

**Project Bionics Pioneer Interview
Richard K. Wampler, MD
Interviewed by Steven Phillips, MD
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[Also present: Jean Kantrowitz and Mark Kurusz]

SP: Dr. Wampler, this is an absolute honor and a pleasure for me to be able to talk to you today. We go back a long, long way. I don't even want to discuss how many years we've known each other. But today we will be having a conversation on your work and your efforts in the area of artificial organs. Here we are at the National Library of Medicine on the campus of the National Institutes of Health, the largest biomedical institute in the world. We're doing this because this interview is sponsored by the American Society for Artificial Internal Organs, ASAIO, where we have been long-time members and colleagues, the National Library of Medicine and the Smithsonian Institute. Before we start discussing some of the questions that I'm about to ask you, I think we should start off by you just describing the Hemopump, and I'll leave it there and let you go into it.

RW: Okay. Well, I'm just so honored to be here today, and humbled. I think sometimes I get a lot more credit for this work than is really mine, but I'm glad to be here and glad to share the story. It's been my experience that people are sometimes more interested in how the idea came about than the things of the technical nature of the pump. But the Hemopump was invented in 1985. It looks like this. It had a flexible cannula. Inside there is a high-speed turbine that ran at 28,000 revolutions a minute, not 2800. And this pump could pump almost a gallon of blood from this end out to this end. And the thing that made this pump elegant and a real contribution was that it could be implemented without major surgery. So this device could be placed through the femoral artery under guidance with x-ray, threaded up into the heart. The tip would go into the left ventricle. The aortic valve would seal along this region, and then the pump would pump into the aorta. And in this way, it was possible to provide the patient with three to four liters of extra cardiac output without major surgery, potentially even just a local anesthetic, and with very little risk compared to conventional LVADs at the time.

SP: Well, I know it's an elegant device. I had the opportunity to use it based on your clinical trials. Would you basically describe what sort of patient this would be of benefit for?

RW: Well, the original clinical trial was targeted at patients with cardiogenic shock, which, at that time, had a mortality of probably over 80 percent. These were patients that didn't come off the heart-lung bypass machine, or patients that had severe myocardial infarction or acute heart failure from -- we had one lady with postpartum cardiomyopathy. And the strategy was to implement support for several days to a week and hope that [heart] muscle that was still living that wasn't beating would recover contractility and permit us to remove the pump.

SP: And we have learned over the years that if you can rest the heart that it will recover to a large degree.

RW: Yes, and the heart has an amazing ability to recover if it can be relieved of its workload. And the first patient, which we did in 1988 with Dr. Bud Frazier, was a patient with a transplant that had acute rejection. He had pneumonia. Dr. Frazier confessed to me a couple of years after we did Mr. Kranich that he picked Mr. Kranich because he was so sure that he was going to die, that he wasn't going to feel guilty if something horrible happened with the pump that we hadn't seen in the cows. And the epilogue to that story is that Mr. Kranich actually went home with a normal ejection fraction and normal heart function.

SP: You make it sound very simple. You make it sound as if you just opened up the top drawer of your workshop one day and pulled out a Hemopump. I really don't believe that's the case. Why don't you tell us about what motivated you, even far back when you were a medical student, into this area.

RW: Well, I have always been an inventor, a gadgeteer. I originally planned on going to engineering school at Lafayette in Indiana. And then I decided to go to medical school instead. I got very interested in surgery, because I really liked working with my hands, and I particularly was interested in cardiac surgery. And that's when I met you, in 1974, I think. I went out to the University of Oregon to take a cardiac surgery externship with Dr. Albert Starr, and that turned out to be a real turning point in my career. The University there really nurtured innovation and they had a real history of innovation. Dr. Starr had pioneered the work with mechanical valves. Joseph Doddard in radiology did the first vascular interventional techniques, which actually started back in the late 60s. Tom Fogarty, as an intern, did an embolectomy with a catheter with the -- the legend has it -- with the tip of a surgical glove tied to a catheter. So there was a really good environment there for new ideas and for permission to try some crazy things. So then I did my surgery training there, and for -- as I look back -- no good reason that I can remember, I became convinced that I wanted to invent an artificial heart. It was a modest dream for a young lad of twenty-six, and it needed to be a rotary blood pump. And these were radical ideas. I don't think people now know just how radical it was, but there was a strong feeling that pulsatility was necessary to maintain physiology. There was a strong belief that these rotary pumps would tear up blood cells and totally damage the blood. But I just believed otherwise. And I discovered the Transactions of the American Society of Artificial Organs in the library. I went and devoured them, looking at the work other people were doing. I even found a couple of authors that were also working on rotary blood pumps in the backwater. One of them, Kletchka-Rafferty, their blood pump, the Bio-Medicus pump, is a standard of care for cardiopulmonary bypass now. But I became convinced that these rotary blood pumps would work. I was a gadgeteer. I had some pretty good hands-on skills. I befriended one of the men at the machine shop at the University, and I started making prototypes, just on my own, made some. Some of them I even cast them out of lost wax, like jewelers make parts, to get parts of my own. I did all of this work in my wife's kitchen, and then I moved on. I drifted for a little while in emergency rooms, and then I just decided I had to come back and pursue this passion that just kept pursuing me. I just

couldn't let go of it. So then I came down to Sacramento and I went to engineering school while I was working in a trauma center. And that's where I learned to speak "engineer," to be able to confront the engineers when they were wrong. And there was a real serendipity there because several people that had been graduates of that program were working on artificial hearts at Aerojet Liquid Rocket in Sacramento. That group later became Nimbus Medical. And those key players, among them, Ken Butler, who is one of the grand old men of the artificial organs group, and John Moise, who just recently died. I came together with them and nine other people, and we started Nimbus. And I convinced them that we should work on a rotary blood pump, which was a tough, tough sell. NIH just spent hundreds of millions of dollars on pulsatile pumps, so it was tough to convince anybody that John Watson at NIH or any of these people that they should look at rotary blood pumps. And then I came up, after thinking about the problems of LVADs, there's a huge surgical procedure to implement them, the high risk of putting them in, large things coming out of people's chests. It just seemed to me the fundamental problem was really access. How can you get it in without working too hard? And then I had an "ah-ha." When I was a resident, I had gone on a medical mission trip to a village in Egypt. And because I was an engineer and because I knew they had water problems, I went to the library and I learned about wells. And in that course, I learned about submersible pumps. So that was in 1976. And then when I started thinking about LVADs in 1984, I remembered submersible pumps, and I thought, you know, you could turn this problem inside out. Instead of doing these big operations, what you could do is you could bring the mountain to Mohammed, and you could put the pump in from below and sneak it in the back door. And this pump that I showed you, Hemopump, is a submersible pump. And it's exotic compared to a water pump, but it's the same principle. And then another thing that happened was that the basis for the pump was actually a derivative of the Archimedes' screw, which I saw used in well irrigation pumps in Egypt when I was there. So my creative experience has always been nudged, if you will, or introduced to me by these serendipitous experiences or things that just come from nowhere and spark something in my imagination and help to solve a problem.

SP: Well obviously, you're very gracious, almost to the point of being shy. But like many brilliant people, you're able to connect the dots. You won't say it, so I will. What you have done has bucked the conventional knowledge and created a whole subspecialty in cardiac support, which is the axial flow or rotary pump, which no one who is above you, or even your peer, believed in until you proved it. Now you describe your history as sort of – "well it was kind of easy. You know, I just got up and I did it." But you were tenacious, and you persisted. I'd like you to tell me a little bit about the serendipitous events that made you move on above and beyond digging a well in Egypt, and some of the barriers that you hit, like the regulatory and financial aspects of this.

RW: Now, as it turned out the technical problems weren't nearly as difficult as the human problems, and I didn't really have much appreciation for those when I started. Our group was engineers, a lot of them were aerospace engineers, or we worked with cardiac surgeons, and those were all problem solvers, technicians, and the cardiac surgeons, derring-do kind of people. And we always imagined that if the company, Nimbus, succeeded, it would succeed because the Hemopump worked, and it would fail because

the pump didn't work. We had no idea that we were going to fail for the reasons that brought us down. And the issues of raising money, millions of dollars, which was, in those times, you know, was tens of millions of dollars on a wild idea by this young guy that nobody really had any reason to believe could do it, and then to deal with the investment community who just wanted to make money. And my group wanted to make a difference. And then to deal with the FDA. I mean, we were trying to save patients who--well, as one of my chief residents said one day in Mortality and Morbidity Conference, he got up--he was explaining a death, and he said this patient was too sick to live, and he died. And these were the kinds of patients that we were seeing. But it was very difficult to run that trial.

SP: Absolutely, for the record, I just want to say that the work that you have done with the Hemopump and the axial flow pumps really were the precursors of the Dr. DeBakey pump, and Dr. Jarvik's 2000, and many other devices that will be coming along the pipeline. Related to this whole effort, really your career, did you have others that were able to collaborate with you?

RW: Well, one of the fortunate things at Nimbus was that there was a willingness to look at new ideas, and I joke with some of them. I think that one of our greatest gifts was that we kept our ignorance intact for a long time. We didn't really talk to the people, the big people, because we knew that they were going to be discouraging. One story I like to tell is that several years later after we had shown that the hemolysis or red cell injury wasn't going to be a big problem, I did a calculation to see what the red cell attrition would be going through the pump. And it turned out to be an astonishing number of only one red blood cell for every quarter million that passed through the pump. And I think if I had done that calculation in the beginning, I might never have tried, so sometimes it's good just to believe. As somebody once said, trust your crazy ideas, design the experiment and get out of the way. The other thing is that a lot of what we believed at the time about heart failure was wrong. And a lot of what we have believed about blood was wrong. And we thought that heart failure could never be reversed, that they were all going to die. We believed that the blood cell was very fragile, that you really couldn't do much to it or it was going to be damaged. Nobody believed in the durability of rotary blood pumps back then. I mean, there were a lot of big barriers. And one of my old bosses used to say, "don't confuse me with the facts, my mind is made up". You know, I encountered a lot of that as I talked to professional people, and people that were in the field.

SP: Well, your efforts certainly have added to the body of knowledge, as you point out, related to heart failure. And your efforts have also put a lot of money in other people's pockets because they've taken your ideas and run with them. I know you're not sitting still. You're very creative and imaginative. Would you show us what the future holds? You have many other pumps.

RW: Yeah, I can show you some of those. Let me see. I did want to say that one group of people that really helped me was surgeons that I ran into. I ran into you who were willing to believe, Bud Frazier, particularly, was willing to believe. I had a lot of support in that regard. You know, and I know I'm getting kind of off track here a little bit. When we talk about the difficulties encountered, when we made the first Hemopumps, we went out and

got a retired rocket fuel pump designer. And I gave him specs and he came back with a design that he sketched out on goldenrod paper, which is hand calculations. And I took that out in the shop and with mahogany and file and chisel, modeled out the first blades, and this is so primitive compared to what we have now with three-dimensional computational fluid dynamics, rapid prototyping machines, numerical controlled milling. There are all these things now that allow you to do things much faster than we could do them back then. So it's been fun now to do a number of other projects and have all these analytical tools so we could do things so much faster. After the Hemopump, which was, at the time, one of the most bitter disappointments of my life, because this was like a child to me to have this invention, and --

SP: And it worked.

RW: And it worked. I would have felt much better if it hadn't worked. But to have it work and then to see it fall apart because of incompetence and greed was really painful.

SP: But you persisted.

RW: I persisted. I did. And the device that's most commonly used now, the HeartMate II, was a direct descendant of the Hemopump. And I worked on the early versions of what now is called the HeartMate II. It's now a commercially successful device. It's approved for long-term implantation, and that company is doing very well. So it has been gratifying to see things happen, and of course, it didn't happen as near as fast as I thought it ought to, but it did happen. So several -- I went back and actually assisted in cardiac surgery for about eight years. But I kept having ideas, and I was visiting my mother in Indiana, and I went into a toy store, and there was a little executive toy that was a little top suspended by magnets. And I stopped and went back and stared at it for quite a while. I bought one and took it home, and the result is this pump. It's now made by HeartWare. It's called the HVAD. And it is suspended with passive magnetic suspension in exactly the same principle as the little toy. And the other suspension is on -- it floats on a blood film. So not only can we pump blood with the use of high-speed pumps and not damage it, we can actually squeeze it in what are called thin film bearings and not damage the blood to any clinically significant degree. The other virtue of this pump over most of the other pumps is that it can actually be placed right in the pericardial space. So it can be -- this goes into the ventricular apex and then a graft goes to the aorta. So it reduces the surgical complexity because it doesn't have to go below the diaphragm, and it's an extremely durable pump. And this device is also making really good headway, and it's being used in clinical trials.

SP: Well, it's really tiny. It's almost the size of a pacemaker. And when you think about the large number of patients who could use a little extra boost, but are on massive doses of medication, in the hospital every other month, the suffering and the costs to those people to be relieved by a device by this, which is easily implantable and relatively safe.

RW: These things, again, the technical problems weren't the really big challenges. You know, I've been good at inventing things, I've really not been very good at picking business partners. And the initial owner of this technology didn't how to run a company,

he had never run a company before. It was a hugely dysfunctional situation, and that company ultimately went bankrupt. And at that time I lost involvement with this pump and it went onto another company. But it is gratifying to see that they made it work. They actually got the thing into clinical trials and surmounted those barriers, because it's -- I mean, now it's hundreds of millions of dollars to conduct a clinical trial. And you don't make money during clinical trials, it's just a huge expense.

SP: For someone who is interested in doing this, a high school or a college student or a young medical student, what sort of advice, if any, would you give them?

RW: Okay. I have a lot of advice. Most people don't take my advice, but I have advice. I think it's really important to trust your ideas and to trust your intuition. And I think, as I look back on my career, in all honesty, I think I'm bright enough, but my real gift was a willingness to be listening, and to take a moment to deal with something unexpected or fortuitous or serendipitous. So my story about the submersible pumps or seeing the top spinning in a toy store -- I get some good ideas in toy stores, actually -- and it's an ability to listen to what's going on, you know, whether, I mean, metaphorically whether it's the force or the spirit or whatever it is. I think there is something that you can listen to and that you can get out of time by yourself or, you know. I run as a hobby, and I solve some pretty good problems running some times, when I turn off my left brain for a while and just let things happen. So I think there is a skill or a discipline in that that you can develop to nurture good ideas. And I always advise people -- I've never been able to raise money on just an idea. I mean, there are lots of good ideas, and you can draw lots of pretty pictures, and now with all this computer rendering, you can come up with some incredible pictures. But I always wanted to have some kind of a prototype. Something that was working that could at least demonstrate part of what you were trying to do so that people could see it. And that's really been a, everything I've done that's gone on to anything, I've had a prototype. This pump, the HeartWare pump, I made that prototype in my garage, and I cannibalized some old Hemopump motors. I called in some favors from machine shops, and I actually ran hemolysis tests in my wife's kitchen, which really didn't make me any marital points, but it did allow me, then, to get data that I could use to submit to the NIH. And I did, as an individual, get an SBIR grant. So I was able to fund the project for another \$100,000 of other people's money. And then I had enough to really go out and find a partner.

SP: You really followed your dream; you followed your passion. As a young doctor, you had a dream to develop an artificial heart or heart pump. You worked as a surgical assistant. You worked in the emergency room. You went to engineering school. I mean, you continued and you persisted, and I think that's the message that I get. And it's not easy.

RW: It's not.

SP: Hoping is just not an answer. You have to follow your dream.

RW: And there were some very discouraging times. I told young people, you'd better get used to crushing, humiliating failure, because those are going to happen. And, you know, there were some experiences I'll never forget. In the clinical trials, the first patient, you know when Dr. Frazier and I went in and talked to Mrs. Kranich, you know, what you're really saying to them is "Your husband it going to die, okay. And we know you're desperate, and this young pup here has this idea, and it seemed to work pretty well on the cows. But we've never used it in a patient, you know. He'd be the first one. And oh, by the way, here's two or three pages of complications, and in all honesty, there's probably another page of complications, we just don't even know what they are yet. So what do you think? Do you want us to try?" You know, and God bless her, she did try.

SP: And you were successful.

RW: And it worked. You know, it was, it was one of the most astonishing experiences of my life, you know, to put this pump that I had worked on into a patient and who was on incredible doses of pressors, balloon pump, dying, and over a course of hours, to see the whole thing start to reverse, you know. He had no pulse. The pump, the Hemopump, was carrying his entire circulation, which we did not expect. We thought there would be an additive effect that in these patients, their hearts just stop pumping. To see his blood gases get better, his fingers get warm, to be able to stop the drugs, and all this in a period of 24 hours for a guy that should have been dead. So it was an amazing thing to see, and it was an experience that was repeated many times in the clinical trials. And that's been the most gratifying thing, that, you know, we touch people's lives. We save people's lives. And now these devices are being used, right now in thousands of patients, but I think soon it will be tens of thousands of patients. And my ideas keep coming. I'm not sure sometimes if it's a gift or it's a bit of a curse, but when they come, I really feel like I want to pursue them. And I think we've seen a whole field of cardiac assist. The whole philosophy of it, I think, is changing. Remember, I said that we thought all these patients weren't going to get better and they were all going to die. Well, we found out serendipitously that if you have somebody on a transplant list for two years, some of these patients' hearts got better on their LVADs. And then that opens the whole question, well, maybe if we intervene earlier, then there will be the possibility of having more patients recover. So then, we could start thinking of heart-assist devices as therapy and not as bridge to transplant or not as palliation and destination. Maybe it would be like cancer treatment. Maybe you would put it in and they would be willing to undergo some inconvenience for six months to see their heart recover. And to do that, the next step is to get a pump that could be put in less invasively or minimally invasively, and it could be left for months. So that's my next project. I'm working on basically a self-contained version of the Hemopump, all of them designed with computer now, and all of it works much better than it's original one. But computers really do make a difference. And this device then can be placed through a vein or through a very small operation, and provide not full flow, but most of these patients don't need full flow. That's one of the other big discoveries, to just pump two or three liters really is enough for a lot of people. And if we can do that in patients that are class 3, then, I mean I personally know two young women that have class 4 congestive heart failure, one of them postpartum heart failure, and another one idiopathic. And their

prospects are not good. You know, even with transplant, they might get ten years, you know. So I think there's a lot of patients that can benefit from this approach.

SP: Well, there's no question your bottom line is helping people. You have a very creative part of your brain, which many of us do not have, but would like to have. And just sitting here I'm wondering about what is your genetic background. Do you have engineers in your family? Doctors in your family? How do your wife and children look at you? Are you just dad and husband?

RW: Well, I think, to answer the first part, I had a lot of really good mentors in my growing up. In fact, I'd like to do some of that as I get approaching quasi-retirement. But my grandfather only had a high school education, but he was an inventor and he was always tinkering and building things. He was a carpenter. I learned woodworking from him. He died of a cardiac arrest, and really that was a big part of my emotional shift to get into this work, you know, was standing at his bedside and watching his life slip through my fingers. It was really, you know, a turning point in my life. My parents, particularly my mother, whom I just lost, was always very nurturing of what her kids were doing. So I was the one that got the lawn mower that didn't run. She would bring home an article about grinding telescope mirrors, and I'd do that in my bedroom. So I always had projects. I was always tinkering and thinking. There was a neighbor across the street that was an engineer that took me under his wing. So I had a lot of things going for me when I was growing up.

SP: Well, that's wonderful. Well, Dr. Wampler, thank you for baring your soul and your heart to us, telling us about your wonderful work and your pioneering work. And we certainly wish you many, many more inventions and years of doing this.

RW: Well, thanks, and I'm very excited about these new projects. I'm working with a really good group, and I think there's a lot of promise. And right now there's nobody else working on minimally invasive cardiac assist, so I think the future is ripe for it.

SP: As again, you are pioneering something that no one else wants to do, terrific.

RW: Well, thanks.

SP: Jean or Mark, any other questions?

Mark Kurusz: I do, Steve. You touched on attending meetings, such as ASAIO, and studying the work of others. Do you want to go into any more detail?

RW: Yeah, we could.

Mark Kurusz: And communication with others, obviously you cited Dr. Frazier and the surgeons who you gave a lot of credit to. The other thing --

[Recording is interrupted]

SP: Dr. Wampler, you are a high-draft choice for speeches. You attend many scientific meetings. You also have a number of colleagues that have gotten on board with you related to rotary pumps. Would you just comment on the influence that formal meetings and sidebar conversations over a cup of coffee in your area has helped you?

RW: Well, there have been a lot. Hopefully, I can remember a couple for you. One thing I will say is that there were a lot of people that, as time went on, believed in rotary blood pumps, but you don't hear their names much at meetings. One of them is Leonard Golding at the Cleveland Clinic Foundation. Leonard was interested in rotary blood pumps, maybe even before I was. He was a practicing cardiac surgeon when I met him, and he was doing some stuff he probably couldn't do now with patients using devices of marginal approval pedigree on patients to support them. He did a lot of work with the Bio-Medicus pump, and then with the pump that was built for a while called the Hemadyne pump by Medtronic. And the men that developed that pump, Bernstein and Dorman, they did some incredible work back in the late 50s and early 60s when the effects of the prolonged pumping of blood and the physiological effects of pumping blood, which I found, and of course, latched onto, because they were one of the few places where I had any affirmation that what I was thinking wasn't utterly crazy. And I know that Bernstein is still around, but I have never met him. Leonard's big contribution was running experiments with non-pulsatile flow in chronic animals. So he put to use Hemadyne pumps in cows, right and left heart, tied off the pulmonary artery and the aorta, and ran these as long as a hundred days with no pulse at all. And again, you know, it was cows, it wasn't people, but it really pointed the way that our bodies are not as dependent on pulses as everybody thought back then. So this kind of critical work really helped a lot in terms of building some momentum.

[RW:] Then at the meetings, you know, of course, ASAIO is a totally different meeting than it used to be. Back then, there were lots of adventurers and pioneers and people were doing some very edge things, so it was very exciting to go to those meetings, you know, and there were several government contractors that were working on some very exciting, new ideas. There were a lot of colorful people, not the least of which was Adrian Kantrowitz, who had a really good stage presence and a very dry sense of humor. And I was always gratified that he was so supportive of my work, even though we were kind of competitors in the field. That's all I can do on that.

SP: Medicine, in general, is somewhat traditional. And when someone comes along with something new, it takes a lot to convince the traditionalists to come on board. How have you seen the change over the past quarter of a century related to heart pumps and the devices like yours, and the acceptance or rejection by the traditional academic health centers and physicians that work on the periphery of what you have done, but care for patients and their reluctance to accept, or their ambition to accept?

RW: Well, I think you're always going to encounter that conservatism, because they're trying to protect their patients. But I do think it's changed. I think so many new things have happened that people have more of a willingness to look at new ideas and to consider new things. And there was actually a lot of interest in embracing the Hemopump

in the beginning, but it was like a lot of devices--it looked really simple, but there was a lot to know. So there were people that ran off and did things and had a bad result, and they didn't want to do it anymore. So, you know, there were those kinds of problems in terms of you really had to have people that were willing to be trained and people that were really going to spend some time dealing with it rather than just trying a new thing. At the time we were trying to get FDA approval, there was a big scandal with the [Bjork-]Shiley valve strut fractures, you know. And this was a valve that, you know, you could have had another valve, but you had a Shiley valve, and somebody didn't do their homework on the stress analysis and parts broke off and people died pretty much like a gunshot to the chest. And then it turned out that Shiley really hadn't been very forthcoming with the FDA, and the next thing you see, Senate hearings and surviving spouses sobbing on the witness stand. So the FDA was in no mood to take a chance on a new technology. So they were extremely rigorous with us and very cautious and killed the [clinical] trial, really. And because the trial didn't succeed, then Nimbus had no way of continuing the program and had to have a basement sale, basically, to stay alive at all. And I hope that environment is changing. I haven't had a new experience with the FDA to really know what it's like or what the approval times are. I hear there are some new things. One of them was an orphan device program, which I think could benefit some of these devices.

SP: Let's pursue that just for a minute. Obviously, any of the work that you do, you're not an island unto yourself. There's financing, and there are regulatory issues. The financing, more often than not, will come from an already established medical device company. The regulatory issues, again, motivate or de-incentivize these companies from getting into the business. Do you have any thoughts about where we are in 2011 related to corporate interest in new devices, even though they may be losing money on it, and what sort of effect the regulatory agencies may have on incentivizing or de-incentivizing.

RW: Well, I still think it's interesting that after all these years, and now that there's at least a couple of devices that look like they have the potential of being barn-burner successes, that none of them have been picked up by any of the big companies. I mean, you know, Edwards picked up this percutaneous aortic valve. I think they paid a billion dollars for this. But nobody is stepping up to the plate to buy an LVAD. And I think it's still, I still think there's a feeling that there's too much risk in this still to really get into it into big way, you know. Thoratec is its own company, and HeartWare, they're both publicly traded companies, and so I think it says something that these devices, especially, sell like for \$80,000 right now. And the reimbursements, I do know something about that. These hospitals are having trouble breaking even with Medicare reimbursement on LVADs right now. So there's still something that has to happen with the whole economics of LVADs and heart assistance.

SP: You and I both belong to a number of different medical societies, but we both belong to ASAIO, the American Society for Artificial Internal Organs. And I have stayed a member for my entire career, and so have you and so have our colleagues. And I'd like you to comment on this, but I might say, because it's such a unique societies; it's a blending of multiple disciplines, including the corporate world and the business world. When we meet, you're meeting with scientists, you're meeting with inventors, you're meeting with

engineers, you're meeting with physicians of all types, and you're also meeting with the corporate world, who are not necessarily there to make money, but they're there to partner with us to bring something to healthcare. No other society that I belong to has that attitude. What are your thoughts about that?

RW: Well, I was glad to see the shift, because I think it does, it shows that they recognize that, sadly, that all the problems are not technical, because we have the tools to solve some incredible technical problems now. And when I go to these meetings, I like to go to the ones that I don't know anything about, just to see if something sparks or what somebody else is doing. And then, you know, there's a possibility of maybe the stem cell stuff could be synergistic with cardiac support, that there might be, you know, a hybridization of treating heart failure. And I think it does show that if you can't get financing, if you don't know people to manipulate or deal with the FDA, you're not going to succeed. It doesn't matter how good your device is. And that was disillusioning, to find out that a mediocre device with really good management and good financing has a much better chance of getting FDA approval than the best thing in town and people that don't know what they're doing.

SP: But you overcame the disillusionment.

RW: Yes, well, I guess. I'm still here, I still love the work. The best time is this stage in my present project where I'm working with a very small team and one small lab where I have a sign, a quote from Thomas Edison that says, "There are no rules here, we're trying to get something done." And another one from Albert Einstein that says, "If we knew what we were doing, it wouldn't be called research." So to do the problem solving and to be able to be nimble, to wake up in the morning and go in and do a test and decide, well, this just isn't going to work, tomorrow we're going to try something different, and just to be able to go out and do it is fantastic. And you can make huge profit, progress, excuse me, huge progress. And that's why the big guys have trouble doing development.

SP: Um-hum, um-hum.

RW: Because they can't get out of their own way.

SP: Yeah. That's great. Are we okay?

Jean Kantrowitz: We're more than okay.

Mark Kurusz: I think it's wonderful.

JK: Absolutely the best interview, interviewee, and interviewer that I have had the pleasure of listening to. It was just great.

RW: Thank you.

SP: Are you getting all that? [laughing]

RW: I did have one final thing I wanted to say.

SP: Oh, sure, go ahead.

RW: Sometimes, and this is an example. I don't know how to take it exactly that I get asked to give history talks. And then I realize that I have been around doing this for a really long time.

SP: You have gray hair.

RW: Well, what's left is gray. And it has been an incredible journey, and I've had a lot of great friendships and colleagues in the field. Fortunately, and I know this sounds a little bit, maybe disingenuous, but I really didn't get into this business to make money. And it's a good thing, because, as you said, I've seen other people make money, but I haven't; I've made a living, but I never really cashed in. But that wasn't why I did it.

SP: Of course.

RW: And the real satisfaction has been meeting patients who have my devices. And I met a patient in Louisville. I went to see him when he was on one of my devices and he was awake. And I said, "Well, Dr. King, my name is Rich Wampler, I'm a doctor, and I invented this pump that's in your chest." And he was so grateful, you know. It's just, you can't imagine, and all of this because of going to Egypt and just having ideas, and then having just the persistence to make it happen, you know, has really made it all worth it. And it has been my privilege to be a part, and I'm grateful to be a part, and I'm glad I lived long enough to see it all start to really happen, because five years ago I don't think many of us thought it was really going to happen. Just recently as five years ago, that it's really got traction. And I've met two patients in Sacramento just in my normal daily activities, not going to the hospital. I met somebody, a neighbor, a friend of mine, who's got a HeartMate II, and I met somebody at a picnic. So it really is happening, it really is gratifying, and I'm glad to have made a difference with it. And I look forward to even more in the days to come.

SP: Well, that's absolutely amazing. I remember very fondly many late night phone calls that we would have conversations about things, and I'm sure many other folks had these conversations with you, and I'm just delighted that you're here and that I'm able to be here asking you these questions, so this is great.

RW: Okay, well, thanks so much for the opportunity. And these are things that I really wanted to say and maybe somebody will look at this tape and get something out of it some day.

SP: Oh, absolutely.

RW: Okay, thanks.

SP: It will be on Facebook tonight.

[A demonstration segment starts here.]

[Inaudible conversation]

[Technician:] Basically we won't need to -- show this to us again like you did the first time. We're going to be focused here so we won't see your face, but if you can talk the same way you did.

RW: Do you have a pointer of some kind?

[Technician:] Well, you didn't have a pointer, just replicate what you had done.

RW: Okay.

[Technician:] So it's just, you know, you really just held it there and just kind of brought it back and forth.

RW: Okay. All right.

[Technician:] You just want to be able to just, as you talk and we will be able to go to the pump itself and then show that.

RW: So you don't need me to say anything now.

[Technician:] I would like if you can go ahead and say it, because that way your hand movements will probably match up pretty well. And actually, put it back down and start from the straight-up position, reach down, grab it and then --

RW: Okay.

[Multiple voices]>> We'll take the cuff off.

>> You don't want to do the cuff.

>> You don't want to do the cuff? I just want to stick it in.

>> All right, are we ready?

>> Yes, we are, we're rolling.

RW: Well, this pump was the result of seeing a spinning magnetic top when I was in a toy store in Indianapolis, Indiana. And it's suspended with passive magnets and actually floats on a film of blood. And I'm so amazed that you can squeeze blood through a thin film

bearing and not damage it and support the circulation. This device can pump up to 10 liters a minute of blood.

[Technician:] Okay. And set it back down. And what was the next thing that you picked up?

RW: This device.

[Technician:] For this one, actually, I wouldn't mind doing it with a boom, because he held it against his chest [inaudible].

RW: This pump is called a Hemopump. It is a small, turbine-driven pump. There's a high-speed propeller on here that spins at 28,000 revolutions a minute. And the blood is drawn from this end of the pump through here and exits around this area of the pump. And the big advantage of this pump is that it can actually be threaded up an artery under fluoroscopic guidance, and then positioned into the left ventricle of the heart. So the ventricle is here, the aortic valve seals here, and then the pump ejects blood into the aorta so that the whole circulation can be supported.

[Technician:] Okay.

[Recording ends]