Hello, good afternoon all, and welcome to our sixth and final session of the 2020 virtual CleanMed series. Our session today is clinical sustainability, environmental stewardship at the bedside. And on behalf of Health Care Without Harm and Practice Greenhealth, we are very pleased to bring you this session in partnership with the Yale Center for Climate Change and Health. My name is Shanda Damaris, and I’m a Member Engagement Manager with Practice Greenhealth, as well as a cardiovascular nurse by background. And it is my pleasure today to be moderating this session for many, many folks across the country. So welcome. I also want to recognize my colleague, Dr. Amy Collins for her efforts in co-developing this session. So thank you for joining us. We would like to thank Kaiser Permanente for supporting our virtual series this year. And while of course, we’re looking forward to future years when we can connect in-person, we do recognize the challenges that our communities, and of course our health professional audience is facing these days. And so that’s why we are excited to let you know that CleanMed 2021 will be an even larger all-digital experience.
So we’ll share more details in the coming months. And we certainly look forward to your participation in a safe, exciting, and virtual CleanMed 2021. So a quick look at our agenda today.

Just of note, the session will be recorded and it will be made available to attendees afterwards; in addition, all audience members are on mute. And so if you have questions or discussion you’d like to have during the session, please do feel encouraged to do that in the chat box. Myself and Dr. Amy Collins will be monitoring that together.

So it is my pleasure to introduce our colleagues that will be on the line to say with us. First off will be Dr. Jodi Sherman; and Dr. Sherman is a Practicing Anesthesiologist at The Center for Sustainable Health Care, at Yale-New Haven Health System. She also holds among many other roles, the associate professor title at Yale School of Medicine and Public Health. Dr. Jonathan Slutzman will also be joining us today. Dr. Slutzman has a diverse background in health care environmental research and environmental engineering.

And joining us virtually today by prerecorded session, is a Practicing Emergency Medicine Physician at Massachusetts General Hospital, and an instructor at Harvard Medical School. Dr. Slutzman has a diverse background in health care environmental research and environmental engineering.
Dr. Cassandra Thiel, is an Assistant Professor at NYU Wagner Graduate School of Public Service. And she teaches in the department of population health and ophthalmology at NYU Grossman School of Medicine.

So with that, I’m honored to hand this over to Dr. Jodi Sherman, who will kick us off.

Well thank you for inviting me. I am a practicing anesthesiologist and have been doing a lot of work in environmental health sector footprinting for the past decade.

And we thought it’d be useful for me to start the presentation with a higher level view of emissions and drivers in health care sustainability.

For disclosures, the Yale Program on Health care Environmental Sustainability, does receive funds from the Association for Medical Device Reprocessors. So why is sustainability in health care? Well, pollution is a leading cause of morbidity and mortality globally, responsible for 9 million deaths annually. Health care itself is a leading emitter of environmental emissions. And reducing health care pollution can improve the quadruple bottom line, meaning better care for the most people at the least cost, and to greatest staff satisfaction.
And engaging health professionals, which are respected leaders in communities and globally around the issue of health care pollution prevention, can be key for societal transformation by affecting public policy and by touching all the patients that we interact with. So it’s important to recognize that globally the health sector footprint is quite large. 4.6% of global greenhouse gas emissions come from health care. That’s an enormous quantity of emissions and a big responsibility, and when our commitment is to first do no harm. The U S health sector is an outlier, while only 4% of the global population, we are responsible for about 1/4 of global health care greenhouse gas emissions. On the left, this is from the Lancet Commission on Climate Change and Health countdown angle report. We see that per capita health care greenhouse gas emissions, as a function of per capita GDP, the U S is an outlier. The bubble width represents a fraction of GDP spent on health care. So we spend more than twice as much in the U S on health care, but we do not have the best health outcomes for that investment. And if we look on the right, these are trends over time. This direction in health care is going globally, not sustainable. We see one outlier here and that’s Greece.
and this has to do with economic instability, and in part related to the Syrian refugee crisis which has very much challenged their health care system. And this is just to bring up an important point that we can reduce emissions by providing less care; that’s not what we’re at all suggesting. We need to improve access to basic and good quality care globally, and it has to be done sustainably.

So delving deeper into the U S, the U S health care sector emits 9-10% of total national greenhouse gas emissions and similar fractions of criteria air pollution. So understanding what that means for public health, the public health damages from the U S health sector, around 614 disability adjusted life years lost annually.

That’s especially due to air pollution and also greenhouse gas emissions, but that’s from total environmental emissions using life cycle assessment modeling. This amount of damages in the same order of magnitude, as the 44,000- 88,000 deaths due to medical errors first identified or quantified by the Institute of Medicine and their famous to err is human report that came out in 1999. This put patient safety on the map for health care. This completely transformed the lens through which we provide health care. It is all done through the lens of patient safety.

On average, 10 years of life are lost
for those medical error premature deaths. So that’s why we’re in the same order of magnitude. To this point, we’ve been ignoring the public health impacts of health care pollution. What we’re saying is that pollution prevention is a new patient safety movement. This is just as important as protecting our patients from the care that we give, we also must protect public health. Delving in further the relative emissions that we’re within health care those emissions come from; a lot of it comes from travel; both staff, patients, visitors. A lot of it comes from the energy that is required to run facilities. This is from the National Health Sector. If you’re not, national health service, if you’re not aware of the sustainable development unit out of England, do you are heavily encouraged to look at their reports. Importantly here a takeaway is that 2/3 of the health sector emissions are coming from procurement; are coming from pharmaceuticals and heavily coming from pharmaceuticals and other chemicals as whether, as well as consumable medical equipment. Numerous studies have shown more than 60% of health care’s greenhouse gas emissions are coming from the supply chain; especially energy and upstream manufacturing.
And so health care administrators and clinicians, we control which devices and which drugs and how many that we use. Whereas manufacturers and regulators really influence embedded emissions and what goes to marketplace. So we have different ways to leverage our voice. And specifically in health care, we have a problem, particularly in the U.S.; so this concept of a candy store culture, where all the resources with rare exception of things like expensive implant devices, everything seems free. So there’s very little accountability to which and how much that we use. So this is a big part of the problem that we face in the United States. Another issue is infection control. Preventing infection is fundamental to everything that we do in health care. It is part of that safety, that patient safety lens that we view all our patient care through. It is fundamental to what we do. It is our job to prevent infection. It costs our health system a lot. And when we have an additional care that is required to take care of patients who have health care acquired infections, that also increases costs as well as the pollution footprint. And of course it’s the right thing
to do to prevent infections. But the problem is that our efforts to prevent infections are driving this trend toward excessive single use disposable device uptake as well as drug waste. And so this is an important area that we need to address.

Focusing on one type of infections, this is surgical site infections. Taking a historical view, if you were to go back a couple 100 years and you had a major surgery, you had about a 95% chance of getting an infection and maybe a 40% chance of survival. If we track the trends over time, we see the greatest change happening between 1860s, 1880, 1900. This happened along with some of Weiss and pastor and (indistinct) and Lewin Hook with germ theory, the microscope to actually prove the germs existed and then creating aseptic and antiseptic practices. So this was the greatest contribution to preventing infection and improving survivability in this case, after surgery. And then you see a slowing of the curve and another bump happening between 1930 and 1940. This was the introduction of antibiotics into our surgical protocols. And so that was the other great detriment. And then over time, you’re seeing improvements in policies and procedures around our protocols.
for antibiosis and aseptic techniques.

And so we are gradually approaching zero here.

So we have less than a 5% chance of getting a surgical site infection,

and a greater than 95% survival rate.

So if we were to continue to look at this curve,

we’re asking tonically approaching zero.

This is the infection rate,

but what we’re doing is we’re trying to get to zero.

And the question is whether or not that’s realistic,

because at the same time

we’re throwing more and more disposables at the problem,

more and more cleaning chemicals;

at the same time we’re throwing more and more resource

trying to get to zero,

we’re also increasing this hidden to date;

hidden indirect disease burden from health care pollution.

So we can’t ignore that anymore.

So ideally we find this nexus here,

it’s very hard to get there, but that’s the aspiration.

And we really have to question

whether or not getting to zero is the right goal.

And so causes of infection are multifactorial.

The most important thing

is aseptic and antiseptic practices;

most notably hand washing.

Patient health status is also important.

So patients who have diabetes and immunocompromised

are a greater risk.

Exposure site, the type of the organism, its virulence,
how much of that organism is introduced into the patient,
and then preventive antibiotics and so forth.
So the bottom line is that all these things contribute
to health care acquired infections.
And the most important thing we need to do
is wash our hands.
We don’t do enough of it, even here in the United States.
The World Health Organization
has a big initiative around this,
but we’re not gonna cure the problem
in sufficient hand washing.
And we’re not gonna cure diabetes
by throwing more and more disposable devices at the problem.
So we really need to look more deeply into these practices.
And as we’ve learned with COVID,
we’ve become so dependent on single use disposable;
not only devices for patients,
but our personal protective equipment or PPE.
So here you’re seeing reusable and disposable face masks,
impermeable gowns, or semi-permeable gowns.
And in this case, video laryngoscopes
or a type of device we use to put in breathing tubes.
We’re so dependent on single use disposables;
and with COVID, the supply chain has been interrupted.
So decreasing the amount of supplies we can actually obtain.
At the same time, we’ve seen massive surges in demand.
And so we’ve had no choice but to,
and the question is why we weren’t using more reusables to begin with, which by and large have lower environmental footprints and sometimes even are even cost beneficial. But we were caught with our pants down with the COVID pandemic; to the point where we’ve had to reuse, extend the life of reused reusable devices, and sometimes not so safely. There is a third party procedure called medical device reprocessing, which is an entire market that can clean and return reusable devices, and return reusable devices, sorry, single use disposable devices for safe reuse. And in fact, we’ve had to figure out under the Emergency Use Act, how to safely extend and reuse these devices. And we’ve done so safely to the point where it begs the question, what’s the difference between a reusable and disposable devices, if we can reuse disposables, not always, but in sometimes safely? So what is a disposable device? Well, this is a actually a label that comes from industry. So single use disposable does not mean it can’t be reused. It means that whoever cleans it assumes the risk of its functionality. Hospitals tend to not want that risk. So they’ve externalized that procedure, but only 2-3% of approved devices are currently reprocessed.
So we have to rethink and come up with better solutions to bolster the resiliency of our supply chain, which also improves environmental mission.

So we need to move from a linear health care economy, which is essentially, take-make waste where we extract materials, make them, use them, and eventually throw them away.

Principles of the circular economy are things like recycling which is probably the last thing that we wanna do. We wanna keep things in use and reuse them, repurpose them for alternative uses when we can’t, refurbish them, and most importantly, we need to reduce the things that we use, and we need to redesign them so that they are easier to clean.

So these are principles of the circular economy.

And so the intergovernmental panel on climate change came out with a special report in 2018, basically saying that two degrees centigrade is not enough. We really need to limit our emissions to get to 1.5 degrees max average temperature increase.

We’ve already seen one degree centigrade warming. This is the curve for business as usual. These are with the current policies and pledges, so even our current policies aren’t enough to get us to the Commitment, to the Paris Climate Accord, and really we need to get to one and half degrees centigrade pathway. And the reason is to reduce the,
It’s not that we can stop climate change, but it’s to reduce the worst harms that are predicted to occur, are already occurring, but especially predicted by the year 2100. We are likely to reach 1.5 degrees centigrade by 2030 and 2052. And really what it’s going to take to get us to limit to one and a half degrees centigrade average temperature rise, is to cut our emissions by 45% by 2030, and get to net zero by 2050. And those of us who are committing the most, especially in the U.S., not exclusively, we have to get there much faster. This is possible within the laws of physics and chemistry, but really what it’s going to take is political will. If you’re not aware, you should know that the national health service has committed to get to net zero. They have a legal mandate, but they have actually made a public announcement. They’re the largest health care organization in the world. They’re the largest employer in Europe, and after the U.S. military and the Chinese military, the third largest employer in the world. So in order to get to net zero, we have to measure our missions. We have to know where they’re coming from, and we need to have a plan of action.
to address where these are coming from.

So improving the electricity source.

I mentioned that most of the emissions coming from our supply chain are in the manufacturing process.

So obviously decarbonizing our electricity grid,

It’s one of the most important things we need to do.

And I invite you to read their reports which is 86 pages,

so but where do we go from here?

So importantly, we have to quantify the pollutants from all our clinical activities.

We need to include environmental emissions in the total cost of ownership as part of our overall decision-making.

Public health needs to be elevated to the level of importance of patient safety.

And it has to be right up there with what we mean by quality and value and care.

And this needs to be leveraged through accountability,

for example, through mandated pay for performance.

So the value equation typically used by health care managers includes taken from the triple aim,

that the outcomes for patients and populations need to be maximized.

Financial costs need to be minimized,

when needs to be factored in there.

are environmental missions in the social costs of care.

We haven’t even talked about social costs,
0:18:49.41 –> 0:18:51.9 things like not harming the communities
0:18:51.9 –> 0:18:54.57 that have the manufacturing plants
0:18:54.57 –> 0:18:58.29 and make our devices paying livable wages.
0:18:58.29 –> 0:19:00.06 So these also need to,
0:19:00.06 –> 0:19:02.17 so unlivable wages need to be minimized,
0:19:02.17 –> 0:19:04.1 or the social impacts need to be minimized.
0:19:04.1 –> 0:19:05.91 So earlier I mentioned the quadruple care.
0:19:05.91 –> 0:19:07.38 I don’t have a picture for that.
0:19:07.38 –> 0:19:10.16 So famously there’s the triple aim
0:19:10.16 –> 0:19:13.68 but the quadruple, the fourth leg of that has to do
0:19:13.68 –> 0:19:18.01 with staff satisfaction, that staff care about these issues.
0:19:18.01 –> 0:19:19.44 And so a summary of take home points,
0:19:19.44 –> 0:19:21.43 not all of which I’ve been able to touch upon,
0:19:21.43 –> 0:19:23.92 but that clinicians were driving health care pollution.
0:19:23.92 –> 0:19:27.61 We are the ones who decide how much to use, which to use,
0:19:27.61 –> 0:19:30.8 it is well-known we over diagnose, we over-treat.
0:19:30.8 –> 0:19:33.05 We fail to prevent disease.
0:19:33.05 –> 0:19:37.4 We fail to end, we failed to treat patients at end of life
0:19:37.4 –> 0:19:38.72 in ways that they want,
0:19:38.72 –> 0:19:43.02 and in ways that are inexpensive and minimize pollution.
0:19:43.02 –> 0:19:45.29 So that’s a big area that we need to address.
0:19:45.29 –> 0:19:47.18 There’s this problem of candy store culture
0:19:47.18 –> 0:19:49.22 and lack of accountability.
0:19:49.22 –> 0:19:52.6 And there’s excess in our infection control practices.
0:19:52.6 –> 0:19:54.56 We need to engage one another,
0:19:54.56 –> 0:19:56.49 that this is about public health.
0:19:56.49 –> 0:19:58 This is about patient safety.
0:19:58 –> 0:19:59.403 They are one in the same.
0:20:00.41 –> 0:20:02.27 Not all clinicians can get involved
0:20:02.27 –> 0:20:05.57 and care about things like making their cafeteria
more nutritious and more locally sustainable. Not every clinician can get involved trying to make their facilities more energy efficient, but every one of us cares deeply and will get involved in how we take care of our patients. So we need to engage one another and how we take care of our patients. Our choices matter, while I have not been able to address in this talk, you will be hearing from the next two speakers about using metrics to be able to discern what’s environmentally preferable in terms of drugs, devices in clinical care pathways; and how we put that all together. This process requires data. It requires more industry transparency. So the value-based payment model, particularly in the United States, needs to factor in resource conservation as how we hold one another accountable. That resource conservation is part of what we mean by quality care. This could not have been highlighted more than with the COVID pandemic. We have a moral responsibility to conserve resources and we can be held accountable to it through our payment models. We need to track our resource utilization and our emissions at the health care organization level, at the practice and practitioner level. This can be done.
We need to add environmental performance metrics to the merit-based incentive payment system. This is through (indistinct) and Medicare and Medicaid. We need to address public policy and regulatory drivers of waste and disposability. Many of us feel very powerless based on our institutional practices or departments of public health or regulations. We need to address public policy and regulatory drivers of waste and disposability. Many of us feel very powerless based on our institutional practices or departments of public health or regulations. We can challenge them. We have the ability to do that. It’s hard, but we can’t throw up our hands. We have to get involved. And then certainly haven’t talked about prevention. Self-care for us as physicians, but also for our patients; whole foods, plant-based diet, exercise, active transport, social, spiritual connections, green spaces this is all part of what has to happen in the transformation of care to prevent diseases. And certainly we need to address the social determinants of health. If we can’t lift our population out of poverty to address basic economic needs and give basic access to health care, we’re never gonna solve this problem. So we’ve got a lot of work to do today, but I’m certainly optimistic. And I thank you very much for your time. Terrific, thank you so much Dr. Sherman. We sincerely appreciate it. All right, I am happy to hand over the helm.
0:22:41.14 → 0:22:44.033 to Dr. Jonathan Slutzman, who will be up next.
0:22:51.9 → 0:22:52.82 - Thank you Shanda.
0:22:52.82 → 0:22:54.55 And thank you Jodi.
0:22:54.55 → 0:22:57.763 It’s always a pleasure to follow you as best I can.
0:22:58.6 → 0:23:00.7 So my task here today
0:23:00.7 → 0:23:05.7 is to give you the super fast brief overview
0:23:06.05 → 0:23:08.89 of health care sustainability science.
0:23:08.89 → 0:23:10.01 For those of you who are fans
0:23:10.01 → 0:23:11.54 of the reduced Shakespeare Company,
0:23:11.54 → 0:23:15.12 this is health care sustainability science, abridged.
0:23:15.12 → 0:23:16.77 Of course, if you have any questions,
0:23:16.77 → 0:23:21.13 please ask, and we’ll try to answer them afterwards.
0:23:21.13 → 0:23:24.58 As a disclosure, I have received travel funding from 3M,
0:23:24.58 → 0:23:28.74 but won’t be discussing any specific items in this talk.
0:23:28.74 → 0:23:30.73 So what is sustainability science?
0:23:30.73 → 0:23:32.51 It’s a research field.
0:23:32.51 → 0:23:34.74 It’s one where we look specifically
0:23:34.74 → 0:23:38.47 at the interactions between the natural environment
0:23:38.47 → 0:23:40.31 and social systems,
0:23:40.31 → 0:23:45.31 and how those impact the challenge of sustainability,
0:23:45.67 → 0:23:50.01 defined as meeting the needs of the present generation
0:23:50.01 → 0:23:53.12 while preserving the abilities of future generations
0:23:53.12 → 0:23:54.393 to meet their own needs.
0:23:55.46 → 0:23:58.91 There are a number of tools within sustainability science.
0:23:58.91 → 0:24:00.53 The one that I’m gonna highlight the most,
0:24:00.53 → 0:24:04.35 and you heard Jodi mention it a little bit already,
0:24:04.35 → 0:24:06.79 is life cycle assessment;
0:24:06.79 → 0:24:11.52 which is a very powerful research tool that can be used
0:24:11.52 → 0:24:14.66 to quantify the environmental impact,
0:24:14.66 → 0:24:18.58 both upstream and downstream of a product or a process
from cradle to grave; from raw material acquisition, through transportation, manufacturing, more transportation, use, reuse, reprocessing, and ultimately disposal. The idea being that if you want to compare different options whether it’s single use disposables to durable equipment, or different surgical procedures that achieve the same clinical outcomes, then you can do it in a holistic way, in a whole body perspective; the same way that we should be making our decisions as we care for our patients. So this is the super-duper five-second version of how to do a life cycle assessment. I promise you, it will not qualify you to do it after this talk, but at least it'll give you a sense for what we’ll be talking about in a few of the studies that I’ll be reviewing shortly. There are four stages to a life cycle assessment. The first is the goal and scope definition. Meaning I’m going to sit down and decide, what am I including in my system or out of my system. And what are the purposes for the study at hand? There’s a very, very different way of doing it. If you’re an end-user talking about purchasing one particular product versus another product, versus a manufacturer perhaps, who’s deciding in the production process which ways to do things.
The next is the inventory analysis. That’s where you would add up all of the emissions coming out of a product or a process, or the material inputs going into a product or a process, which leads to the impact assessment where we translate those material flows into some sort of normalized impact on different environmental qualities. And there are different categories of impacts that you might wanna include. Some that you might have heard of would be climate change potential, or ozone depletion potential or human health impacts. And then throughout the whole process comes interpretation analysis. It’s a somewhat iterative approach that as you’re doing it you’re continuing to see what you’re getting and how you can improve the process. So with that behind us, I’m going to give a really, really tiny taste of the spectrum of sustainability science in health care. Each of the four studies that I’ll be discussing are published in peer reviewed publications. And I believe that all of them are even in the last handful of years. We’re gonna start at the highest level here where Jodi Sherman and Matt Eckelman did this study with Matt Eckelman at Northeastern University.
trying to quantify what are the environmental impacts of the entire U.S. health care system. And if you've ever quoted the number that about 10% of U.S. greenhouse gas emissions come from health care, this is the source for that data point. And what Sherman and Eckelman did, was what we call an environmental economic input-output life cycle assessment where they took data, economic data on spending patterns essentially, for U.S. health care, and used translation tables, their economic input-output tables that try to connect a dollar spent in one particular field, where does that then go? And what are the emissions potentially associated with that? For example, if you spend $10 on ground transportation or $100 on pharmaceuticals, or $1000 on durable medical equipment, what are the emissions associated with that? And those kinds of data are great for looking at very large scale systems. You can imagine that what I just described before of doing a life cycle assessment, adding up all of the inventory components for your product or your process, can be quite tedious even for a simple small scale item like the pad of paper that's sitting on your desk right now for you to take notes.
There are a lot of steps that go into that. So imagine trying to do that for a health care system as a whole, it is prohibitively complex. So that’s where economic input-output comes along. And you get these really interesting results where you can look at over time, in this case, the greenhouse gas emissions associated with the U.S. health care system as a whole. And what you can see is that, for the 11 years, both the proportion of total U.S. greenhouse gas emissions from health care has increased as well as the absolute number. So a number of industries actually decreased over that time, but health care continued to grow, and it shows the extent of the challenges. So if you look beyond greenhouse gas emissions and see that there are other output categories or environmental impact categories; you can get these kinds of results where you have an absolute number in some normalized unit. For example, if we look at the ozone depletion potential, it’s measured in kilograms of CFC 11 equivalence, and you can see what the health care total is versus the national total. And then the fraction that health care represents including the global warming potential up at the top,
which is that 9.8, nearly 10% number. So let’s move down from what this might have been, let’s say the 50,000 foot study, and go down to about 10,000 feet. And here we have a study by McNeil Lily-White and Brown of carbon footprinting of operating theaters. This study was done by some Britains and some Canadians. So they call it an operating theater, where I come from they’re operating rooms, but this was done looking at three different hospitals on three different continents. Vancouver General Hospital, the University of Minnesota Medical Center, and the John Radcliffe Hospital in the U K National Health Service. And what they did was looked at the scope one, scope two, and scope three emissions from the operating room complex at each of these hospitals. It turns out that they’re not terribly different in size, so we can compare the numbers closely enough for our purposes. And in scope one, they had direct emissions of anesthetic gases, scope two were purchased energy, or they actually moved their onsite energy generation for heating into the scope two number of it. It made sense for their purposes, and it doesn’t change the total. Although many people would consider that in scope one.
And then scope three, they considered the supply chain for the operating rooms. And what they did was this hybrid greenhouse gas footprinting study, where they apply readily accessible and accepted greenhouse gas emission factors for their anesthetic gases and their energy generation based on grid and fossil fuel burning emissions. And then for the scope three emissions, which are the hardest to quantify, they basically did waste audits, and extrapolated to a year of waste generation separated into the predominant material which not surprisingly was mostly a variety of plastics, and then apply the factors for those. And what you see is that they’re pretty large differences in the greenhouse gas emissions footprints from these three different sets of operating rooms. With the number that jumps out, the biggest to me, is the huge difference in scope one emissions between these three hospitals with Vancouver General being fairly comparable; but the John Radcliffe Hospital being immensely lower. And that is, if you look in the top left table, predominantly driven by zero deaths fluorine use at John Radcliffe Hospital, it’s just not available on formulary. And Dr. Sherman can wax poetic about the benefits of doing that at your own hospital.
This kind of a method is really useful, for again, a larger scale study, but you can quibble a bit about that, that scope three emissions number, which as I said, is really challenging to quantify. So let’s move down from the 10,000 foot level to more the 1000 foot level. And look at a process life cycle assessment where somebody would look at the individual components of a product or a process, and add that up, and get the emissions associated with that. Here we have another study by Dr. Sherman and Eckleman with Lewis Radley, assisting in the middle there. This is a life cycle assessment and a life cycle costing assessment of laryngoscopes. It’s possible that at many of your facilities, you’ve seen a transition from reusable, durable laryngoscope, handles and blades, to some combination of disposable blades and potentially disposable handles as well. And as Dr. Sherman said, this is based on the potential for infection control with variable benefits. But let’s answer the question of what are the environmental impacts? So the first figure that you see, is that the scope of boundary of what was included in the study and the different phases of the life cycle assessment that we talked about initially,
and then the bottom of the lab boxes is the costs that were included. So here we have some results. Again, similar to that large scale, 50,000 foot total health care system study, you have the same impact categories. You're just looking at a different set of options, and this is comparative rather than temporal. So we’re not looking at the same system over time. We’re looking at different options within a system. And these results are scaled so that the lowest impact is one, and the others are multiples of that. So you can see that in almost all categories, the multi-use blades, and multi-use handles under high level disinfection, have the least environmental impacts with single use disposable devices, in some cases hundreds of times more impactful on the environment. And you can make really pretty charts that show you just visually strikingly how different these are; but what’s most striking about this study, I think, is the life cycle costing piece. And this chart right here, you’re seeing the emissions. So these are greenhouse gas emissions. And then you can go to the next chart which is the same options in the same order, but here we’re looking at the costs. And it’s worth noting that the ones that are the most environmentally impactful,
also happen to be the ones that are the most expensive. So this is not necessarily a case where we’re gonna save money by using single use disposables, by not spending money on reprocessing. This is a case where doing the right thing environmentally will often help your financial bottom line as well. We’ve gone from the 50,000 foot level to maybe the 10,000 foot level to the 1000 foot level. And now we’re gonna go to ground level, and do some dumpster diving. This is from an emergency department waste audit. This is the most recently published of the studies that we’re reviewing today. And this is one of mine, done with Sarah Sue at Brown and Cassie Thiel here, you’re gonna hear from in just a minute or so, Mike Mellow at Brown, and then I was leading this study. We did perhaps one of the simplest kinds of health care sustainability studies there is, which was taking all of our trash and dividing it, and measuring it, quantifying it and reporting it. And this was the first time that a North American Emergency Department really did a dedicated waste audit. These numbers represent 100% of the waste generated from our emergency department in 24 hours, with the exception of pharmaceutical waste; which is complicated, why we didn’t do that but it’s actually a really small number for our facility.
And the take home message is, that over the course of one day, we generated about 1400 pounds of waste. The vast majority of which was plastic. And if we extrapolate that over a year, we’re talking about somewhere around 225 tons of waste, just from one emergency department. The disposing of that waste for one day, just the disposal, not the upstream impacts, but just the disposal, is equivalent to driving your average car 7,700 miles; which for some people is actually more than a year of driving; just disposing of one day of our waste. So it can be quite impactful. And then as you saw from the McNeil Study, these waste audit numbers can then be an input for additional footprinting studies. So our key takeaways: sustainability science can identify many things that we can do that can have marginal environmental benefits and an aggregate can be quite significant. And some of the things we identify can be pretty big on their own. However, these larger scale economy-wide shifts. Like Dr. Sherman mentioned, energy source changes in the UK, can have a much larger impact. And that I want you to take away that life cycle assessment is an extremely powerful tool.
0:39:11.9 –> 0:39:16.13 for making these evidence-based clinical procurement
0:39:16.13 –> 0:39:17.91 and other decisions when it comes to
0:39:17.91 –> 0:39:20.34 what is best for us environmentally.
0:39:20.34 –> 0:39:21.173 And with that,
0:39:21.173 –> 0:39:24.053 I will say thank you and turn it back over to Shanda.
0:39:26.99 –> 0:39:29.31 - Excellent, thank you so much Dr. Slutzman.
0:39:29.31 –> 0:39:31.92 This has been terrific.
0:39:31.92 –> 0:39:34.1 All right, so now I am eager
0:39:34.1 –> 0:39:39.1 to get Dr. Cassandra Thiel session up and rolling here.
0:39:39.1 –> 0:39:41.05 And so she is not able to join us today unfortunately,
0:39:41.05 –> 0:39:44.08 but we will hear her Zoomed in.
0:39:50.27 –> 0:39:51.103 - [Cassandra] All right.
0:39:52.17 –> 0:39:53.85 Well, thank you very much for having me.
0:39:53.85 –> 0:39:55.1 I’m sorry I can’t be there in person,
0:39:55.1 –> 0:39:58.29 but I’m glad to be able to share some of the work
0:39:58.29 –> 0:40:00.61 that myself and colleagues have done in ophthalmology
0:40:00.61 –> 0:40:03.333 to work on sustainability in clinical care pathways.
0:40:03.333 –> 0:40:05.46 Let me (faintly speaking) slides.
0:40:05.46 –> 0:40:07.85 So why are we looking at ophthalmology?
0:40:07.85 –> 0:40:09.8 It’s a really interesting specialty.
0:40:09.8 –> 0:40:12.28 One, they perform a lot of surgeries
0:40:12.28 –> 0:40:14.53 and surgeries are resource intensive and quite wasteful.
0:40:14.53 –> 0:40:18.43 and surgeries are resource intensive and quite wasteful.
0:40:18.43 –> 0:40:20.27 This is just one of my favorite studies,
0:40:20.27 –> 0:40:22.48 is from a Neurosurgical Department out of California,
0:40:22.48 –> 0:40:25.12 but they monitored How many of their supplies
0:40:25.12 –> 0:40:26.61 they were throwing out without being used.
0:40:26.61 –> 0:40:29 And found it was about 13% of their total supply costs,
0:40:29 –> 0:40:30.81 were completely unused.
0:40:30.81 –> 0:40:33.44 If they could somehow not waste those materials,
0:40:33.44 –> 0:40:36.49 they would save about $3 million a year in their department.
And this is very common across all surgeries, even within ophthalmology. So it’s a good area to focus on. Another reason we’re looking at ophthalmology is because it’s a large specialty. So they performed cataract surgeries kind of their bread and butter. And basically everyone needs cataract surgeries, if you live long enough. It’s one of the most performed procedures worldwide. And in the U S, we spend a lot of money on cataract surgeries. About 1/2 of that spend is coming from Medicare, and cataract surgeries alone account for 12% of Medicare’s budget. So this is a really big reach within a specialty, and beyond that it’s actually growing, right? So we have more people, they’re getting older, and we’re also trying to expand capacity into regions where they previously didn’t really have a lot of ophthalmologists or access to eyecare. So this has a lot of potential for change. And that was one of the exciting reasons to look at ophthalmology specifically. So what do we know about what’s going on ophthalmology? Well, there was a study that was published 2013 out of the U K, it was on carbon footprint of cataract surgery. The most common form of cataract surgery in developed countries
0:41:41.17 –> 0:41:43.72 is called phacoemulsification or phaco.
0:41:43.72 –> 0:41:45.89 And so they looked at phacoemulsification
0:41:45.89 –> 0:41:48.09 and found that it emits about 180 kilos
0:41:48.09 –> 0:41:49.5 of carbon dioxide equivalence.
0:41:49.5 –> 0:41:51.9 So these are the greenhouse gas emissions.
0:41:51.9 –> 0:41:54.02 That’s a good one to a British person living for a week.
0:41:54.02 –> 0:41:55.05 And this is first surgery
0:41:55.05 –> 0:41:58.6 that lasts anywhere from 30 minutes to an hour typically.
0:41:58.6 –> 0:42:01.84 Over 1/2 of those emissions
0:42:01.84 –> 0:42:02.82 were coming from procurement of supplies,
0:42:02.82 –> 0:42:06.12 for those of us who study life cycle assessments
0:42:06.12 –> 0:42:08.65 or carbon footprints of surgical procedures.
0:42:08.65 –> 0:42:11.95 A lot of the footprint comes from the supplies.
0:42:11.95 –> 0:42:13.58 And of course in the U K, similar to the U S,
0:42:13.58 –> 0:42:16.16 a lot of the supplies are single use and disposable.
0:42:16.16 –> 0:42:19.603 So this led to some interesting thoughts.
0:42:20.91 –> 0:42:22.28 My first thought was,
0:42:22.28 –> 0:42:24.13 okay, so we have these developing countries
0:42:24.13 –> 0:42:25.35 where everything, or sorry,
0:42:25.35 –> 0:42:26.55 developed countries where everything
0:42:26.55 –> 0:42:30.02 is kind of on a single use disposable end of the spectrum,
0:42:30.02 –> 0:42:31.55 but there’s gotta be other places in the world
0:42:31.55 –> 0:42:32.597 where that’s not the case.
0:42:32.597 –> 0:42:34.67 But these surgeries are conducted everywhere.
0:42:34.67 –> 0:42:36.84 Not everyone can afford
0:42:36.84 –> 0:42:39.48 to use supplies in the same way that we do.
0:42:39.48 –> 0:42:42.84 And so this took me to a health care system
0:42:42.84 –> 0:42:45.8 called Aravind Eye Care, it’s in Southern India.
0:42:45.8 –> 0:42:46.67 They’re very notable.
0:42:46.67 –> 0:42:47.89 There’s actually a Ted talk on them
if you wanna learn more about what they do, they really developed out of financial efficiency models. So their founder initially thought, if McDonald’s can make hamburgers so cheap for everyone around the world, why can’t we make cataract care just as cheap for everyone around the world? So their mission is really geared at providing eye care for people who can barely afford it. And so they’ve designed a surgical center here that is very efficient, but is looking at reducing costs to the point where they can be a profitable health systems. They don’t rely on donations, they’re consistent. But where people can pay either the market rate or anything below that down to zero. So I think it’s about 2/3 of their surgeries or 1/2 of their surgeries are free or reduced rate. And with the people who pay the full rate, they’re actually a profitable model. And so it was really based out of finances, how they develop their efficiency. But I went there to look at, of course, the resource use; because that does tie into that financial efficiency. So here you can see their operating room, a little different from in the U S, we have four beds and two surgeons. So one surgeon operates on two beds. Typically they’re operating on one bed while the other one’s being prepped. They’ll flip all the equipment over, operate on that one,
while the first one is being kinda cleaned up and the next patient is brought in and they just go back and forth between the beds. So this really reduces their overhead. And you can also see that they have a lot of reusable supplies here. This is prior to COVID, things have changed a little bit during the pandemic; but essentially they have all reusable masks, gowns, head coverings, drapes, all of that stuff is reusable. So they’ve really cut down on the resource efficiency or resource use. And you may be wondering now, well, that’s all well and good, but what about infection control practices? And that’s where Aravind was particularly interesting to look at because they have really good metrics for their complication rates, rates of success, post-surgery, and they’re actually better than the U S in quite a few metrics. So that last one there, the rates of endophthalmitis is an eye infection that is not very common, but it’s one of the worst outcomes you can get in a cataract surgery. And you can see the rates for that are much lower than the U S. So this is a really interesting place to look, because they’re clearly doing their surgeries well, but in a very different way from how we do things in the U S.
0:45:16.41 –> 0:45:18.61 So while I was there and monitored their waste generation,
0:45:18.61 –> 0:45:21.137 this is just one visual for how different things are.
0:45:21.137 –> 0:45:25.3 And we have one phaco in the U S on the left,
0:45:25.3 –> 0:45:26.83 it’s the garbage produced there;
0:45:26.83 –> 0:45:30.45 and 93 phacos are ovens on the right.
0:45:30.45 –> 0:45:33.05 So a huge difference in the amount of materials
0:45:33.06 –> 0:45:35.283 that we’re using in each of these surgeries.
0:45:36.48 –> 0:45:38.25 This is look at the carbon footprint.
0:45:38.25 –> 0:45:41.77 So this is comparing Aravind to that U K based study.
0:45:41.77 –> 0:45:43.22 And what you’ll notice is that,
0:45:43.22 –> 0:45:45.41 of course, the U K has a much higher footprint
0:45:45.41 –> 0:45:49.23 than Aravind does for the same procedure.
0:45:49.23 –> 0:45:51.66 So it’s like driving car 500 kilometers in the U K,
0:45:51.66 –> 0:45:53.283 versus 25 kilometers in Aravind.
0:45:54.82 –> 0:45:57.19 And it’s just really interesting to note this, right?
0:45:57.19 –> 0:45:59.72 We have the data now to show the resource use
0:45:59.72 –> 0:46:02.22 and these are just some ways to visualize it.
0:46:02.22 –> 0:46:04.85 So Aravind has some really interesting takeaways
0:46:04.85 –> 0:46:06.17 that we could potentially bring back
0:46:06.17 –> 0:46:09.03 to more developed countries.
0:46:09.03 –> 0:46:11 The first one is really about their physical layout.
0:46:11 –> 0:46:12.87 So they paid very close attention
0:46:12.87 –> 0:46:14.75 to setting up their operating rooms,
0:46:14.75 –> 0:46:18.84 in a way that would optimize for the surgeries themselves.
0:46:18.84 –> 0:46:20.89 So it’s set up a lot like an assembly line.
0:46:20.89 –> 0:46:24.05 It may be uncomfortable for a lot of patients in America,
0:46:24.05 –> 0:46:25.02 at least to go through this;
0:46:25.02 –> 0:46:26.68 in India, didn’t seem to be a problem at all
0:46:26.68 –> 0:46:29.98 but the patients are always the ones who are waiting.
0:46:29.98 –> 0:46:32.89 It’s never the surgeons or the surgical teams,
0:46:32.89 –> 0:46:34.92 because they’re the high value item.
0:46:34.92 –> 0:46:37.71 So patients are kind of ushered through the system.
0:46:37.71 –> 0:46:40.21 They’re given their preoperative drugs.
0:46:40.21 –> 0:46:42.18 They go through anesthesia
0:46:42.18 –> 0:46:43.85 prior to going to the operating room.
0:46:43.85 –> 0:46:46.327 They are led into the operating room and let out.
0:46:46.327 –> 0:46:48.19 But the surgeons always have
0:46:48.19 –> 0:46:50.35 someone available to operate on.
0:46:50.35 –> 0:46:52.13 And it’s part of that is the physical layout,
0:46:52.13 –> 0:46:55.08 the flow of the patients through that system.
0:46:55.08 –> 0:46:57.14 They also engage in what’s called task shifting.
0:46:57.14 –> 0:46:59.02 So this is basically,
0:46:59.02 –> 0:47:01.51 they’ve trained a lot of young women actually,
0:47:01.51 –> 0:47:03.39 there’s a different story on that end of the spectrum.
0:47:03.39 –> 0:47:05.19 But young women from the community
0:47:05.19 –> 0:47:07.97 are trained up basically as nurses,
0:47:07.97 –> 0:47:11.095 they call them mid-level ophthalmic professionals;
0:47:11.095 –> 0:47:13.97 and they handle a lot of these other tasks
0:47:13.97 –> 0:47:17.253 so that the surgeon can focus just on cataract surgeries.
0:47:18.1 –> 0:47:20.9 So the woman in the center here is their scrub nurse,
0:47:20.9 –> 0:47:23.6 the two in green, in the darker green,
0:47:23.6 –> 0:47:25.1 they’re the ones bringing the patients in and out.
0:47:25.1 –> 0:47:28.13 They do the preoperative work and the post-operative work.
0:47:28.13 –> 0:47:29.66 Because you don’t necessarily need a surgeon
0:47:29.66 –> 0:47:31.32 to do those things.
0:47:31.32 –> 0:47:32.4 So this allows the surgeon
0:47:32.4 –> 0:47:35.823 to just do cut to close cases all day in.
0:47:37.31 –> 0:47:38.64 Standardization is another thing
0:47:38.64 –> 0:47:41.52 that Aravind has gotten very good at.
0:47:41.52 –> 0:47:42.353 They have standardized
Of course, the pathway steps for the patients.

So every patient’s doing the same thing all the way through the surgery.

They standardized the instrumentation.

I think this is really important, because in the US we see a lot of variability in what materials are used during the surgery, even if we have custom packs or standardized kits.

So every surgeon might use a different proportion of those things.

And even for reusable items that can lead to a lot of wasted effort, because we have to clean the whole kit, even if it’s not used.

So Aravind has standardized those instruments phase.

And pretty much every surgeon uses almost everything that’s in there every time;

which leads to this third part of standardization, which is the surgical approach.

So there’s very little variation between surgeons on how they operate,

which means it could be a little bit boring for the surgeons themselves, right?

They’re able to do the surgery in about five to 10 minutes instead of the half hour to an hour, it takes here.

So you can imagine if you’re operating on 40 people a day,
doing the same procedure over and over,
it could get a little bit boring.

But the benefit of that is that everyone on surgical team
knows exactly what’s happening. And with that standardization, I think that actually improves your outcomes as well. Another thing they focus on of course is reducing their waste. Waste is just money thrown out the door. And to do this, they maximize reuse, and that includes their drugs. Their drugs are all multi-dose. So they’re not throwing out partial bottles. They’re using them on multiple patients, as long as they’re safe. And they’re able to basically reduce how much garbage they’re producing, and also minimize how much material they’re bringing into each surgery. Finally, and this is the most important, they’re maintaining their safety. So they can’t maintain, they can’t actually achieve their mission, right? Of a high value eyecare for low costs, if their surgeries are not doing anything good for their patients. If the patients are leaving worse than they came in, and then there’s no point in doing this at all. And that’s probably the ultimate waste, right? Is surgeries that don’t go well. So they’re really careful about maintaining safety, about making sure that everything needs to be sterilized between cases is sterilized, and that’s really key to their model for its success.
So to go back into the U S, we see a lot of variability in our cases. This is just to look at surgical supply costs for phacoemulsification of five different U S facilities. And you can see a wide range in cost of supplies, whether it’s kind of the purple stuff on the bottom, which are the single use supplies, or if it’s drugs or the IOLs, inocula lens that they’re replacing the cataract with. Here’s our ovens costs, so much, much smaller of course. We wanted to focus a little bit more on the drugs here because it was a contentious point for a lot of the surgeons we were talking to, may find they were throwing away so much of it unnecessarily. So we went in to four different medical centers in the Northeastern U S, and just measured how much of these drugs were thrown out after every cataract case. And here are our findings, right? The eyedrops in particular, were heavily wasted between patients. So these are, they’ll put a couple drops on a patient’s eye and then they have to throw out the whole bottle. Even if the bottle is labeled as multi-dose, as is the case with dilating drops, even if the bottle is something that the patients would be using after their surgery, as this case of antibiotics.
And you can see for eyedrops, that almost 80% of the drugs are thrown out at two of our sites. This has financial cost, right? You pay for those drugs at those two sites that threw out the most, that’s $190,000 worth of drugs run out each year from cataract surgeries. That would pay for an additional 53 cataract surgeries at each location, if we somehow didn’t throw them out. On the environmental side, of course, we’re manufacturing and delivering these drugs, and that has a carbon footprint. So the two sites that wasted the most are throwing out about 105,000 metric tons of CO2 unused. We’ve already admitted those and we’re not even using them. That’s like driving a car between Alaska and Florida, 51,000 times a year. And these are just like a single site. That’s throwing away these drugs in their cataract surgeries. So there’s a lot of waste happening here. This led us to conduct a national survey, right? We’re wondering if what we’re observing in our surgeons is universally true, where they’re frustrated with the amount of waste. So we surveyed members of the top four ophthalmological societies, and had about 5% of the U S ophthalmological population respond. And the major conclusion,
is yes, they’re concerned about climate change. Yes, they’re concerned about how much trash is generated in the operating rooms. We asked them very specific questions about what drugs or supplies they would consider reusing or multi-using. And there was actually a surprising number who were comfortable with that, that they would prefer reusable over disposable. But they felt that there was too many regulatory barriers to doing so, is a liability issue more than anything else. So they wanted more discretion to reuse, and they also wanted manufacturers to do more to consider the carbon footprint. So these are some really interesting takeaways that led for two of the ophthalmological sites that led for two of the ophthalmological sites to join the medical society consortium on climate and health. So they’re engaging a little bit more on this political side. So overall, what I love for you to take away from this particular presentation is that low resource settings may be a great place to look for more efficient resource use. And the surgeries are conducted all over the world. There are sites globally that are doing this very well, but with a very different resource use profile. Not every place can afford to throw away supplies like we do here in the U.S. And so if you’re looking for ways to change that, there are great examples already out there.
And I think another of this is that we’re all individually passionate about this, but at some point we have to build this up to a larger level and engaging with your professional societies is a great way to leverage those collective voices. It helps to gather the data of course, to have carbon footprinting data, perhaps even surveys to show how widespread this interest is. But engaging those professionals societies is a really great way to try to create political change much more quickly. And finally, I like to say this, 'cause a lot of physicians are a little anti-industry and I can understand why.

But industry is part of this puzzle as well. So the people who manufacture these devices also set the instructions for use and influence regulation on them. And you’re not gonna change the system without engaging industry as well. So these are some of the major things that I think could really help any specialty who’s looking to change their carbon footprint and make health care more clinically sustainable. So I have a few funding support shown here, that I’d like to thank, and of course, lots of research partners. So I will leave it at that. If you do have any questions, please feel free to email me. I may be on maternity leave for the next few months,
but I will try to get back to you. Thank you.

Fantastic, and apologies again for not having Dr. Cassandra Thiel in person with us, but we are very grateful that she was able to do that ahead of time.

All right, so as we close out the session here, we really only have a short moment to do a Q&A.

And so I want to open up the question for maybe a 60 second answer for each of our panelists on the line.

How have you been able to incorporate environmental sustainability into your relationships with patients or colleagues, to really spread this as part of the culture within your health system, or roles with other organizations?

I'm happy to go first. As an anesthesiologist, it's less a conversation I have with my patients. It's just not something that comes up. But I have it every single day with my colleagues. And basically my observation is driven every single research question that I've addressed.

Just as an example, the question about reusable versus disposable laryngoscopes that came about because there was a sweeping trend toward disposable laryngoscopes.
0:56:07.01 –> 0:56:09.15 that was (indistinct) evidence-based.
0:56:09.15 –> 0:56:12.51 It came from a loophole in the regulations,
0:56:12.51 –> 0:56:16.5 and how it was interpreted by the joint commission.
0:56:16.5 –> 0:56:18.53 And so after doing,
0:56:18.53 –> 0:56:23.28 not only LCA looking at the emissions and costs,
0:56:23.28 –> 0:56:25.74 we also, I also had to do a careful review
0:56:25.74 –> 0:56:27.12 in the infection control literature,
0:56:27.12 –> 0:56:30.33 and there was nothing to substantiate the transition.
0:56:30.33 –> 0:56:31.73 So that has been an ongoing battle.
0:56:31.73 –> 0:56:34.72 And that is just one device out of thousands.
0:56:34.72 –> 0:56:36.15 But as a conversation I have every day,
0:56:36.15 –> 0:56:38.65 I work in a teaching institution every day.
0:56:38.65 –> 0:56:43.04 My residents are drilled on both resource conservation
0:56:43.04 –> 0:56:45.21 and environmental preferable practices,
0:56:45.21 –> 0:56:47.57 where we have data in my specialty
0:56:47.57 –> 0:56:49.61 because of my research collaborations.
0:56:49.61 –> 0:56:50.78 We have a lot of information,
0:56:50.78 –> 0:56:52.78 but that’s not true of many specialties.
0:56:55.12 –> 0:56:56.89 - Thank you Dr. Sherman
0:56:56.89 –> 0:56:57.723 - I would add
0:56:57.723 –> 0:57:00.85 that it’s challenging in the emergency department
0:57:00.85 –> 0:57:03.62 to have long conversations about topics
0:57:03.62 –> 0:57:07.37 that are not directly germane to the care at hand,
0:57:07.37 –> 0:57:10.72 but with my patients, certainly patients
0:57:10.72 –> 0:57:13.52 who come in with asthma exacerbations,
0:57:13.52 –> 0:57:17.92 or respiratory illnesses, or heat exposure,
0:57:17.92 –> 0:57:19.89 or plenty of other conditions,
0:57:19.89 –> 0:57:21.92 I’ll frequently mentioned that;
0:57:21.92 –> 0:57:24.17 if you’re wondering why this is happening,
0:57:24.17 –> 0:57:27.17 allergens are a lot worse now than they used to be.
0:57:27.17 –> 0:57:31.28 And heat exposure is an important factor.
And then certainly with my colleagues, both on the clinical side and the administrative side, I have conversations at least daily about the environmental impact that we have and how it’s harming our patients. So it’s a big factor in our clinical care.

Thank you so much Dr. Slutzman.

As we wrap up here together everyone, I just wanna share gratitude again for my colleague Dr. Amy Collins, of course, our presenters today; Dr. Jodi Sherman, Dr. Jonathan Slutzman and Dr. Cassandra Thiel.

And if you’re interested in learning more, check out these websites and resources, especially the Physician Network and the Nurses Climate Challenge.

As a reminder, this session will be posted on the website linked below. And if you have further questions after this session, feel free to reach out to either myself or Dr. Amy Collins.

Thank you again for joining us all during this challenging time in health care, and we are so grateful to have so many allies in this work.

Stay safe, stay healthy, and thank you all. Bye now.