



**Episode 16: Leading History**  
**Elias A. Zerhouni, MD**  
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**Geoff:** This month, we have an extra special holiday treat for you. As you will soon hear, Elias Zerhouni has had profoundly broad influence both within the field of radiology and well beyond it through the establishment of national policies for the organization and prioritization of health sciences research, advising international heads of state on science and technology strategy, facilitating the global availability of vaccines, and reorganizing one of the world's largest pharmaceutical companies to pivot from small molecule discovery to the development of therapeutic biologics. Elias Zerhouni has fearlessly approached his career as a series of professional disruptions that offer a lesson to us all in taking chances and making bold decisions.

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No matter where you are in your career, as you listen to Elias's story, I invite you to reflect on your own journey and the decisions that you may be facing. There are valuable insights and lessons for everyone here. So sit back, grab a soothing beverage, and settle in for a long and remarkable conversation with a wholly original radiologist, scientist, innovator, and leader.

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**Geoff:** Hello and welcome to "Taking the Lead" podcast from the Radiology Leadership Institute that profiles radiologist's leaders, seeking insight and inspiration from a variety of perspectives and experiences. I'm Jeff Rubin.

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Today I am speaking with Dr. Elias Zerhouni who immigrated to the United States from his native Algeria after attaining his medical degree at the age of 24. After completing a radiology residency at Johns Hopkins University, he began a highly productive career on the Johns Hopkins faculty contributing fundamental tools to the use of CT and MRI in the diagnosis and characterization of cardiothoracic disorders that remain fundamental to practice today. He rose to become chair of the department of radiology and executive vice dean of the Johns Hopkins Medical School where he simultaneously led radiology while sequentially overseeing the clinical practice and research enterprise for the whole of the medical school. Following six years in those roles, he was appointed by then-president George W. Bush to become the 15th director of the National Institutes of Health, the only radiologist and immigrant to the United States with that distinction.

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While serving as director, he introduced the roadmap for medical research, navigated the politically charged topic of embryonal STEM cell research, and saw the passage of the NIH Reform Act of 2006 among many other accomplishments. Upon completing his tenure as NIH director, he served president Obama as presidential science envoy in the Bill & Melinda Gates Foundation as a senior fellow. Within three years, he again reoriented his career serving eight years as president of global research and development at Sanofi, a global pharmaceutical company headquartered in Paris, France. One year after concluding that role, he continues to provide his vision and expertise as professor emeritus at Johns Hopkins University while serving on the boards of the Lasker Foundation, Research America, the Danaher Corporation, and the Foundation for the National Institutes of Health, and I'm sure a number of other endeavors as well.

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Our goal in creating the "Taking the Lead" podcast is to support your leadership journey. And with that in mind, I'd like to tell you about a new sponsor, Carnegie Mellon University's Master of Medical Management program. Carnegie Mellon offers this degree exclusively to experienced physicians to build expertise in evidence-based management, business strategy, and technology for the future of healthcare leadership. We'll put a link on the page for this episode. Be sure to visit to learn more about Carnegie Mellon university's MMM program.

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Elias, welcome to "Taking the Lead."

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**Dr. Zerhouni:** Thank you, Jeff, for having me. I appreciate it.

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**Geoff:** Delighted. Now, you were born and raised in Nedroma, Algeria. Can you give us a sense of what your life was like growing up there?

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**Dr. Zerhouni:** Well, I was born there and there's a small village in the mountains on the West side of Algeria that existed for hundreds of years. There was a tradition of this village, goes back to Roman times. That's why the name Nedroma, which means in the local language, against Rome. So it was a village that always resisted foreign interventions if you will. And it's famous for that. It also has a great tradition of learning dated back to the 9th-century. And so I grew up in an environment of individuals that came from different cultures. Some of them actually, came back from Spain after the Queen, Isabella, sort of, threw out the Jews and the Muslims out of Spain. And there was a big diaspora that sort of settled in my village. And so my village was really at the intersection of local cultures, the Morrish culture that had really shined in Spain for 800 years, and traditions of learning.

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And so when I grew up, my father who was a teachers of mathematics and physics, really insisted on education as the path forward in life, as well as my mother who, unfortunately, could not go to school after three years of education because, at the time, the French colonial powers did not allow individuals who were not collaborating with the French to go to school. And her family were not pro-French. So she was prevented from going to school, which she regretted all the way to the end of her year life at age 92. And so she was a huge motivator for education. But I didn't grow up in that village. I was born there. I always maintained connections. But at age two, we moved to Algiers, the capital where I underwent my education.

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**Geoff:** Terrific. And brothers and sisters?

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**Dr. Zerhouni:** Yeah. I have actually, six brothers. So we're seven boys, which really helps you in life. You know, how do you manage six brothers? And I had one sister who was the oldest, but unfortunately, she died of measles during World War II. And so we grew up as a family of seven boys. My mother always wished to have a daughter. And so every new pregnancy she was praying to have a daughter. And so she told me, she said, "I was hoping you'd be a girl." And she was so disappointed. I was number five in the family. And so she was always hoping that one of us would be a girl. So, when I grew up, I had long hair until the age of five because she really were so hurt by losing her first child, a daughter, that she wanted to have a renewal, if you will, of that life that was lost to measles.

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And so she was really, a strong mother, but her self was completely committed to education because she didn't have the opportunity to go to school. And so until the end of her life, she was always motivating all of us to shine in education. My father was a teacher of mathematics and physics in middle school and then in high school and then went to the university. So he was self-educated towards the higher end of his education. And also, was a very strong motivator for all of us to pursue education, in addition to the context of our village, which was a very multicultural education-driven village with a population that was 75% Muslim, 25% Jewish, all who had been rejected from Spain

by Queen Isabella, and reestablished, if you will, the brilliant Moorish culture that existed in Spain for 800 years.

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And so I was steeped into this notion that to succeed in life, you had to excel at education.

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**Geoff:** Sounds like a rich environment for growing up and it must've been a busy household with all those boys.

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**Dr. Zerhouni:** Oh yes. It teaches you, actually, how to manage yourself in the context of six brothers. I was number five, by the way, so I had two younger than myself and four brothers older than me, so you had to become a very good diplomat to manage that transition year, if you will, because my older brother was 10 years older than me and my younger brother was 10 years younger than me. So I was right in the middle. That is actually a defining experience. You know, and we were very tied together. Even today, we've never disconnected because of this very strong family values that we had of standing by each other.

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**Geoff:** That's marvelous. Now, do you recall, what was your first job growing up?

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**Dr. Zerhouni:** My first job. That's a good question. You know, I was in high school and I was very good in math and physics, and my father always said, "Look, you have to be a scientist, a physicist or an engineer. I don't want you to be a doctor. I don't want you to be a lawyer. Those are professions that I don't respect. They're not really intellectually challenging and what you wanna be is an engineer." And I said, "Well, look," I had very good grades in high school and in my country, you went from high school to the university. So I had time between the two and I said, "Well, what should I do?" And he told me, he said, "Look, why don't you look for a job in an engineering company?" And he knew a lab that worked in construction engineering.

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And so my first job actually was a construction engineer in the laboratory. And that I think was a defining experience because what it was was to control the quality of concrete. So the way it works is that every construction out there has to fulfill some specifications. And the way they fulfill specifications, they send you samples of the concrete and the steel they're using. And I was basically, a lab assistant testing all these concretes and samples and the steel that was used to build those.

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And one problem occurred during that summer and there was a site where the constructors were having problems. Every time they would build a wall, the wall would collapse. And they were wondering why. And so they came to the lab and they said, "Well, we have a problem." And so I did some research on the site and discovered that the reason the concrete was failing is there was a little dust, which I discovered through what we call granular metric analysis. So you analyze all the components from the rocks to the pebbles to the sand to the dust. And I realized that the dust was coating the rocks and therefore, the cement could not attach to the rocks. So they said to me, "Well, so what do you think?" And I said, "Well, you should wash the rocks before you pour the concrete." And that's what they did. And it worked.

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And so I was like a hero and my line was traced, you know, to engineering and physics. And my father was proud of me. And so that was my first job. And that's how I went to the university. I didn't go for medical school, initially. I went for a high degree in mathematics and physics. But then I

changed because I had an experience that changed my outlook on life. And I was volunteering in the mountains of Algeria as a student and discovered the misery of tuberculosis and poverty. And I was very touched by that and I thought that medicine would be a more useful profession. My father was absolutely distressed that I would pick medicine. He said, "You'll be bored, it will never work for you, you're not that kind of guy."

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And sure enough, I switched to medical school. After three years, I realized that, yes, he was right. I mean, at the time medical studies were like rote learning and you just learned everything by heart and you remember it. And then you had to regurgitate that at the time of the exams. And I was very disappointed in the way they taught medicine at the time. And that's when I decided, "Well, maybe I'm gonna switch out and go back to what I'm good at. You know, engineering, physics, math."

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And then a radiologist at the time, who was an uncle of mine said, "You're making a mistake. You should stick to medicine, but go into radiology." Well, at that time, Jeff, radiology was what we call basement medicine. You know, the radiologists were in the basement and dark rooms. They were processing the films, it smelled, and they were not considered the best scientists or doctors for that matter at the time. And so I said, "Why should I do that?" And he showed me the first CT scan obtained by Godfrey Hounsfield, if you remember the Nobel prize winner who won the Nobel because of that invention. And he explained it to me. Said, "Oh, there's an X-ray tube. It rotates around the head. And then there's a computer and there's an algorithm. And it reconstructs the image with Foria [SP] transforms." And I fell in love with that idea. I said, "You know, this is the perfect match for me because I am good at that stuff. And I love medicine and its ultimate goal, you know, helping people." And so that's how I decided to go into radiology, but not in radiology in the classical sense. I wanted to do research in that.

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So my first job was my first scientific experience on the ground, discovering a cause for failure of concrete by this microscopic dust that no one had picked up and then I was able to fix it. So, that sort of discovery, if you will, led me to say, "I could be good in research." And then the combination of radiology and mathematics and physics really attracted me and that's why I decided to do that.

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**Geoff:** That's an amazing recounting. Yeah.

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**Dr. Zerhouni:** Yeah. But you know, the problem was no one could teach you that. You know, computer CT scanners were completely new and no one really, in my country, knew anything about it. And when I decided to go into radiology, the dean was upset with me. He called me up. He said, "You're a good student. Why do you wanna do that? That's for the guys who you get C-minus grades. You don't wanna do that." And I said, "Why not?" He said, "Wow, I don't understand why you wanna do this. I mean, it's not a favorite... Why don't you do cardiology or surgery and?"

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So we had this argument and I said, "You know, I really think this is something that's going to have legs. What should I do?" He said, "Well, the only way you can succeed is you have to go overseas because there's no way we can teach you that or support that." And I said, "How do I do that?" He said, "Well, you have two choices. You can go to the US, you can go to Sweden, you can go to France." But that French option didn't work out because my mother said, "If you go to France, I won't speak to you again." I said, "Why is that?" Said, "Well, the French took over the country and they didn't let me go to school. And I don't think there'll be fair to you either. So go to the US, go to Sweden, but don't go to France."

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And that's how I decided to take the equivalency exam for US medical schools, which was the CFMG at the time. You know, for like two years, I studied English and medicine in US textbooks to get my test. And my professors were not happy with that because I wasn't attending class and I wasn't really paying attention to what they were saying. And I almost got fired from medical school because of that. And I was called in by the dean for a disciplinary action about me spending my time, you know, studying US textbooks rather than following classes. And that same day, that day of the disciplinary council, I got the letter from the CFMG saying that I had passed the exam and that had never happened in that medical school were somebody passed the American exam, which was considered the best in the world at the time.

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And so they went and said, "Okay, we're gonna fire you, you're gonna have disciplinary action." I said, "Well, I was really trying to get the American equivalency, sir." And he said, "Yeah, you're joking. You're kidding us. I mean, nobody passes that." I said, "Well, here's the letter." I showed the letter to the dean. He looked at that. He said, "I don't believe it. Is this a true letter?" I said, "Yeah, I just got it this morning." And he was so happy. I mean, he said, "Guys, we shouldn't discipline this kid. We should encourage him." And so the thing turned from a disciplinary action when I was gonna get fired, potentially, from medical school to, "What can we do to help you? What can we do to help you?"

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And that dean was really a terrific guy. Actually, he was a neurophysiologist. He had studied in the US and knew the US system and he knew, actually, the folks at Hopkins. He knew the dean, he knew folks at Harvard. So he said, "Listen, where do you wanna go?" I asked him, I said, "What are the good places?" He said, "Harvard or Hopkins?" I said, "Well, if you get me a job there or a scholarship I'll go to either one of those." And he got me a little scholarship, which was not much at the time to survive on, and he connected with Russell Morgan, who was then the dean of the Johns Hopkins School of Medicine, who was the radiologist in chief and he contacted him and hey have this kid, he's a little funny, he's weird, but he thinks radiology is the thing of the future. Would you take him for a visiting scholarship? And Ross Morgan answered him and said, "Yeah, I'll give him a try."

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And that's how I came to the US. So I didn't come as a resident or anything. I came on a scholarship, which was short term. And I started working with the folks at Hopkins basically, as I arrived in computer tomography and worked with Russ Morgan about algorithmic reconstructions. And within three, four months, you know, I learned English because I didn't speak English very well at the time. I had learned German, which was helpful because Martin Donner, who was the chairman of radiology at Hopkins, actually, he was German. And so because I couldn't speak English very well in my interview, I switched to German. And he was so impressed he said, "Well, if you can speak German, you'll speak English soon." And so Stan Siegelman, who was the vice-chair at the time said, "Why don't you come in and spend time with the students and see if your English improves because I think your English is not good enough and you should really go take some English courses?" And I answered. I said, "Sir, I don't have a long scholarship. I only have a few months and I'm here to learn what I can and go back home. And so I don't wanna waste time learning English. I just wanna be in the midst."

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And he did. He said, "Well, why don't you go with the students?" And introduced me to a medical student who became a very good friend, actually, and collaborator later. And I spent like two months with the rotation, the medical student rotation. At the same time, I was working in the lab and enjoying myself tremendously. But my problem was that I had a wife and my wife was pregnant and I had to get a job. So I started looking for a residency and I had offers at the time. So I went to Siegelman and I told him, I said, "I have an offer from," it was Bill Melinda, I think, "and I think I'm

gonna take it." He said, "Wait, wait, wait, wait, wait, don't, don't. There is a resident who is leaving the program, let me talk to the faculty and see if we can switch you to the residency." And he did. He did. So, after six months, they made me a resident in the program. And that's how I became a resident, and then chief resident and the rest is what you know.

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**Geoff:** Yeah. Amazing how things work out. What a tremendous recounting. Now, as a 24-year-old immigrant to the US, what struggles did you face upon your arrival here?

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**Dr. Zerhouni:** Well, the first struggle was language. Okay? I mean, I agonized about writing. You know, we had to write little things when we were in the program. And so, my education was in French. So that was the first obstacle to really get to be good at expressing yourself, at sharing ideas. The second is, you know, the culture here for students is much more interactive. And so, here you were supposed to ask questions, speak up. You're not supposed to be obedient and silence, which is the European way, if you will. You know, you're a student, shut up, sort of thing. And here it was more like, "Hey, participate."

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And I remember because I was gun shy, I didn't do it. And Fred Stidic [SP] was a great radiologist, pulmonary radiologist. One time came to me, he says, "Do you have any questions to ask?" And I said, "Why did you ask me that?" He said, "Listen, I wanna know what you're thinking. I don't particularly care if you're just there and silent. We don't need that." And so he encouraged me to speak up and be more expressive. And so I learned that in America, it's a country of freedom and people don't judge you by your silence. They judge you by your ideas and by your questions. And I had to learn very quickly that... Do you know what the most stupid question is, Jeff?

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**Geoff:** No.

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**Dr. Zerhouni:** It's the question you don't ask. That's the stupid question.

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And so I became very curious and very engaged then. But then, I didn't have any money because my scholarship was very small and I had a wife and kid. And because I had the equivalency and I had done an internship, emergency room and all this, I went to the chief resident at the time who was short to cover nights. And so he said, "Listen, we know you're good. I mean, you obviously have done quite a good job, and since you're looking for opportunities to make some money, why don't you take nights for the program?" And I said, "Okay." And so I started covering nights in the emergency room at Hopkins.

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Now, you know, it's 1975, Hopkins emergency room. It was much more exciting than what you see on TVs. You know, in the ER shows on TV. I mean, you had gunshot wounds every night. Then you had to really help the surgical team, the medical team. And so I learned how to interact, understand the culture, and make friends as well, and gain respect. At the time, it was hard, but it allowed me to survive until I got a permanent job.

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**Geoff:** Yeah. Fantastic. So your early career was noteworthy for your contributions in CT and MR, most notably the characterization of lung nodules through CT assessment of their X-ray attenuation properties and myocardial tagging with MR which has provided many insights into myocardial mechanics and the diagnosis of pericardial disease. There are few sensations quite like those

experienced after realizing that you have accomplished a first that you know will bring great impact to the care of patients. How would you describe your early career on the faculty at Johns Hopkins?

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**Dr. Zerhouni:** First of all, Johns Hopkins is an extraordinary institution and I considered it my, you know home away from home. Second, I think the people in the department of radiology at Hopkins were exceptional. You know, Stan Siegelman, Matt Friedman, Fred Stidic, others. And they were very supportive and they really, really bend over backwards to help me out, you know, establish myself. I mean, I didn't expect to be chief resident at the time, which implied that you worked with all the other departments organizing the grand rounds and organizing all the residency staff. So that was really exciting. But the thing that made my career was Stan Siegelman who was the vice-chair for radiology. And the first CT scanner came, and if you remember in those days, CT scanners were mostly for neuro applications. And so they divided the time between, the morning was CT scanning for body imaging and the evening was for neuroimaging as there was a 10-second scanner. So you could hold your breath and take a scan.

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And Stan asked for volunteers to work with him, but you had to start at 6 in the morning, and not a lot of people wanted to do it. And I jumped on it. I said, "Stan, I know it's a hard rotation, but I'll be happy to work with you." And he said, "Okay, you're in." And that was my first assignment if you will. And Stan was a great mentor. I mean, he worked really hard. He was smart. And the job required that you selected the cases that you were to scan because we only could do eight, nine cases a day. So that position put me in contact with the head of surgery, the head of medicine, the chief residents in all the other departments deciding which cases will go through the CT scan the next day. And I learned tremendous amounts of medicine that way. And so I became pretty good at judging what was needed and what was not needed.

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And then Stan came up with the idea, said, "You know, we should study pulmonary nodules because a lot of people are getting operated for no good reason." And there were papers from the Mayo Clinic that showed that nodules were calcified. And so I started this project at the instigation of Stan Siegelman and then found out that it was actually not so simple, that the reconstruction algorithms were changing the numbers. And so all my early research was standardizing the measurement capabilities of CT scanners. So that was my first contribution if you will. And at the time, it was absolutely antithetical to what the surgeons wanted because they wanted to operate. Whereas, we wanted to prevent surgeries, unnecessary surgeries. So I learned also the tensions within medicine about who did what.

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And so when I did that program, I also engaged into a multisite research study of pulmonary nodules after having standardized the scanners with a phantom that I created. And that was my first patent my first direct contribution. And it worked. But you know, there's something you're not mentioning, you say what is it that really defined you personally in terms of your sort of transition to saying, "I can do this, I can discover my own approach to radiology"? And that was the relationship I had with General Electric at the time.

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And I wanted to develop high-resolution CT. In fact, if you look at the literature, my initial personal contribution that entirely is mine was the first description of high-resolution CTs in the textbook that I wrote with Stan and David Nadish [SP] at the time. And then I developed that with what we call physiologic high-resolution CT. That was before MRI tagging, which was another beautiful idea that took shape and really told you one thing that is fundamental to radiology. And that is that biology needs to be quantified. And so, if you really look at the arc of my career, you find that all of it is related to the need to quantify biology, whether it be in CT or MRI or cell imaging or even the



research I did later. So the convergence of physical sciences with biological sciences through the means of accurate quantitation of biological phenomena is the fundamental thematic if you will. The theme of my research ideas.

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**Geoff:** Terrific. Now, amongst great impact in your scientific work, bringing innovations to our field. At what point were you drawn to administration and what drew you in that direction?

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**Dr. Zerhouni:** That's a great question. What happened, as I realized the notion of convergence between physical and biological sciences, I also needed to have grants from the NIH. And what I realized, when I applied for grants, the NIH turned me down. And the reason they turned me down is they said, "Well, all of your techniques, high resolution, and fast imaging, and tagging is really interesting, but we won't fund it until it applies to the mission of our Institute." So when you did an algorithm, it applied to everything, not just cancer or cardiovascular.

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And so I got turned down. I was very frustrated with this and I realized that I had to really build a team that was multidisciplinary, that could go into the applications that would get us to be funded. And that's what I did. And that's when I started to manage rather than just do research. And I recruited Elliot McVeigh, who was a physicist from Canada and Bill Brody was the chairman at the time, understood what I wanted to do. In fact, I probably created the first truly multidisciplinary laboratory at Hopkins with, I mean, people from computer science, from image analysis, from biology, from radiology, from cardiovascular medicine. And so we were actually touted as an example. In 1990, there was an article in science that described my lab as the model for the future where the barriers between disciplines will be broken.

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And so I did it and I did it within the Hopkins system by essentially getting allies and having joint appointments with the help of Bill Brody and others within the school of medicine. So very quickly, we became one of the best-funded laboratory at Hopkins in terms of NIH funding, NSF funding, DOD funding. And so I proved that, in fact, science was changing and that if you didn't change towards the converging type of multidisciplinary team, you'd be left behind. And that I think is the first time that I realized that managing and leading with ideas of new structures, new concepts of how you develop science. I think that was the first time that I became sort of what you said, and I was a leader rather than just the follower.

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**Geoff:** So far ahead of your time in setting up and paving the way with bringing diverse inputs in your scientific team. It's fantastic.

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Few of the leaders on our podcast describe their ascent as a straight line. After completing your residency at Johns Hopkins, serving as chief resident, and then three years on the faculty, you left as an assistant professor to go to Eastern Virginia Medical School for four years before returning to Johns Hopkins. What led to that move?

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**Dr. Zerhouni:** Because my wife, you know, she's a pediatrician, and so we had our first child, so she put on hold her career and she wanted to go back to her residency to do a pediatric residency. Fred Stidvic, who was my pulmonary medicine mentor, became the chair at that school. And he made me an offer. He said, "You know, I'll create a lab for you and I'll recommend your wife. If she gets the residency there, would you come?" And I said, "Yeah, I would."

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The other issue there was that I didn't have a Green Card, which is always, you know, when you're an immigrant, you're always three months away from being thrown out of the country, you know. And Fred said, "I will claim for you what we call a special competency visa, that you're really contributing in unique ways and that they should give you a Green Card."

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And so, one, because my wife obtained a residency there. Two, because Fred was there and willing to help and continue my research. That's where I actually created all my high-resolution CT work. It was at EVMS. So I decided to take it and that's what life is all about. You know, people always think that you planned it and it was like, you know, premeditated, but it wasn't. It was just circumstances of your own life, your own family, the context. And that's why I went there for four years and then returned to Hopkins.

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**Geoff:** Got it. And what led to your return to Hopkins?

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**Dr. Zerhouni:** Well, basically, Stan kept telling me, "You're wasting your talent, you're wasting your life." I was really well paid at EVMS because it was sort of a private practice in an academic environment. And I said, "Stan, I'm doing well." And so he said, "Yeah, but you know, it's a shame, it's a waste. And come back."

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And so I agreed with him because I was getting bored, to be honest with you. I mean, what I was doing and the research was not appreciated. I mean, Fred Stidic appreciated that, but not the others. The others were saying, "You know, we're here to do medicine. We're here to do radiology or get the films read," and so on. Which I did and I was pretty good clinically. And so he said, "Look, we have a new MRI center. We're looking for talent. I think you should come and work as a co-director of the new MRI division." And I told him, I said, "I know nothing about MRI." And he said, "I know. That's why I'm calling you because knowing you, you'll come up with something. And why don't you come back? It will be good for you, good for your career, more interesting. You're done with your wife's residency."

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So he's the one who got me back and at one-third of the salary I was making at EVMS. To be honest with you, my wife never understood how I would relinquish such a nice package to go back to Hopkins, but I was basically feeling that inside of me there was something more to contribute. And Hopkins, I just felt was my home, you know? And so, to me, it was like coming back home.

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**Geoff:** Yeah. Rewards go well beyond the monetary.

[00:35:10.740]

**Dr. Zerhouni:** Yeah. But when you have two kids, and I had the third on the way, your wife sort of thinks differently.

[00:35:16.863]

**Geoff:** Yeah. Understood, completely. Now, with the very strong emphasis on research and administration in your career or when did you actually cease practicing clinically?

[00:35:29.553]

**Dr. Zerhouni:** I never ceased practicing until I became the executive vice dean, because then it was impossible to do it, but I'd never ceased that. You know, at Hopkins they say, first and foremost, you're a physician. So to get respect you have to be a great clinician. And then if you're a clinician-scientist, that's even better, but you cannot earn the respect of your colleagues, and especially of the colleagues outside of radiology. A lot of people, I felt, were a sort of focused too much on radiology itself, not interacting with the others in the system. And radiology has the advantage of dealing with every physician and every disease. And that's where you're on your new keeps.

[00:36:16.235]

And I had my colleagues, like Elliot Fishman, for example. I mean, he's highly respected because he deals with the issues not as he sees them, but as others see them. And the only way you can do that is by practicing medicine. Otherwise, you're not credible. At the same time, if you wanna be a clinician-scientist, you have to have NIH grants. And so it's a hard job to be an effective clinician-scientist, but it's very rewarding.

[00:36:43.640]

**Geoff:** Yeah. So true. Did you anticipate the transition away from clinical practice occurring as early as it did in your career?

[00:36:53.945]

**Dr. Zerhouni:** No. I really wanted to continue to practice, but it was not possible. However, I continued my research, so I decided to keep my grants and keep those active in both MRI and other activities that I was doing with my team. And we did. And so I decided that it was more important to sustain the research enterprise within the department than me reading things that others were doing extremely well. But I would keep in touch, but I'll tell you, I was stressed because I had like three jobs. I was a chair of my department, I was the executive vice dean, and we had a huge issue with the clinical practice. So I had to manage the faculty in terms of the clinical practice and deal with the outside. And the outside was really threatening in those days. If you remember, it was managed care and they wanted to essentially, exclude radiology from all the contracts.

[00:37:52.188]

So, I became very concerned about the context and I saw the future in entities that would be beyond the walls of Hopkins. So when I became chair, I requested that I would be allowed to establish an outpatient network. And I had had experience in that creating startups and outside ventures during my earlier career. So I convinced the dean that, you know, the survival of the department required that. And I created a company called American Radiology Services which combined 80 radiologists, 33 imaging centers, 18 hospitals in the region. All of that because we were under so much pressure by the managed-care entities, which did not want to have patients come to the expensive Johns Hopkins. So that our volumes were going down, our clinical reimbursements were going down. And I saw the writing on the wall. I said, "If you don't get out of here, you're gonna die."

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And so I did. And I led the effort at Hopkins to sort of open up the clinical practice to the outside world, which at the time, was not standard philosophy because people said, "Don't worry, people will beat a path to our clinical skills and wonderful worldwide reputation." And I was skeptical of that. I said, "You know, markets are markets, they're powerful, and if you don't react, you're gonna be left out." And that's what led me to be then executive vice dean and then dean for practiced. And then because of that, I became dean for research because of the multidisciplinary model that I had developed.

[00:39:38.013]

**Geoff:** I wanna unpack each of those in turn, but I just want to observe just how unique your whole perspective was with a clear focus and expertise on scientific discovery and innovation to pivot into

recognizing the direction of the markets and establishing an entirely new clinical entity in order to address some of those market pressures is really a remarkable focus and a remarkable transition.

[00:40:10.781]

**Dr. Zerhouni:** I think it's because one of the qualities of leadership is that you have to dominate your fears. And that's what I learned from the get-go. Because when you're an immigrant, you're leaving your country, you're coming to a different country, you have no friends, no families. You know, Algerians are not common in America. So, I had no network. And so you have fears and you learn how to dominate them. And then you dominate them. You do what you think is right. And like I always said to everyone, I said, "You know, there's no wrong time to do the right thing." And so you just do it because you've dominated your fears and also, you don't want to follow the herd. And in those days, I can tell you what I was promoting was not standard thoughts. It was really out of the box, if you will, at the time and considered risky. But you know, we advocate for it and you make it happen. And when it succeeds, you get an opportunity at the next run and you do it and you enjoy it.

[00:41:12.263]

And that's what leadership is all about. I mean, if you don't dominate your fear, if you don't really look at the context, if you don't understand the ecosystem, how could you be a leader?

[00:41:22.378]

**Geoff:** Yeah. And these are bold moves and clearly, not the traits of a defensive leader. You were blazing your trail.

[00:41:32.143]

**Dr. Zerhouni:** I had no choice. Yeah. You think, you know, I just sat down and I was like dreaming of something. No, no, no, no. That's not the way it was. I had no choice. I had a burning platform and I knew that if it kept going the way it was going it would be a failure, personally, and that would not serve the institution.

And so when you have that pressure, you come up with things. It's not like I dreamed up of ideal things, but I sort of felt the trends and I said, "You're not gonna succeed unless you're not putting a multidisciplinary team together. And oh, you're not gonna succeed unless you're really more anchored in the total market of radiology rather than just for your department.

[00:42:16.529]

**Geoff:** It's not just about the ideas though. It's about executing. And you had the idea to aggregate these 80 radiologists from the community and to enhance the platform, open up the clinical practice at Johns Hopkins, but then doing that, about getting everybody on the same page.

[00:42:34.672]

**Dr. Zerhouni:** Oh yeah. That was hard. That was very, very hard. I mean, it took us a year and a half, actually, to convincing all the folks around Hopkins because they don't trust the big institution. It's like other institutions have the same syndrome where the private docs don't trust the academic institution. So I had to build trust. I was lucky because many of these private radiologists were former residents, so they knew me personally. And that was the most important thing, and that is that they respected me because we had worked together side by side and so they knew me and it didn't really have a distressed of me as a person but of the institution, in general. So we had to overcome that, but it worked out. It worked out, not without difficulty.

[00:43:22.007]

**Geoff:** In addition to having that benefit of your former residents knowing you, what other things did you do to gain the trust of these radiologists?

[00:43:31.114]

**Dr. Zerhouni:** Actually, this is a great question. How do you gain people's trust when it comes to self-interest and issues like that? I came up with the principle that people are well-intentioned and if you have the same set of data that is curated by all parties on the table, 95% of the time what I observe is that people come to the same conclusion. If you are an advocate for a certain thing and you show them the data and you share that, no passivity, no sort of, I know best. My experience was that it was absolutely the best way to lower barriers, if you will, to collaboration.

[00:44:10.161]

And so that's the principle of leadership I used. I used it at Hopkins, I used it at NIH, I used it everywhere. Even for things that are very sensitive like revenues and income and monies because we can talk all high principles, which we should, and we do, but at the end of the day, people have to make their own decisions. And to bring them to a common view, which is what the role of leaders should be to bring people to a consensus. And you cannot just sweet talk people. You have to respect them and you have to really show them why you think this is good and give them the data. Physician-scientists are data-driven.

[00:44:50.880]

And so that's what I did. I did that with the radiologists. I told them, "Listen, here's the way I see the market. You're gonna be in trouble just like I will, but if we hang together, we'll be stronger." And that I think carried the day.

[00:45:03.343]

The same thing is true when I was asked to manage research because research was really going down, had trouble at Hopkinson, and I realized that there was a maldistribution of space, maldistribution of resources, so I did an inventory and I created this with a colleague of mine, [inaudible 00:45:21.201] and we shared it with all the chairs and everybody else and we created proper metrics, and at the end, people agreed. And so that's how it became successful and we regained number one status.

[00:45:32.978]

**Geoff:** I just wanna put a lens around what seems like an incredibly productive six-year period when you step it up to lead the department and simultaneously, becoming executive vice dean. Where it appears as though the first half of that period, the first three years, you were the vice dean for clinical affairs, president of the clinical practice association for all of Hopkins Medicine, and then you made this transition to be vice dean for research. These are hugely different roles. How did you sort of take all of this on all at once and maintain enough of your personal energy and abilities to juggle such diverse roles?

[00:46:17.347]

**Dr. Zerhouni:** You know, I don't know. Retrospectively, I was crazy because I had like three jobs at once. But the feeling I had at the time was that it was needed, number one. Number two, I always said, and I believe today, that a head of a department of radiology has to get involved beyond the department of radiology. The best chairs in radiology around the world and around the country are those who really get institutional issues under their belt. Okay. If you look at Bob Grossman at NYU, I mean, he's extraordinary. And he was a radiologist. Why did he do this? Because if you knew him and you talked to him, 50% of what we talked about had nothing to do with radiology, it had to do with the context, the environment, the pressures, what was driving the institution.

[00:47:08.241]

And if you do your job right, well, I always tell people that if you're a chair, make sure that you have a role in the institution beyond your department. So for me, it was a 50/50 arrangement, but I had very good people in the department and I organized myself to have delegated to individuals who are outstanding. So I had great support. And so that's the key. The key is not so that you do everything

yourself, but trust people and build teams around you that can do most of the work because otherwise, you can't do it.

[00:47:43.043]

So, the two principles that you're asking me to describe is number one, build a team that you trust and you can delegate to. You have to trust them and let them do. I'll give them power. Don't interfere with everything they do. Micromanaging is the antithesis of being able to do what you described. The second piece of this is that when you take on something, you have to have a certain level of vision, if you will. Now, the reason I became research dean, it's not like I wanted to, I was asked to, because I kept advocating for this lowering of the departmental barriers, creating these institutes without walls, which we did, which became very successful. So success breeds trust and trust breeds success. So, it's a cycle, but you can do it if you really realize that you are not needed at every moment, every minute of the day in your day job, right, if you have a good team around you. And then you intervene at critical moments.

[00:48:48.983]

The image I use is the image of the Chinese juggler. You know, the guys who rotate plates on the stick. And you know, the Chinese juggler does not rotate every plate all the time, he just goes to the one that's wobbling and he fixes the wobbled one, gives it more energy and then goes to the next one. And that's how he can take three, four, or five of them at the same time. That's what I did. Is the Chinese juggler analogy is what I call pulsed management. You intervene and you pulse the issue that you're dealing with at the time when it's wobbling and do your job as a leader, put it on the right path, give it some energy, put the right people in place and move onto the next issue.

[00:49:26.150]

**Geoff:** Yeah, beautiful visual imagery with that. Just to clarify, when you were presented with the opportunity to take on leadership of the department of radiology, at that moment, simultaneously, you said, "I will only do this if there is a platform for me more broadly within the institution."

[00:49:48.636]

**Dr. Zerhouni:** Yes. Absolutely. No, no, no, no. Wait, wait, wait, wait. No, no, let's be correct. What I negotiated was not that. I didn't want to take the job unless we had three things that were important done. Number one, I wanted the department to be given the permission to go outside into the outpatient imaging world. I said, "Without that, I'm not taking this job." And you know, the practice at Hopkins at the time was that every department was fully committed to only work in the hospital. Okay? And I said, "The world is changing. I need that authorization." So that was one. Second, obviously, when you take on a job like this, you are negotiating what we call a diary. And I analyzed the needs and I realized that in nuclear medicine, we had some needs and so on. So you have to have capital commitments because radiology is very capital-intensive.

[00:50:38.476]

Okay? I didn't ask really, for anything beyond that at the time of my negotiation. What happened was when I took the job, I realized that the clinical practice was mismanaged, that it was going under. And I went and complained and complained and complained. And you know what happens when you complain a lot, you get the job. And so that's what happened. I talked to Ed Miller, I talked to the dean at the time, and the acting dean, and the previous dean, and I said, "We are in trouble here." And they said, "Okay, why don't you be on the committee to look over the clinical practice?" Because it was affecting me directly. It was affecting the department directly. So I did it in a selfish way, in some way, because I wanted to understand why we weren't doing as well as we should.

[00:51:25.466]

And that's when I got there, I got the data, I looked at the analysis that they were providing, I put in my own mind into it and realized that the way it was going was basically a dead end. And I had talked to Ed Miller and I said, "Ed, this is going nowhere." And then the discussions occurred

between Ed, and then he said, "Why don't you come and help me with the clinical practice?" And that's what happened. So it wasn't like I wanted to, I had to.

[00:51:53.700]

**Geoff:** Just going back in time a little, I noticed that in 1985, at the age of 34, you became a consultant to the White House under President Ronald Reagan. How did that opportunity come about? And what did you do in that role?

[00:52:07.737]

**Dr. Zerhouni:** Right. Basically, I was called in because as you remember, I had developed a technique to analyze pulmonary nodules. And his medical team found pulmonary nodules after they operated on the president for his colon cancer, and so they all thought this was metastatic disease. And the reason I was called in as a medical consultant, I was not a political consultant or anything, just medical, is because at the time, he was always treated at a Naval hospital in Bethesda. And you had to have a consultant status because you had confidentiality rules and so on for the White House before you could do that.

[00:52:45.788]

Then I when there and I met the president and I examined the president and I did the CAT scans of his nodules and determined that they were not malignant and after that, basically, I was advising them to just wait to do a watchful waiting strategy rather than what they wanted to do, which was to remove those nodules. And I said, "I really don't think it's justified, but you can find out in a few weeks, if they grow, then you know it's metastatic, but I don't think so. And they followed my advice, which meant that every six weeks, I had to go back and re-examine the nodules and indeed we showed that they didn't grow, they were stable and that's what my role was.

[00:53:27.255]

**Geoff:** Wow. You were following president Reagan's lung nodules with CT scans every six weeks?

[00:53:33.117]

**Dr. Zerhouni:** Yeah. The first one we did, and then one more time, a couple more time I think. And then it was not really needed anymore because you could see on the X-rays that it wasn't changing.

[00:53:43.762]

**Geoff:** What an amazing brush with the federal government is almost like foreshadowing the future.

[00:53:50.947]

**Dr. Zerhouni:** Again, it was serendipity. It was no intent. I mean, it just happened that one of my residents from Eastern Virginia Medical School had worked on the project. What happened to be an attending at the Naval Hospital. And she remembered and she advised them. She said, "Well, I know a guy who knows how to tell the difference between malignant and nonmalignant," and she connected me with the medical team.

[00:54:14.935]

**Geoff:** Wow. And once you were engaged with the medical team and with White House personnel, was there any effort on your part to further make connections or to build relationships given that serendipitous platform?

[00:54:32.027]

**Dr. Zerhouni:** No, not at all. I know that they connected with the dean at Hopkins telling him that I was being asked to be a consultant temporarily. So it lasted a few months and then after that, it just died off.

[00:54:45.736]

**Geoff:** Oh, great story. Now, just six years after becoming chair and executive vice dean, you were nominated by then-President George W. Bush, and subsequently confirmed by the US Congress as the 15th director of the National Institutes of Health. An agency that at the time employed 18,000 people and had a budget of \$27 billion. As you think back to your years at Johns Hopkins, what qualities do you believe you conveyed as a leader that gave the president confidence in your appointment?

[00:55:17.346]

**Dr. Zerhouni:** Well, first of all, you have to remember that I was on the scientific advisory board of the National Cancer Institute at that time because Rick Klausner, who was the then director of the NCI, had asked to develop an strategic imaging sciences plan for the NCI and asked me to help with that. And I refused. I was busy at Hopkins, I was just med chair. Some people recommended he talk to me. And I was used to the NIH not being very supportive of imaging and I had fought to create the NIBIB. I supported that effort. And NCI was responsible for the imaging sciences. And I also noted that many times we would give advice and they wouldn't be followed. And so I refused.

[00:56:06.724]

And then I got a call from Rick Klausner and he said, "You know, listen, this is quite an unusual, nobody turns me down. This is important. This is a big thing, needs to be done." I said, "Listen, I'll do it under one condition. And that is that whatever we recommend, good or bad, you can say yes or you can say no, but you cannot say, maybe. I'm tired of working for the NIH. And I always end up with reports that end up in drawers and nothing is happening." Remember this was before the creation of NIBIB. So. And he said, "I promise you that I will do that."

[00:56:41.412]

And so we entered into this effort where we defined the strategic plan for molecular cellular imaging and the future of imaging and cancer and so on. That was 1996 I believe, or...yeah. And I had used one of my residents, Marty Pumper [SP], to help me with a new vision. But then I put a committee together that was amazing because it had cell biologists, molecular biologists, biologists, physicists. I mean, it was a multidisciplinary committee that I put together that was outstanding. Actually, one of them just became a Nobel Laureate. And we produced the report which he loved. And he said, "Not only am I going to support it," and he put his money where his mouth was and he supported the whole cell and molecular imaging program that they launched and the centers that were funded for that. And he put me on the scientific advisory board. So I knew about the NIH and NCR through NCI.

[00:57:42.590]

And then I was elected to the Institute of Medicine in 1999. And so I was known to be somewhat of a Maverick and a little different maybe, I don't know. And you know, when they looked for a director of the NIH, they looked at recommendations and they asked the Institute of Medicine. So I think I was put on the list.

[00:58:02.726]

I believe that the primary reason I was put on the list is because people at Hopkins recommended me. In particular, Bill Brody, who knew people so that your name comes up. But then the real difference is throughout the interviews. And in the interviews, it was very obvious that I was a very different breed than anybody else they were looking at. And at the end, they had like three finalists. And I guess they presented them to the president and the president asked, "Who is this guy?" And at the end of the day, they just decided to take a chance on somebody who didn't have the right pedigree, you know, not Harvard graduate or Yale or whatever, different. And I think the president at the time wanted that. He said, you know, he told me, he said, "You know, if you are somebody who comes out of Algeria and you did what you did at Johns Hopkins, I love that story. I want you to do the same for the NIH." And that's how I got recruited.



[00:59:01.734]

But again, when I was recruited, I already had a vision of what needed to be done. So I didn't go there as a complete naive because I was on the scientific advisory board of NCI and I had seen the issues that NIS faced, which Congress had identified also as issues of again, silos, not a lot of interactions. The budget was doubling. No one was leading really, a strategic plan for the budget that was doubling. So issues were there and the question was did you have an approach that would be credible? And I guess my approach was considered credible. And I'll tell you the truth, at the beginning, I wasn't sure I wanted to do this job because it's a high-risk job for a career. You're very visible and you can be considered inappropriate. I mean, no radiologist had ever been in the high position like that in NIH.

[00:59:55.505]

And coming from where I came, I'm not a molecular biologist, you know, I didn't have the right pedigree, really. I mean, before me, there was a Nobel Laureate, Harold Varmus, who was the NIH director. So I was unsure. And I consulted with Harold. And as it happens, I was also on the scientific advisory board of the Memorial Sloan Kettering at the time for Harold Varmus. And I suspect that he played a big role in encouraging me and putting my name in because when I asked him, he said, "Oh, let me talk to you." And we had a five-hour sort of debrief about all the issues and he told me, he said, "You should do it. And it would be a terrific thing for you and a terrific thing for NIH." So that's how I ended up accepting the job.

[01:00:44.478]

**Geoff:** Fantastic. Now, you mentioned understanding the issues well in advance of the engagement that you had had with the NIH during your years at Hopkins. What came first, your clear vision for what needed to happen at the NIH or the offer or a possibility of an offer and then your formulation of that vision?

[01:01:09.263]

**Dr. Zerhouni:** No, the first thing that happened is a phone call saying that... You know, they called me actually, from the White House. I said, "Yes, what can I do for you?" "We'd like you to consider the NIH job." And I thought it was the NIBIB job, you know. And I said, "You know, I already indicated I'm not interested in the NIBIB." And the person, who was the presidential personnel contact said, "No, no, no, we're not talking about NIBIB. We're talking about NIH." I said, "Are you sure you wanna really talk to me?" And that's how it started. So first, I had to be in the mix. And when I got in the mix, which took a few months, I mean, it didn't happen overnight. And when I got into the mix, that's when I started crystallizing and synthesizing, "What would you do if they offered you the job?" And then through the interview process, I expressed what I thought was really needed and the directions that you would take. But it wasn't a formulated plan. It was a direction.

[01:02:09.098]

**Geoff:** Sure. And I got to say that the way you described President Bush's, approach to your candidacy raises his esteem to me. I love the way he recognized the way that you were so self-made and accomplished so much given your background. And that that was a quality or trait that he really valued?

[01:02:33.344]

**Dr. Zerhouni:** I think so. And also, you know, remember that the NIH had not had a director for a year and a half between Varmus and myself. And what he also needed was somebody who would be accepted by the Senate to the confirmation process. So remember the appointment is not just the presidential appointment, it's also a Senate-confirmed appointment. And in those days, you know, the Democrats had the Senate and he was nominating somebody and there was a huge controversy about STEM cells and so on. And so the people were very worried that he would appoint somebody who was politically motivated. I'm an independent, I'm not a Republican or a Democrat.

[01:03:10.567]

So there was that also, but he also felt that my personal story would be very appealing to Senator Ted Kennedy who was the chair of the confirmation committee. Okay? So when I met Ted Kennedy, who was basically the one who decided yes or no before the nomination, whether it would be confirmed by the Senate, he really liked the fact that this was an unusual choice, different from the run-of-the-mill choices that they always consider. And he loved my personal story. He actually knew the story of Algeria or himself. He visited, he knew the country. And we hit it off very well.

[01:03:48.367]

And I was confirmed in five weeks from start to finish when everybody told me, you know, "Elias, is gonna take months before you get confirmed." So I was shocked, actually, I wasn't prepared to be confirmed so fast. And it did happen because both of them had this sort of human understanding that somebody different needed to be there. Both President Bush as well as Senator Kennedy. And they consulted with each other before making a nomination. Those days there was bipartisan work done. It wasn't like today's Washington.

[01:04:25.746]

**Geoff:** While we're on the topic of leadership qualities, I'm interested in hearing, in your opinion, what do you believe it takes to be a leader?

[01:04:34.506]

**Dr. Zerhouni:** That's a good question. I've read all these leadership books that people talk about and so on. And then when I try to crystallize it, personally, the way I feel about it is that you have to have first, what I call heart. If you don't love something, if you don't have the heart for something, don't go into it. I mean, you have to have the heart for what the mission is for what you do. You have to have a human conviction that this is worthwhile to spend part of your life doing it. So the heart comes first. And then the spine. The spine is that nothing that is significant is easy to do. It's always difficult. And actually, if there's no resistance, that means you're not changing anything. So you have to be ready. You have to have a very strong spine, you have to be resilient. Third is brains. So always people think that leadership is intelligence first. I don't agree with that. I think leadership is first the heart to what you do and then the spine to stand for what you wanna do. And then the brains to be able to execute what you want to do.

[01:05:40.550]

Now, those are the three components that I think are essential, and then there are many subcomponents that we already touched on, which is trusting and people building good strong teams. Definitely building a transparency approach to your leadership, not be a micromanager because that destroys the ability of others to contribute. You know, if everything is you, then the others feel disempowered and alienated, so you have to be a team builder and inspire the team by your heart, not by your brains. People don't respect you because you're very smart. They respect you because they know that it's important to you. You love what you're doing and you love them.

[01:06:23.022]

**Geoff:** Very well said, and I love the anatomic orientation.

[01:06:27.891]

**Dr. Zerhouni:** [inaudible 01:06:27.202] medical.

[01:06:29.086]

**Geoff:** It's fantastic. Now, shortly after your initial appointment at the NIH, you released a roadmap for medical research in the 21st century to identify opportunities and gaps in biomedical research. You briefly described the development process for that initiative?

[01:06:46.797]

**Dr. Zerhouni:** Yes. In other ways, when you deal with the situation, and I learned that from my previous experience when I really tried to help with the radiology system at Hopkins, I realized that you have to engage. You can't just dictate. You have to really come up with a process that allows people to transparently and openly tell you what they think is needed. So I organized that process.

[01:07:10.995]

And I was appointed in May and I started my job in May. And I assembled my team. I said, "I really want to consult with the community at large this summer." Oh my God, doctor, it's gonna be vacations and it's gonna be hard and we don't work that fast." I said, "No, no, no, you don't understand. We need to move faster and I need to get input from the community at large." And so I created this process where I basically said two things because you have to be clear when you want to really direct a large institution.

[01:07:45.819]

Number one, I asked the following question and I framed it in a way that was very specific. I said, "What is it that no single institute can do or is doing while at the same time we know that the NIH should do it?" Okay? So, in other words, I came up with that sentence by saying, "You know, science evolves and the institutes are in their mission, but are there things that are falling through the cracks right now of science that is emerging that none of the structure as we know it is attending to?" So that was the first thing. I said, "What is the roadmap of NIH should be, what is it that no single institute can do that the entire NIH needs to do for the country?" Okay? So that was sentence number one. And you have to work to get the sentence that's short, clear, and understood by everybody.

[01:08:39.344]

The second I said, "I want to consult with, you know, the opinion-makers, the opinion leaders of our ecosystem if you will. But I want to ask them the following question. I said, if you had five minutes with the new director of the NIH, what would be your top three or four recommendations?" And that was it. And then I send the staff, I said, "You go ahead and invite all the people, give me the list." And so we invited 300 people to come and it's five different sessions. Or six. I can't remember, but we had like the entire scientific establishment come, including patient advocates and so on. And they came and we had like the series of meetings with both internal and external leaders. But I asked them to come prepared. I said, you know, "You're not here to give me a speech. You're here to give me, if you had five minutes with me, what would you tell me is the most important thing to do?" And they did.

[01:09:36.033]

And so we correlated all that by the end of the summer. And that's what led to the first iteration of the key drivers of the roadmap. You know, what I call the rocks, which was addressing the complexity of biology, re-engineering, the clinical research enterprise, and the new next generation of scientists. So those were the themes that came up because I showed them the data, I showed them what all of them had put in as their top priorities and I did the count and I said, "You know, you seem to say that your top priority is to break the barriers between the institutes so that we can have biocomputing, computational biology." All these things that were not being supported. And there had been reports that indicated they should be, but they were not. Why? Because it's simple. The National Cancer Institute only moves if it's something that relates to cancer. And the Heart Institute... Because they have their advocates, they have their stakeholders if you will. And they don't want money to go to something that really does it sort of them directly.

[01:10:41.184]

And that's when I broke the code. I showed them that there was a need for a joint roadmap for something that was common to the entire organization, not just to every one of them. And that's what the roadmap was all about. It was a change management strategy, which led to a completely new

view about how to direct research at the NIH and created this reform act that now drives the NIH to the point where it can address emerging areas of science much faster than it did before.

[01:11:13.012]

**Geoff:** Yeah, it's fantastic innovation and in a sense, it sounds like, essentially, creating a strategic plan, but within a very specific scope that was NIH-specific.

[01:11:24.197]

**Dr. Zerhouni:** Right. It's not a strategic plan. I thought about this. It's not a strategic plan because it wasn't really designed as, okay was the end all be all of all of NI Science? No, no. It was, what is it that we need to do as an institution that no single component of the institution can do? So it's a strategic plan in reverse if you will. It was like what is missing? In the combination of all strategic plans you all have, what is missing?

[01:11:51.534]

**Geoff:** Yeah, sort of a gap analysis.

[01:11:53.227]

**Dr. Zerhouni:** Yeah, maybe that's a better word. Yeah.

[01:11:56.687]

**Geoff:** Excellent. It seems then through your description that a large part of the purpose of developing the roadmap was to help the NIH deliver on its mission to a greater extent to fulfill these missing gaps, but it also seems to have served the public from the standpoint of creating a platform to communicate priorities?

[01:12:20.120]

**Dr. Zerhouni:** Yes, absolutely. Remember in those days, the NIH budget was being doubled, Congress was very frustrated because they didn't understand where we were going. And so I told them, I said, "I need to build a vision that can be shared to explain what is it that the NIH is doing differently with its new budget authority, okay, so that we can convince the American people and the Congress that the funds are well-expended?"

[01:12:47.707]

So that allowed me to address this issue, which was front and center. People were very frustrated that they were hearing 25 different songs from the NIH, but not a reuniting one, but also the roadmap changed the parameters of what NIH funded because I opened up NIH to physical sciences. So I said, you know, the convergence of the scientific fields require us to fund things like computational centers and biology. To fund things like structural biology, to fund things like physics of molecular matter.

[01:13:23.440]

And in the span of four or five years, we doubled the funding of non-biological sciences at the NIH to the extent they were relevant to the NIH mission. So, that's what it was. It was an instrument of leadership because if you can't communicate, like I said, in a clear way, what division is, you won't have advocates. You won't have people following you. They don't know what you're talking about. And they didn't know what NIH was standing up for. I think today is different. I mean, you can see critical initiatives that the institution and Francis Collins are launching, which are relevant to the science of today. Well, that wasn't the case before the roadmap process was established.

[01:14:06.743]

**Geoff:** Yeah, it's fantastic to see the ongoing impact and that essentially, you introduced an innovation that has changed the course of the general culture and scope of what the NIH considers within its breadth of science. And it's phenomenal.

[01:14:25.613]

**Dr. Zerhouni:** The most important thing, Jeff, was to institutionalize that by a new law. So if you go back and say, "Well, what did Elias really do with the NIH in seven years?" Twenty, 30 years from now, people will say it was the NIH reauthorization reform act, the reform act of 2006, which passed in a bipartisan fashion at a time when Democrats and Republicans were at each other's throat. That, to me, is the biggest accomplishment of my career is to be able to shepherd this and make it happen in a time of very difficult bipartisan politics because it changed the direction and the philosophy of how you manage a federal agency. And actually, you know, it was reviewed. There was a 10-year review of the roadmap by the National Academy of Sciences and pretty much gave it a pretty good mark.

[01:15:21.577]

**Geoff:** I'm glad you shined a light on the NIH Reform Act of 2006. It was something that I did wanna ask you about. It established the NIH common fund as well as a new division of program coordination, planning, and strategic initiatives. But I understand that NIH was essentially 14 years in the making. And so, maybe you could describe a little bit what was your role in getting it across the finish line? And what benefits did it bring in pursuing the roadmap?

[01:15:49.566]

**Dr. Zerhouni:** It wasn't 14 years in the making. What was happening is that the reauthorization of NIH was 14 years late. Nobody could make a real authorization happen because there were like critical issues like STEM cell research and brain IK STEM cell research and all of that. Political issues that were preventing an agreement and people were standing by their position. So the first thing I had to do was to, essentially, remove the minefield and get an agreement that we want to talk about this. That fundamentally, I got an agreement from Ted Kennedy, from Martin, that nobody will use as a wedge these issues of politically sensitive issues that I got in the White House to agree to that all in private, very private conversations. And so that was the first step. And people committed. They said, "You know, we need the NIH to be doing better, and it needs to be reauthorized."

[01:16:44.684]

The second was showing the template for reauthorization. And I told them, "Look, I don't want you to reauthorize me if you don't think what we're doing works." And so between the roadmap that I started in 2003 and the act, there were three years. And the feedback that they were getting was positive. I said, "Finally, the NIH has a process. It has the coordination of programs. It's not like a confederacy, it's more of a federation." So they agreed with a template of the roadmap that I presented.

[01:17:13.622]

Now, there were many opponents. I mean, you cannot imagine even to the last minute, people didn't think the reform act will pass because the tradition was that no authorization of NIH had ever passed for the past 15, 20 years. And to do that, I had to really work with the Congress first, I mean, the house. And then when the law passed of the reform act, it had to go to the Senate. The problem is the Senate had turned Democrat. And so a lot of senators in the Democrats side said, "Oh, this is a Republican bill. We want to have our own bill. We want to reopen the whole thing." [01:17:49.865]

[01:17:49.865]

So I went to see Ted Kennedy again, who had become a very strong supporter, and I told him, I said, "You know, you have the end of the Republican Senate until December. And yes, indeed, in January, you'll be in power. But frankly, it's not good for the American people. I mean, this thing is ready. Is there any way we can get it passed to the Senate without your opposition while the Senate is in session?" And he did. He took on upon himself to remove all of the politically motivated opposition and then passed it down the last hour of the last day of the 2006 Congress.

[01:18:29.532]

That's what happened. People went to bed thinking on that Friday, at 6, basically sending me condolences about my effort to get the reform act passed. And even my own legislative assistant, he

said, "You know, doctor, just go get a glass of wine. It's over. It won't pass. It's going to close at midnight and we're done."

[01:18:53.418]

And all that evening I was on the phone with Senator Kennedy, Congressman Dingel, [inaudible 01:18:59.817] Barton basically negotiating the last things that they needed to be happy with to get the thing passed. And it did happen. And at 1:59, a.m., it passed the house with a pass back from the Senate. It passed the Senate at 1:30 a.m., and it passed the house at 1:59 a.m. And if you look at the reform act, there is actually something interesting in there that is that at the end of the act, there is a paragraph that relates to the child insurance programs, SCHIP program. It has nothing to do with NIH, but it was part of the consensus, the political consensus that was reached to get the NIH reform ACT through.

[01:19:40.199]

So that was great legislator understanding by the leaders of the Senate and the leaders of the house at the time. People that you don't see anymore, or at least I don't, but that was really why it passed because people felt it was important for the country, important for the institution, and important for me because I told Ted Kennedy, I said, "You know, if this dies, my job is finished. I'm moving on." And he didn't want me to. He said, "Oh, I want you to stay." So that's how I had to finish my second term because I had promised Ted Kennedy that I would not leave until the next election.

[01:20:16.349]

**Geoff:** That is an amazing story.

[01:20:18.427]

**Dr. Zerhouni:** Yeah, it is.

[01:20:19.382]

**Geoff:** A long way from CT of pulmonary nodules.

[01:20:22.206]

**Dr. Zerhouni:** Yeah, it was fun.

[01:20:24.371]

**Geoff:** Yeah. Amazing. 2003 is seen as a high watermark for funding of the NIH. And although nominal allocations increase in subsequent years, adjusted for inflation, funding was in decline during your subsequent years as director, to what extent did uncertainty and variations in your budget influence your ability to pursue your agenda for the NIH and provide a stable base for operations and scientific support?

[01:20:50.998]

**Dr. Zerhouni:** The downturn was related to Katrina, the hurricane that touched New Orleans. And because of that hurricane, there were a huge demand for federal funds. And so that's where the first year where the rise of the NIH budget stopped because of that event. Right? Then the roadmap was funded separately, \$1 billion in 2007. But then after that, it got flat until the financial crisis with a \$10 billion over 2 years funding for the NIH that was there. But if you looked at the whole trajectory, you knew that medical inflation was higher than the rise. And so the ability of NIH to fund the same amount of grants was going down for two reasons. One is the stagnation of the budget after 2006, and two, the fact that many institutions had invested in new laboratories, new scientists. I mean, the resource capacity of the United States almost doubled in the period between 1999 and 2005 and 2006 with a corresponding demand for grants.

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And so the pressure was on the success rates more than it was on the amount of dollars that were going. So we had a bigger enterprise that was hungrier for grants because the institutions had invested in it, which really created pressure on the success rate. But we were funding more research, you know, not less research. What happened though is that the young investigators were getting hurt because, in 2006 and 2007, we saw a big decrease in the number of young investigators or what I call new investigators funded. So that's when I reacted and I created the system for a separate review for what we call new investigators. So that was the tension. The tension was the success rate was not as good because the demand was higher and the supply was flat. And the second was it was hitting specifically the next generation of scientists.

[01:23:03.838]

And so then that became my number one issue all throughout the end of my tenure to protect the next generation of scientists. And we did. And Francis Collins continued that. So we have specific grant programs that allow someone who is just out of training to compete for funds instead of what I believe is a bad trend, which is that first NIH grants today are achieved at age of 42, 43. We have more investigators over the age of 65 than we have investigators below the age of 35. That's not a good trend. And I think these erratic moves of the budgets are doing that because they're hitting primarily that up and coming generation, which doesn't have the preliminary data to convince the peer reviewers that they need to be funded. And so the NIH had to respond accordingly.

[01:24:01.590]

**Geoff:** Yeah. And since you bring it up, just last week, I sat on a study section that was specifically dedicated to helping young investigators get their first R awards. And so that ethos is still continuing at the NIH and it's a real pleasure and a privilege for me to be able to be in that position of helping in that aspect of your legacy of supporting the young investigators.

[01:24:25.323]

**Dr. Zerhouni:** I'm glad to hear that.

[01:24:27.621]

**Geoff:** Absolutely. I wonder, you know, within the context of having to deal with the supply and demand as you put it. The variations and budgets and the growing enterprise, do you have any general advice on managing through budget uncertainties or unexpected budget cuts?

[01:24:47.182]

**Dr. Zerhouni:** Well, the general advice is always to never build infrastructure that you have to sustain with fixed cost over variable costs. So always try to make your enterprise as flexible as possible, not as dependent on fixed costs. So big buildings, like what I call Taj Mahal's of research, you know, or laboratories or big longterm, very expensive projects that really will essentially increase your fixed costs are dangerous because if you're counting on a steady rise of the budget, you can't count on that. Especially today with all of the situation in the federal budget is under pressure and healthcare is taking a bigger and bigger share and then you have defense that takes it to bigger and bigger share. So it's really hard to predict that you will have that rise in the grants process that the federal government needs to support to sustain a large infrastructure. So be flexible, be nimble, be able to go up or down in your configuration if you will. Don't make big longterm commitments, too expensive fixed infrastructure that you'll have to fund forever.

[01:26:05.805]

**Geoff:** Great advice. You established the RCDC, Research Condition and Disease Categorization system as a computerized reporting system to categorize the NIH's funding and medical research. What led to your prioritization of that initiative?

[01:26:24.085]

**Dr. Zerhouni:** Well, again, the same thing. It was in response to this sense that the community had that NIH was opaque. And so you had patient advocates who are very important to the NIH and to research in general because their voices are a lot stronger than the voices of scientists in Congress. Okay? And they were always complaining that their disease was getting less than that disease and that we had more people suffering here and their disease was number one and should it be number one. So, again, with the philosophy that I shared with you before, I wanted to quantify that and make it transparent because I believe that if you have transparent data, you have a better conversation and the opportunity to create a consensus. So that's why I created this RCDC so that that we had a tool that was objective, that was transparent, measurable, where everybody could see where the reality was. Instead of coming up with these ideologically-driven sorts of positions.

[01:27:23.225]

The second, I wanted to show what the impact was in every congressional district in the US. So I created a database that showed the funding district by district in the United States, which allowed me and the advocates to show to every congressional delegation how we were supporting the economy and the activities of their research enterprise in each one of the states. So those were the two reasons for that.

[01:27:51.540]

**Geoff:** It seems clear that the RCDC did to a certain extent, benefit internal operations and strategic decision-making within the NIH by making the data that you just described available, but perhaps an even greater impact is the public reporting and transparency related to grant funding. What additional steps do you envisage that could make the value of discovery and advancement in medical sciences even more accessible to the public today? Because it seems that we have a gap.

[01:28:22.913]

**Dr. Zerhouni:** Yeah. Well, the first thing I did, and that's not something that that is well known, is that made the decision to make NIH completely paperless. So when I came in 2003, I decided to make the entire process from application of grants to analysis of grants to funding of grants completely paperless. So we created the NIH business system. In fact, the NIH is the first agency that had an end to end electronic system because if you wanted to analyze what was really happening in science, you couldn't do it out of scan papers. And so that allowed us to put some artificial knowledge management software to find out where was science going, what were the hotspots in science so that you had a better tool to see what the total scope of what we were doing was. So that happened in 2006, we completely made the grant process paperless. We used to have trucks and trucks and trucks coming with paper at the NIH at the time of submission. Today there's nothing like that. It's all done electronically. And again, this is something where implementation is as important as the concept.

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And we did and were the first agency to get it done. We didn't toot our horns on this because we didn't want other agencies to feel resentful to the NIH because we always were considered the protege agency that always had the money. So I kept it quiet. But that led to what you are talking about. And there was an online tool to identify what is happening in the world when you analyze publications with artificial intelligence algorithms and knowledge management algorithms, and then what is it we're funding? Okay? So the two together is what allows the NIH today to decide like the brain initiative. That's a very important initiative that transit scholars launched and the collaborations with industry on certain issues like genetics of Alzheimer's disease, for example, things that you know from the analysis that you're not doing enough of in your portfolio and you need to really reinforce that. So it's a cycle of knowledge, understanding gaps, and filling the gaps.

[01:30:38.911]

**Geoff:** Yeah. Is fantastic. And part of my question tends toward the gap that still exists in the public's awareness and understanding of the value of the investment that is being made in advancing the



medical sciences. And I wonder if you envision a next-level or a next-step to the system that makes the information of how these resources are being allocated even more accessible to the public, not so much accessible in terms of they can go online and see it, but accessible from the standpoint of their understanding.

[01:31:16.106]

**Dr. Zerhouni:** Well, that's a good question and a difficult question because there is a general distrust of government agencies and government structures in general by the general public. That's number one that you can see in poll after poll that people are a little distrustful of science and technology in general. They believe that that's what created global warming and that a lot of the pharmaceutical companies are not trusted. And so it's really a complex issue. I personally believe that the best approach is to really educate the advocates, the people who are engaged because a lot of the population is you can spend billions on education. It won't change anything because the ones who are vested in an effort are the ones who need that information and that interaction. And it's happening. It's happening a lot more than it did before. I mean, I just had a speech at the Alzheimer's Association And the engagement of patients and patient groups and others is really where the education of the public needs to happen. And you need to really be president social networks, not the typical communication strategy. You need to create communities of advocates and patients who depend on progress of science to improve their own human condition.

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And that is where I think the effort needs to be directed and we're not doing that as well. But you can see it. I mean, you can see things like 23andMe and you can see things like PatientsLikeMe. You see in social networking the emergence of new communities of knowledge.

[01:33:00.097]

**Geoff:** Terrific. Terrific point. I'd like to ask you about balancing personal beliefs with demands placed on a leadership role. At the time of your appointments, the NIH directorship research on embryonal STEM cells was a major interest to the scientific community but was strongly opposed by then-President Bush. How did you approach that issue?

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**Dr. Zerhouni:** Well, you know, I had a very frank conversation and I said, "I'm a scientist, you're a politician. I'll tell you what the science is, you're the politician, you've been elected, you make the political decisions, but I don't create a political situation here. "

[01:33:40.105]

**Geoff:** Eleven years ago, and coinciding with Barack Obama's election to the US presidency, you stepped down from the NIH directorship and President Obama appointed you to serve as one of the first presidential science envoys to foster scientific and technological collaboration with other nations during a time when you also served as a senior fellow with the Bill & Melinda Gates Foundation. What was your portfolio of activity during that year?

[01:34:08.985]

**Dr. Zerhouni:** I decided to leave the NIH before the election because I thought it was time, after seven years. After having passed the reform legislation for the NIH I thought, you know, I could do something else. And I was approached by the Gates Foundation to be a senior fellow to help in the research agenda of the foundation for global health. Almost a couple of months later, Obama made a big speech talking about the soft power of the United States and in particular, collaboration in science and technology. And he had the idea of creating three special presidential envoys for science and technology for the United States.

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And so I was one of them and I became a special envoy for the White House and the State Department when it came to interactions with other countries in terms of science and technology. In that regard, I ended up visiting 22 countries and spreading the word about the openness of the innovation system in the US, the ability for us to collaborate around the world, and to build, if you will, relationships, not based on just pure political calculus, but the need for humanity to develop new solutions for the health burden that was present around the world. And that dovetailed very well with what I was doing with the Gates Foundation as well. And so that was a really enjoyable period of time that I spent doing that. So.

[01:35:34.566]

**Geoff:** Was your time largely self-directed in both of those roles?

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**Dr. Zerhouni:** No. In the Gates Foundation, it was self-directed. It was helping the foundation do work around the world in terms of global health issues. But for the role of presidential ambassador, it's really guided by the State Department and the White House in terms of the priority countries to visit and so on. So that was more directed.

[01:35:58.350]

**Geoff:** Was that a science-led agenda or was it sort of politically directed with conversation focused on science?

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**Dr. Zerhouni:** No, it was mostly science and technology. I mean, we try not to combine the political and the science and technology. We wanted to separate the two, although they cannot be separated because it does relate to international relations, but it was mostly science and technology.

[01:36:24.554]

**Geoff:** And so the State Department was positioned to recognize what were key priorities for science and technology and to help to identify the key international partners for your engagement?

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**Dr. Zerhouni:** Right. I mean, there was a science advisor at the state department as well as the office of science and technology at the White House. So we coordinated all of that. Because remember, there were three ambassadors, so we had to divide the world in the appropriate ways and the State Department decided which priority countries we needed to visit and establish better ties, if you will, from the scientific and technological point of view.

[01:37:01.922]

**Geoff:** I see. With respect to the other two ambassadors, where are you mostly focused geographically or was it your scientific expertise that determined the relative engagement amongst the three?

[01:37:14.357]

**Dr. Zerhouni:** It was the question? It was geographic because we covered different parts of the world. Bruce Alberts was on the West coast, so for him, it was easier to cover Asia. I was on the East coast, so I covered Europe and the Middle East, Africa. That was my territory. And it overlapped with the global health agenda that I was interested in.

[01:37:34.252]

**Geoff:** Yeah. And I'm curious, after running a giant government agency in the NIH and interfacing with both politicians and the world's top scientists for six years, what did you take away from this year of international service with the Gates Foundation and serving as a presidential envoy?

[01:37:54.140]

**Dr. Zerhouni:** Well, the main lesson was how to align agendas between Europe and the US and the countries that we visited in terms of their own priorities. And in different countries, there are different priorities. And we try to understand and align because when you look at the US government, we have 14 different agencies that relates to this crown of collaborations in the science and technology and health fields. You know, you have USAID, you have the National Science Foundation. So it was more of an integrator of what is it that the US government interface should be to be more effective knowing that governments themselves have limitations on funding. They have different rules about who they fund and especially when it comes to collaborative efforts. And so that's where my skills, if you will, were most useful because I knew the drivers, if you will, of budgetary support for different activities. And I was able to really align the US government in terms of priorities that were determined, if you will, jointly between the leaders of science and technology in different countries and ourselves.

[01:39:03.399]

**Geoff:** Now, within these roles, what kind of organizational support did you have? I mean, again, I imagine after coming from leading the NIH, there was a tremendous administrative backbone to help you achieve your goals. Did you have to get used to a leaner team?

[01:39:20.096]

**Dr. Zerhouni:** Well, the team was provided by the state department and the White House. So it is not a big team because when you really look at it for each country, you get a briefing about all of the interactions, economic, political, and otherwise so that you understand the context. And that was extensive briefings. The other thing is that once you're a presidential envoy, you have a rank, if you will, that allows you to visit with the heads of states because you're basically the envoy of the president. And so that facilitated things enormously. I would go to countries, I would often meet the head of state or the prime minister and would be accorded if you will, the protocol rank of a special ambassador. So that made it easier, frankly. And that was the idea of having presidential envoys rather than lower-level representation at a diplomatic level. So in each country, you would meet the ambassador, you'd be briefed on the latest, and then you'd meet with significant partners, a minister for science or the minister of health and others so that the conversation was really deep. And then, you know, you had to basically summarize that. So I was always accompanied by the chief of mission or the ambassador himself and then people who would come with me as well on the trip from the state department.

[01:40:35.039]

**Geoff:** Sounds like a fascinating engagement. Now, having surveyed the landscape of global health and current initiatives for its improvement, how would you order the key imperatives for greatest impact in raising health worldwide?

[01:40:50.261]

**Dr. Zerhouni:** Basically the greatest impact is achieved when you see collaborations across countries and commitments across countries. So when you're looking at the vaccines initiatives, for example, which were important, you realize that unless you had organizations like the global fund or the Global Alliance for Vaccines where everybody participated, both the recipient countries as well as the donor countries, you couldn't really get traction because you didn't get alignment. So the creation of supernational entities that can align the agendas of both the government as well as the philanthropic world is essential to achieve these sort of goals.

[01:41:31.948]

**Geoff:** So that's interesting. You essentially select an organizational superstructure that is you have described aligns governments, aligns philanthropy and such as really a key driver for raising a health impact as opposed to specific scientific discoveries. I'm taking away from you that the scientific

discoveries are important, but ultimately, it's this organizational superstructure that's so key to moving the needle.

[01:41:59.551]

**Dr. Zerhouni:** That is the lesson that you take because what you realize is that you can have discoveries but they do not connect with the people on the ground. You need an organization on the ground. You need health systems that are designed to be able to vaccinate, for example. And they need to have the technology like cold chain, for example, for vaccines. Also, you need to have people reaching out to the population that you want to vaccinate, especially when it comes to vaccines like, for example, the eradication of polio.

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And so we had like 73 countries that eventually joined to be members of this Global Alliance on Vaccines, which was very successful. It had already started and we encouraged, if you will, the ability for us to create a permanent structure which is now in Geneva next to the World Health Organization. And so that was the goal. The goal was to create supernational structures that will be able to achieve the goals on the ground and deliver the discoveries to the people who need it.

[01:43:02.300]

**Geoff:** Yeah, that's excellent. With this conversation of enabling social change, I wanna harken back to something we discussed a little earlier. You said we need to be active on social networks and create communities of knowledge comprised of patients and advocates as well as physicians. What steps can we take to best effect better engagement toward building those communities?

[01:43:26.782]

**Dr. Zerhouni:** The step is to do it. What tends to happen is people stay within their own environment. So, for example, if you look at the Alzheimer world, it's clear that you're not going to solve this problem just with one country working on it. And so you need to have alliances that are global and supernational in that regard so that you can conduct the trials, evaluate the science, encourage scientific areas, and avoid duplication between different countries or the European Union, the US and China, for example, and the countries that really need to participate in that context where they have a aging population if you will, or issues of noncommunicable diseases like neurodegeneration or heart disease.

[01:44:11.443]

So those models, if you will, have become understood that you can't do it with government agencies directly. You have to have an intermediary that is a neutral ground intermediary that has the resources to implement the changes, and especially create the human capital that is committed to delivering global health advances to the world. I mean, today, if you look at the results of vaccines, immunizations around the world, we achieved an 85% coverage for most of the WHO recommended vaccines. You know, that's a remarkable achievement because that was not achieved until basically, this decade.

[01:44:52.743]

**Geoff:** It is a remarkable achievement, unquestionably, and I'm glad you returned back to vaccines because I can't help but also think about some of the headwinds that we're facing in our own country around perception of vaccine and risks and hearkening again to communicating with patients with the public in an effective way so that there isn't an undermining of all of this tremendous work occurring at a high level, at a scientific level, at an organizational level. What is your perspective on how we can potentially address these public concerns?

[01:45:31.629]

**Dr. Zerhouni:** Well, the fact is that you have a tremendous amount of anti-vaccine sentiment in developed countries. This is where it comes from. It doesn't come from the poor countries where

patients are still seeing the impact of infectious diseases on their children and so on. So, for them, participating is essential. In other countries like the US or France, you see anti-vaccine movements which proliferate through social networks and fake information. I mean, misleading information. And so that you have to basically counter that with the proper information and the proper engagement of the scientific world with the society in which they live.

[01:46:12.593]

**Geoff:** Are there any examples that you might point to that you think have been particularly effective in overcoming some of the misconceptions that the public might have?

[01:46:24.757]

**Dr. Zerhouni:** Well, in autism, for example, I mean, at NIH we did trials and observational trials in different countries to really evaluate this potential link between the vaccines and autism. And for years, it was really a big battle because you had to provide the data showing that, in fact, there was no connection between the vaccines and autism. And when the discovery of the genes, which seem to be driving autism are neurodevelopmental genes. They're not infectious or immune disease genes, immunology genes, so that you realize that there was no link. That you need to basically disseminate as knowledge at the various levels of governments and public health and so on so that you can have allies in each country to do that. But you know, the thing that is most amazing to me is that the vaccination rate went right back up as soon as measles epidemics were noted in the US and in Europe and you had some patients who, unfortunately, died. So sometimes facts on the grounds are the best advocates for your movement, if you will, of saying, "No, the benefit is much greater than the risk," if you will.

[01:47:40.860]

**Geoff:** After working for a not-for-profit university, the federal government, and non-governmental organizations, you joined Sanofi as president for global research and development. How did establishing a research agenda for Sanofi differ from your prior positions and how did corporate strategy inform that agenda?

[01:48:02.975]

**Dr. Zerhouni:** Well, first of all, it was a completely unexpected turn in my career. I mean, I did not seek to go to industry. I was being sought after because of my experience at the NIH. I had been approached by a large company when I was at the NIH to become head of R&D and I declined. I didn't know anything about drug development to be honest with you. I'm a radiologist. I had learned a lot about science across all fields of sciences as NIH's director. My knowledge was very wide and encyclopedic about how to discover the true mechanisms of disease and the targets that you could address. The thing I didn't have is how to address them. But the reason I got into it is because I was asked to consult for a pharmaceutical company by its CEO who was open-minded. He said, "You know, 95% of all we do fails. This failure rate is too high. And frankly, we are basically repeating things that we have done in the past. And I would like you to help me redesign if you will, the R&D vision for this company." I told that CEO that I wasn't really interested in working for industry and what I did was I said, "I'll be happy to look at it and tell you what I think should be done." And that's what happened.

[01:49:21.770]

So when I looked at it, I realized that the ecosystem, essentially, between academia, government and industry was really complimentary, but the amount of science, if you will, translation was insufficient. And this is where I suggested a strategy to the CEO saying, "You know, you really need to change the way you're doing your research and understand that pass of small molecules is not going to be the future. It's gonna be complex biologics like antibodies and gene therapy, cell therapy. And you need to enter that world." And it was exciting because you know, I have an engineering background, so I like to do things and I like to make them happen. And so, at the end, after a year and a half of interactions, he convinced me to take the job, which I did in 2011.

[01:50:15.199]

**Geoff:** You mentioned that you really weren't interested in going into industry.

[01:50:19.846]

**Dr. Zerhouni:** Yeah.

[01:50:20.524]

**Geoff:** Why was that? What was the basis for your reticence?

[01:50:23.137]

**Dr. Zerhouni:** Because there's a negative perception. It's called the dark side. And so you always felt that, well, industry, I don't know what they do. It's not a very good reputationally. I mean, I could see that the perception was not very positive and so on. But then when I looked at the people I met there, the scientists who were there, the mission that they have, which they feel really committed to finding cures and finding disease-modifying therapies, I mean, that was really exciting. Through that consulting, I discovered a part of the world that I didn't know. And you know, I'm a little bit of a risk-taker and adventurous. That's why I changed careers so often. And I felt like this was an inflection point where I could make a contribution. And that was the driver. So I didn't care what reputation would be after I saw the size of the mission and the excitement of being able to direct something like that for a part of my career.

[01:51:25.672]

**Geoff:** Yeah, and I mean I understand that the R&D budget for Sanofi is about \$6 billion, annually. I'm curious, how is success defined when leading such an effort and what were you able to do to drive that success?

[01:51:41.887]

**Dr. Zerhouni:** Well, you know, in this world, the ultimate success is whether or not you came up with something that makes a difference for patients. Right? And you get it approved by the FDA into the guidelines of medical practice so you change the medical practice, that's success. Now, how you get there and the road to that is very difficult and hampered by a lot of failures. So one thing I learned is that, you know, at the NIH you had to fund the hope. In industry, you have to fund the reality of a product. And you cannot be misled if you will by empty hopes or empty concepts. You have to prove them and you have to prove them experimentally. And that was the challenge, if you will, because on the one hand, you control a budget to make things possible. And then, on the other hand, you have a budget that you need to allocate to things that will make the most difference to patients at the time you were there.

[01:52:41.519]

**Geoff:** Yeah, I mean, I'm thinking about time of development and commercialization of a new drug and being able to deliver on annual benchmarks, which seem to be two completely different timescales. And I'm kind of curious about when you initially started on this path with Sanofi, what kind of milestones were you looking at on an annual basis to say, "Yeah, we're going in the right direction?"

[01:53:10.790]

**Dr. Zerhouni:** Right. Well, you know, you have to understand where the industry was going through. At the time, the industry had been notoriously unsuccessful in coming up with follow-on to their blockbusters. Okay? So there was a big period of innovation and blockbusters that came and made a huge difference, but they were losing patents. And so when you lose the patent exclusivity, you basically go from one day having a drug that is exclusive to you to having many copycats, many generics. And so the prices just kind of come down and you can't sustain the company unless you

have a new wave of innovation. So the industry is driven by this wave, after wave, after wave of new products. Otherwise, it doesn't survive.

[01:53:55.901]

And so that basically was the problem at Sanofi. They were losing patents on almost half of their revenues in the next four years. And they asked me to say, "Can you come up with a strategy to sustain us?" Otherwise, we will not have the necessary products, if you will, to survive.

[01:54:14.469]

And so that's what I was asked to do. And the way I did it is exactly what you said, you know, was I really templated the approaches that I was going to recommend on the timeframe that you were talking about. And this company was going to lose its main drugs between 2011 and 2015. By the end of 2015, it would have had no exclusive patented products or brand medicines if you will.

[01:54:42.283]

And so that was very difficult to see how you would fix that. That's why the previous CEO was let go, the previous head of research was let go, and they were asking for new leadership to do that. And so I came up with a strategy which related to shifting the focus of the company away from small molecules, which was exclusively what they were doing. Two biologics, two new modalities. So I had a strategy that essentially, convince the company to pivot towards biologics in a big way.

[01:55:16.667]

And so we did this through partnerships. I signed partnerships with companies that were more advanced than us, biotech companies. So entered the antibody field with a company called Regeneron, we entered the R&A interference field with a company called Alnylam. And my strategy was very simple. I said, "You know, when you don't know something partner to learn the one thing you don't know. And eventually, by partnering, you learn, and eventually, you master that new field and then you come up with your own ideas." And that's the idea.

[01:55:49.558]

And so, in the meantime, we developed internally very novel technologies like try specific antibodies. No one had ever done that. And we had articles in science and a recent article in nature showing that in fact, that could help because it would address multiple targets at once. In other words, there's no disease that can be controlled by one drug, one target. Diseases require combinations, whether it be oncology or immunology. It's really hard to modify a human disease by just a single approach. Even infectious diseases, sometimes you need a combination to be able to cure an infection. Well, the same thing is true in oncology or immune disease, immunology or other diseases. Diabetes also requires multiple approaches.

[01:56:39.091]

So I came up with a concept of multi-targeting within the single drug design. And that's where we started making progress with monoclonals and then bi-specifics and then tri-specifics, and now we have acquired technology and developed technologies that can address three, four, or five targets at once. That's why the portfolio evolved, if you will, from a small molecule only portfolio to a toolbox, if you will, that was much richer but also allows faster development because frankly, when you have a monoclonal antibody, that's the best way to address a target because it's so specific to the target.

[01:57:20.685]

**Geoff:** That is an amazing articulation of your strategy and journey and particularly appreciated, you're calling out one of the tried and true principles of if you don't have a core competency partnering to achieve it provides a very rich and rapid way to adopt important competencies. I want to turn specifically though to this notion of having a scientific workforce that was focused on small molecule production and the need to essentially pivot them. You had the partnerships but you still had the big internal organization. Was there a lot of disruption in the professional labor pool?

[01:58:03.136]

**Dr. Zerhouni:** Yes.

[01:58:03.751]

**Geoff:** During this time?

[01:58:04.960]

**Dr. Zerhouni:** That's an excellent question. Actually, you cannot do it without changing the labor pool because the tradition that came from 100-year of development and research in industry was based fundamentally on medicinal chemistry and the discovery of small molecules because small molecules are really attractive. I mean, if you can find one, it's great. The problem is 99% of the molecules you try to develop do not at the end, end up being clinically viable because of toxicology, because of side effects, because of other things.

[01:58:38.290]

So you had to sort of change the culture, number one. But also remember, when I took it over, it was like 13,000 people all committed to medicinal chemistry. So you need to restructure, slim down first, get to partner with people so you can learn. Eventually, you bring the people you need that understand this field of technology and learn from partnering with others and also open up the company. Because what tended to happen in these big companies is that they were internally focused. They have what I call the not invented here syndrome. And they really poo-pooed everything that was outside of their expertise, that is a very common cause of failure in big organizations. You stay focused on what you do and you forget what is happening around you.

[01:59:28.469]

So the two things I did is I reduced the footprint of small molecules, increased the footprint of novel technologies, partnered to create a portfolio within five years, which we did, and allows the company, if you will, to survive, what we call the patent cliff, which is a huge loss for these companies if they don't have replacement drugs and solutions. And so that was the plan. [01:59:53.934]

[01:59:53.934]

So one, redirect towards complex biologics and partner to learn to master and eventually dominate what you are interested in doing and the diseases that you want to change. And we did this two ways. We also acquired a company called Genzyme, which was right in line with what I thought was the best strategy, rare diseases, enzyme replacement, and we did that by acquiring a Boston-based company called Genzyme in 2011 which give us a step-up, if you will, in our ability to enter the biologics field. So you sometimes acquire, you sometimes partner, and you have to also restructure completely both the workforce that you have but also its culture. In other words, be open to the outside, collaborate with academia, go and partner with biotech companies in an open way, in a fair way. And we did that. We did that.

[02:00:51.834]

**Geoff:** This is all tremendously logical and obviously, very, very effective. One thing I'm very curious about is that as an academician at heart and somebody who then ran the large governmental organization of the NIH, you step into an organization where there are probably people who have worked there for 25 or 30 years amongst the executive team, amongst the leaders of the various business units and you are calling for a culture shift and a directional shift for the company that was probably very uncomfortable for other people who had tremendous power within the organization. To what extent did you work to sort of soften the environment, to overcome barriers, entrenchment, and anyone that was really seeking to maintain the status quo and work against your vision?



[02:01:51.883]

**Dr. Zerhouni:** Well, that's the difference between industry and government or academia. You know, government and academia are very conservative in changing things. Not so in industry. The company had been really formed by acquiring many different companies. It had 31 sites of research. Each one subcritical in size. Each one closed on itself. And so I had to make some basic decisions about closing a number of facilities so that you can have a concentration of talent in fewer places.

[02:02:23.332]

Number two, when you look at the R&D world, there are functions that are needed anyway, no matter what you do. And so regulatory or clinical development is the same whether you do an antibody or you do a small molecule. So the piece that needed to reform was the innovation piece, not so much the execution piece. And so you made that calculation. And indeed it was very hard. I mean, Jeff, I had demonstrations against me in France, for example, because I wanted to close research sites, which had been longstanding in different regions. So the politicians get into it, they don't want you to close an R&D side with hundreds of people, but you treat people fairly and openly and transparently and you make sure that there is a transition path where the majority of them either inside the company or outside the company.

[02:03:12.558]

So we did that, and it took 4 years in France to get it done, but it took about, I would say, a year in the US and 18 months in Germany, which tells you that it's very different country to country and the labor market is so much more flexible in the US as opposed to France or Japan or Germany. So I learn all of that in doing it and, but I preserve the majority of the key skills that were needed to develop drugs because the companies that we partner with were innovative companies. They didn't know anything about regulatory or development. So I said that's the strategy. It's like partner on the innovation side, you know, new targets, new molecules, but keep the development machine, which is what pharma companies are good at because we have a worldwide footprint. We can have research sites in Russia and in China and the US everywhere. And that infrastructure you keep because that's really what gives you the right to be in a large pharma company.

[02:04:15.302]

**Geoff:** That's perfect. I wanna turn a little bit here and ask you with so much experience in strategically directed R&D, what do you believe is the role, if there is one, for strategically directed R&D within an academic or even a private radiology practice?

[02:04:37.161]

**Dr. Zerhouni:** Well, in imaging, I think there is a tremendous amount of possibilities because today, what is lacking in R&D is the ability for you to have a biomarker that tells you whether or not you're really addressing what we call target engagement. Are you really hitting the target that you think you're hitting? Well, the only way to know it in many diseases is by imaging. So if you have an antibody, it's great to be able to image it to see if it goes to the target that you've designated. So that's one piece.

[02:05:09.250]

The second is academia itself wants to go up the food chain, if you will because a lot of the discoveries come out of academia. The only problem is 95% of those discoveries don't amount to a drug at the end of the day. So you have to be selective. But a lot of universities today are really trying to do this actively.

The technology transfer piece and anytime there is something that comes out of academic department, you have a tremendous amount of entities now, venture capital funds, seed funds, incubators, that come around and try to take this technology or this approach and then make it into a small biotech company.

[02:05:51.664]

So the environment, the landscape has changed. In the past, 25 years ago, everything happened within the confines of a R& D division within a big company. Today, it's much more distributed. It's what I call the era of distributed innovation. Well, it's coming from many different directions, not just in the US but globally. And you have to be really on your feet to know what is emerging that's really important. And how do you get involved in that?

[02:06:20.030]

Well, academia has to do its part. I mean, often, you will go deal with a university and they're very ignorant of the realities of bringing discovery and translate it into a real benefit for patients. They're very naive about it. I mean, look, NIH has a budget right now of 39 billion, but the industry spends 140 billion every year on R&D. And so it's really hard for me to see how academia can take it from A to Z in terms of discovery all the way out. So the ability to partner, to be open to collaboration, to encourage the creation of effective biotech companies out of the academic environment. The SICO system is really what the game is all about. It's an innovation ecosystem that relies on all partners to be smart about the total process.

[02:07:19.841]

**Geoff:** Yes. And if academia is at sort of the front end of the discovery end of this ecosystem, my question is more not about academia participating soup to nuts, but more about, you know, imagine yourself once again leading a radiology department and the standard way that research is done is through investigator-initiated activity, which is often directed specifically by the interests of those investigators. And so the portfolio of activity within the department ends up being a reflection of the constituents principally without any top-down R&D priority. And that's the question that I'm asking you. Do you see a greater role for there being a structured research agenda in order for academia, and let's say an academic radiology department, to be more contributory, more constructive, or do you believe that fundamentally, the creativity, the flexibility, the freedom of investigator-initiated research is the way for academia to contribute?

[02:08:32.670]

**Dr. Zerhouni:** I think it's absolutely the creativity that you don't want to stifle by top-down concepts because the top-down concepts come always from reality on the ground that you already know about. In biology, we have to realize we know so little about the total system of biological interactions at the [inaudible 02:08:56.899] level or tissue level, organ level. This really needs a discovery.

[02:09:00.929]

Now, academic centers are absolutely the best to generate that knowledge or at least tentative knowledge and ideas. And if you top-down this, you lose that ability for pioneers to come out and have ideas than you and I cannot even imagine. So I think it's very important for academic centers to keep that freedom, to keep that individual creativity to come up with new ideas.

[02:09:27.034]

The second point is that academic centers have access to patients and patient samples and understand the human disease in the human population. The industry doesn't have that and the government doesn't have that. So that's a specific thing that should be encouraged. Please work on understanding in your context the diseases that are coming to you and patients who are suffering and want help. And I think that's the second part of academic missions that should never be forgotten. And that is that we understand how to cure diseases in mice a lot, but that is not translatable into humans unless you study humans. And so my big push was to say the goldmine of ideas that academia has is really the thing that needs to be encouraged and consistently supported. The ability for those scientists, especially physician-scientists, to study human populations in conjunction with the basic scientists is really the core of what the value is in academia.

[02:10:29.429]

Now, when are you wanna translate that or transfer that into a more of an industrial-type construct, if you will, with small biotech on? That should not be the core activity for the academic center. It should be nice to have, but not essential. And it's not the essence of the mission. Academia is the place that trains the next generation of scientists with new ideas that will transform the world.

[02:10:57.656]

Now, remember, when you say about R&D in pharma companies, all of it is actually composed of former academics who were NIH-funded, who came to industry to make a difference. And so it's a continuum, but I think we should not mix up the missions. Academia is the place where the product of academia is knowledge and the product of industry is products. And we should not really mix up the two because otherwise, you end up with what I've experienced in big pharma where the commercial interests dictate the agenda in R&D. And that's what leads to failure

[02:11:35.313]

**Geoff:** Excellently stated. Excellent.

[02:11:38.733]

When I became chair of radiology at Duke, you offered me a piece of advice that I have never forgotten. You said to me, "When making decisions, always have a strategy in mind." For our listeners, would you explain how you've used strategic decision-making and why you chose this message to impart above all others?

[02:12:00.672]

**Dr. Zerhouni:** Because people tend to complicate and complexify issues. And if you do not make the effort of identifying what the fundamental drivers of any situation, right? Your department or your institution or whatever you do, if you don't do that effort and you cannot express it in a half a page of concepts or strategic concepts, you haven't done your work. And so it's what I've known at the NIH as the rock, pebble, and sand director because every meeting I would say, you know, "This is not a rock. What you're describing right now is a piece of sand for the edifice that we want to build." Or it's a pebble or it's a big rock. And so differentiating your analysis of the situation into what I call the force vectors of a situation. So, for example, I described to you the rise of biologics. That's a force vector. The rise of external innovation, that's a force vector. The rise of academia interacting and collaborating, that's a force vector.

[02:13:06.871]

Otherwise, you get up and you get lost in the charade of small interests, operational decisions, tactical things, and it's not a strategy. So I learned that from my time at Hopkins when I was executive vice dean, dean for research and I was like lost. I said, "What do I do now?" Do I manage the space? Do I manage the budgets? What do you do?" And when you do that, you end up with 300 pages of consultant generators, strategic plans, which sounds good, beautiful slides, but at the end of the day, they're not actionable.

[02:13:40.184]

And I was told by a member of the board when I presented at Hopkins my first iteration of a strategic plan for the school of medicine, they said, "It's too complicated. You have to come back to me with one page of exactly what are the decisions, the strategic directions and vectors you're gonna follow. And so that was my advice to you. It was don't get into the sand and the pebbles. When you build a house, you first build the design of the house, as the architect, and then you build the foundations. So focus on the foundations that you wanna build rather than on the bricks and mortars that come around the foundation or the details in the rooms, you know?"

[02:14:20.764]

**Geoff:** That's great advice. Now, you have been hailed as an administrator who has the ability to find solutions where others see only obstacles. That's a pretty powerful statement. Can you offer any insights or examples that support that assessment?

[02:14:37.335]

**Dr. Zerhouni:** It relates exactly to what I just told you. I make the effort through interactions and through getting advice about what are the essential things that we need to focus on that are drivers of change and adaptation and success? I did that in my department. I did that at Hopkins. I did that at the NIH. I mean, the roadmap for medical research was exactly that. It was based on wide consultations, but at the end, I synthesized, if you will, what I consider the main drivers of the progress that we need to make. And that came to three teams. It was like re-engineering, clinical research, multidisciplinary teams, and team science, and then what I call disease networks and pathways, understanding the molecular mechanisms in a systems biology sense of human disease in humans. So those are the three things that I kept pushing.

[02:15:33.775]

And then the last but not least is the fact that the teams of science that you needed to solve the problems were no longer the isolated scientists with three postdocs trying to find a basic mechanism. But they would be converging teams where you would have physicians and biologists and engineers and physicists coming together in what I call convergence between the physical and the medical sciences. Well, that concept of convergence is a rock that's not a pebble. It's not a sand. Because it's a structural change in the entire ecosystem where you're coming to bring on equal level mathematicians along with data scientists, along with radiologists, along with pathologists and so on.

[02:16:16.349]

So you realize that the barriers that had been created by the 100-year of research driven by Pastor [SP], you know, that came out of Europe, and then the research we had done in the last 50, 60 years was more what I call reductionist research. You reduce things to its fundamental elements. I think we're in a different phase of history. We do reverse engineering of total biological systems. And you know, that idea took me a while to develop and buttress, but then I realized that this was a force vector of orders of magnitude more important than whether you had compensations for your faculty or not or you know, you have to look at the major trend and focus on that. That's what a leader is supposed to do.

[02:17:03.463]

**Geoff:** Yeah, absolutely.

[02:17:05.292]

**Dr. Zerhouni:** So that may be why you get that comment about me. But you know, when people who know me, well they say that they say, "You always seem to want to dig into the essence of the issues that you're dealing with and extract from that the rocks and then build around it the pebbles and then eventually, the sand." But at the end of the day, that's really the essence of this. What are the rocks of the building you wanna build? Vision that you have. And if you do that, and you can convey that. Then you can attract people who are also attached to your vision, are passionate about this. They believe in it. And actually, you know if you've hit a rock when you have advocates who themselves take on the mantle, if you will, of pushing that agenda.

[02:17:50.627]

**Geoff:** You were appointed chair of innovation at the College de France in 2011. You've led large organizations in academia, government, and pharma. I'm interested in your perspective on innovation. What does innovation look like to you and how does your approach to implementing innovation translate across these very different organizational archetypes?

[02:18:15.893]

**Dr. Zerhouni:** Well, that's a good question. The reason I was asked to do that is because there was a sense at the College de France that the science of science, right? The science of understanding the process of science was not that developed and the science of innovation was also not developed. And so they were asking people like myself to sort of come in and structure conceptually, an approach to innovation. At the end of the day, it was very obvious to me that no innovation occurs unless you have freedom of exploration. And I came to the concept that there are layers of innovation activities that all depend on the Explorer mentality. Okay? If Christopher Columbus had not been an explorer and discovered America, there wouldn't have been the second wave, which is the pioneering wave, the pioneers. So the people who landed, James Style, they were pioneers. They didn't discover America. They were the pioneers that came in and were pioneers in their own way about what is this new country? How does it really look like and work and so on and so forth? And then the third wave is what I call the settlers. You know, the world is understood. The country is understood. We know its geography, we've explored it, we know where the rivers are. So you need to settle cities around rivers and around harbors and so on.

[02:19:40.029]

So do you follow me?

[02:19:41.153]

**Geoff:** Yes.

[02:19:41.584]

**Dr. Zerhouni:** So innovation is a multilayered activity driven by different people with different cultures. And the big foundation is that generation of young and generally young investigators who want to explore new territories of science. That's where the fundamental innovation comes from. So people like Watson and Crick or when they explored the structure of DNA and discovered it, it really motivated a ton of other pioneers who then said, "Okay, how is it translated? How's it controlled? How is it really translated into RNA and RNA into proteins?" And then all of a sudden, in 20 years, the entire system of DNA, RNA, proteins was understood by the pioneers. And then you have the settlers, the people who do genetic engineering and they create Genentech. And then they create new ways of creating proteins because they understood that if you could code DNA, you could then generate the new proteins.

[02:20:42.965]

You see. That was my concept in the concept of this revolving door between explorer, pioneers, settlers, explorers, pioneer, settlers. When somebody explores a new area, it brings in an energy to that through its second layer of people who are more pioneers. They're not explorers in the same way as the initiators of a new field.

[02:21:09.137]

**Geoff:** You know, I really appreciate the explorers, pioneers, and settlers because many have ascribed innovation to not simply being the discovery, but the reduction of a discovery to practice and to seeing it fully implemented. One of the key enablers of that full spectrum of innovation, as you highlighted, is culture. And yet organizational culture is a force that can make or break leaders. Are the generalizations that you can offer about culture and cultural change across the various organizations that you have participated in?

[02:21:46.256]

**Dr. Zerhouni:** It's a tough question, but culture comes from the founders of any institution. If you look at Hopkins, frankly, the great unknown about why Hopkins became great, you and analyze it and it comes back to the early leaders. The Mayo Clinic, the Mayo brothers, I mean, they created that culture. And that culture is really strong and drives essentially, the pattern of behavior and the pattern of activities that any institution is gonna follow. And so the breadth of an openness of the leaders in

accepting explorers were in their midst. And then settlers and pioneers is really the key. And you have to have that concept. And some leaders have that concept.

[02:22:31.112]

I mean, the people who created Stanford, you know, from MIT, they had that concept. They had a concept of operation in their mind for the culture they wanted. So MIT has always been open and it was created to be open to the world of industry. And they did it. And they seeded that philosophy to Stanford because the dean of engineering from MIT became the leader of Stanford at the time. That's how they created Fairchild Industry and all the things you know from the Silicon Valley.

[02:23:02.791]

So if you look at the world, there isn't, in my view, a general culture of innovation in the US or France or there are [inaudible 02:23:10.936]. You see it in Boston because the institutions that were created there were drivers of knowledge generation. And if you look at the map of innovation in any country, it's not the fuse. It's really concentrated in a few areas. You know, we're lucky we have Boston, we have the Bay Area, we have the area here around Baltimore and the triangle next to your place at Duke. So you see that it's heterogeneous and it's not something that can be replicated by administrators. It has to be a work of fashion, if you will, by some founders.

[02:23:51.910]

And that's why sometimes you have to create a new institution. You can't build on an older institution. So when you say, "Okay, how do you affect culture change?" Well, build a new completely from the ground up, a new concept, a new institution with a new myth. And that's what universities have done. And if you look at the Broad Institute and MIT, it came out of nowhere. It came out of the ground and has become one of the most influential institutes in the world of biomedical research.

[02:24:21.101]

**Geoff:** It's a fascinating perspective for universities, in particular, hearkening to the founders and their influence. If we turn our attention to another type of organization, like the NIH, for example, much has been written about the cultural headwinds and inertia that you faced at the NIH, as well as the issues that you tackled head-on. In light of all of your experience, what is your perspective on organizational change, in particular, your advice to leaders facing cultural headwinds where change is hard but necessary?

[02:24:56.640]

**Dr. Zerhouni:** Well, you know, every organization as it grows becomes Claros [SP]. Okay? It's like you aging and me aging, we lose muscle mass, we become tied to routines and so on. So every organization, every 50, 60, 70 years has to go through a redo. And that's what universities have done. I mean, from the divinity college at Harvard that was created in 1636, and look at Harvard today, it has changed over time because it has followed this fundamental driver or saying, "We train the next generation of the intellectual capital of the country by adapting our structures in our culture to the needs of the generations that we are facing." So that's the thing. Every organization will have points of resistance, especially successful ones because when you're successful you tend to protect what you've been successful with. You don't wanna take the risk of changing because the delta between what you have and what you wanna have is perceived as not that great.

[02:26:01.371]

Why build cars? I mean, we're doing great with horses and buggies. I mean, the same thing is true in academic institutions. Change is not gonna be welcome. It's going to be difficult because you have vested interests that exist and have been successful. And this is one of the things I tell people. I said the number one cause of failure for a new leader is to do what made them successful over and over and over again. And that's what I've observed. And so when people come from a successful background and they are promoted, you know, it's the Peter principle. You get promoted to your level

of incompetence. And if you don't understand that what made you successful before is not gonna make you successful in the future. And so that notion of being courageous enough to challenge the status quo and yet understand the drivers of why there is resistance, that's key to being a transformative leader.

[02:26:58.714]

**Geoff:** Another great leadership skill is the ability to roll with the punches and adjust to rapid change on the road to facilitating growth. Was there ever a road that you began to take, saw that it was not going as you envisioned, and so you shifted to take another different course of action?

[02:27:17.447]

**Dr. Zerhouni:** Yes. Obviously, that happens. Only stupid people never change their mind, you know. So you do adapt. But the key thing is the rocks, the fundamentals of your strategy. You have to be resilient and stick to it. Because if you don't, what you do, you just create chaos. If you change your mind because there's resistance by... If there is resistance along that challenge, the fundamental strategic decisions you made, that you need to pay attention to. Most of the resistance is related to the pebbles in the sand. "Oh, my God, you've moved my cheese here. You've moved the kitchen. You've moved the bathroom and all this." That you just resist and be resilient and say, "Yeah, I understand it's painful to change the bathroom, but we're gonna change it because the foundation of this particular strategy requires you to change that." However, if you come to a point where the fundamental strategy is clearly experientially creating points of failure, well, then you can back off and you say, "Okay, I was stupid. Now, let me be smart."

[02:28:24.534]

**Geoff:** Are there any examples in particular that you might share of a path that you started and you realized, "No, this isn't gonna work. I'm switching gears."

[02:28:35.071]

**Dr. Zerhouni:** Well, on the NIH, when I realized that the structure of the NIH did not allow for the roadmap to occur as I wanted, I had to change the legislative strategy completely. I really thought I was the director of NIH and what I said would happen. The problem is that you realize that I had missed the legislative angle, the political angle of what needed to be done and I hadn't really put that down as a strategic driver. And so, in this case, I didn't back off. I just added the strategic vector, which I hadn't really envisioned at the beginning.

[02:29:11.375]

**Geoff:** Great. Trust emerges as a recurring theme in several of the responses that you've had earlier in our conversation. You speak of leaders needing to trust the people they supervise as well as those being led needing to trust the leader. What strategies can you offer for overcoming preexisting trust issues for a leader who steps into a distrustful situation?

[02:29:38.915]

**Dr. Zerhouni:** I don't think there's a general formula for that. Right? I mean, that's so specific and it's people related. The best example I can give is not me, but the current CEO of Microsoft. Well, he's been extremely successful because when he came to the situation, I happened to know a little bit about that, he realized that the success of Microsoft had been based on decentralized leadership, right? So the leaders were doing what they needed to do within their own business line.

[02:30:08.503]

And what tends to happen in any organization is the leaders of that tend to become siloed. And when they become siloed, you create a tremendous amount of distrust because division A wants the resources, division B wants the resources. So the people start fighting. It's the same thing in departments in schools of medicine. You have this constant fight between the different structures that you created. And so you need to break that. And he did it by saying, "Oh, wait a minute, we are one

Microsoft. And when we move, we moved together into new directions. And I don't want the new move to be challenged by the pre-existing powers or the barons of the system in preventing the new moves from happening." Okay? So he made it very clear that this was what he wanted to do.

[02:30:56.004]

And so trust comes from clarity, from transparency in your intent. And then you will have resistors, no question. And what he did is said, "Okay." He gave them a chance. And when he found people who weren't willing to play in a collaborative way, he just changed them. So sometimes you have to make the tough decisions. And often, these resistors are really prominent people. I mean, well, my experience is that the people that you have to really get in line are powerful because they are powerful because they've been successful. And so you always face this issue of, "Why do you wanna change department acts? It's been great. It's been wonderful. What's your problem?"

[02:31:38.334]

And so often what happens in organizations, they don't change until the platform is burning. You know, when things are no longer going and then they bring the Messiah who is going to turn that around and to recreate trust. So trust is a long process but it depends on the organization at the time you are really taking the lead for it.

[02:32:00.845]

**Geoff:** Absolutely. You've blazed a truly original path. Were there any role models that you can recall either within the medical field or beyond that inspire you?

[02:32:12.510]

**Dr. Zerhouni:** No. No. I was scared every single time. When I came to the US, I was scared. When I ran my computer tomography work and I established my MRI division, my research lab, I was scared. When I became executive vice dean, I was scared. When I became NIH director, I was scared. And when I became head of R&D for Sanofi, I was scared. Why? Because I hadn't done it before. And so I was attracted by the unknown and the challenge and I was scared by it. And if you don't fear and scare and this motivation of saying, "I'm going to overcome my fear and the way I overcome it is not by grandstanding but by learning." And so the fast learning ability that you develop in those experiences is absolutely key. If you come with fixed ideas and you already know what you wanna do and you're very templated in your mode of operation because you have a great pedigree or you know, "Look, I've been at this university, I'm a good guy, I'm a great guy." You develop arrogance. And arrogance does not mix well with adaptivity and learning.

[02:33:27.168]

And I mean, I knew nothing about drug development. I mean, I was scared. I learned. In three months, I just kept my reading time was about it and I learned everything there was to know. I talked to hundreds of people about it and learned from it. So you have to have a good level of fear, a failure to basically drive yourself to learn about what is the mission you need to accomplish. So it's a combination of self-motivation, driven by a challenge that you find attractive, but also fear that you need to dominate. So dominating your fears is probably the number one. And the way to do it is by learning as fast as you can in things that you're not comfortable with, to begin with.

[02:34:13.820]

**Geoff:** Have mentors played a role in your leadership journey?

[02:34:17.394]

**Dr. Zerhouni:** Yeah, absolutely. Oh, yeah. I mean, without mentors there's no way that you develop. It's like everything else. I mean, when you're a child, you don't know yourself. And mentors see in you things that you don't yourself see in yourself. Do you follow me?

[02:34:33.708]



**Geoff:** Yeah.

[02:34:34.562]

**Dr. Zerhouni:** So mentors have more experience. They're usually older. They have the ability to compare you to others and to tell you where are your place really is, and to show you things that you may not see in yourself. And that's what I think mentors did for me. whether it be Stan Siegelman or Bill Brody or others that I have interacted with. They always sort of advise you on saying, "You know what you're doing here is really good. You don't appreciate it, but that's valuable. Why don't you work on that?" And they point out things too about you that then you use and you develop as a skill set. It's like being a musician. I mean, if you have a good ear and you're gifted, the way you become Mozart is because your father is telling you, "Hey, you have a gift here." So discovering your own gifts can not happen by yourself. It happens because mentors identify them for you and help you with that too because you become part of their success. Do you see what I mean?

[02:35:34.399]

**Geoff:** Yeah, absolutely. Now, mentorship and mentors clearly are a very, very important early in one's career. I'm interested, the extent to which you relied on mentors and advisors as you ascended through these more senior roles.

[02:35:51.162]

**Dr. Zerhouni:** All the time. All the time. I mean, the number of times I have a sort of kitchen cabinet where I go and consult, you know, Bill Brody has been, you know, a terrific guy. You go to when you face a decision and you tell him, "Look, here's how I see the world. Do you agree? What do you think?" And he'll say, "You know what? I would look at this, look at that. Stan Sigelman the same way. Stan probably saved my career because he told me, "You're wasting your time doing what you're doing. Why don't you come and do MRI?" I said, "I don't know anything about MRI. I'm not in the field. And he said, "I know you can learn it. I know you have that ability, so why don't you try it?" And that's the kind of advice that is invaluable.

[02:36:34.884]

So you'd need to have constant interactions with people you trust who have no agenda of their own to advise you and if you don't seek that, you're gonna fail. And this is what I told, you know I had a commencement speech I gave at MIT where I said the most important rule I learned is the 50/50 rule. Fifty percent of what you do should be in your discipline and what you know best, radiology. And 50% of what you do should be outside of it. Because if you don't, you will never be a leader because you'll never have the bandwidth to understand the total landscape.

[02:37:10.803]

**Geoff:** Yeah. The mentors that you mentioned, the advisors, are people that Stan and Bill go way back in your career, to what extent do you seek to recruit advisors from beyond the medical field or that really, you know, bring very fresh and unique perspectives to your considerations in more recent years?

[02:37:34.380]

**Dr. Zerhouni:** Oh, absolutely. I mean, I have friends in the finance world, I have friends in the accounting world, I have friends beyond medicine. And in medicine also, I have friends beyond radiology. I mean, I'm only giving you the radiology guys here, but I mean, you have a network. Even in politics. I mean, I had a great mentorship relationship with Senator Kennedy. He helped me tremendously in seeing that rock of the legislative pathway that I needed to follow. So you find them around you, you develop a trusting relationship, but you seek them out. It's hard work to have a mentor. You have to sustain them as well as sustain yourself. But the network of honest, intellectual exchange, mutual support based on real value, not you know, false values of, "Oh God, I'll help you if you help me sort of thing. There was no exchange of value. It was pure high-value interchange to try to advance something greater than both your mentor and yourself.

[02:38:42.213]

**Geoff:** Fantastic. We've talked about a succession of great successes and some astounding innovations. Revolutionary change usually requires the ability to assume risks where the outcome is not at all a guarantee. And you've already stated that you're a risk-taker. Every risk-taker has experienced some failures. What do you consider to be your greatest failure?

[02:39:04.476]

**Dr. Zerhouni:** That's a good question. I think, first of all, I think my greatest failure was not to spend my early time in more fundamental aspects of research. I think I was too driven by the environment to publish things that today, I look back and I say, "Gee, I wish I could have spent my time on more important things than that." So that was one that I regret that I could have made more impact earlier. I was a little dispersed initially, so that's one.

[02:39:33.410]

The other is to be too possessive of certain things. Like I developed high-resolution CT at the beginning and I sort of kept it under wraps, but I didn't really exploit it. I didn't write enough papers about it even though I was really at the foundation of how the thing was evolving. I did it through other people like Chris Harold who developed physiologic HRCT and so on.

[02:39:56.451]

So I think I was a little dispersed and I regret that because I really did not help the people who really put their thing with me. And we did publish great papers. I mean, you can look at the, but I would say three-quarters of what I published was of low impact. I should have focused on higher-impact things on what I call rocks, but I didn't have that in my mind at the time. It was just, get your CV published or perish. And that was stupid. I thought.

[02:40:24.469]

**Geoff:** I can totally relate to that perspective. And that sensibility resonates with me as well.

[02:40:31.996]

[02:40:31.996]

You've been an innovator within our fields since your earliest days and have a tremendous breadth of awareness and perspective on the direction of medical sciences. Looking ahead, what do you believe are the most promising opportunities for radiology within the next 5 to 10 years?

[02:40:48.438]

**Dr. Zerhouni:** Two. Artificial intelligence to study large populations and extract patterns that are relevant to disease states. So, for example, to me, AI of the brain or brain MRIs over a longitudinal period of time to see how the brain changes in different individuals to predict, in fact, whether Alzheimer will develop or neurodegeneration or how do you really combine imaging information in oncology to better drive the personalized oncology therapies that you want to apply? And by reading out, if you will, the changes that occur that can inform you about the evolution of the disease. That's very important. And I think radiologists are absolutely in the driver's seat there to do what I call population imaging, not individually imaging with one report at the end. I mean, if you widen your view on that, you realize the power of this. I mean, if you had millions of MRIs of the brain with the clinical history of what happens to these people from a childhood all the way to old age, I mean, that knowledge is going to be absolutely critical to understanding neurological diseases. You can do it for other things too. So that's one.

[02:42:04.237]

And the second, I think, is what I call biomarker imaging where you understand a target and you image it. So would it be an antibody or a cytokine or a cell? Cellular imaging. As you know, I've been an advocate of molecular cellular imaging since the '90s and it has made great progress, but I don't

see the radiology departments taking that. I mean, that happens in nuclear medicine and I think nuclear medicine is going to be the field that I see make more progress, and it should be encouraged to enter into areas where the translational world requires localized information of a functional nature about specific targets that are yet to be imaged.

[02:42:50.926]

**Geoff:** Great. You recently retired from Sanofi, but it's very hard to imagine you slowing down much. What are your current plans and aspirations for the future?

[02:43:02.073]

**Dr. Zerhouni:** I really, right now, I don't want to have an operational role, but I tell you, I'm solicited a lot. I'm back on the foundation of NIH board and they asked me to rejoin that. So I'm there. I'm on the Lasker Foundation Board, you know, the Lasker Prize. And I'm on the Research America Board. A lot of nonprofits. I'm on one for-profit board, so I sort of serve as a advisor, guru-type, for ad hoc things that don't require a tremendous amount of time. And I'm writing.

[02:43:33.828]

**Geoff:** Writing. What are you writing?

[02:43:35.103]

**Dr. Zerhouni:** I'm writing what I'm talking to you about.

[02:43:38.138]

**Geoff:** Excellent. A book?

[02:43:39.933]

**Dr. Zerhouni:** Yeah. Yeah. Or a series of articles. I don't know yet.

[02:43:43.854]

**Geoff:** That's marvelous. That's tremendous. Elias, I can't thank you enough for the time that you have taken to unpack so many rich and unique experiences for us all. I thank you, not only for this conversation, but I should also thank you for years of mentorship that you have provided to me. You are an inspiration for our field. You are unique in so many ways and have so many phenomenal lessons to impart. Thank you for joining us with this conversation today.

[02:44:16.917]

**Dr. Zerhouni:** You're very very kind to me. I have to tell you, I call Hopkins my home away from home and I call radiology my fundamental home. And I have always had a sweet spot for radiology. And as you asked me, I felt like it was really important because that's my family if you will. Hopkins is my home, radiology is my family, scientific family. So thank you for asking me.

[02:44:50.521]

**Geoff:** As we close this episode of the RLI's "Taking the Lead" podcast, I want to once again thank our new sponsor, Carnegie Mellon University's Master of Medical Management program offered exclusively to physicians. This professional degree from Carnegie Mellon builds expertise in evidence-based management, business strategy, and technology for the future of healthcare leadership. To learn more about the MMM program, please be sure to check out the link on the page for this episode.

[02:45:19.871]

Please join me next month when I speak with Daniel Mollura, the founder, president, and chief executive officer of RAD-AID International, an organization dedicated to improving and optimizing access to radiology in low-resource regions of the world. While earning a bachelor of arts and government and concentrating on international relations at Cornell University in the early 1990s, Dan

worked as an economic research associate within the international trade administration of the United States Department of Commerce. Upon his graduation, he began a three-year stint at Goldman Sachs as a financial analyst within the equities division of the investment research department.

[02:46:02.699]

He subsequently refocused his career on medicine, returning to school for pre-medical science certification at Columbia University, followed by medical school, radiology residency, and nuclear medicine fellowship at Johns Hopkins University. A serial entrepreneur, Dan founded three companies while completing his residency and fellowship, including Now You Know Media, an audio publishing company, Front RAD Technologies, a PACS and imaging technology company, and Rad-Aid International. Upon completing his training, Dan began a 10-year period as staff physician in the department of radiology at the National Institutes of Health Clinical Center, and as an imaging scientist for the National Institute of Allergy and Infectious Disease.

[02:46:50.931]

During these years, Dan increasingly focused his nonclinical time on building RAD-AID, endorsed in 2011 by the World Health Organization. RAD-AID's radiology readiness tool provides for systematic data collection for assessing how imaging technology can be planned and implemented to match the needs and resources of a community and has been a critical enabler in bringing onsite radiology services to the more than 30 countries in which RAD-AID operates today. Supported by more than 10,000 volunteers from 100 companies and 75 United States university-based chapter organizations, RAD-AID's massive global health footprint relies upon a dedicated team of volunteer, operational, regional, and in-country leaders, all reporting to Dan as president and CEO.

[02:47:44.315]

My conversation catches Dan at a key moment in his life and in the life of RAD-AID as he bids the NIH farewell to dedicate his professional efforts to RAD-AID on a fulltime basis.

[02:47:56.641]

If you've enjoyed this podcast, I invite you to do three easy things. Subscribe to the series so you need never miss an episode. Share the link so your peers can listen to and like or rate every episode so more people will discover it.

[02:48:14.873]

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