FEMALE SPEAKER: Welcome to Mayo Clinic COVID-19, Expert Insights and Strategies. The following activity is supported in part by an independent medical education grant from Pfizer Inc. and is in accordance with ACCME guidelines.

CARL ANDERSEN: --Andersen. I'm a physician here at Mayo Clinic Rochester in the Division of General Internal Medicine. I've held a few practice leadership roles in our division and so got interested in telehealth in that capacity. I have some experience with implementation of telehealth at our practices. And so apparently that experience makes me qualified to give the talk here today.

So my job today will be to do an overview of the benefits of telemedicine. Luckily for me, the world of telehealth is relatively new in CME, so it allows me to claim to be an expert in this field. The counterpart of this talk is a talk by my colleague Dr. Sara Bonnes, who will be giving a discussion regarding the negatives of telemedicine. So I have nothing officially to disclose, but I will disclose, unofficially, that I'm a bit of a cynic at heart. And so it's really challenging for me to give a talk only on the positives of the subject. I'll do my best.

I'll also disclose that my practice is mainly one of seeing patients in national and international settings. My take on telemedicine will probably be very different than that of the rural primary care provider. So please keep that in mind. Also I'll disclose that while I've tried to make this talk as data--driven as possible, there are limitations in the data available to us. A lot of the data available is in outdated technology. And there's certainly a need for a rigorous RCT data in this field. So I feel it's important to disclose that.

So our objectives today are to discuss the benefits of telemedicine. I'll focus on a few main areas. So I'll focus on access and access that it provides patients. I'll focus on cost and outcome data which is relatively recent. And then I'll finish with a brief talk about safety.

So any good telemedicine talk will always start with a picture of a pterodactyl. So obviously I've started this talk with that picture. This is a picture from the Field Museum in Chicago. At the base of the pterodactyl, you'll see a few kids of my

friends. So for copyright reasons I had to take my own photos in this presentation. You may be thinking, what in any way does a pterodactyl have to do with telemedicine? And it is loosely related because the first credited reference to telemedicine was by Hugo Gernsback in 1925, in which he outlined an idea for an invention he had called the "teledactyl."

So he published this in 1925 in the *Journal of Science and Invention.* And it was a way he thought that physicians could take a history and perform a pseudo-physical exam on a patient who was not in the same location. He thought that the technology for this would involve radio frequencies and would be available to us in the United States by the year 1975. So the history of telemedicine didn't exactly play out as Hugo Gernsback had predicted, but he was correct in that the primary goal, at least in its infancy, was providing access to patients who otherwise wouldn't have it. So this was really the first goal of telehealth.

And much like other technology in our world today, innovation in telehealth received a much-needed boost from NASA-funded projects in the 1960s, aiming to provide appropriate medical care to astronauts while in space. Innovation in the area of telehealth although really took off in the '80s and '90s, and again, in that setting really focused on providing access to patients who otherwise wouldn't have good access to medical care. So they focused on the military population, rural populations, and the incarcerated population. By the 2000s, you have many more opportunities in telemedicine. And by 2015, 85% of Americans have access to the internet. 2/3 of Americans have access to a smartphone.

So some initial success stories, at least as it pertains to access-- so Project ECHO was a pilot in New York rural communities performed from 2014 to 2016 providing geriatric mental health assessment and specific, sub-specialist connections to rural primary care patients and rural primary care providers. They showed that access significantly improved. This led to increased health care utilization and total increase in cost, but decreased cost in the setting of inpatient admissions and emergency room costs.

Another success story in access involves the Louisiana State Health Care Services' response to Hurricane Katrina in 2005. They proposed a telemedicine model for prisoners. Mainly, they center around infectious disease care and mental health

care. From this study they showed that there were high rates of completion and treatment plans established in this model. They also noted higher provider and patient satisfaction in this model.

In terms of access today and in the future, so in 2016 there was a *New England Journal of Medicine* study that indicated that to patients-- the fundamental aim of telehealth is really providing access. And you can see why that would be important to patients, because in 2016 the average primary care [INAUDIBLE] in the United States has to wait 20 minutes for a 20-minute appointment with their primary care provider. And that encounter in total takes up two hours for that patient when you factor in travel times, wait times in the clinic, and time with the physician.

The goal to telemedicine in the future is to provide better care and better access to those 20% of patients that account for 80% of expenditures. It should be noted that telemedicine has the potential to address and improve disparities in health care as it pertains to race, age, disability, location, socioeconomic status. It also has the potential to worsen those disparities. So this is something that needs to be very closely monitored as we progress forward with this.

In terms of access, it's also important to note the improvements in continuity of care and triage. So there are great potentials in continuity of care specifically in the rural population. So you have primary care providers that would want continuity with their patients that wouldn't really be able to provide that continuity for location reasons. Also, it's important to note that with access it's not only important to get access to the patient, but access to the right care. So triage and telehealth medicine provides improved potential in triage. We've seen this in the setting of the pandemic, and it's important to note.

Lastly, I'll just mention that access to quality care can't take the form of inpatient telemedicine care. This is really something that was proposed and developed by Johns Hopkins. I know I'm probably going to get in trouble for crediting Johns Hopkins in a Mayo-sponsored talk like this, but I'll do it anyway. So the Hospital in Home model was something driven by Johns Hopkins with the goal of providing hospital-level care to the acutely ill from within their home, with the thought that in its best form it would improve outcomes, decrease costs, and improve the overall patient experience.

So I'll transition here. Before we transition to the next part, I did just want to mention another picture from the Field Museum in Chicago. So this is a picture of the Tyrannosaurus rex named Sue. Sue is named after Susan Hendrickson, the paleontologist who discovered her in 1990. So sue is 67 million years old. She probably died when she was around 28 years old. She had many healed injuries that they discovered from the fossil record. Interestingly to me, they can also state with confidence from the fossil record that Sue almost certainly had gout.

The segue in this talk centers around cost. So the Field Museum purchased Sue for $8.3 million shortly after the discovery in 1990, making Sue the most expensive fossil in the world by far. This is my shameless segue into a discussion regarding cost in the setting of telemedicine. So I mentioned that the infancy of telemedicine, the focus was always providing access to patients who otherwise didn't have it. It's only recently that there was a realization that telemedicine, when implemented correctly, could actually improve costs and potentially outcomes.

Despite this discussion, there are overarching concerns regarding the intuitive theory that access would lead to increased health care utilization, which would lead to increased costs, especially within Medicare patients. Because this is a talk regarding the benefits of telemedicine, I think it's my job to provide the rebuttal to that argument. So the rebuttal focuses on the potential offsetting cost savings in that model. So I just wanted to review some of the literature that's available on this setting.

So I mentioned that in the Project ECHO study from New York rural communities they saw that there was decreased costs in the form of decreased emergency department admits. This was also seen in the 2012 study with the telemedicine model in Nottingham City that showed that when they supplemented their existing face-to-face models with the telemedicine model, they saw fewer ED admits and visits. Furthermore, there is a suggestion that in certain telemedicine models you could have fewer hospitalizations and fewer hospital days.

So the AbleTo program is a national provider in telemedicine. They found within their cardiac health program those patients had fewer hospitalizations and fewer hospital days when enrolled, as compared to their standard face-to-face models.

There's also been a suggestion that when telemedicine models are implemented in nursing homes that could lead to decreased nursing home admissions. So in such a study in 2016, they found that the participating nursing homes in this study had decreased admission rates of 4.4%. That seems small, but it led to annual cost savings of $150,000 per participating nursing home, with the caveat that each of those nursing homes had to invest $30,000 in the technology required to implement that telemedicine program.

It's also been suggestion that if you implement telemedicine triage prior to ambulance transport, you could significantly reduce ambulance transport and the cost associated with that. So a study from the Houston metro area showed that if you have emergency department physicians doing triage prior to ambulance transport, with the 1,500 patients that were studied only 11% actually went on to travel in the ambulance. 75% of those triaged were able to be transported safely by taxi, and 5% ended up staying in the outpatient setting and never actually had to go into the emergency department.

Probably the most significant study in terms of a cost reduction model in the setting of telemedicine is a VA model that was proposed in 2012 and studied. So in that study, they showed that per patient that was enrolled in this telemedicine model, which augmented the face-to-face care model, they had annual cost savings of $6,500 per patient annually. This led to $1 million in system-wide savings for that telemedicine model within the VA. The questions that remain from that model were all regarding outcomes, which I'll talk about in a second.

Lastly, I'll talk about cost savings in the form of the Hospital in Home model. So this has been well studied and showed that with the Hospital Home model, as you would guess, there was decreased cost in that model. The main cost savings were in the form of COPD admissions and CHF admissions, as compared to standard of care in the inpatient standard setting.

So I mentioned that it was relatively recent that people thought that costs could be improved in a telemedicine model. It's even more recent that there's been the suggestion that outcomes could actually be improved in telemedicine models as well. So from a study in 2020-- this was a randomized controlled trial of 200 patients randomized to standard of care and face-to-face visits versus a 100% telehealth

model with wearable technology and intensive 24/7 surveillance. So they studied these patients, these 200 patients, at one year and assessed hypertension management. And there were significantly better outcomes in the telehealth model with intensive monitoring with wearable technology.

There's also been a suggestion of improved outcomes in the setting of heart failure management and follow-up. So another randomized trial with 1,500 patients again randomized to standard of care with face-to-face management and follow-up versus a telemedicine model, wearable technology, and near 24/7 monitoring for these patients, the telehealth model showed reduced mortality and decreased hospitalization rates within that population.

There have also been successes in dementia care. So this was a non-inferiority study. And the primary outcome that was studied was caregiver confidence in providing care to their loved one and ongoing management. So this outcome-- so there is non-inferiority in the telemedicine model. It also showed significant cost reduction and reported improved convenience by the patients in the telemedicine model.

Similar successes in Parkinson's management-- so 195 patients within this trial randomized to a telemedicine model of care versus standard face-to-face care. Outcome that they studied was overall patient quality of life and telemedicine model was non-inferior in this setting. So again lastly in talking about the Hospital in Home model, this was a meta-analysis of 16 RCTs which indicated that in the Hospital in Home model you had reduced mortality and reduced readmission rates, as compared to standard, inpatient care.

So I just mentioned quite a few studies. I feel it's important to mention some of the limitations in the data that exist. So many of the studies that I mentioned, as you may have noticed, involve small trials that are single center. A lot of the cost data that I mentioned is nonrandomized data, The outcome data, usually more recent studies, more randomized data in that setting, but very much limited to specific settings like dementia care, Parkinson's care-- very difficult to comment on potential for outcomes when implemented in a more global setting.

It also should be noted that many of these trials were very open about how

resource intensive a telemedicine model was, especially in the setting like heart failure, hypertension monitoring, where you had wearable technology and almost 24/7 monitoring by someone offsite. It should be also noted that there are very few examples of improvements in costs and outcomes simultaneously. I think the Hospital in Home model was able to accomplish that. There are very few examples of decreasing costs while improving outcomes within the same telemedicine model. I mentioned quite a few studies here.

There are many studies that I read that I didn't mention in the talk because they largely involve outdated technology. Most of the data that we have in this field is on outdated technology that wouldn't have a place in today's health care. I mentioned in the setting of the VA study. But while there is some suggestion that there could be improved costs and potentially improved outcomes, there is much more of a question regarding whether outcomes are actually improved when you have large telemedicine models like that in the VA study.

So I'll talk briefly about safety. I think outside of the NASA projects from the 1960s, much of the innovation in telemedicine was born out of crisis, so in the setting of natural disasters and pandemics. You have innovation in telemedicine that was seen in the MERS pandemic, and then, obviously, a real thrust towards innovation in the setting of the COVID-19 pandemic. Obviously in the setting of a pandemic and when we're dealing with transmissible disease, telemedicine offers protection to health care workers and patients. It also involves safe and effective triage, which is as important as ever in the setting of a pandemic.

While telemedicine can offer improved safety in this setting, there are also concerns that arise with privacy and security that would need to be addressed in the future if this becomes more widespread. Data in this field is severely limited, but something tells me that in the coming months we'll have a lot more data in terms of safety in the setting of telemedicine in the COVID-19 pandemic. And I won't talk about this much more because there is an entire talk dedicated to telemedicine in the setting of COVID-19 that will be given by my colleagues.

So in summary, you have many potential benefits to telemedicine. In the infancy of telemedicine, the goal was always improving access to patients who otherwise didn't have it. Still as of today that remains the primary aim in the eyes of the

patients as to what telemedicine could provide the world. It's more recently that there has been discussion regarding of how telemedicine could improve costs in healthcare. And even more recently there's been discussion regarding how in select circumstances you could have improved outcomes in the setting of telemedicine.

Obviously in the setting of pandemics and natural disasters, you have enhanced safety with a telemedicine model, as opposed to face-to-face. And although there's limited data on this, there's some data to suggest that telemedicine models , when implemented in appropriate settings, could improve satisfaction for patients and providers, for instance in the rural care setting, improving continuity of care with the primary care provider and their patient.

Some final key points-- so I mentioned I'm a cynic. I can't just solely talk about the positives of the topic. I do want to mention a few caveats. With the talk, I've talked about the benefits of telemedicine. But really, I don't want to state that telemedicine globally is superior to face-to-face care. We know that's not the case. In many ways it's inferior to face-to-face care. I think my colleague Dr. Sara Bonnes, in the counterpart talk on the negatives of telemedicine will discuss this in more depth.

In discussing access and cost, there is fairly good data to suggest cost improvement in certain settings and in certain areas. And there's a thought that those cost savings could offset some of the costs that would be generated by the improved access. While that seems a little bit more clear, the question of whether telemedicine can actually improve outcomes is a question that's largely unanswered. It's important to note that telemedicine and innovations in telemedicine do have the opportunity to address some of the disparities that exist in healthcare. It's also very possible that those could worsen these disparities. That is something that needs to be studied and it's important to note.

It's clear from the data that's available to us that telemedicine, at least in today's world, requires the proper application. So success stories in telemedicine, as you've noted from the talk, are primarily successful when they augment existing face-to-face care models. They're also successful when they're implemented in select forms in subspecialties that are naturally a good fit with telemedicine, so things like radiology, psychiatry, dermatology, follow-up care for things like dementia and

Parkinson's, which I've mentioned.

I want to again note the limitations of data that we have. There is a need for rigorous RCTs to show improvements in outcome data before telemedicine is more globally implemented. It's also important to note that the success stories in telemedicine, some of which I've mentioned here in the talk, have leveraged new technology, like wearable technology, that enables the possibility of 24/7-monitoring from the home, either in the setting of heart failure follow-up, or hypertension management, or true, in-patient care, like the Hospital in Home model, so definitely a need to leverage new technology in this area but also study it to make sure that it actually does improve outcomes.

So here are the sources that I used for the talk. Lastly, I want to thank you for your attention today. If you didn't pay attention, I have no way of knowing that. But for those of you that did, thank you for that. My email address here is listed below. If you have any questions or would like clarification on anything I talked about today, please feel free to email me. And stay tuned for the counterpart piece to this talk, which will be by my colleague Dr. Sara Bonnes talking about the negatives in telemedicine. Thank you.