While most patients view hospitals as a place of healing, providers know that, in some cases, hospitalization can be a source of harm. Medical errors are the third-leading cause of death in the U.S., and most occur during hospitalization.

In this “AMA Moving Medicine” podcast episode about health care innovation, Richard Milani, MD, chief clinical transformation officer at Ochsner Health System, in Southeast Louisiana, outlines the need for innovation in the inpatient setting and offers tangible solutions that can drastically improve patient outcomes.

Below is a lightly edited full transcript of the presentation. You can tune in on Apple Podcasts, Google Play or Spotify.

**Dr. Milani:** We—meaning the whole world, from a health care perspective—have a problem in our hospitals: These are not safe places. Now, they’re necessary places, but it’s the third-leading cause of death in the United States—medical errors, mostly occurring during hospitalization.

It's about 400,000 lives each year. If you're a Medicare patient, there's a one-in-four chance of receiving harm during your hospitalization. And then from an infectious disease standpoint, you'll develop an infection about one in 25 people, more so even in the U.K. And then talk about loss of control. It's shocking when you take a step back and think about the life of a hospitalized patient.

You come in, I take your clothes away from you. I put you in a gown. I put a name tag on you with a number on it. I throw you in a room. I come in when I choose to. I don't tell you much. I try. I don't tell you what's going to happen, what just happened. I don't give you results. I overload you at one time when I make my rounds, and of course you absorbed 5% of that, and then your wife or husband shows up and ... “What did the doctor say?”

“I don't know.” It goes on and on and on.

So, being a hospital patient has been called, quote, “one of the most disempowering situations one
can experience in modern society.” About 90% of hospitalized patients want to review their hospital meds, but only 28% have ever been given the opportunity.

And then the scariest thing of all: Only about a third of hospital patients can correctly name even one of their hospital physicians. Just one. Only a third. That means two-thirds can't name any. And some of us have grease boards, and a lot of good that does. And there's 100 people walking in with coats, in and out, and I don't know who's what and where. That's just the way it is, right? About 20% of patients experience adverse events within three weeks of discharge. Discharge in the post-acute period is a really scary place.

And then this came along. This was a wonderful paper by Harlan Krumholz, and has well been described, but he described it, I think, really well. This whole concept of post-hospitalization syndrome. And if you're not familiar with it, let me describe it for you quickly. It's an acquired period of vulnerability derived from the allostatic and physiologic stress that patients experience in the hospital.

What do we do to them? Well, we surely don't let them sleep, that's for sure. There's noise, there's lights, people coming and going, the door's open. I can't get this. I can't get that. And then guess what? If you just now fall asleep, the nurse is going to show up five minutes later to do something, collect your vitals. And then after that, when you just fall asleep, it's 4 o'clock, 4:30—time to draw your blood. Well, [there’s] nothing like turning the lights on, putting on a tourniquet and ramming a needle in my arm to say, "Go back to sleep now." That really worked really well.

So you can imagine, it's not a great place to get sleep, and if you don't get sleep, you change your circadian rhythm, and I'm going to talk about that. We don't feed you, we just give you sugar water. You might have a lot of pain. You're going to receive a lot of medicines, especially if you're older. That's going to impact your cognition. And then I confine you to bed, because I don't want you to fall. So, you're going to get deconditioned pretty fast. Man, I can't wait to go.

If you look at unrecognized, and I want to underline the word unrecognized. Unrecognized, that means the nurse doesn't pick it up, I don't pick it up, you don't pick it up, everything's fine. I'm sending you home. About a third of patients have unrecognized low cognition. You have to do these mini mental tests at discharge to pick it up. But everything looks good. They're getting it, looks like they're getting it. They're nodding their head. They understand, everything's good, out the door.

And you go, "Okay, so what?" And a month later, most of it goes away. So what? They're out, cognition's off. Big deal. Come on, you're making a big deal.

Well, let's look at this. Let's look at readmission data. This is Medicare readmission data. Two-thirds of readmissions in the United States are for reasons unrelated to the reason they came to the hospital. Let me make sure I say that again. So, you came in the hospital for heart failure and 10 days later, you come in for a GI bleed. I wasn't getting Warfarin or Heparin. I come in for pneumonia, and a
week or two later, I come in for heart failure. The point is that two-thirds of the problems are something that's completely unrelated and not even close to why they came to the hospital to begin with.

This is a nice paper out of Cleveland Clinic that looked at readmission and cognition. And what they found was the single greatest factor that predicted readmission was this unrecognized cognitive impairment at discharge. Hmm, maybe I could start connecting the dots. So, I'm doing stuff to people in the hospital that impairs a variety of factors, and maybe this cognition is just one of the signals that I can grasp. And by the way, if I have that signal, I'd double my readmission risk.

So, a lot of things are happening. There's a lot of noises—I mentioned, lights, camera, action—a lot of things that are going on that alter your circadian rhythm. And you go, "Why is that important?" Well, it's important in everything that's alive. We all have clock genes. Why? And who cares?

Well, it doesn't make any sense for my body machinery to gear up and get ready for all the things that are happening today—including eating food and digesting food and using that energy and putting it in the right spots and getting ready to do all this stuff—at 2 in the morning if I go to sleep at night. I mean, that would be sort of an inefficient thing. And likewise, it wouldn't make any sense to have none of that ready to go when it's 8 in the morning or 9 or whatever it is when you're really rocking and rolling.

These clock proteins regulate all these factors, and they impact everything. We make proteins, our genes make proteins. That's what they're doing right now in all of you, and 43% of them are controlled by a clock protein. It means it's timed. It's set to go off at this time, whether you like it or not. And if you monkey with that, maybe nothing happens.

Well, this is the impact on chronic circadian disruption. We know it increases heart attacks. We know it increases strokes. We know it increases cancer. We know increases diabetes, injuries. In fact, the World Health Organization in 2007 called shift work a carcinogen. … Just having shift work.

But this is the effect of a one-hour shift in time on you and me, and it occurs, unless you live in Arizona, for daylight savings. Across our nation, that one-hour shift in time—in your bed—increases stroke by 20% and heart attacks by 71%.

And after that 24 hours passes, it goes right back down. If I look at automobile accidents, if I look at fatalities on the highway, all dramatically increase that one day a year, and then it goes right back down.

That's a one-hour change in your bed. Now, you're in a hospital bed, nobody could sleep in that damn thing, and I'm doing a lot more than one-hour change. What could it do?
This is wound healing. If you get a burn and you get the same level of burn to the same amount of body surface area, the same depth, the same everything … day versus night, and if it occurred during the day, it heals 60% faster than if it occurred at night. That's legit.

This is a paper out earlier this year that if you do aortic valve replacement surgery: In the morning or in the afternoon, who do you think wins? Yeah, the afternoon wins. So when are heart attacks, ST elevation heart attacks, the highest? In the mornings. Heart failure after a heart attack: When does it occur most likely? If you had a heart attack in the morning. It turns out that there are clock proteins that alter ischemic protection. It's the Rev-ErbA system, not that any of you care about the genomic piece of this, and it's safer in the afternoon.

So, the conclusion of this paper was perioperative myocardial injury is transcriptionally orchestrated by circadian clock in patients undergoing aortic valve replacement. The Rev-ErbA antagonism is the pharmacologic strategy for cardioprotection. Afternoon surgery might provide perioperative micro protection. … If you just did this to the afternoon, you would prevent one out of every 11 MACE events. You would eliminate one. Out of every 11 patients, you'd prevent one event.

If you want to say, "I'm going to do something real simple when I get back to my hospital, I'm going to push all of these cardiac surgeries, or the valve surgeries, to the afternoon," you're going to reduce cardiac events, heart attacks, readmissions and heart failure just by doing that, because you have better ischemic protection in the afternoon than you do in the morning, until we could come up with a pharmacological way to block Rev-ErbA proteins.

This is a clock protein. The environment of care. So, we said, "OK, we know this. We understand this well. We understand that the hospital is a disaster. … We don't give you information, and it's a disaster for a circadian perspective to our patients. What if we make some simple changes? What if we just do a few simple things and see if it makes a difference? Maybe it's just a waste of time."

So, we looked at this. Here's that guy again, but this time now, he gets an iPad that gives him who his treatment team is. It's got a bio. It's got a picture of your physician and a little bio about her, and it's got a picture of your consultant and a little bio about him or her, and a picture of the nurse. And now, "Oh, so that's who Julie is, and that's who Joe is and Sam is and now I can see who's who." It tells me what my diagnoses are, and then it gives me information if I want to read about it. It tells me what my meds are right now, and I can read about those if I want.

It tells me about the upcoming schedule. "Oh, I've got CT planned for this afternoon. I got a whatever, a catheter, a pacemaker, whatever it might be. And when we're over, it's giving my results real time. So, I had labs done this morning. When they come back, I get to see them too. … Anything, there they are, real time.
Moreover, I can record the conversation with my doc. I don't know about you, I know you need to make rounds, but I can tell you this happens all the time. I'm making rounds and they go, "Oh, doctor, you just missed my wife. She was here waiting for you, and now she's down getting coffee," whatever. And I go, "OK, I'm going to try and weave my way back again, but let's go over what we're doing and what we're going on." They just hit record. They play it back for themselves, because they can't remember everything I told them, as much as I want them to, and they play it back for their spouse or whoever it might be.

Educational resources, scheduled diagnostics, et cetera. We changed phlebotomy. It was shocking to me to find out, but the average phlebotomy time in my hospital is right there, 4:57. Go right back to sleep. I'm going to come in your bed tonight, in your hotel room, open the door, pull up a thing, turn on the lights. It was like your mom when you were a teenager, getting you out of bed because you wanted to sleep late. Your mom would throw you on the floor. That's what she did with me, but the point is, yeah, now go back to sleep.

We said you can't come in unless it's timed, sometimes you have to get a timed thing every X hours. I got that. We're not interfering with that, but just routine, just your regular stuff, you can't walk in the door until after 6. I'm sorry. Too bad. And if the doctor is a little inconvenienced for a few minutes, so be it, life's tough. Our job is to improve patient care, not to make my coffee just the way I like it every single time. Don't get me wrong, I'm not against docs, but the point is, let's not put the tail before the dog.

So, we change it until after 6. Now, I didn't get into the whole lighting, but there's things called intrinsic photosensitive retinal ganglion cells that we all possess. It's a third receptor in your eye. I always thought there were two, and now I learned there's three, and these things are how you change your circadian rhythm. All I have to do is expose it to a little blue light and it changes my circadian clock. And that's why like your iPhone or your laptops have that sort of night shade, they call it.

Well, they can figure it out. We can't even do it in our place. So, we put in red lighting in each of the rooms and the nurse has to go in there just to change an IV bag or do something where they don't have to wake you up, that's the light they use. It doesn't, in fact, impact those intrinsic retinal photosensitive ganglion cells.

You won't believe the noise that occurs in your hospitals, and you don't know until you measure it. I started measuring and it was like, "Oh my God." The World Health Organization actually has a recommendation that our hospitals be under 40 decibels at night. There is. It's been that way for years. I didn't know anything about it.

And then I started measuring, and you go, "Oh, my God." There are carts going down there at 2 in the morning. Stuff like that. You learn all this stuff. And so now I'm changing the wheels on the cart to
rubber and I'm doing that kind of stuff. I mean, it's just stuff. And this has been well described in hospitals—not just mine, all over the place. So, we monitor that.

And then this is how we obtain vitals. There is no cuff anymore. This is using pulse wave velocity. It's FDA approved. So, I collect pulse, blood pressure, respiration … temperature, body position every minute, and it goes right into the EMR.

Nobody's waking them up, and it's mobile. It's wireless. They can go cruising all down the hall, do whatever they want to do. I'm collecting it, and moreover, I'm catching more data. And by the way, when there's an abnormality, it just pushes an alert to the nurse.

So, here's our outcomes real quickly. I'm not going to go through all of the outcomes. I'll give you a couple of highlights. If you look at HCAHPS data, we had a control wing. Their overall mental and emotional health were obviously much higher. Understanding about their medicines, obviously, was significantly improved because people are thirsty for that information that we were never providing for them.

Quiet around the room … much more quiet since we made an effort to do something about it. What's interesting is that as people sleep and you improve their circadian rhythm, they have less pain. And if you have less pain, you need less pain meds. Interesting.

Our length of stay dropped by about 10 hours. So, the hospital administrators love this because 10 hours is a long time. … So, our people are getting out faster, and they're coming back less.

Going to ICU has dropped, and our readmissions at 30 and 90 days—I'm just showing a 30 day, but I can show you a 90 day—has significantly dropped as well. These little changes have had rather dramatic effects.

I've got a couple of minutes left. I'm just going to show you real quickly some potential around artificial intelligence. I'm going to pick on one thing, although we'd done now several things, but let's pick on codes. Let's pick on patient deterioration, and we're talking about the inpatient setting. This happens every day for all of us. So, we all round our patients, we're doing the right thing. I'm excluding now … people that are DNRs and things like that, or hospice. We're just looking at the general population that's coming into our general hospital wards. We're staying out of the ICU for now. And guess what happens? Codes occur all the time.

In 1953, we invented—not me, the health system invented, the first one was in Copenhagen—an ICU. What a concept. And we'll take people that are really in the worst shape and put them there, and hopefully we could do a better job. And we have.

And then in 1960, we invented this concept of CPR. So, we'll train people, and here's the algorithms
you go through, and you do it this way, and here's how you do it well, and that's good and that's bad, and that's helped.

And then later on, in 1979, we started with a more advanced form of life support. And all these measures have made a difference, but they're all focused on the same thing. "I've already fallen and broken my leg. I've already coded and now I'm trying to improve my response after the fact." And there's nothing wrong with that, but this is our data today.

If you have a cardiac arrest in the United States, your chance of getting out alive is 25%; 75% mortality. If you're septic, you have a 15% mortality, but that doesn't include the 6% that are going to hospice. So that's 15% that die in your hospital, another 6% going to hospice care. And finally, if you have respiratory failure, it's a 40% mortality. We keep on focusing on the same thing, which is good, not that we shouldn't, but maybe we should start looking upstream a little bit.

So, there are a bunch of standard, conventional statistics that look at this—this modified early warning system. It's looking at, "Oh, are you a male or female?" … And the false positive rate, it's crazy, but it's capturing things here, and it's not very effective because there's a lot of sub-clinical variation. It doesn't mean you're going to deteriorate, it's just physiologic variability.

This is it. This is the most current, effective tool that you have today across the planet in predicting risk of deterioration. It's called a Modified Early Warning System. It was published years ago. Systolic blood pressure: it's a scale, heart rate is a scale, respiratory rate, temperature, after you score. Then you get a chance of ICU admission or death within 60 days—7.9% in this case.

By the way, that's me. I put myself in there. Don't worry. I did this about six months ago, so I'm not going to die or be in the ICU in the next 60 days. But the point is, like, "Wow, that's pretty crappy." And moreover, 60 days, really? It's just not very good.

So, we said, "Let's look at this, and let's run across the spectrum, from the moment you come in the hospital, every five minutes throughout." So, I can finally say, "Oh, you're really in sub-clinical deterioration." Could I predict that using artificial intelligence? That's the question.

Well, it turns out that once you hit that area of deterioration, you've got about four hours from the time you hit that where it's noticeable to when you will arrest. Four hours. Four hours is enough time. Maybe I could do something. So, could I predict it?

This is news. I don't know if you're used to looking at these C-statistics, but this is the area under the curve. A C-statistic of 0.58 is horrible. It's a little better than flipping a coin, which is what that new system is. If you get to 0.7, you have a good model. If you get to 0.8, it's a great model.

This is ours right now: it's 0.89, so we can predict with basically with 90% accuracy that this human
being is going to deteriorate rapidly in the next four hours. Now, you go, "Man, that's pretty cool."
Well, that's only half the battle because now I can say, "The fish are over there. Go fish." But if you
don't go over there and go fish, what good is it going to do?

So now you have to figure out an intervention. "Is there something we can do? Could we prevent the
code?" Just because I said something's going to happen doesn't mean we can do something about it.

... 

We outfitted these people with Apple Watches. Why? Not because we just want to be cool. Because I
have four hours. I don't have 14 hours. I can't have you miss this message, and nobody's using
beepers anymore. So yes, it'll give you a direct message to your phone, but if your phone's in your
back pocket or in your purse or you leave it in a bag, you missed it. This gives you a tap and
you look and you go, "Oh, that's exactly what it says." We're using billions of data points that it's
consuming every minute on every patient and then saying, "Look here."

Well, it worked. We ran a pilot and the pilot wasn't even 24/7. Not that I didn't want to do a 24/7, it's
just when you run a pilot, you're just begging and borrowing ... to get people and to go, "I need you to
do this kind of stuff." Running a pilot Monday through Friday, during the day, that alone, if you look at
the totality of codes, reduced all codes. It just didn't move them around, it just reduced all codes by
44%. So, imagine now we're running it 24/7, 365, and we'll see what the impact of that will be.

That's the impact of AI. And I can tell you right now, I can predict who's going to get a pressure ulcer
in my hospital before they get it. I can predict who's going to get C. diff in my hospital before they get
it. There's more, but there's a lot of things that one can do if one has good clean data and is using
machine learning in the proper fashion in those things.

Right now, what we're doing is interventions. Now we're testing, "Let's test this intervention versus
that intervention, and split test it to see what's going to be the best intervention for each of these
patient safety issues." We typically operate in that 10% of the pie. If we looked at that whole pie in
terms of behavior, genomics, environment, social circumstances, we typically live in that 10%, and if
we're going to make substantive changes going forward, we've got to open up that whole pie.

Even modest interventions that impact timely communication, behavioral and social factors,
can really yield impressive results in chronic disease care.
And finally, hospitals function to maximize efficiency of operations sometimes at the expense of
patient safety and quality. They don't do this on purpose, they just never realize they did.
Opportunities abound for improving outcomes and satisfaction.

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