

**BERNARD GERSH:** This is Bernard Gersh at the Mayo Clinic. And with me is my colleague, Dr. Charles Bruce, who is here to talk about a remote monitoring system that he has been involved in developing for the last, what, 10 years Charles.

**CHARLES BRUCE:** Thank you, Bernard. Thanks for the opportunity to be sharing this with you.

**BERNARD GERSH:** Tell us basically about the nuts and bolts of the system, and then really, what you think the implications are applications are.

**CHARLES BRUCE:** Well, a group of us-- Virend Somers, Paul Friedman, Kevin Bennett from engineering, and myself, about more than a decade ago-- envisaged a remote monitoring platform, much like you can imagine a dashboard that you would have in your motor vehicle, sort of unobtrusive sensors monitoring the tire pressure, and then an alert light coming up telling you something's wrong.

Well, could you imagine something similar for human wellness and health? And we thought about, well, how could we develop a platform that would do this? And what we have now is a system that employs a sensor, what we call the Body Guardian, which is an adhesive worn patch with a rechargeable unit that you wear on the chest. It's unobtrusive. It's capable of recording an electrocardiogram. It's able to determine respiration rate, as well as body position and activity level through a throughway accelerometer.

**BERNARD GERSH:** So Charles, just tell me the difference between this. I know there are a whole host of remote monitoring devices being used in heart failure-- from thoracic impedance to other parameters of fluid volume, and so on. And how does this differ from that?

**CHARLES BRUCE:** Well what's neat about the solution is that we try and address the low latency. So identifying an issue, and then acting on that issue immediately, and then seeing what's the effect of that action. And then, performing another action.

**BERNARD GERSH:** So this would be a change in rate, respiratory rate, a change in pulse rate.

**CHARLES BRUCE:** And it's totally programmable. It has various parameters that you can set. It then communicates wirelessly, potentially with-- for example-- sensors like a wireless blood pressure cuff or scale, or any other information that's available on the internet. And then, based on smart algorithms, can then alert the patient to do something.

**BERNARD GERSH:** So you mentioned a scale. How does that fit into this? Because obviously, if you're dealing with heart failure, I mean, weight is terribly important.

**CHARLES BRUCE:** Yeah, although it may not be the only measurement. So rather than also simply measuring these physiologic parameters and just transferring them to a repository, the idea here is integrating these signals in an intelligent manner to take data and turn it into knowledge. So say, for example, you have someone who has a heart rate of 60 for the last few days, but suddenly, goes to 120-- exceeding a certain parameter. You then factor in, is this person active or inactive? If the patient's inactive-- maybe sleeping with a heart rate of 120-- that would suggest there's a problem.

Integrate now the information of a steady declining activity level over the past few days, plus the steadily increasing weight, and that maybe suggests that this patient, for example, has developed atrial fibrillation.

**BERNARD GERSH:** And how would you get the information about decreasing activity? This is information that the patient would enter.

**CHARLES BRUCE:** No. So there's an inbuilt accelerometer that is determining the longitudinal relationship of these parameters. So that's what's really beautiful about this, is that this is a prolonged monitoring system that you can then look in trends over time, integrating the information, and then hopefully yielding new information that can help us impact this vexing problem-- say, for example, of hospital readmissions for patients with heart failure.

**BERNARD GERSH:** So that really, Charles, is maybe the lowest hanging fruit, if you will. But hospital admission and readmissions for heart failure, huge problem economically. It's certainly a metric of the standard of care. There's great deals of concern about it, because a lot of the admissions are unrelated to heart failure. But they may be related to comorbidity. So how would this system get at that? Let's say, someone with heart failure is now readmitted. They also have chronic obstructive pulmonary disease, and they're readmitted with pneumonia?

**CHARLES BRUCE:** Well, that's a good thing. So we actually have a grant now to actually study this very thing. It may be that there's a subgroup of patients who would most benefit from remote monitoring. And there may be a subgroup that isn't. And it may be that there are some patients, for example, with multiple comorbidities with high frailty scores that really won't benefit from this kind of solution.

**BERNARD GERSH:** I mean, this really is important, isn't it? Because the early attempts at telemonitoring-- if I can use the word-- for heart failure, particularly, for heart failure readmissions, have been some studies have been modestly positive. Some have been very neutral. So it really is an incredibly important area.

**CHARLES BRUCE:** Absolutely. And we think this is a huge opportunity to study.

**BERNARD GERSH:** So the grant is to look at the effect of this upon outcome.

**CHARLES BRUCE:** Yes. When in fact, it's not only to look at the outcomes, the predominant part of this grant is actually looking at identifying what solution will work best in achieving these outcomes. This really represents a good example of what we hope to be able to achieve, is taking an institution-- a top tier institution-- turning it from a brick and mortar health care provider, and turning it into a digital health care provider.

One way patients say, for example-- I probably sound funny to you because I come from South Africa, you know that. And just imagine the day that a patient, say, for example, with postpartum cardiomyopathy, living in rural Africa in a mud hut, but who has access to a cell phone is capable of connecting with me in my office here in Rochester, Minnesota. It really is a huge opportunity for us to impact care at a distance.

**BERNARD GERSH:** Charles, I love the analogy. And probably, the audience won't understand either of us since we both have South African accents. But I do love that analogy with a hut in Africa, and the concept. Thank you very much, Charles. And thank you for joining us.