SA: Hi, I’m Stephen Ash, a practicing physician with Indiana University Health Arnett in Lafayette, Indiana. Today is June 20, 2014, and I have the pleasure today to interview Dr. Marty Roberts, a long-term friend and associate with many common interests. Marty has been responsible for a number of innovations in the dialysis field including creating the first commercial practical PD [peritoneal dialysis] solutions, working with Dr. Maxwell at the time inventing the first workable and repeatable PD catheter, the Trocath, design of a number of IV solutions, working with Don Baxter Company developing the vinyl tubing sets, blood tubing sets, now used for hemodialysis and then, of course, the sorbent kidney, SORB regenerating column that’s still the only practical method for reusing and treating dialysate to remove toxins. Marty received a bachelor of science in chemistry at the College of New York in 1942, went to Brooklyn College, got a master’s in organic chemistry, working on pyrimidine synthesis, and finally a PhD in biochemistry at the University of Southern California. We are deeply thankful to Marty for his long support to ASAIO and he’s been a stalwart member and contributor. So Marty, I had a few questions. What led you to get a master’s degree in organic chemistry and then a PhD in biochem?

MR: Well, I had a bachelor’s degree in chemistry and I was working for a beer consulting firm and my job was assaying the beer and it seemed to me that I didn’t want to be assaying beer for the rest of my life, so I decided I would take a master’s at night while I was still working. The unusual thing is that Brooklyn College allowed you to take a master’s at night. It took me three years to get a master’s. Once I had a master’s, I realized that I didn’t know as much as I thought I knew and I needed a doctorate. So I went on, I applied for a scholarship and received a teaching scholarship from the University of Southern California. That’s how I ended up at USC and in Los Angeles.

SA: And moving from New York to California was a side benefit, right?

MR: That is correct, right. I like swimming in the ocean and I said, "Well, I can now swim in the Pacific Ocean."

SA: Yeah, might as well. And you first became familiar with dialysis, I guess, related to the subject of peritoneal dialysis?

MR: Yes, with Morton Maxwell wanting me to make a first commercial PD solution.

SA: And up to that time, how was Dr. Maxwell doing PD?

MR: He was making his own catheters. He was making his own solution in a laboratory.
SA: Was it a lactate-based solution, as well?

MR: Yes.

SA: And what were his catheters like?

MR: His catheter was a nylon catheter and he inserted the nylon catheter using a large trocar; and so the method is to insert the trocar, remove the obturator, and insert the catheter, pull the tubing out, and then sew the catheter into place in the peritoneum.

SA: And your invention the Trocath was a single insertion with a pointed stylette inside a relatively stiff catheter, right?

MR: That is--. I used the Maxwell catheter, which is a stiff catheter. And instead of using a separate trocar, I made the Trocath into essentially a trocar with the catheter being the on-site tubing and with a wire being the obturator. The advantage there was that the hole made by the obturator was smaller than the catheter, so the catheter stretched the skin and it was automatically sealed. There was no need to do any stitching.

SA: And you tested this in animals, I guess?

MR: I tested this in rabbits.

SA: To make sure that the shape was such that it would go through the peritoneum but not through the bowel?

MR: No, not quite. The thing I was interested in [was that] all trocars were three-pointed and I wanted to know whether there was a real reason for the three points or whether that was just circumstance. So I inserted-- I made the obturators with a single point. I made it with two points. I made it with three points. I made it with four points. And I pushed it through the skin of a rabbit and I also pushed it through some steaks for the other method to see whether there was a difference in the point, and it turned out that the three-pointed trocar was the right way to go.

SA: Well, it’s stayed ever since. Then you also designed some IV solutions with Kendall McGaw, or rather Don Baxter Company, is that right?

MR: Yes. My first solution was-- Interestingly enough, the first job I had with Don Baxter was to make a solution, oral solution as a nutritional solution and it was called Calorigen. It was a concentrated solution of starch and sugar and was given by a nasal tube. The nasal tube was designed by someone else and the solution was run directly into patients' stomachs by means of the nasal tube. That was the first solution I made. After that I started talking with physicians and found out that there was a need for solutions for acidosis, for alkalosis, for unique situations, so I started making unique solutions for that purpose.
SA: And in terms of creating the commercial PD solution, what were the challenges you had and what made it a successful PD product?

MR: Well there were essentially two challenges. First of all, you wanted the solution to be clear and colorless, and some solutions precipitated when you sterilize them. Some solutions turn brown when you sterilize them. So the job was to correct the formulation so that they were clear and colorless.

SA: You adjusted the pH? You came up with a pH range?

MR: The pH was one way. Changing the ingredients was another way, of course, and then the other part of the problem was that the solution should not precipitate or change color in storage for a year. Well, it takes a year to do that, so one of the ways is to heat the solution up to 60 degrees centigrade and keep it at 60 degrees centigrade for a period of time and see whether it turns yellow or precipitates under those conditions and that’s how it would be an accelerated storage test.

SA: Speaking of PD solutions, when I started doing peritoneal dialysis in the mid 70s, all the solutions came in glass bottles.

MR: That’s correct and Morton Maxwell had designed it with two liters but when we started making the solution, we had to make it in one-liter bottles because the regulations required that no solution could be greater than one liter. So I went to the regulatory agents and told them that this should be really two liters and there was no danger in running two liters into the peritoneal cavity rapidly and they accepted the suggestion and we were able to do two-liter bottles.

SA: Was it a big change for the industry going to the bags?

MR: Yes, definitely. Don Baxter spent a long time trying to develop bags and eventually Baxter Laboratories was the first people to come out with a bag.

SA: Okay. How did you come to be involved with the Seattle Artificial Kidney Supply Company, which is a division of Sweden Freezer, in Seattle, and what did you do there?

MR: That’s a very good question because I was at Don Baxter and one day while I was working there I got a phone call from Mr. Swenson, who was the CEO of Sweden Freezer, and he said to me, I would like you to come to head a dialysis division that I’m going to form called the Seattle Artificial Kidney Supply Company, “I’d like you to be head of that company and I’ll pay you, let me know how much you’re making right now.” I told him how much I was making right now and the offer was so good I couldn’t refuse it.

SA: That’s great.
MR: He then invited me and my wife to come to Seattle. He put us in the best hotel in town. He had the rabbi call us and invite us to join the synagogue there and they really put on a show [so] that obviously both my wife and I moved to Seattle.

SA: Wow. And the principle physicians behind that company I imagine were Dr. Blagg, Dr. Scribner, and others from Seattle?

MR: Yes. I’m trying to remember the name of the engineer, the engineer -- Wayne Quinton.

SA: Yeah, Quinton.

MR: Quinton was involved, so actually Scribner and Blagg were the people who were telling me and Sweden Freezer, or I should say the Seattle Artificial Kidney Supply Company, how to build the machines and what they needed. And one of the things they needed was a blood tubing set that would be commercially available. And Sweden Freezer had a Japanese division in Tokyo. They contacted Japan Medical Supply and arranged for me to visit the Japan Medical Supply and show them how to make blood tubing sets.

SA: And they were made out of PVC, vinyl, right?

MR: PVC, yes, which at that time all IV solutions administration sets were made out of PVC, so it was just changing from a IV solution to a blood tubing solution.

SA: Right. And that was 1966, so--

MR: That was 1966.

SA: So chronic in-center dialysis wasn't around. Of course, the Northwest Kidney Center was training patients for home dialysis around that time.

MR: That is correct.

SA: And, of course, it was used in acute, and so the Seattle Artificial Kidney Supply Company made a dialysis machine at that point.

MR: That is correct. They made a dialysis machine based upon the design by Dr. Scribner.

SA: And what eventually happened to that company and to the product?

MR: The product, they also made a central system and the central system was sold to many people. I stayed in the company for approximately five years, at which time I got an offer to get into sorbent chemistry, which sounded very interesting, and also what was interesting about it is that it was in Los Angeles, so it was an opportunity to get back to Los Angeles. So I left the company after working for them five years, and the company Sweden Freezer itself ended up going out of business because Swenson, the CEO, had no one to succeed him, so the company just disappeared.
SA: He made a lot of good ice cream at the time, didn't they?

MR: I still have the ice cream machine. I have an ice cream machine that I use whenever I have a party.

SA: It still works?

MR: It still works.

SA: Wow.

MR: I had to replace the Freon but other than that it still works.

SA: Yeah. The story of sorbent dialysis is interesting. So Organon Teknika was the one that hired you in 71, is that right?

MR: No, that is incorrect.

SA: Yeah. The first one was--

MR: There’s a series of companies involved and actually that’s been one of the problems with sorbent technology is that there were too many companies involved. Marquardt is an aerospace company located in Los Angeles, and they realized after World War II that they were going to lose a lot of government money, so they essentially told their engineers to go out there and see what else you can do as an engineering job, so one of the engineers got a job, got a grant from the government to reclaim agricultural wastewater. Agricultural wastewater essentially has too much sodium and if you can just remove sodium and put it back on the soil, you can use it over again, so here’s a situation where regeneration fits into the picture. And he developed a number of ion exchange resins and the important thing is that agricultural water is very cheap, so you have to regenerate it very cheaply and he was successful in doing this. And one of his cousins ended up on dialysis and he said, “Well why throw all that dialysate down the drain, why don’t we regenerate that dialysate?” So Marquardt got a grant from the NIH, and through Morton Maxwell, and through Arthur Gordon, who actually were the persons who got the grant because the company itself could not get a grant, and Maxwell and Gordon were both nephrologists, so they headed the group and they hired a chemist by the name of Larry Marantz. It was Larry Marantz who developed the sorbent system and that started in 1968 and continued under Marquardt and then in 1971 they decided that they were going to go on the market and they changed the name from Marquardt to CCI Life Systems because at that time, CCI had bought Marquardt and they wanted to have a name that would be recognized more in the field of healthcare rather than associated with aerospace. That’s the reason for the name [change] to CCI Life Systems. So I was hired by CCI Life Systems and I was the first person to join the company who was knowledgeable in the dialysis field. Everyone else was in the aerospace field or had been hired just for the job of developing sorbent systems. But my job to begin with was to convert a research machine to a machine that could be manufactured and sold.
So we went to a rather complex machine to a very simple machine, and at that time most patients were home patients. So the machine was designed for use by a patient at home. It had only three knobs and one knob was the major knob, so it was very easy for a person to learn how to use the machine.

SA: And for many, many years that machine remained pretty much unchanged, right?

MR: That is correct. To begin with, since CCI had no market in the medical field, my first job was to try to find people who could market the machine and I went to see Baxter, I went to see other companies. Interestingly, 3M was one of the companies that was interested and they all decided that the sorbent system wasn't going to sell, so I ended up setting up a marketing group to market the machine ourselves. So I started out as vice-president of marketing.

SA: Wow. You did well at that. So what were your concerns and what kind of tests did you have to do before you felt that this column could actually regenerate dialysate?

MR: By the time I came there, they had already done dog work and demonstrated that they could keep a, they could maintain a dog who had been nephrectomized. They had already gone to humans. So by the time I was hired, it had already been proven that the machine could maintain patients. That was not part of my job.

SA: When was the first time you saw a patient on a sorbent dialysis?

MR: I think it was probably in Seattle. I remember seeing a home patient, going to their home in Seattle.

SA: What did you think about--

MR: I thought at the time this is great that we can keep a patient who would've been dead within a month, we could keep him alive indefinitely.

SA: And that there were no obvious differences in the clinical outcome with proportion dialysate which goes down the drain or the sorbent, right?

MR: That is correct.

SA: Yeah. Don't you think it's kind of remarkable that such a simple collection of mostly inorganic things, zirconium oxide, zirconium phosphate, charcoal, and a layer of urease can remove all of the toxins that the kidney would normally remove and not remove too much good stuff?

MR: Yeah. Actually I never made that claim. We’re talking about 1971 and 1973 when we went on the market. Even today, we don’t know all the toxic materials that have to be removed. All I can say here is that we put people on this machine, they were maintained, they did well, and years went by and they still did well, and there was no evidence that we
were missing something. There was also no evidence that we were taking out the good stuff and I would say that we did remarkably well with a system that was unique at that time.

SA: Yeah, as Dr. Wampler might have said, serene stupidity is a wonderful thing. So you obviously then turned your attention and desires toward regenerating peritoneal dialysate with sorbents, right?

MR: Before that I turned-- I would like to add another contribution, and that is in 1973, with the start of private dialysis units, so many dialysis units were set up and the market for home hemodialysis disappeared; and the REDY machine had been designed for home hemodialysis. So as vice-president of marketing, it was my job to find a new market and the market that appeared to be a good niche to get into was acute hemodialysis. And the acute hemodialysis required the situation of being able to change the dialysate for the patient rather than force the patient to be maintained on a standard solution, which was the game plan at that time. Everybody was dialyzed on the same dialysate. And the big advantage of the REDY system was it used only six liters of solution, so it would be very easy to make a special solution for a patient and also, as you dialyze the patient, you can change the solution right in the machine. So what I did at that time was to work with a nephrologist and design special dialysates for different patients. We designed dialysate for people who had alkalosis. We designed solutions for people who had acidosis. We designed solutions for people who had low calcium, people who had high calcium, people who had low calcium, and that was the unique thing about the REDY system, it was very easy to change the solutions. You can also do a stat test on the patient, and for example if you're correcting alkalosis and you do a gas on them and found out that you weren't correcting it you could then change the dialysate while the machine was running and you continued to correct the patient.

SA: So what many of us read as the sorbent primer, I take it, was one of your principle works?

MR: Yes.

SA: Right. Yeah, it was remarkably flexible. And you stayed with that company and eventually changed to Organon Teknika, right?

MR: Organon Teknika was one of our distributors in Europe and they had signed the contract that they would sell as many machines in the following year that we sold the previous year and they didn't realize that I was selling a lot of machines. So they ended up with a lot of machines and they tried to change the contract. They were unsuccessful. At the same time, the guinea, which was money, the Dutch money at that time, had gone up and the dollar had gone down, so the easiest way was to buy the company and change the contract, so Organon Teknika bought the company.

SA: Wow. And somewhere along there you actually worked with physicians to see if you could regenerate peritoneal dialysis, right?
MR: Yes. I started off-- that was also a contract between Morton Maxwell and Arthur Gordon and the physician who actually did the work was Dr. Blumenkrantz, and this was done at the VA Hospital in Los Angeles called the Wadsworth Hospital.

SA: And there had been some animal tests before that and--

MR: They had done some dog tests.

SA: Right, yes.

MR: And they had shown that in a dog that the REDY cartridge could be used for PD solution.

SA: And the results were generally positive. There were a few problems in the patients, right?

MR: There were a few problems when we began using the REDY cartridge as is. We found that after about four hours, the patients complained of fullness of the stomach. They just didn’t feel well and I surmised that the problem was probably due to the urease and so I requested a-- I went out and found somebody who could make non-pyrogenic urease and we took out the urease from the cartridge, put the non-pyrogenic urease into a separate vial so that when the solution came out of the patient, it washed the urease into the cartridge, where it was trapped by the alumina, and once we had purified the urease, we had no longer any problems with the REDY cartridge. We had no reaction whatsoever and did twenty patients. I did one patient for two months and we had no reactions whatsoever from the patient.

SA: Then there wasn’t ever a commercial product which regenerated peritoneal dialysis but somewhere along the way you decided to make sure there was one and helped in the formation of AWAK Company [AWAK Technologies, Inc.].

MR: There’s a little bit of a story there in that once Dr. Blumenkrantz and I had shown that the REDY cartridges could be used for PD, we designed a machine called the-- well, I forget the name of it—oh, Pericycle, designed a Pericycle and we gave it out to various separate nephrologists for them to try and to do PD with the Pericycle. At that time we were purchased by Organon Teknika and at the same time, that was the same year that CAPD came out. And Organon Teknika decided that CAPD--and everybody else mistakenly thought--that CAPD would take over the entire peritoneal market and there was no point in having a machine for PD and they withdrew all the machines and actually destroyed them.

SA: How many were built?

MR: About four of them.

SA: Wow. So after a hiatus of about ten years, you did decide that the time was right to create a company and create a product to regenerate PD?
MR: No, that’s not quite right.

SA: That was just a guess.

MR: While I was with CCI Life Systems in 1977, I published two papers. One paper was how to build a wearable-- I should really go back. I want to go back a little bit. As with the REDY system, I went out and went to dialysis units, and I could see these patients sitting there, spending four hours to five hours a day, three days a week just sitting in these chairs and I felt that there must be a better way of doing this. So in 1977 I published two papers, one saying that you could build a wearable for hemodialysis, and the second one on building a wearable for peritoneal dialysis. And the company told me this was “blue sky,” it would be millions of dollars to develop such a system, there was no guarantee that it would work, and forget it, so when I retired in 1985, I called up Dr. Lee and I said let’s work on a wearable and that’s where we started working on a wearable.

SA: And you continued to work with Dr. Lee on that for ten years?

MR: We worked from 1985 to 1997, when we developed a patentable idea. The idea was to go into a patent by UCLA, and UCLA looked for licensing to build the machine and eventually it was Dr. Lee, actually, who found the licensing by going to Singapore, talking to some of the nephrologists there, and one of them said, “I can line up a whole bunch of rich people and they will provide the funding for a company”, so the company was formed in April of 2007 for the main purpose of a wearable artificial kidney.

SA: And the Singapore government contributed to that also?

MR: The Singapore government provided some grant money for the system.

SA: Okay. And I’ve seen a prototype of the device, I believe, at our meeting and I’ve heard you talk about it, but can you describe how it’s going?

MR: Yes. So we have now gotten to a point where we feel that we could standardize the product. The product weighs one kilogram. It’s small enough to fit into a purse or a carrying case so that the patient will be carrying the AWAK over their shoulder. There will be just a tube from the AWAK to the peritoneal cavity, which could be hidden, and one of the things we did a survey with patients and they said they did not want it to be obvious that they were dialysis patients, and this is a system where it isn’t obvious that the patient is on dialysis. And so whatever the patient is doing, they can just leave the shoulder bag and put it on a table next to them if they don’t want to be carrying it, if they’re working, and at night they put it on the bed stand and go to sleep. It’s a 24-hour system.

SA: This gave you an opportunity to sort of redesign the sorbent column, which really hadn’t changed a lot since the early days of Organon Teknika, right?
MR: As you alluded to earlier, when we-- We had no problems doing PD in the patients with Dr. Blumenkrantz, but then it occurred to me that when we start working with, possibly working with CAPD patients and put them on the PD sorbent system, there might be a difference between and so I ran some CAPD spent fluid through the sorbent cartridge and discovered that the protein in the CAPD solution could displace the urease off the alumina, so when we designed the AWAK we decided that we would chemically bind the urease so that's a major change. We still have the ZP. We still have the HCO. We still have the carbon.

SA: But are they in layers as in the other product or is it--

MR: That's confidential.

SA: Confidential, okay. Off the record, it will be more confidential probably, so--

MR: Yes.

SA: Have you-- You’ve been a staunch supporter and great contributor at ASAIO over the years, and at ASAIO we are always talking about what are the problems, what are the solutions, what’s new, what new technologies are there. Have you felt that dialysis has really progressed in the last twenty years, for example?

MR: I don’t know. It’s interesting that you bring up the last twenty years because the ASAIO was primarily kidneys when I first joined them. I joined the ASAIO in 1960, so I’ve been with ASAIO for a long time. And over the years it has gone into heart, and renal has become a very small part of the number of papers that are being presented and that’s because there’s been very little advance. The major advances in the field have been to modernize the sensors, to modernize the machine, but as far as the patients are concerned, there’s been no change. Patients still have to sit four to five hours, three times a week.

SA: I guess one change is in the implementation. What do you think of the daily dialysis routine or nighttime hemo as a therapy?

MR: I think the way to go is nighttime. There’s no question in my mind that frequent dialysis is the way to go.

SA: Biggest limitations to that, what do you--

MR: Limitations to that is that we’re moving into a situation where it becomes too expensive to be doing the frequent dialysis at a dialysis unit, so the patient has to move home and the machines that have been developed over the years have become more and more complex, and less and less capable for a patient to be using at home. So there’s a need for a complete redesign of the home hemodialysis machine for a patient at home.

SA: There have been some efforts to create machines that are somewhat easier to use at home and one of them was the Renal Solutions Allient machine that had a sorbent regeneration. Another was the--
MR: The Allient machine was not really simple. I saw the machine and my opinion was that the Allient machine would never sell.

SA: It was-- it’s still not on the market, by the way, but a replacement is supposedly on the way and then there was a machine from Chicago and I’ve forgotten the name that--

MR: Aksys machine.

SA: Aksys machine, yeah. What did you think of that one?

MR: The Aksys machine was very good. The important feature of the Aksys machine is that you do not have to change the blood tubing set. You can use it over and over again for about thirty times. The problem with the Aksys machine is that after a few years of heat sterilization the sensors went off and they had all kinds of bugs and they were all different, so it’s difficult to correct the problem, and the Aksys machine eventually went off the market but the people that used the Aksys machine were very, very pleased with it.

SA: And then there’s been some effort to create an implantable artificial kidney using silicon membranes and other approaches. What do you think of that?

MR: Implantables are more than ten years away. I do not expect to see an implantable in less than ten years.

SA: You would envision a machine that could be used, say, at night on a bed stand or used during the day. Would it be both? Would it be 24 hours a day with your, with the machine envisioned--

MR: The reason why I built the wearable, or I should say invented the wearable, is that I feel that one should be dialyzed like your own kidney, you should be dialyzed all the time. You shouldn’t be dialyzed just a few hours. But I also recognize that maybe some people would prefer not to either carry a shoulder bag, so I think that the other approach will be a system that will work overnight. Short dialysis each day is the way to go, but I think that the patient will get tired doing short dialysis every day.

SA: So do you envision that overnight dialysis, like peritoneal--

MR: I envision overnight nocturnal dialysis as being the way to go, potentially five days a week or six days a week. It may turn out to be adequate to do every other day. That may be an adequate way of doing nocturnal dialysis.

SA: With peritoneal dialysis?

MR: Makes no difference, hemo or peritoneal.
SA: Okay. What do you think are the biggest innovations in dialysis that you’ve seen? I mean, you were involved in the very early phase of both peritoneal and hemo, so what are the biggest innovations since ‘66?

MR: Oh, as far as the patient is concerned, very little. The big innovations I see and it’s sort of just like I was able to change the REDY system to different dialysates, it’s now possible to change the dialysate in the single-pass machines. The sensors are a lot more efficient. We now have screens to tell the patient or the nurse what to do, instead of having to have a book at your side and use it, so there’s less chance of errors being made. I think the major improvements have been in the machine and the use of that machine.

SA: And do you think-- How about membrane changes, obviously we’ve gone from, you know, flat plate to coil to hollow fiber dialysis?

MR: Well I started with the Kiil dialyzer. That was quite a mess to put together and, of course, the plate dialyzer was a little bit of improvement over that, but the plate dialyzers are big and I think the hollow fiber is an important invention with hollow fiber added. As we can see it’s lasted for years, at least the last twenty years, as you brought up.

SA: Right and, of course, controlled filtration has improved dialysis.

MR: Control of the UF, yeah, has improved.

SA: Do you see a great role in ASAIO in bringing about these improvements in dialysis therapy and fostering novel ideas?

MR: Yes, I-- Well, the reason I’ve belonged to the society all these years is that I feel that the society does an important thing in the field. I get up, give a paper, and somebody says, well why do you figure that, why do you figure that, and I don’t agree with this or I agree this, so I have an opportunity to get a critique of my paper, which I don’t get when I publish a paper. So I think it’s important to be able to present a paper. I think it’s also important that I go to Dr. Kolff and say, ”I’m thinking of this, what do you think of this,” which you can’t do when you read their papers. And so I think there’s an important use of these ASAIO relative to coming here and meeting people and getting critique of what you’re presenting. I’ll be presenting my paper tomorrow on the AWAK and I’m looking forward for people to tell me why I should go a different way.

SA: Ironically, by the way, I think that the first abstract submitted on CAPD in 1976 was actually turned down by ASAIO.

MR: Yes, I understand that.

SA: But it doesn’t mean that it wouldn’t have worked out, that there wasn’t the same discussion going on either way. And you’ve published over fifty peer-reviewed publications in your career with a lot of very influential and creative people. How about the publication
process itself? I mean, you could invent things without doing these publications, you could test them. What's the value in publication?

MR: The value in publication is to present to the scientific community what you've done and how you've done it, so that they can build on what you've done and improve on it. If we all kept secrets to ourselves, then there would be no progress. I think it’s important to publish what you’ve done so that other people can improve on it, and you in turn improve on them. So you step up and move ahead and this is one of the reasons why a patent is published so that everybody else can see the patent, but at the same time give the inventor protection over twenty years so they can recoup the amount of money they’ve spent putting into developing the product.

SA: And you also have a number of patents, I think twelve or something like that?

MR: Yes.

SA: U.S. patents. How about corporations, do you see that the companies in the dialysis field are trying to innovate, to change and improve in general, or are those type of innovations only left to small companies?

MR: I think the large companies aren’t doing enough in the way of speaking to patients and developing and speaking with the nurses and physicians, developing products that they want; and I think that’s where the small company comes in because usually small companies are developed by people who’ve seen a need like either being a physician or a nurse or working with these people. They come out with that need, and then it usually ends up that these large corporations then eat up these small companies and that way they advance and begin to meet the needs of the patient. But I don’t think that large corporations are looking enough at what the needs are of the people. And this is where I think the ASAIO can do a job perhaps a little better than right now is if they could perhaps by actually publishing unmet needs. For example, I think the ASAIO could get experts in from various fields and say, “What unmet needs are there?” and actually publish these unmet needs and let these young investigators, who are looking for something to work on, look at these unmet needs and say, “Ah, this is what I’m interested in,” and have them work on it. That’s my suggestion for ASAIO.

SA: Yeah, that’s very creative. Someone said that if you want to know what advancements will occur in the future, all you have to do is look at the unmet needs of today.

MR: That’s correct.

SA: Because someone will fix it sooner or later. So speaking of that, what do you think dialysis is going to look like in twenty years?

MR: Well, in twenty years, I think my wearable one will be out there and people will be using my wearable. I expect dialysis to move more towards the home because I think that’s the only way you can do frequent dialysis is to do it at home. So I definitely expect the
dialysis population to increase at home. The dialysis units will be primarily for those people who are incapable of doing home hemodialysis.

SA: So do you think with the right machine, the majority of patients could do dialysis at home?

MR: Yes. There is, of course, with hemodialysis a problem with access. A large number of papers on access and there’s still a need for better access for a home patient.

SA: Yeah.

MR: With peritoneal dialysis, we have the problem of the peritoneal membrane becoming too porous so that there’s a problem with fluid loss and, therefore, these patients end up on hemodialysis. With my AWAK, pardon me for the promotion, the AWAK is set up to deliver dialysate at a physiological pH whereas dialysates which are on the market right now are acidic; however, there are more compatible dialysates on the market but so far they have not demonstrated an advantage as far as the peritoneal membrane is concerned, so I see a definite advance in getting a peritoneal dialysate which is more bio-compatible than the solutions that are on the market.

SA: Speaking of that, if you look at advanced peritoneal dialysis solutions, bicarb based or pH balanced or low glucose degradation products, most of those solutions or all of those more physiologic solutions are in Europe and not the U.S.. The U.S., we have basically glucose solutions with lactate and we have Icodextrin. What do you think is the problem there? Do you think it’s a problem in regulatory approval?

MR: No, I don’t believe the problem is regulatory at all. My personal opinion is that these companies do not see--so far, these solutions have not been shown to be that much advantageous that the American physician would be willing to purchase these solutions, and large companies have decided that there's no market in the United States for these solutions. That's why--

SA: Interesting, yeah.

MR: But I’m not associated with the company, so I’m not sure.

SA: Do you see any role for oral sorbent therapy?

MR: There's been a number of people like Eli Friedman who's been in that area. I think you can perhaps use oral therapy for a short period of time to delay the start of dialysis, but I don’t see oral therapy as a means of replacing dialysis.

SA: Right.
MR: I’ve been interested in diarrhea therapy, which is one type of oral therapy. I’ve been interested in the various bacteriological methods, and I don’t see any of them getting to a point where they would be used.

SA: So there’s probably some toxins that could be removed pretty easily orally, say potassium or--

[Multiple speakers ]

SA: Or excess hydrogen and acidosis but not all of the organics could be expected to be transferred.

MR: Oh the big, big one is urea. I still remember Dr. Kolff coming on stage and saying, "You mean urea is not toxic?" He took a jar of urea and spilled it on the floor, and he says, "This is not toxic?" This was at an ASAIO meeting, too.

SA: Right.

MR: Do you remember that?

SA: I do, actually. And the-- My feeling is it’s not the urea that’s toxic but all that nitrogen that’s sitting on the floor, that’s toxic. That leads to lots of other toxins.

MR: Well it’s true that urea is not toxic in small quantities but you can’t just keep on accumulating urea.

SA: Or nitrogen, either one.

MR: Right.

SA: So what kind of recommendations would you give to a young scientist, maybe a biochemist, who’s interested in improving artificial organ therapy or artificial kidney in particular?

MR: Oh, I would say look at the patient, talk to the nurse, talk to the physician, and see what you can contribute to the field, and you’ll surely find something you can contribute.

SA: And your career has been one really of collaboration. I mean, you’ve collaborated with physicians who have great interest and great experience in new therapies, and then you collaborate with business people, other scientists, you mentioned have been involved in the creation of the sorbent system.

MR: I’ve collaborated through many physicians where I’ve actually been invited to go on grand rounds.
SA: Good for you and I’m sure you’ve contributed as well if any questions come up. How vital is that? I mean there may be some young scientists who figure they can do it all on their own.

MR: All along I’ve been the interface between the company and the medical profession, and I think this is an important role. The engineers design a product and they design, they write the directions on the new product. I go to the physician with the directions and the product, and the first thing they do is tear open the package, put the product on a patient, and never read the instructions. So the object lesson there is you design the product so that it can be used without having to read the instructions.

SA: And is it easier in the small company to get that kind of collaboration and--

MR: Yes.

SA: --general work than in a large one?

MR: Yes, that is much easier.

SA: You’ve been in both, actually.

MR: Actually I’ve been primarily in smaller companies. I’ve not worked for very large companies. The largest company I worked for was Don Baxter.

SA: If you had something to do over, what would it be?

MR: I would’ve gotten an MD degree.

SA: Really?

MR: My mother-in-law said when she discovered that I had a doctorate, not an MD, she said I’ll be willing to put you through medical school and I said, "No. I want to do research," and I found that I have been hampered in my research by not having an MD degree, that I could’ve done a lot of things where I needed cooperation with an MD that I could have done myself.

SA: Would you have foregone the PhD to get an MD?

MR: No, I would’ve gotten both.

SA: Both. And if you--that’s it? No other missteps?

MR: No, I think I’ve done very well. I’ve never been without a job.

SA: That’s great. And you have a very strong and supportive family, as well.
MR: Yes.

SA: You've been able to maintain that in spite of all of these career-changing projects. Any suggestions there?

MR: I don't know. I love my children. I spend as much time as I can with them and they all get along very well. I have no problems with them and they all are supportive.

SA: So a matter of priorities, keeping that straight. Well, thank you very much. You've been a great friend and a great collaborator for years, and I appreciate your giving us your thoughts, looking backwards and forwards. Thank you.