dr. Roger Bauman, who worked with me here in Rockville, agreed to go to Boston and become the coordinator of a radiology baseline study at Mass General Hospital. Among its many activities, Mass General had seven different film libraries with 150 people working in them to file x-ray films in the proper patients' jackets, know where the jackets were, and find them when needed. This was complicated by clinicians who kept interesting cases where nobody could find them. Dr. Bauman, I'm going to call him Roger, called me one day and said a couple of people visited him yesterday with a very strange proposal. They were with a "start-up" company that produced labels with vertical lines and were trying to get a contract with Sears Roebuck to put them on every one of the Sears Roebuck products for inventory control. They thought it might be useful to visit a hospital to see if there were any applications, and met with Roger, who had just finished an analysis of film library operations at Mass General. They discussed labeling the film jackets that became a major advance in radiology management, and in millions of other applications. The "bar code label" had been in use up to that point as painted lines on railroad freight cars, and the "start-up" people called me to ask if I had ever seen bar code labels on freight cars. They described them, and I went to the Rockville train station and saw a freight train come through that had bar codes on the freight cars, and an electronic reader at one end of the station to indicate which freight cars were to be transferred to other trains. I asked Roger to continue negotiating with the "start-up" team in Boston regarding a collaborative study of bar code labels on Mass General film jackets. It was remarkable. When physicians at the hospital learned that they could access interesting films within minutes when they were labeled and the electronic readers would indicate where they were, the physicians returned hundreds of interesting film jackets that they had been holding in their offices because they thought they would not be able to get them back. After a year of using the bar code labels to help manage the film library, it was possible to realize a 50 percent reduction in staff. Each of the affected staff members was offered computer training and a job in information systems.

Baseline studies at six other institutions confirmed how radiology activities might benefit from computer applications, where emphasis should be placed on computer programming, and how the applications could be coordinated to become an integrated radiology information system. At Hopkins, the system included the reporting of film interpretations based upon preliminary work with a lexicon of the terms and phrases displayed on an IBM 2760 unit that allowed radiologists to touch the screen, produce and edit the report, and sign it. The reports were transmitted to printers in outpatient clinics and wards for the referring physicians, who would have them in minutes. The reporting application became a commercial product called SIREP by the Siemens Corporation and by 1975, was installed in over 100 radiology departments in the U.S. and Europe. The advent of computed axial tomography (CAT) at this time adversely affected sales of the radiology reporting system such as SIREP. However, the acceptance of automated reporting added impetus to its inclusion with the applications identified in the baseline studies that became components in defining what a radiology information system should comprise. This effort generated enthusiasm for establishing the Radiology Information System Consortium (RISC) as the organization representing institutions that were interested in defining problems, developing components, testing them, and serving as a user group to refine the systems after they were installed.

Steve Horii: Well, I'd like to expand on that a little bit since you started talking about the early history of a group that would eventually become RISC… what's your recollection of how the Radiology Information Systems Consortium got started?

Joseph Gitlin: The exchange of information related to the early work on computer applications in radiology prior to formal publication of the baseline studies involved preliminary reports and presentations at meetings sponsored by the American College of Radiology (ACR) for interested academic physicians and researchers. In 1978, it was agreed that the best way to turn the concepts into reality was to organize a group to agree on goals and prepare a requirements document that could be the basis for a request for a formal proposal from three computer companies that had expressed interest in radiology applications. The Digital Equipment Corporation (DEC) was selected to work with us under a formal contract, and our group of 12 institutions formed the organization called RISC to be able to sign the contract and work together with DEC. RISC provided academic exchange of radiology information and test facilities for DEC, set priorities, and kept the department chairmen informed of progress.

Steve Horii: So, RISC was a group of academic institutions plus the Center for Devices and Radiological Health (CDRH)?

Joseph Gitlin: Yes, since I was with PHS at the time, I was an honorary member of the group of 12. The director of CDRH appointed me as liaison with RISC and the Hospital Association of Pennsylvania that provided administrative support for the group.

Steve Horii: Do you recall where the formation of this group took place?

Joseph Gitlin: Yes, the decisive meetings were at the University of Pennsylvania, in an old-fashioned conference room not far from the hospital radiology department. We had three meetings there that resulted in the formal organization of RISC. At the time, Ron Arenson was the key representative of the University of Pennsylvania, and served as chairman of the meetings with representatives of the other institutions that played key roles in working with DEC.

Steve Horii: I'm afraid that progress has taken its toll and the hospital redid the entire front entrance that, what was that area, is gone; so, I think, in fact during the SCAR meeting that was held in Philadelphia, we went to look for it. And I think that's when we discovered that it had been renovated out of existence. (Dr. Gitlin: I should have saved the railing). Now the other, I think, fairly important thing for us to talk about a little bit, is something I have a lot involvement in, and that is the ACR/NEMA Standard; and certainly the stories about how it got started are legendary. But there are a lot of people who haven't heard them; and I'm sure we haven't heard all of your anecdotes about this. But I'd like to have you give us a bit more on your perspective on forming the ACR/NEMA Committee.

Joseph Gitlin: For PHS and radiology, 1972 was a landmark year because computed axial tomography (CAT) manufactured by EMI, a British firm, was evaluated here in Rockville by the FDA radiological health organization and approved for human use. Based upon the first reports, the public, practicing physicians, and public health officials, as well as manufacturers and computer people, were very interested in the development and applauded the approval in ’72, especially for brain scanning. A sidelight in evaluating the performance of the early version of CAT for human use involved the initial hard copy printouts that displayed the numerical results of the scans. Dr. Hounsfield, who shared the Nobel Prize for his contributions to developing the CAT technique, came to the U.S. frequently during the approval process, and used the numeric data on hard copy to interpret the results. Dr. Hounsfield was an engineer by training, so viewing numbers on paper was acceptable, but it wasn’t the best display for radiologists, and soon after the unit was approved, EMI provided an electronic unit that displayed the scanned x-ray images on a screen for interpretation by radiologists. This development was a major advance in health care and the acceptance of digital imaging in radiology. Nuclear medicine had been using radionuclides for several years before to display digital diagnostic images on a screen, but in conventional diagnostic radiology, CT was the first widely adopted development that produced digital images directly for interpretation.

When the implications of CT utilization were considered by practitioners, industry, and government agencies, it was understood that it was not a standalone event. It was going to grow, both vertically and horizontally, and other modalities and computer systems were going to be available to health care providers. The next major development occurred in 1982, when magnetic resonance imaging (MRI) was approved by the FDA for human use. This event reinforced the recognition of the need for different modalities to be able to communicate with one another, and that computers be able to transmit data to imaging equipment. This was the justification for developing the communications standards. It was also recognized that in implementing such standards, manufacturers be able to have their equipment communicate without any loss of proprietary information, which was a big hurdle.

At the Radiological Society of North America meeting in ’92, we had one of the first demonstrations of the potential of the Standard to support communication among disparate modalities and different manufacturers’ equipment. My understanding of German was pretty good from my assignment in Wiesbaden and I overheard the Director of Siemens Medical Division tell his representative who was serving on the ACR/NEMA committee at the time, in German, “The display of that Siemens image on a General Electric monitor tells me they have stolen our proprietary information.” The Siemens representative explained to his boss, in German, that there was no loss of proprietary information; it was the standard that made it possible for this communication. I reinforced the statement to the Director, and in English, said, “I hope you understand that we took great pains to be able to communicate without giving away any proprietary information, and in the next demonstration, you’re going to see a GE image displayed on a Siemens monitor.” He rushed over to see that happen, and he shook my hand and said, “I am satisfied.” There were many hurdles that took weeks and months to overcome, but we finally obtained general agreement from all of the interested groups in government, industry, the American College of Radiology, and academe to give high priority to the implementation and further development of the standard.

Steve Horii: When you think of it, what was the incentive for companies to do this? So, I know that the CDRH/FDA had some role in establishing…in getting these people together in the first place. I mean why, the ACR I could understand because it represents the users. NEMA represents the manufacturers, but why would they ever talk with each other?

Joseph Gitlin: I sat in on some of the policy meetings with members of NEMA at the highest level and of course, the ACR and the academic community. Initially, there were objections related to concerns about proprietary information, but in general, the senior people from industry realized that outside of Europe, the American market was made up of hospitals, radiology departments, and clinics that rarely purchased all of their imaging equipment from one manufacturer. Most of the hospitals, radiology departments, and clinics installed modalities made by different manufacturers, and the logic of being able to communicate among the disparate modalities was understandable in the mixed environment. The decision makers from the companies said, "OK, as long as we can be assured we will not lose our proprietary information, and that you are talking about making it possible for different companies to be selected by the users of this equipment in the U.S." They also recognized that by participating in the development of a standard, industry would have people on the scene "to keep their eyes open and make sure the standard works and proprietary information is kept."

Steve Horii: Well, the ACR/NEMA standard and the subsequent DICOM standards are voluntary standards. Not all of the FDA standards are voluntary.

Joseph Gitlin: Getting the several interested groups together to talk about the need for standards in medical imaging was emphasized in 1982 with FDA approval of MRI 10 years after CT became available. Everyone concerned understood there was a serious communications problem that had to be resolved. I was appointed by the Director of CDRH to be liaison with the interested groups of manufacturers, since I was a member of RISC well known to the academics and had been appointed a fellow of the American College of Radiology. With Bob Britain's leadership, when he retired from PHS, it was NEMA, representing industry, that completed the participation. The communication problem and the proposal to develop a standard were well defined for all the major groups and an agenda was prepared for a meeting in Rockville, where all concerned agreed on the proposal. The agreement on participation in the development was that it would be a "voluntary" standard. And knowing that in advance, John Villforth, who chaired the meeting, called upon me to speak. I had prepared by borrowing a gauntlet at the Smithsonian and a very nice glove from one of the ladies in our group. With regard to a choice between a mandatory or voluntary standard, I asked the attendees, "do you want the iron fist or the velvet glove?" The agreement to develop a standard on a voluntary basis was very successful. John Villforth was prepared to agree to that and within a week, he obtained formal approval from the PHS hierarchy to have the CDRH participate in developing the voluntary standard as well. This was another landmark in the progress of radiology applications that was admired by other disciplines in medicine, and, as you know, the work of ACR/NEMA, which became DICOM, has been adopted by many other disciplines of medicine.

<u>Steve Horii:</u> I know that prior to the advent of the ACR/NEMA standard, there was an interest on the part of the military for teleradiology support. And it's my understanding that you were involved in some of the early projects in teleradiology. If you would, I would like you to just expound on those a little bit.

<u>Joseph Gitlin:</u> The earliest was with ships at sea in 1975. This was related to work at the Uniformed Services University of the Health Sciences (USUHS) and preliminary testing of film digitizers at the Johns Hopkins Applied Physics Lab (APL), which you may know is supported by the Navy. In the case of serious illness or injury to personnel on Navy vessels at sea, usually larger ships had x-ray equipment aboard and the ability to produce x-ray examinations on film with fair quality. However, medical officers aboard the ships often had difficulty in interpreting some of the more serious cases. Captain Jerry Thomas at the USUHS asked what might be done based on my work with digitizing x-ray films. We showed that a reasonably good x-ray film could be produced and digitized by a trained pharmacist mate using an x-ray machine and a digitizer installed on a Navy vessel. The problem was how to get the images read when you're 3,000 miles away from a radiologist. With the support of the Navy Surgeon General, Jim Zimble, Naval communications provided priority time on Navy satellites to transmit digitized medical x-ray images from ships in the Pacific to the San Diego Naval Hospital for interpretation by radiologists. A somewhat humorous problem occurred after a successful technical demonstration. The security officer at San Diego would not accept receipt of the images except in coded form that required decoding and added several hours to the process before the images could be interpreted by a qualified radiologist. But, we showed that ships at sea, in many cases, did not have to change course to care for a seriously ill or injured sailor, and the ship's mission was not interrupted. The interpretations also confirmed serious cases that could not be treated aboard ship and required transfer to hospital ships. The digitization process and transmission of images by satellite was recognized as important to medical care, but it took two months to convince the Navy security office that the images didn't have to be coded or encrypted and were not classified as military secrets.

The Air Force had a similar problem with personnel in remote mountains in Korea. We used that as a pilot study to show that technicians in the Air Force units could produce acceptable x-ray examinations on film, digitize them, and transmit the images via satellite to an Air Force hospital for interpretation. The demonstration was performed in cooperation with staff at Malcolm Grow Hospital at Andrews Air Force Base. Again, we showed that with digitized medical images and professional interpretation, decisions could be made about patient care using the limited medical resources available to small units, or if the patient needed to be transferred for care in a hospital.

The earliest civilian example in which I participated was with Dr. Bob Gayler, a colleague at Johns Hopkins who was also interested in the accuracy of reading digitized images on computer displays. After evaluating digitizers and showing that they could be used to convert x-ray film exams to digitized images, we addressed the issues of transmission of images for remote interpretation and consultation. With the cooperation of the MITRE Corporation in 1978, we installed a display monitor and used telephone lines locally to transmit digitized films from George Washington University Hospital to MITRE in Virginia at 19 kilobits per second. We were favorably impressed with the first 10 exams that we saw, but the satisfaction soon wore off because it took 20 minutes to display a full digital x-ray image on the screen and begin reading it for abnormalities. That day sitting in Reston, Virginia, Dr. Gayler and I agreed that we had to have storage at the reading location to retain the images and then access them for interpretation. As a result, we gave high priority in related projects to meet the storage requirements of medical images after they were transmitted over telephone lines, so they could be accessed quickly. This was an important factor in facilitating teleradiology in health care delivery for civilians.

Steve Horii: Joe, I know that one of the things you are well known for is the number of different, well known individuals in this field who have worked on informatics, and particularly in PACS; and I wonder, if you would, just tell us a little bit about those folks you know who were early pioneers in this PACS effort.

Joseph Gitlin: Well, going back to the beginning of current knowledge about radiation and its uses in health care, one might start with the Manhattan Project which, as you know, was highly classified during WWII. Much of the work included radiologists who helped test many of the applications that were developed and had close working relationships with physicists. Two of them who were interested in medical applications were **Lauriston Taylor** and **Harold Wyckoff** who, after the war, were senior physicists at the Atomic Energy Commission (AEC). When health and safety responsibilities were transferred from the AEC to the Public Health Service, they became Senior Advisors to the Radiological Health Program directed by Jim Terrill, who organized and managed it for 20 years. Drs. Taylor and Wyckoff also served on the Surgeon General's National Advisory Committee on Radiation and helped identify areas of concern to public health, and applied their expertise to programs aimed at developing measures for estimating exposure and dose related to medical uses of radiation. These two men were early proponents for the use of computers in radiology for research purposes.

In an area more directly concerned with the current practice of radiology, recognition of **Roger Bauman**'s contributions is well deserved. He was interested in nuclear medicine and radionuclides that utilized digital imaging for patient diagnosis before CT was available. Roger made several notable contributions to the practice of radiology, related to his interest in RISC and the Radiology Information System. In addition to demonstrating the use of the "barcode label" on film jackets, he was a leader in defining other computer applications in radiology at Mass General Hospital.

Our good friend **Sam Dwyer**, who also is no longer with us, made contributions to be reckoned with from his early days at the University of Missouri and then at Kansas, where as an engineer he developed many of the algorithms that made it possible to acquire, store, and retrieve medical images. Of many pertinent stories, Sam had made an arrangement with Leavenworth Prison in Kansas and he called me, since I was working on teleradiology at the time, and said he wanted to provide x-ray examinations to the prisoners at Leavenworth but there were a few practical problems to be solved. His team wanted to train prisoners who had the capabilities to become adequate x-ray technicians to do the examinations. They also wanted to avoid sending a qualified radiologist to the prison on a regular basis to interpret x-ray films. He asked if it was practical to digitize them at the prison and transmit the images to the university via telephone for interpretation. He and I conducted a pilot study for about three months and showed that it could be done with reasonable accuracy. After the program had been operational for several weeks, Sam called me and said, “We have to stop the x-ray examination service at Leavenworth.” And I said, “What happened?” He said, “Our x-ray tech escaped!” and Sam’s team had to train somebody else.

He did wonderful things, always with great humor. Earlier at Missouri, Sam worked with two other “pioneers,” Dr. **Gwilym Lodwick**, an orthopedic radiologist, and **Don Lindberg**, a young resident in Pathology, who was able to get a grant to install one of the first computers available from the Public Health Service for diagnostic research. I got to know the three of them when they worked together to show that pathology and radiology diagnoses could be improved by computer applications developed by Dr. Lindberg, particularly bone cancer studies based upon x-ray films produced by Dr. Lodwick. At the time, Sam Dwyer had the lead in developing a radiology reporting program using the computer at Missouri. Radiologists produced reports by using a keyboard to enter terms and phrases and the reports were immediately available to referring physicians. When Dr. **Russell Morgan** and I went out to see the program, Sam was very interested in the lexicon we had developed for radiology reporting at Hopkins, which he adapted for the system used at Missouri. We became fast friends as well as colleagues and looked back at the visits to Missouri in ’62 and ’63 as the beginning of a series of meetings of researchers interested in computer applications in radiology. This led Dr. Lodwick to obtain the cooperation of the American College of Radiology in sponsoring a meeting in

1964 in Chicago that was the precursor of the RISC/SCAR/SIIM meetings since that time.

John Loop at the University of Washington and I became close friends in the 1970s. He not only was responsible for the Department of Radiology as Vice Chair at the University of Washington but as Chairman at the Kings County Hospital in the city of Seattle. Both hospitals had many of the problems that we noted in the baseline studies at other medical centers, and Dr. Loop was very interested in utilizing the results at his institutions. He recognized computers, even their basic use related to billing for x-ray examinations and film library management, as a tool to improve departmental operations. He was an avid fisherman and he flew to Alaska twice a year to fish and to train x-ray technicians to improve their skills because they often had to work on their own, especially in remote areas to serve Native Americans. He knew about the limitations of telephone transmission of x-ray images, but he believed that teleradiology, with appropriate image storage devices, could be used successfully to interpret x-ray images for Alaskans and avoid the delays of mailing films to Seattle. We installed the equipment and implemented the program at several locations in Alaska and the University of Washington, where radiologists viewed the digitized images on monitors. The readers were satisfied as long as the images that were sent over the telephone lines were stored before reading. This also led to my learning how to catch salmon in Alaska when I went with John on several occasions to help train the technicians. John is no longer with us.

Among the representatives of industry, **Bob Hindle** stands out as a proponent of digital imaging and an advocate of the ACR/NEMA standard. He was with Philips for many years and really understood the importance of keeping Philips executives aware of our baseline studies and the need to build hardware and software systems to meet the changing requirements of American radiology. His advocacy and particularly his good relationships with many U.S. university radiology departments were used to convince the Philips organization to continue the production of advanced systems for in radiology.

Herman Oosterwijk was an active member of a working group in the early days of developing the ACR/NEMA standard. He is still quite active in promoting the standard and conducts seminars for users in radiology and other medical disciplines. He deserves recognition as a young pioneer who has matured and still is very enthusiastic about both the importance and the use of the standard.

Charles Parisot is probably the longest continuous industry member of ACR/NEMA and DICOM. He has made many contributions to advancing the standards and gaining acceptance from GE to support their development both in terms of hardware and software. He is one of the most energetic advocates of digital imaging and computer applications in radiology that I have known, and a strong proponent of the information and communications systems we have developed during the past 30 years.

Alan Rowberg is an accomplished pioneer in many ways. I first met Alan when he was a student at the University of Washington working with John Loop. He received an MD and did a residency at UW. He was very interested in the technical aspects of both computers and medical imaging, and made many important contributions to the state of the art. You could always count on Alan to get a job done and meet the deadlines. He was an active member of the RISC users group and established the webpage for SCAR that is a key link in the SIIM organization today.

Roger Schneider was the Director of Research at CDRH here in Rockville and a major contributor to many of the developments in medical imaging. He was particularly helpful when we conducted the National X-ray Exposure Study and the conversion of exposure data to organ dose estimates. Roger’s position as Director of Research made him an important contributor to advancing the state of the art because he had the authority to make decisions on evaluating imaging modalities such as CT and MRI before approval for human use.

Roger Shannon was a clinical radiologist at a number of institutions including George Washington. He was a theorist and early proponent of medical informatics. When the decision was made to adopt the name of SIIM with informatics in the title, Roger felt the organization was headed in the right direction. As computers became available to medical researchers and supported radiology applications, he applauded their implementation to better understand how to interpret imaging information. Roger Shannon deserves recognition as a pioneer, especially since his enthusiasm for imaging informatics has proliferated.

Sridhar Seshadri was a member of the radiology computer staff at the University of Pennsylvania when the Radiology Information System (RIS) was implemented. He was an active member of the RISC/DEC Users Group and contributed to the extension of the RIS at Penn. My recognition of Sridhar as a pioneer is based on his accomplishments as a vibrant, industrious, and enthusiastic developer of software and interfacing devices for RIS and PACS. His work with Ron Arenson was important to the acceptance of computer applications in radiology at the University of Pennsylvania and other medical centers.

Bob Wagner was a senior physicist and prolific author of scientific papers on medical imaging equipment at CDRH. He made important contributions to developing testing methods to determine whether or not these modalities met performance specifications and complied with health and safety standards. Bob was a strong advocate of the ACR/NEMA standard's efforts and made important technical contributions to their adoption. Bob is no longer with us.

<u>Steve Horii:</u> I think this includes a fair number of academic types, but you also have some experience amongst the various vendors, having worked at CDRH. And I'm wondering if you could give us a little bit of perspective on the sort of a vendor side of the early developments of RIS and PACS?

<u>Joseph Gitlin:</u> After we negotiated the agreement between RISC and the Digital Equipment Corporation (DEC) to be our partner, two of the key people from DEC were the manager of the group, **Dick Corley**, and a bright young software developer, **Leslie**

Harrison. Dick was able to convince his superiors that developing the first RIS was something special and different from developing hardware and software for other commercial application. He was sufficiently articulate to get approval by his bosses to work as a partner with RISC and put in the extra effort needed to satisfy radiology and other health care providers. This did not produce a lot of income for DEC at the time, and Dick was responsible for making sure that what was agreed upon was delivered. When things went wrong during the three years of development, Dick would ask software people like Leslie Harrison to work for weeks at a RISC development site to determine the cause of the problem and to make sure the fix was installed and working. Leslie was able to resolve most of the problems and gained the trust and respect of the radiology staff at the six participating institutions.

Peter Grassman of Siemens was a Senior Fellow at Erlangen, Germany and was instrumental in making a major decision that the company should invest and produce the first commercial version of the automated reporting system using the Lexicon that we developed at Johns Hopkins. He assigned two experienced engineers for two years to Hopkins to modify the system for marketing and maintenance. In return, Johns Hopkins agreed to train radiologists at medical centers in the U.S. that bought the unit to compensate Siemens for their extra effort.

Ron Schilling belongs on the list of pioneers because of his special interest in furthering computer applications in radiology when he was with Toshiba. He was a leader in making the important decisions about company priorities and moving ahead with DIN/PACS during his years with SCAR and is still active with SIIM. Ron has seen many of his ideas related to digital imaging brought to fruition through the cooperation of industry, government, and academe.

Steve Horii: Now I notice that you've talked a little bit…you've mentioned here and there, the DIN/PACS project. And something that I was involved in when I was at Georgetown was the digital imaging network system or DINS project. And I knew you were involved in that, but perhaps you could tell me a little bit more about what your role was there.

Joseph Gitlin: At the time DIN/PACS became feasible for demonstration, we were moving ahead with established RIS installations at many institutions, and teleradiology had been accepted and implemented in a number of areas. The acceptance of the ACR/NEMA standards and progress toward DICOM also made it possible to expand radiology applications, especially in the areas of image storage and transmission. I was able to obtain some funding from the Department of Defense to support evaluations of three university medical centers, Georgetown, Washington, and George Washington. Each of these had slightly different systems and it was useful to evaluate and compare these to identify areas of improvement.

Because of the DoD support, a system was installed at Madigen Army Medical Center at Fort Lewis, Washington that worked closely with the University of Washington in Seattle to build on the successful components of DIN/PACS at the medical school. The Walter Reed Army Medical Center in D.C. cooperated with Johns Hopkins in conducting a baseline study of the image storage and retrieval equipment for the radiology department. In addition, the National Naval Medical Center at Bethesda had two major interests in utilizing DIN/PACS. The Center in Bethesda was responsible for providing medical care and consults with a number of Navy bases within 100 miles, of which Patuxent Naval Air Station was one of the more important. There were many costs associated with patients traveling between the Naval Air Station and Bethesda Naval Hospital. Having a teleradiology connection and other links available improved the promptness of diagnosis and treatment and reduced the costs of transferring patients to Bethesda.

Also my previous association with the Air Force Surgeon General in Wiesbaden was renewed and he gently reminded me that we were not paying much attention to the Air Force. He asked me to work with the Chief Medical Officer at Malcolm Grow Hospital at Andrews Air Force Base, where we set up an active teleradiology program to link several remote locations with the main hospital. So, we covered all the bases.

Steve Horii: Now you eventually retired from the Public Health Service and got involved in industry a bit as well as academia; and I would like you tell us a little bit about that history.

Joseph Gitlin: My retirement from PHS in 1986 generated a major roast on a Friday night at a hotel in Rockville, and what should have been a very dignified genteel dinner turned into a roast of Dr. Gitlin. One of the speakers was Dr. Russell Morgan from Johns Hopkins, who announced much to my surprise that he had approved my appointment to be a member of the faculty at Johns Hopkins starting Monday morning, so I didn't get any time off. Lee Bryan, with whom I had become friendly because of his interest in developing advanced teleradiology systems using satellites, also made an announcement that he was thinking of forming a company to market these ideas and invited me to be a founding father. I obtained permission from Johns Hopkins to be a part-time member of the Vortech organization, which was very interesting because my previous work with furthering radiology information systems, PACS, and teleradiology had been primarily concerned with applications within the area of academe.

It was quite a change to participate in a "start-up" company to develop systems for this area and become profitable. I worked half time as an Associate Professor at Hopkins and the other half as Director of Medical Affairs for Vortech. While I was with Vortech, the company was active with the ACR/NEMA Standard and one of its key technical people, Bill Bennett, became Co-chair of the DICOM committee. Within three years, Kodak, that everyone knew as a film company, bought a 20 percent interest in Vortech and invested in other companies that provided digital imaging products. By 1990, Kodak exercised their options and became the owner of Vortech, at which point my wife and I felt it was time to reduce my working days, and I retired from Vortech and continued part time at Johns Hopkins.

Steve Horii: How would you say your life was there working in the vendor community compared with working in academic life…busier or not as busy, different kind of busy?

Joseph Gitlin: Certainly a different kind of busy. The biggest difference between a "for-profit" organization and academe or a government agency is a much greater emphasis on financial matters, which are life or death to a start-up company. The atmosphere at Vortech was very energetic and competitive. Decisions were based primarily on what could be done to improve the bottom line, which from a survival point of view is essential. Planning was done in terms of how can the company's products and services be improved, which was healthy. The Vortech offices were in the same building as the American College of Radiology in Reston, Virginia, and the commute from our home in Silver Spring across the Potomac River Bridge was over an hour. So, after five years I was pleased to limit my travel to the radiology department at Johns Hopkins.

Steve Horii: Yes, actually, the reason I ask you about a comparison there is also with your perspective and knowledge of the history of these various things that have happened. I'm interested in you telling us a bit about what you see as the importance of RISC, SCAR, and SIIM and maybe where you think imaging informatics is headed?

Joseph Gitlin: As you know, I'm somewhat prejudiced about the establishment of RISC, which was a very unusual organization. It was unique in the sense that it comprised a group of volunteers working closely to advance computer technology towards what we thought was a very important goal, namely improved delivery of radiology services in health care. This was a labor of love for most of us, and as some of our wives observed, it was a time consuming effort. Because it was a new development, the radiology system and the related papers that were presented and published, emphasized the improvements in radiology practice, and the achievements were in themselves a reward for the efforts. RISC was truly a seminal organization and finding a partner like the Digital Equipment Corporation (DEC) that collaborated with us through the installation of the first six systems made those rewards most satisfying.

I think RISC's achievements and how it accomplished them was very appropriate. I'm often asked what would you have done differently, and I'm hard pressed to say we should have chosen another goal or that we made some serious mistakes. It was the right thing to do at the right time and very rewarding. However, upon achieving the initial results, all of us were quite aware that we had made a major leap, but we were only beginning to utilize advanced technology and there was much more to be done. This is the rationale for developing the standards and for working on DIN/PACS, the networking and the picture archiving phases that we evaluated. These activities required different expertise and external funding, and RISC recognized the need to continue its efforts.

However, the experience with DIN/PACS made it inevitable that RISC change its primary reliance on institutional membership, and we established a subgroup named the Society of Computer Applications in Radiology (SCAR) which was open to individual members who had expressed interest in working with RISC. In addition to increasing the membership, it led to taking ownership of the *Journal of Digital Imaging* (JDI), which Roger Bowman negotiated, and establishing our meeting on an annual basis.

SCAR attracted a large cadre of qualified, talented people from industry, government, and academe who concentrated on solutions to DIN/PACS problems, extended the ACR/NEMA standards and identified future activities related to advances in technology and medical imaging. SCAR co-existed as a subgroup of RISC for eight years when most of the RISC/SCAR goals had been achieved and new digital imaging modalities became available. This lead to the formation of SIIM with medical imaging informatics being a major focus to support decisions about changes related to the delivery of health care. However, since "the past is prologue," it is important to remember the achievements during the RISC and SCAR days, which are foundation blocks for SIIM and today's activities.

Steve Horii: So, you would count yourself amongst those who fell in the…because there was some controversy about the change of the name from SCAR to SIIM; but I would take it that you would fall on the side of being more incorporating of other imaging specialties and techniques, rather than just limiting it to radiology?

Joseph Gitlin: I was very much in favor of extending the ACR/NEMA and DICOM standards and technical advances we had developed in radiology to the first outreach program with cardiology. This is an important discipline in medicine and many computer applications are of mutual interest. The frequency of cardiologists referring patients to radiology to be examined and the results being made available to the referring physicians is a typical example. I see medical informatics as applicable to all of medicine, particularly now as we develop the concept of the regional medical archive and implement an information system on a network that provides physicians with immediate access to medical information on patients who have been seen elsewhere. So, we're on the right track, but we've got to overcome many obstacles before the systems are operational. The problems include the costs of transmitting these data and the security measures that are necessary both to ensure that we identify the right patient when we ask for information at a different institution, and we have to be very careful about protecting patient confidentiality and privacy.

Steve Horii: Well, I think, I'd like to sort of start winding this down by asking you about a little perspective from five decades, from a little more than five decades, of work in the field. You certainly have accumulated a lot of exposure to different things. And what I'm curious about, is what you see as, sort of, the surprises along the way, the sort of unexpected things that affected what we did. And, also, if you did have it to do over again, or, if you could tell people you should do this over again, what you would tell them that we could have done better?

Joseph Gitlin: The major problem as I saw it and experienced it frequently, was practitioner opposition to implementing computer applications in radiology and using new imaging techniques. Physicians who are my contemporaries did not go to medical school to learn to type. When I suggested to colleagues that they learn enough about computers to be literate and use them to update clinical information and obtain medical records, they often responded, "Mary, my assistant can use the computer to do that and besides she makes good coffee. What will happen to Mary if I start doing her work?" In effect, because we did not emphasize the need for computer literacy in parallel with the developments in the technology, we encountered resistance to change. This has been resolved because recent medical students have learned to use computers in grammar school, high school, and as undergrads. Now 100 percent of medical students are computer literate and you rarely see any of them without a laptop. So, this is a problem that's been solved for the future. There are still a few physicians my age who wouldn't think of touching a keyboard, but retirement is solving the problem. Not recognizing the lack of computer literacy among physicians in the 1980s slowed down acceptance of computer applications in health care.

Other than that, the sequence of RISC's efforts was just about right, in fact, it was almost necessary to do it the way we did. We would not have learned the importance of storage and retrieval, and transmission problems in radiology if we didn't have radiology information systems installed that required these technical advances. I also think that networking and image transmission problems have opened the door to opportunities for companies that have replaced "Ma Bell" years ago. They are beginning to understand, with some prompting by health care providers, that the subject is very important, very expensive, and requires many talented, motivated employees to increase efficiency and reduce the costs of delivering health care. Despite the many difficulties, acceptance of digital imaging and computer applications in radiology and other disciplines is increasing and should have a major impact on both the efficacy and costs of heath care delivery.

Steve Horii: I'd actually like to close with something that is sort of a personal observation – and that is other folks I know who have been in the Public Health Service, when I see them, they are often in uniform, you know, Mel Greberman and John Villforth. However, in all the years I've known you, I've never seen you in uniform; and I'd like you to explain a little bit, why that might be.

Joseph Gitlin: Well, I had the experience of Naval ROTC and wearing a Navy uniform during World War II. When I was assigned to Maritime ships that had Naval gun crews, I wore a different uniform similar to the Navy's. After graduating from Penn, I joined the Public Health Service and wore a PHS uniform for three years. When I was recalled and served in the Air Force, I had an Air Force uniform during my tour in Europe until 1956. In 1957, I returned to the Public Health Service and was able to wear my original PHS uniform during my assignment with the Accident Prevention Program. When I was offered a key position in radiological health in 1958, both the pay scale and the health and retirement benefits were less desirable as a commissioned officer with four children, than becoming a civilian. So, I became a civilian with reserve status in the PHS Commissioned Corps. You just never saw me on the occasions when I wore one of the five different uniforms, and due to changes in girth you probably never will.

Steve Horii: Well, thanks. There's one thing here that makes me curious, though. You mentioned having some illuminating anecdotes. I am very curious about how you got an Imam to say that film doesn't violate his Islamic doctrine about photography.

Joseph Gitlin: Earlier in this discussion I mentioned the chest x-ray screening program in Europe where we did examinations for tuberculosis among military personnel, dependents and indigenous workers on our bases. The U.S. Air Force Command in Europe included all of our bases from Oslo, Norway to Dhahran, Saudi Arabia. One of three bases in North Africa was in Morocco, where our hospital reports indicated a relatively high incidence of tuberculosis. Before we sent a mobile unit in to conduct the screening program, we asked our embassy to check with both the national and local governments where the bases were located to arrange for a meeting with the proper authorities to answer any questions about the program. Usually these were related to the actions taken when a positive case was found among the indigenous workers. This included questions about the assistance we could offer in treating the patients, since we had a fund that could be used for care and treatment such as isoniazid.

We were aware that the population of Morocco was largely Muslim and that a personal photograph was forbidden by Muslim tradition. Since we were planning to perform chest x-ray examinations and put the images on film, the Muslim belief might prevent indigenous personnel from participating in the program. One can make a case that an x-ray film is not really a photograph, and we decided to obtain a ruling from a recognized authority. We learned that the principal Imam in Morocco was a Harvard graduate and through the U.S. Ambassador's office in Casablanca, we made a formal appointment with the Imam, who was in Marrakesh. He knew about the issue we were going to raise and had preliminary discussions with his advisors to obtain support. We had a formal meeting in the morning with translators, as if the Imam couldn't speak English, and answered the questions he and his staff asked about the chest x-ray program. We answered in English that was translated for the group. We met again with the Imam informally that afternoon, and this time he spoke in English. He said, "It's all settled. The papers will be signed within a week. You can start the program." It was a memorable experience that I couldn't resist putting on the list because it's certainly an interesting highlight.

Steve Horii: Well medical imaging and international relations…that's a pretty hard combination to beat. So, Dr. Gitlin, thank you very much for your help with this; and we certainly appreciate all of your efforts in putting all this information together for us.

Joseph Gitlin: Thank you for reminding me of things I have long since forgotten.