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Beth Taylor, DCN, RDN-AP, LD, CNSCBeth Taylor, DCN, RDN-AP, LD, CNSC : I am going to address the first two objectives that we mentioned earlier. Real quick, the role of lipids in parenteral nutrition. We know that they have a triglyceride core, what is different is what is the source of fatty acid. That source of fatty acid is going to drive how much or if we give optimal essential fatty acid source, the linolenic, remember in the alpha-linolenic, taking you back, it is also going to determine how much of the phytosterol levels are in that lipid, the source of the fatty acid. You will see I have a little thumbs down there because those are the things that are not really metabolized well and can lead to some cholestasis. It is also going to determine how much alpha-tocopherol levels or antioxidants that are provided via those lipids, and that gets a thumbs up because that is going to help scavenge free radicals. But all sources of lipids are a good calorie source. So, sometimes we just need to give calories to our patients and all of them are a good calorie source. And remember, we need some lipids because they are pre-cursors to many systems that are going on and they are parts of our cell membranes. So, lipids are not a bad guy, we need to include those in our PN at some point. Now I know that everyone has seen these pathways; we talk about them all the time. The omega-3, omega-6, and omega-9. So, I have got a little thumbs up next to the omega-3 because it is the less pro-inflammatory response pre-cursor of all of the unsaturated fatty acid pathways because it has the EPA, DHA, and the 5-series leukotrienes. Then, we have the omega-6. It gets somewhat of a thumbs down because it leads to arachidonic acid and the eicosanoids that really can drive—have a little bit more of an inflammatory response. Then, the omega-9, which I am not ever

sure how to interpret it, but sometimes it is supposed to be inflammatory, kind of neutral. Then, I am going to mention to remind you what we do tetraene to triene ratio, and Carol will mention this in her case. What does that mean? You are measuring the mean acid, which is an omega-9, and you're measuring the arachidonic acid in the omega-6. How did our lipids evolve over time? You can see here, I think most of us were at Dr. Dudrick's opening lecture. He is the reason we are here. We started back in the 60s with soy bean oil, and then we introduce the MCTs, which burn up really quick 'cause they are more easily absorbed. Then, we went to structured and olive oil lipids, the olive oil giving more of the omega-9. Then, we introduced the fish oil–containing lipids, fish oil omega-3s. But the pure fish oil, we have to remember, because it is pure fish oil, is an incomplete lipid source. Another way to look at this, is also what I kind of mentioned in that first slide, is how much of everything they provide. In that first generation, the 100% soy bean oil, you will see that it is a really good source of our essential fatty acids, our linoleic, and our linolenic. I want you to take a look, if you look at the ratio omega-6 to omega-3s, 7:1, and it has how much of the thumbs up, thumbs down, alpha-tocopherol and the phytosteroids. Sterols, not steroids. Then I highlighted the other one that we actually have in the US. That is the reason those are in blue, just because at this moment in time, that is what is available to us. And you can kind of look at the lipid source, you know, how much of the soybean oil in each, and what they are composed of. But you will notice in the four-oil that we are dropping. It is a little less of the essential fatty acids, but more of the thumbs up and a little less of the thumbs down. What do the guidelines tell us? They tell us that, the critical care guidelines, we thought we would limit soy initially in the critically ill for the first week in

that acute phase. And that is kind of where the other guidelines have sort of fallen, that maybe we need to look at some alternative lipids, though could be considered. This are the doses of what you would have to get to give your essential fatty acids, and you will notice that you have to give a little bit more of the four-oil in order to get your essential fatty acids in. Lipid dosage recommendations between the two that we have now. Less than 1 g/kg for critical care in the soy, and for stable, you can go 1 g/kg, with a maximum of 2.5. Now in the four-oil, that recommended dose can go a little higher, 1 to 2, again some maximum 2.5. We would hold both of them for triglycerides over 400. We have an infusion rate cutoff for soy, and we are not sure at this point what would that infusion rate cut off or if there needs to be one for the four-oil. Now, really quickly, I am going to introduce a few meta-analyses in my last few seconds. We are not going to dive deep into them but just to show you what is out there. Now, you notice the data on this one is 2012, so it was not done here in the US because we did not have anything but soy at that time. But this one was looking at any emulsion with omega-3 versus those that did not have omega-3, and when they pooled these 23 studies together, what they found was really no difference in mortality rate, but if you kind of get down toward the bottom, they were starting to see reduced markers of inflammation. The follow-up meta-analysis by Manzanares in 2015 compared fish oil emulsions with non–fish-oil emulsions, 10 randomized control trials. You can see the findings here: no effect on the big guns, but started to get some reductions. The Honeywell meta-analysis just came out here in 2018. It repeated any emulsion with fish oil versus those without, and this is what they found. In their outcomes, they saw lower triglyceride concentrations, markers of inflammation, and liver function enzymes, just trends toward decrease in the bigger

gun outcomes. Last but not least, I will just introduce this one small randomized control trial that looked at four-oil versus soybean. It was well done. It was a double-blind randomized control trial, but small, just 30, a few over 30 patients in each group, and they could also start enteral nutrition by day four. You will see here that not surprisingly, you got more fish oil in the one group, but they started to have some trends in reduction of liver enzymes and some of those inflammatory cytokines. These are my conclusions, that there is a potential that we might get some biochemical and clinical effects with the four-oil, and we are going to have to think about what we will see long-term. It may be early, but we will see what my colleagues up here have to tell us about that right now

Todd W. Canada, PharmD: Good morning, thank you all for coming out this morning. It is my role to talk about at least the use of doing this in terms of a pragmatic effect of approaching use of lipid availability your institutions. As a pharmacist, this is a relatively simple thing from my perspective, but if you have never gone through a pharmacy and therapeutics committee, I will try to walk you through the process, and at least think about some of the things to consider before you approach going to a group like this. These are my disclosures. And I wanted to start with a clicker question for you. So, if you would grab your clickers really quickly. The question I have for you is: Which of the following best describes your institution in regards to parenteral nutrition? Number one is no formal nutrition support team, where it is written by various healthcare prescribers. Number two is an informal recommendation provided by a dietitian or a pharmacist, but it is written by various physicians. Number three is formal nutrition support team with a dietitian and/or pharmacist writing orders, and then number four is a formal nutrition support team with physician director, nurse, dietitian, and pharmacist evaluating patient

prior to initiation of parenteral nutrition. If you would vote now, please. It looks like a varied group—kind of what I expected. It looks like the vast majority are probably at least with some degree of a formal nutrition support team, which you would expect at a meeting like this, which is good. I thought I would start at least with a pragmatic approach to what has been actually shown by the use of lipid emulsion around the world. For those of us who have never seen at least the International Nutrition Survey that was done four different years, and they culminated all this, and Cheryl Edmunds put this into a really nice analysis. They had about 450 patients. They looked at these patients that were on parenteral nutrition for a minimum of five days, they got about 1400 calories. And when they looked at the percentages of patients that at least received either no lipid emulsion, or either a soybean oil based, or any of the other various products, because this was an international study, so not just the US, but also of other countries. And you can see that the vast majority of other countries still use soybean oil even in that respect. When you looked at some of the outcomes that they looked at, and this is just one of them, where they looked at the cumulative likelihood of being discharged from the ICU, when you looked at these graphs that showed this, at the very bottom of the graph you will find is the soybean oil. And if you look at the very top of the graph it is the fish oil. The fish oil obviously represented a very small percentage of this patient population, and the thing that we just do not know is, kind of in the middle there is the black line, and those are the patients who did not receive any lipid emulsion. So, there are no clear explanations as to why those patients may not have received it, but looking at a pragmatic approach of what has been published, and what is in actual use, this is the closest we have at least to an international view of this.

One of the things I think that is important to think about when you think about adding nutrition products to your formulary at your institution, most of you have probably dealt with this in the last 10 years just primarily because of shortages alone, and one of the things that I think is very important is if you do not have a nutrition support professional at your institution, a lot of people just may assume that all nutrition products are the same. Many of you may remember back in 1994, there was an FDA safety alert and it actually related to the use of an institution that just switched their amino acids only. You may think well, why is he talking about amino acids? Well, this all comes down to a pharmaceutics issue of not knowing what is inside these products— pH differences, things of that nature—and there are actually reported patient deaths associated with that. So, switching between products, you really need to know the differences between these products, how would you choose one over the other, and then how would you use those in your specific patient populations for your own institution. The other concerns that you may have is that some facilities may have gone to utilizing standard commercially available products now instead of compounding, and so it really comes down to what is best for your institution. If you think about the products that have been at least FDA approved in the last several years, you will see that there are a multitude of products. It started in 2013 with Clinolipid, they started again in 2016, and then most recently in 2018, with at least the availability of an official product in the United States. When you look at least the continuum of at least safety associated with these oils, obviously, there is a fairly wide continuum of these. And if you look across, you will see we do not unfortunately have safflower oil anymore, but it is the highest percentage of at least our essential fatty acids. But if you look on the other end of the spectrum, it is

primarily omega-3 based with fish oil. When you look at the differences between these products, and Beth has already shown this slide, I think it is important to realize that the biggest differences between these are just the percentages of essential fatty acids. I would definitely focus on that in terms of how you dose this at your own institutions, because when we have had shortages, a lot of facilities may have cut back, and changing those practices back to current day practice is not always an immediate thing. So, it is something to think about in terms of how you choose these products, how often they are given, and then what percentage of these products are actually essential fatty acids for your patient population. Some of the questions that you will need to ask yourself is what are the unique benefits of this product over your own existing. You could choose at least to use soybean oil with the multi-oil, or you could even do it now with the at least olive oil/soybean oil. If you think about doing this in terms of replacement, what are the considerations? And one of the considerations that I think most of you in the room may or may not be familiar with is that there are case reports about at least reducing the toxicities of local anesthetic overdose with at least a soybean oil–based emulsion. So, some institutions may not understand what you need to have at least one or two or maybe even more of these products, and so you would have to really look at the patient populations you are looking for. You may want to go back and look at your own institution, and I have just listed my own at least numbers here for patients because it is not only just the inpatient side, you also have to think about the outpatient side. Some institutions do have their own homecare facilities for these. The other things that are listed here are just some of the items that we will go into, at least your monograph that you are going to present to your pharmacy and

therapeutics committee. One of the things that I always like to point out is what may seem like a relatively easy presentation, but when you start showing the similarities of how these bags look, you can easily have mistakes that occur just because of the way the products look in terms of similarity. And I will just give you a picture here to show you the differences between at least a soybean oil and a multi-oil bag. You can clearly see there are definitely going to be questions. If you look at trying to develop the supporting evidence, and I realize that these are all relatively small, and so, if anyone is interested in these, I am more than happy to share these with you. But what I did at my own institution is look at the patient populations that would be more affected, and what would the supporting literature be for utilizing a product such as the multi-oil product. Going through and at least finding supporting evidence to at least advocate for at least where these would be best used. One of the things that I like to show, and obviously it is early, so I always like to think of the most renowned nutrition advocate that we have in the world is Dr. Oz. So, when I went to our pharmacy and therapeutics committee to at least be part of the presentation for this, most of the questions I got were just like his audience. I was quite surprised at some of the questions that most of the physicians, at least on our pharmacy and therapeutics committee, were not familiar with about these products. Keep in mind, if you do not practice in nutrition support, you delegate this to someone else maybe at your facility. They really are not going to have the expertise for making some of these decisions, so you are going to have to go through a lot of this stuff with these people, explain the differences, why these things are important, and at least try and figure out some of the things that some of them may not even be aware of. And I jokingly put this on here about there is a black-box warning on all lipid products,

and a lot of physicians are not even aware of that. So, it is useful to know, especially in the broad spectrum of all physicians within your facility who may be utilizing these products, and then how many of them actually think about essential fatty acid deficiencies for their patients. One of the things that I think is really important to think about, and this study would never be done in humans, and part of it is just the ethics of doing something like this, but looking at the relative immunosuppression based upon the different type of oil that is based in your lipid emulsion. This is the only study that I could find that actually compares this. It is an animal study, it was a rat heart transplant model, where they looked at basically only varying the content of fat and doing this specifically as an intravenous oil-based fat. So, they used a saline control, and saline control the heart lasted about a week. If you looked at the group that got soybean oil, it lasted a little over 10 days. The group that got safflower oil lasted roughly over 13 days. And with fish oil, they lasted over 12 days. The interesting thing is that when you look at single oil source products, they all tend to be immunosuppressive, and this is the only study that I could find that really shows this information. When you look at the combination of 50% safflower oil with 50% fish oil, you actually can get basically back to saline. So, you have virtually loss of that immunosuppression by the combination of these oils. And part of this may be something that none of us ever even thought about 40 years ago whenever we had the soybean oil–based products is that the omega-6 to the omega-3 ratio may be very important in this regard. When you look at the phytosterol content of these products, obviously there are differences between these, and obviously the more plant based these products are, the higher the phytosterol will be in these. The most important phytosterol is probably Stigmasterol, and it is the one

that is most associated with at least liver dysfunction. If you look at the variation between all these products, there are variations in terms of the amount of phytosterol, and if you think about long-term exposure, especially in long-term parenteral nutrition patients, these may become considerations, especially when you think about parenteral nutrition associated liver disease. One of the things I always like to show, and this is a very old study, it was published in 1978, but it shows that these patients were receiving two liters of a soybean oil–based lipid emulsion. And you can see by roughly about the second to third week, you see substantial increases in their liver function tests. Granted, all these patients were being grossly overfed because that is what we thought was very cool back then, and clearly it has changed in terms of our practices. But, part of this is even exceeding the dosages recommended at least in the package inserts for all of these emulsions as well. Some of the things that you should think about whenever you are utilizing a product like this, you may want to institute restrictions on their use, and some of the things that you can list are some of the things that I have here. You may want to focus utilizing some of these in critically ill, where most of the evidence has been shown to have the biggest benefit in terms of infections. But then you may have other considerations, such as a bleeding risk, in some of these patients, especially if you are approaching a therapeutic dose. Some of the other things listed here are really dependent upon at least the patient population you are serving in that regard. If you look at revising your use, especially if you decided to keep two at least lipid emulsions, and one being a multi-oil, maybe one being a soybean oil–based product, you would want to at least think about it in terms of which patients would be most ideal for these. I work at a cancer facility, and so sometimes we have severely malnourished patients,

they probably would be the best patients associated with utilizing something high in essential fatty acids in that regard. We may also want to use these in episodes where at least immunosuppression would be useful, and when we get to the cases, I will go over some of this with you as well. Some of the things whenever you are doing this, the structured education I cannot elaborate this enough to you, but it has to be associated with preparation, as well as administrations, so not only are you having to educate prescribers, the pharmacy compounding area, but also all the nurse administrator, administrating nurses for your institution, and so that is a huge job. If you have a system where maybe you are using a total nutrient add mixture, or maybe you are doing this as a separate infusion of a lipid emulsion, that is just another step. They are going to have to learn the differences between these products. If you have a computer physician oriented electronic system, you will have to make sure that you update and validate those order sets for these as well, making sure that all that gets accomplished. Then, if you have different patient populations, you will probably have multiple order sets to revise. For those of you that have smart pump libraries, you have also got to update those. So, this is not an easy overnight fix whenever you do these. It takes a real structured plan. To really have this as being a structured process, you really want to establish the benefits that you would have, at least for your patient populations that you are bringing this for, create a monograph that supports at least the specific patient populations you would be serving in that regard, and then be really prepared to answer some of these questions. Because I would guess that most of you would probably be well-versed in the understanding of this, but maybe not the physicians who are not necessarily doing this on a daily basis. Then, really the most important thing is

establishing that education and operational plan for putting this into place. With that, I will turn this over to our next speaker.

Mara Lee Beebe, MS, RD, LD, CNSC: Good morning. It is an honor to be here with you today and share our experience using a new four-oil ILE product at Ohio State, and also share with you some data that we have collected along the way. I do not have any disclosures. Today, I am going to discuss with you the criteria that we developed for us in our institution to use four-oil lipid. And we are going to discuss if any benefits existed for these patients. We are also going to highlight any safety and efficacy outcomes that we found. I would like to acknowledge Lisa Mostafavifar. I am presenting here in her place as she is unable to travel at this time. She is our specialty practice pharmacist for acute care/surgery/trauma, and she was a leader in getting this product on formulary, and is the lead author on our study. Before taking this product to formulary, we sat down as a multi-disciplinary group of surgeons, dietitians, pharmacists, and we reviewed the current literature available at that time, and just discussed amongst us who would benefit most in our patient population from this product. Unfortunately, at that time, there were only a few studies that showed improvements in LFTs, triglycerides, compared to soy oil. One of the limitations of these studies were the short timeframe, of about four weeks being the longest. We went ahead and added the four-oil lipid product to our formulary in 2017 with the following critieria. We used it for patients we were deemed to be chronic or previously on TPN chronically at home, AST/ALT levels greater than 3 times the normal limit, triglycerides greater than 300 to 500, hyperglycemia refractory to insulin, or patients that we wanted to manipulate the TPN to improve glucose control by dosing lipid greater than 1 g/kg. We continued to

use soy oil lipid for all other patients or patients with allergies to the four-oil lipid. Later on, we considered drug shortages as an indication because we had readily available pre-packaged doses of the four-oil ILE that we could infuse with pre-mixed TPN during that shortage period. After attaining approval for the use of this product and adding it to our formulary, we decided to collect some data on the patients that we used it for. And this is the information of our study. Our primary objective was to look at safety and efficacy of using this product or for various treatment durations, particularly longer than four weeks. We also wanted to look at the effects of the four-oil ILE on LFTs, triglycerides, CRP, and other markers, and to also look for any signs of essential fatty acid deficiency. Our study was IRB approved as a retrospective chart review, and we collected the data over just shy of one year. We looked at initial laboratory values before starting TPN, and then collected those same labs after TPN was discontinued or the patient discharged. We also looked for any adverse events related to the infusion of four-oil ILE, and we looked for signs or symptoms of essential fatty acid deficiency. We did not obtain any lab values, tetraene to triene ratios, but we just looked for physical signs or symptoms. Then, we completed descriptive statistics and considered a *P* value of less than 0.05 as significant. These are our results. Our baseline characteristics, we had a total of 117 patients in our study. Most of these patients were in the surgical population on TPN for post-op ileus, small bowel obstruction, or fistula, and we had the main indication for transitioning to four-oil ILE as patients deemed chronic, followed by a large proportion of patients that received it during the shortage period. I would like to point out our dose, our mean dose of four-oil lipid was only 0.8 to 0.9 g/kg. At that time, we were mostly using the standard size 50-g bag, and I think there was an adjustment

period for dietitians to get used to dosing above 1 g/kg/day. I think if you looked at some of our more recent patients, this dose might be a bit higher. Our duration, unfortunately, a lot of patients only received it a few days because of the shortage, but we did have 15% of patients that received it for two to four weeks, and then another 14% of patients that received it for greater than four weeks. These are our initial versus final lab values for all patients, and you can see that we had statistically significant differences in our liver enzymes, T bili, and CRP. Since a lot of our patients were on it for a few days, we wanted to pull those out, and only look at patients that received it for greater than five days. Unfortunately, the numbers are no longer statistically significant, except for CRP, but we do still see trends in decreasing AST/ALT and T bili. We scoured the charts to look for any adverse outcomes, and we identified seven very non-specific possible adverse events, and a clinical pharmacist went through these charts and used the Naranjo Adverse Reaction Scale to evaluate them. Four of these events were deemed doubtful with a score of zero, and three deemed possible but low causality, with scores of three and four. We concluded that we were using appropriate criteria for the use of four-oil ILE in our institution at this time. We demonstrated that therapy beyond four weeks, as far as we could see, was safe and efficacious. And it was an effective alternative during a period of shortage. Most benefit was seen in the CRP reduction, but we did see trends in decreased AST/ALT and T bili, and we are hopeful that with a larger patient population, those trends would be significant. We also feel there is a low likelihood with four-oil lipid–associated adverse events. Lastly, I just want to provide some practical considerations after using this product for about two years. One of the things we always need to do is review patient allergies, which for

four-oil ILE, is similar to the traditional soy lipid, with the addition of fish, and that has come up occasionally. We also want to consider is this feasible for a patient at home if we are starting it for the purpose of chronic TPN. You need to know is this product available in your community at the extended care facilities, or the home infusion companies. Are they providing it? So if your patient is started in the hospital, can they continue it at home? Remind yourself to use appropriate dosage; it does take a little while to get used to that. 1 to 2 g/kg/day and a minimum of 15% to 20% of total calories to prevent essential fatty acid deficiencies. Then, fluid considerations. Since we are using this product in a two-in-one system, we are adding additional fluid with using the Smof or four-oil ILE. For patients, if you are using large doses, that could be another 250 to 400, 500 mL of fluid. These are our references for you to use that helped us decide our criteria.

Carol S. Ireton-Jones, PhD, RD, CNSC: Thank you very much. I am going to talk to you today about intravenous lipid emulsions and home parenteral nutrition. And I find that my esteemed colleagues have set the stage so well, so I am very happy to present this today. These are my disclosures. I am a very slow slide mover clearly. Wrong button. We do not have buttons in home care. Sorry about that. I wanted to start out with challenges in home parenteral nutrition and long-term parenteral nutrition in particular. The first and foremost thing before we think about anything really is catheter care. We want excellent catheter care, and avoidance of catheter-related bloodstream infections is number one. If you ask our patients at any time what their biggest concern is, they want to make sure their lifeline is well taken care of. Second of all, macronutrient need and content of the parenteral nutrition, the carbohydrate, protein, fat

component, so, amino acids, dextrose, and lipid. Micronutrient needs, is the MVI adequate, is it meeting this patient's needs. And trace elements as well, for example, manganese. Do we really need the four or five concentrate, or do we need to provide these individually. I have not made vitamin D a trace element. I do not know why I put that there, but vitamin D is one of my biggest concerns because I do not have a good resource for my patients who have very low vitamin D levels and need more supplementation than is available today. The last bullet is the ability to take in oral nutrition. Now we know some of these patients can really eat, so it is not the ability to take it in, but it is really the ability to absorb oral nutrition. That big button really works. That is great. Then, the challenges specific to intravenous lipid emulsion are—in my opinion and in what I have seen in the literature—is the length of therapy. So, how long is this patient going to be on parenteral nutrition. If it's going to be short-term, six days, you may be able to make different choices, but 30 days, 90 days if you use the Medicare guidelines. For us, we have patients, or I know we all have seen patients who have been on 30, 40 years, so in that case, you will probably make different decisions. Also, the ability to take in and absorb fat. Some of our people eat and cannot actually take in adequate fat because as Beth mentioned previously, there are small requirements for linoleic and alpha-linolenic acid. But they have to be able to absorb it. And then dextrose tolerance. Is there an incidence of hyperglycemia? Total calorie need. Do they have a high calorie need or a low calorie need? We do not overfeed, although I think I was in practice during the time that Todd was talking about, the 45 calories/kg. So glad we stopped that. And then the lipid emulsion itself. Do you choose the soy oil–based lipid emulsion? Well, you know we did for many years

because that was all we had until 2016. Do you choose the four-oil, do you choose fish oil based, although that is indicated in particular for pediatric patients, and are you concerned about the phytosterol? So, when you are choosing a lipid for a long-term patient, you put all of these points together. These are the two commercial products that are available currently for adult long-term home PN patients. You can see one is 100% soybean oil and the other is a combination of oils. Most important to remember here is that there is a different level of linoleic and alpha-linolenic acid. I think we have each said that. So, I wanted to be part of the crowd that said that. As you are planning, and you are using the four-oil lipid emulsion, I think that Mara Lee mentioned about 15% of total calories to meet essential fatty acid needs, that is very different for us if we have been using 100% soy oil. Make sure you make that change. And really the recommendation might be 1 to 2 g/kg of body weight with the four-oil intravenous lipid emulsion. This is a suggested decision tree, if you will, for adults receiving home parenteral nutrition and your decision on intravenous lipid emulsion. The first question I ask is the consumer receiving less than 10% of total calories from soy oil intravenous lipid emulsion. If you did not know, once you have been home on parenteral nutrition, you are no longer a patient; they like to be called consumers. So that is why consumer is there. They are not shoppers, they are consumers. This first one would be are you just giving them the minimum to meet essential fatty acid deficiencies or to prevent essential fatty acid deficiency. The second is the consumer receiving a lot of soy oil–based intravenous-based lipid emulsion to reduce IV dextrose intake. So, they are a long-termer and receiving a lot of soy oil–based intravenous lipid emulsion. So, a higher risk for inflammation and the pro-inflammatory effects. Are the liver enzymes

above normal? Has the consumer had previous liver enzyme or glucose tolerance issues? And then, has soy oil intravenous emulsion just been limited or withheld. These are the questions that I say if you have had a yes to any of these, then go ahead and consider the four-oil intravenous lipid emulsion. Let us see here, not sure how I went backwards. There has been one, up until several studies presented here, this has been the one long-term study of patients receiving four-oil intravenous lipid emulsion by Dr. Klek and colleagues. What a pleasure to get to visit with him at this meeting. But this is a four-week study comparing soy oil and multioil intravenous lipid emulsion at baseline and after four weeks. And as you can see in this study that is presented here, AST, ALT, and T bili were significantly decreased with the four-oil lipid emulsion. Just a very quick long-term study that we presented here yesterday at the rapid-fire session. The group that I work in is a long-term home parenteral nutrition provider, and we studied 20 of our adult patients who had been on soy oil–based intravenous lipid emulsion, and then we switched them to multioil intravenous lipid emulsion: 12 months of soy oil, 12 months of multioil lipid emulsion. And then we collected the data from their HPN formulation, and then we also collected the lab's liver enzymes. What we found, and this is the demographics of these patients, their average length of therapy was 16 years. The reason for parenteral nutrition was short bowel syndrome, pseudo-obstruction, or dysmotility. Interestingly, I think this was, we made the change isocalorically, but the significance, as you can see here, is there was a significant difference in dextrose administered with multioil, and with that being decreased, an increased amount of lipid emulsion with the multioil. But again, the calories were the same. As Mara Lee showed in her study, and ours is long-term now, so one year, we

had mean decreases in Alk phos, AST, and ALT that were demonstrated, but these were not statistically significant. In summary, it is an exciting time for us clinicians in the hospital and at home. We have options for intravenous lipid emulsion in parenteral nutrition and, in particular, in-home parenteral nutrition. We have the ability to consider using a four-oil intravenous lipid emulsion to provide both essential fatty acids, but also to provide calories, and there may be other potential benefits. Thank you very much.

Carol S. Ireton-Jones, PhD, RD, CNSC: This is Mr. G. He is a 62-year-old male. He is 5'11'', weighs about 70 kg. His goal is a little bit higher than that. He has Crohn's Disease and has had multiple resections, so now he has short bowel syndrome. He has additional diagnoses. Type 2 diabetes probably brought on by the number of steroids that he received in treating his Crohn's Disease. He has slight renal insufficiencies. His BUN and creatinine are elevated; BUN continues to go back and forth from being elevated. His diet is home parenteral nutrition, and he has received that for the past three years because he was unable to maintain nutritional status without that. But he still tries to eat an oral diet, but he has poor absorption and a lot of diarrhea. His lab data that we have been evaluating. His liver enzymes have been fairly consistent, in the high range for long-term home PN, as you will see his HPN order in a moment. But his T bili has been within normal limits. Electrolytes fairly stable. Glucose was fairly well controlled, although he has every once in a while a history of spikes of hyperglycemia. This is his parenteral nutrition order. I recommended about 2000 calories for him. In this particular case, he received 75 g of amino acids, 400 g of

dextrose, and receives insulin at the same time. And then he has been receiving soy oil intravenous lipid emulsion at 300 mL three times a week. This provides about 1900 calories, and about 13% of total calories from soy oil intravenous lipid emulsion. What you will see that are remarkable, Alk phos, AST, ALT, are all elevated, which, when in the presence of soy oil intravenous lipid emulsion, I think we may have considered normal liver enzymes, but as you can see, we may be able to make a change with this.

Beth Taylor, DCN, RDN-AP, LD, CNSC: Clickers. Everyone get your clickers.

Carol S. Ireton-Jones, PhD, RD, CNSC: What would you consider the most important point in evaluating a modification of the intravenous lipid emulsion in this patient? Would it be his liver enzyme abnormalities? The need to correct his essential fatty acid deficiency? Two, optimize parenteral nutrition solution, so decreasing dextrose, increasing lipid, and providing adequate calories. One and three or I am unsure. Please answer. So, is he receiving less than 10% of calories from soy oil? Well, he was not. And he was not also receiving 25% to 35% of calories from soy oil to reduce the IV dextrose, but that would have been a next consideration, and I really did not want to do this because this is a long-term patient. His liver enzymes were definitely above normal, and he had had some previous issues as well. So, with this, the next thing to do was to change his parenteral nutrition regimen a little bit. And we went here to the multioil intravenous lipid emulsion. In this, I was able to give 220 mL seven days a week, which I thought was very interesting because now I was able to have a really balanced nutrition regiment for him. A few more calories, about 100 extra calories. And his liver enzymes initially began to decrease. But as you can see in the second column,

after being on this for about six months, his liver enzymes were in great shape, and I was able to actually decrease his calories because he had been able to gain some weight. In particular to look here, his dextrose went from 400 to 380 g to 340 g. So, we were able to decrease his dextrose and increase his lipid component of his nutrition. And as you can see here, his glucose levels improved as well. As we begin to think about the case panel discussion, we will not do this until it is all of us, but my thoughts for you as you are thinking about intravenous lipid emulsion in long-term home PN patients, how does the clinician decide which one to use. And then, what are the home to hospital transitions and hospital to home discharge considerations. I think those were well delineated by you, Mara Lee. For this particular case, I am happy to say his liver enzymes improved on the four-oil intravenous lipid emulsion. His dextrose calories were able to be decreased, so we were able to manage his glucose better. And his total calories decreased over time; however, we were able to keep the intravenous lipid emulsion within the recommended level to prevent essential fatty acid deficiency. And that is my case.

Todd W. Canada, PharmD: Since I am at a cancer facility, I thought it would be interesting to at least give you a perspective, and I really know not all of you work in that type of an environment, but some of the things to think about whenever you are considering the use of parenteral nutrition. I thought I would go through a relatively, I would not call it a straightforward case, because a lot of the patients we see have a complex medical history. This was a 30-year-old male. Relatively good health until he

developed a recurrence peripheral T-cell lymphoma. He was initially diagnosed and treated, and then unfortunately had recurrence, and then underwent at least at our facility a match-related donor stem cell transplant. This was done approximately at the beginning of September. The patient's only other past medical history at that time was really just related to an iron deficiency anemia; relatively good health, like I said before. He was admitted roughly two months after his initial stem cell transplant after he was hospitalized and then obviously discharged after the transplant. And when he was admitted, he was admitted with severe diarrhea, nausea, and vomiting. A note: The day after admission, he underwent esophagogastroduodenostomy and a flexible sigmoidoscopy, and the things that they were able to identify is that he had various at least of graft-versus-host throughout his intestines, as well as his stomach, and it injected basically as aspects of his intestines. In terms of his weight when you looked at it, his weight toward the end of August was roughly 83 kg. When you looked at his weight on admission, he had lost a little over 14%, and his body mass index at that time was 21. Clearly, this is a patient that is starting to get into that very extreme weight loss in a very short time period. When we looked at his just assessment, I am really just thinking about when most of his weight loss had occurred. It really had occurred in the last three weeks prior to admission. And his nausea and vomiting were making it such that the only things he could keep down were just liquids. And then unfortunately, with the secretory diarrhea, very difficult for him to properly absorb some of those nutrients, even in that context. But one of the things that obviously after admission, the workup of his graft-versus-host disease that they were anticipating was the most likely concern, he was still have intermittent emesis, as well as up to 4 L/day of stool. One of the things

that obviously was the only avenue for feeding this gentleman was to utilize his existing central venous catheter. And the initial parenteral nutrition formulations that we listed there, part of this is in the context of this patient was obviously diagnosed with graft-versus-host disease. I will show you in a few minutes some of the therapies of this, but it included obviously the use of corticosteroids, which could obviously increase his risk of hyperglycemia. Starting off with relatively low doses of dextrose just because he did not have a past medical history of diabetes or any form of corticosteroid-induced diabetes, there is no, at least that will not occur at least, especially with the doses they typically use for graft-versus-host disease in these patients. His initial caloric intake was around 600 calories on day one. Went up to roughly 1000 calories on day two. And we actually had the ability to do indirect telemetry on this gentleman as well. His indirect telemetry came out to roughly around 25 calories/kg, whenever you look at this, and at least in looking at the indirect telemetry we had for him, it actually looked like a relatively good study. Some of the things in terms of his lab work that were somewhat unusual, that I thought were somewhat unique for someone that is having up to 4 L of diarrhea a day, he really did not have the electrolyte abnormalities that I was anticipating for seeing this. And one of the things I think that is most important to at least in terms of his overall effects is that he had actually engrafted, and his white count was still low, but in terms of engraftment, that actually looks pretty good for stem cell transplant in that context. When you looked at his liver function tests, we were actually doing relatively well in that regard as well. And when we looked at some of his at least micronutrients and vitamin levels, surprisingly, the only thing that was low initially was his zinc. And I listed on there his C-reactive protein, and it being so elevated that may not necessarily be a true

zinc deficiency in this regard, just because of its acute phase response, especially in the context of an elevated CRP with that zinc level. His vitamin D level was actually considered to be in the sufficient range for our institution, so it was very surprising. I was really expecting him to have fat soluble vitamin malabsorption, especially as much weight as he had lost over a short time period. Obviously, I mentioned that corticosteroid therapy would be initiated in this gentleman, and they usually will typically start with roughly about 1 mL/kg and do this a couple times a day. Obviously, in terms of some of the other therapies he was receiving, put him at risk for other at least potential drug/nutrient reactions, possible effects on his renal function. And then he was placed on a tacrolimus infusion. Part of the problem with utilization of things like tacrolimus is that it is associated with hypertriglyceridemia in these patients, and so it makes it very difficult sometimes to actually be able to feed them because the corticosteroids are causing hyperglycemia, and then you have got other drugs on board that are causing hypertriglyceridemia, so it is very difficult to figure out the best ways possible for doing this. They even attempted the use of octreotide in terms of trying to reduce the secretory diarrhea, really no effect, and that was eventually stopped. Then basically the patient was made NPO, and it really did not dramatically affect his diarrhea. I have a couple of pictures there showing his duodenum from November and then his transverse colon. This patient virtually had refractory graft-versus-host disease because almost none of the therapies worked in this situation. So, you are on at least hospital day three of parenteral nutrition, and asking you at least in terms of the context, where would you go at this point? Would you continue to provide his parenteral nutrition without intravenous emulsion? Two, would you provide parenteral nutrition with

the soybean oil–based lipid emulsion? Three, would you provide parenteral nutrition with the multioil-based lipid emulsion, or four, would you provide parenteral nutrition with the fish oil–based lipid emulsion? Looks as though the majority of you chose to use the four-oil–based lipid emulsion. Some of the things that obviously I am not as good of a teacher as Carol, and I will try to emphasize at least a couple of things that might be very important in a patient like this. If you look at what we actually did in terms of our use on day three is that we actually utilized the use of a soybean oil–based lipid emulsion, and part of it was because it has an immunosuppressive effect, as I showed with the animal studies. In a patient like this where you are refractory to other therapies, you are least, considerations of utilizing something that could actually be potentially beneficial from a therapeutic point of view may actually be useful in terms of the overall context of this patient's care. Thinking about it in that regard may give you a different perspective of how to use some of these things.

Todd W. Canada, PharmD: I just have the outcome of this case. One of the things that I mentioned before is obviously this was a steroid-refractory graft-versus-host disease. They eventually tapered these. They actually put him on some other therapies. Ruxolitinib can actually cause worsening hypertriglyceridemia, and in this patient's case, his triglycerides went into the 600s on this therapy. So, somewhat challenging in terms of managing patients in this regard. Fortunately, they did eventually stop that drug and so we were able to resume his at least lipid emulsion. But some of the things to point out is that unfortunately, even though our best nutritional efforts, if you cannot control the underlying disease, it really shows the graph that I have

there at the bottom, with looking, his serum albumin over the time period of his parenteral nutrition start really showed no improvement, unfortunately. With that, I will go to our next case.

Mara Lee Beebe, MS, RD, LD, CNSC: Our next case is a little bit of a combination home/hospital patient. This is a patient that I typically see that bounces in and out from home to the hospital. Our patientis a 65-year-old male with a history of Crohn's Disease, and he has been on TPN for a few years due to short bowel syndrome from multiple bowel resections. We felt he had about 120 cm of small bowel left. He came to us from a local hospital to Ohio State, which happens frequently. Patients are managed at smaller community hospitals and then transferred for a second opinion. The dietitian did a thorough nutrition history and assessment and got his home PN formula, which you can see below, which is kind of your usual distribution of dextrose, protein, and fat. It is important to note he was on traditional soy oil at home. He is 5'8'' and 51.2 kg, and from talking to the patient, we had identified that he had lost about 7.5% of his weight in the past three months, and he does not have any allergies. We did some thorough digging through his medical history to get some labs, and some things to point out are a steady rise in his liver enzymes, his T bili, his triglycerides, which we often see with patients on longer term TPN. And so, at this point, we have a question for you. If you were evaluating this patient and thinking about what TPN recommendations you would make in the hospital, what strategy would you recommend? Withholding lipids until AST/ALT normalizes? Continuing his home PN formula, but replacing soy oil with four-oil ILE? Continuing his home PN formula, but reducing soy oil ILE? Or I am unsure?

[Music playing] The correct answer is three. In an ideal situation, if you have four-oil ILE, you would replace the soy oil ILE. And withholding would not be appropriate, but in some cases, number four could be appropriate if you do not have access to four-oil ILE. If it is not on formulary yet, your community nursing homes or home infusion do not have it on formulary yet, you could reduce the soy to help to help with those liver enzymes. And that kind of has been our traditional practice in the past. So, we have made the decision to change the patient to four-oil lipid. What would be an appropriate starting dose for this patient? One, 0.5 g/kg, two, 0.8 g/kg, three, 1.2 g/kg/day, or four, 3 g/kg/day? [Music playing] Most of you chose number three, which we feel is the correct answer here. For one and two, you would be lowering or getting the same number of calories, and if we recall, he was losing weight, so he might benefit from additional calories. And three would be outside of the range recommended for 1 to 2 g/kg/day. So, 1.2 g/kg/day fits in that range and would give him a few more calories than he was getting in his prior home PN.

Beth Taylor, DCN, RDN-AP, LD, CNSC: Now we are just going to have a little discussion among ourselves, and then we are going to kind of get into our post-survey. On the cases, one of the things I wanted to kind of ask, kind of Mara Lee and Carol the most, is when would you think, and Todd as well, when would you make that transition? So, what would you consider chronic that they have now turned into that chronic long-term patient, and you are going to be concerned that in the future with LFTs, etcetera? What do we consider chronic?

Mara Lee Beebe, MS, RD, LD, CNSC: A new patient on TPN, we can consider at least expecting three months or more of therapy chronic, which may seem slightly short, but I think it depends on the patients, what has happened to them, their condition. If we see a patient that had huge bowel resection, we are going to anticipate they are going to be on it for a long time.

Beth Taylor, DCN, RDN-AP, LD, CNSC: And same for if you have someone discharged on soy, Carol, and their LFTs were still within that somewhat normal range, would you wait to think about soy oil or would you want to be preemptive?

Carol S. Ireton-Jones, PhD, RD, CNSC: I think that is really the crux is this is you have to think about what you are doing. It is not a knee jerk reaction always. You really think about your patient and their status. And if the patient was doing well, then you might leave them. But again, you have to think about those other considerations. Is it going to be a long-term patient who is getting quite a bit from soy oil? If it is a limited amount and your patient is tolerating it and you do not think you see any challenges, as you said, liver enzymes are okay, and they are able to get the right combination of macro nutrients, then I am not sure I would change.

Beth Taylor, DCN, RDN-AP, LD, CNSC: Todd, I have a question for you because you have some interesting cases with all of these different medications like you pointed out. What do we know about stability differences and compatibility differences between the

two? And how would you address that if a physician says can we give this drug alongside this lipid, or how would you suggest they approach that?

Todd W. Canada, PharmD: Yes, that is a really good question because one of the things you will find that is a complete void in the literature is actually anyone doing that type of literature anymore. And the person that used to do most of it was actually at my facility, has since retired, and no one has taken over in terms of that support. A lot of times you are left with contacting the companies to find out if they have any information, but most of the time, especially for newer drugs, and for any of you that work in oncology, I can tell you that it is very challenging because we obviously have a number of new drugs for dealing with this. And so, a lot of times your best bet is to sometimes we have to end up cycling parenteral nutrition just so we can give some of these other drugs in the interim outside of that so that you do not have influencing factors at least preventing; if you have no compatibility information, you can at least give those drugs hopefully safely.

Beth Taylor, DCN, RDN-AP, LD, CNSC: And I bring that up because similar to your patients in the ICU is sometimes availability of access. Sometimes you are making decisions based off how long you have the lumen open to cycle, etcetera. That is great. I think because we want to get to some of the questions, we are going to move on to the post-survey. Everybody, clickers in hand. Home people, play along, let us see how we do. If preventing essential fatty acid deficiency is a concern in your patient, which lipid would provide the highest amount? Give it a go. [Music playing] Let us see how we

did. 100-% soy oil. Let us see how we compared to the before. We all got smarter. Life is good. In the review by Honeywell and colleagues, which of the following were associated with fish oil–containing lipid emulsions. I will not read them all. Go ahead and give it a go. [Music playing] Number three, very good. How did we do? Again, we are just growing by leaps and bounds here in our intelligence. Now, big one, let us see if we have made you a little bit more confident in going back. Do the elevator speech with your administrators. [Music playing] We are very confident, confident, I like it, it is the top three. At least we did not have a whole lot of dismal. Come see us afterwards if you need a little more help. It looks like our confidence has grown. That is the key. And it is hard to do it in one session, but really as Todd was going get your confidence level up a little bit before you go and make the presentation. Which of the following is the most pro-inflammatory? [Music playing] We did so good on that the first time there was not a whole lot of room for improvement when you have a room full of really smart people. The case study, remember our Crohn's lady, how would we have adjusted her PN based on her expected duration and things within normal limits? What would be the best approach? [Music playing] We went with provide lipids using the four-oil, supplying 4% to 6% of total calories. Actually, you see the flashing light, we did not do so great here probably in this patient because it is a shorter term, all her liver enzymes are in normal limits, that you could get by with just using that soy oil lipid, and you are giving enough for an essential fatty acid. One of the things that you think about, and I saw a few of the questions, if you are going to have both, you are going to have to set your criteria for which ones you will use for which patients.

Carol S. Ireton-Jones, PhD, RD, CNSC: I think this is such an important question here. You just said it and I am going to emphasize it again. If you always use making sure you get 4% to 6% of total calories from lipid and you have been using the soy oil based, you cannot make that transition to the multioil. You have to make a change in the base that you can give when it is the multioil or four-oil lipid emulsion. I really liked this question because I wanted to pick three, except that it said 4% to 6% of calories. That is a really, it is a trick.

Beth Taylor, DCN, RDN-AP, LD, CNSC: It was a trick question. You need to give 10% to, more like 15% to 20%, right? 15% to 20%. Remember our home PN patient who had been on over a year was starting to have some issues. Pick away. [Music playing] Switch to four-oil and reduce the dextrose load. Excellent. Look how smart you guys are. Again, we had an increase in knowledge. That is a case, and I think Carol showed that really well in her case study about when that would be appropriate. I hope the home people did well. Now we have some questions from the audience, so I am going to look at them really quickly. There are a lot on stability, so we kind of talked about that a little bit in your answer. And so, I have my answer, but I am going to ask the audience this question. How many of you that are in ICU hold lipids that have soy, are holding lipids the first week of ICU stay? Be proud. How many do not? It is mixed. How many of you are not quite sure what you do? I will tell you being on the guideline committee that was the most contested answer, where we had great consensus in everything else, it was really close there because that is based on one study. So, as you can see, it is a little mixed, it kind of depends on the case. Personally, we usually

hold them for the first five days. Mara Lee and Carol, both of you can kind of talk to this one, is that transition from hospital to home. And how to handle that. Some of you brought it up that if they are coming out on soy, what are you going to do to make sure that you can even, do you switch them to a four-oil before they leave, because it is going to be long-term, and how you are going to make sure that is going to get covered and everything else. Are there issues with getting it covered for your patients, the use of the four-oil?

Mara Lee Beebe, MS, RD, LD, CNSC: When we first started using this product, we kind of looked out into the home infusion companies to see if they could provide it, talked to them to see if there was going to be a cost problem. And if we had good indications for the use of it, the home companies in the area were okay with us starting it and felt that they could get reimbursement for it. So, we usually start them or make that transition in the hospital and make sure they tolerate it before they go home. And we also have a list of the nursing homes or skilled nursing facilities, LTCs in our area, and if they can provide it. And if there is a patient that I am very adamant that they get it, I will contact that location and make sure or have the case management talk to them and make sure that they can get it. There have been times where I notice the patient comes back and they were not getting it. So, if you are not careful about your selection and follow up with it, the patient may not continue that therapy.

Carol S. Ireton-Jones, PhD, RD, CNSC: I would just say that you evaluate each patient. If I am speaking from being a dietitian who works with a home patient, if the

patient comes to me on soy oil and I think that they would do better on the four-oil, I am just not going to stop nutrition because darnit I want four-oil. I take the time to transition them and assess to make sure that that is the most appropriate for them. When they go back in the hospital, that is when a long-term patient will call and say, can you believe they do not have this. And they could go to soy oil for a short time and probably even survive, so I think it is okay.

Todd W. Canada, PharmD: Could I just add one thing to that discussion, is if you are transitioning someone to a multioil product at home, one of the concerns would always be the allergic reactions these patients may experience. So that would be something I would think you would probably want to do in an inpatient setting, as opposed to a home care setting, especially if you do have any kind of adverse-related effects associated with, especially food potential allergies for these patients.

Carol S. Ireton-Jones, PhD, RD, CNSC: I agree with that. However, I cannot think of a time that there have been allergies I have seen associated with soy oil, so it is the key piece I think is going to be asking about the fish allergies with the new product.

Beth Taylor, DCN, RDN-AP, LD, CNSC: There have been a couple of questions here that I am going to address to you, Todd. Again, on what do you think about, talked about risk of bleeding with the use of four-oil.

Todd W. Canada, PharmD: The risk of bleeding is—I think it is a consideration. I do not know how much literature there is to support this because if you go to the literature and you look to see how many patients have had experiences with severe bleeding. And I am at a hospital where the mean platelet count in our ICU is less 30,000, so all of those patients are at substantial risk for bleeding. And the use of a product that contains fish oil would always be of a concern in this regard. One of the things that you will find in the literature is that there really has not been an association with the multioil-based product, and part of it is because most patients may not approach that 0.2 g/kg of the actual fish oil as a therapeutic does, and it is really dependent on how much the multioil is added to their parenteral nutrition. So you really have to look at it in the context of what is the actual fish oil dose of this, and then what could the potential adverse reactions be related to that. If you look at what has been published and traditional dosing, it does not appear that there is a severe bleeding risk with it. But certainly, if you have an ICU patient, low platelet count, you are probably at a much higher risk in those patient populations.

Beth Taylor, DCN, RDN-AP, LD, CNSC: Would you say that there are probably some things that we still need to learn? It is still relatively new, right? A couple of you have asked about when should I see a change in LFTs. If you have that long-term patient like you did, Carol, and their LFTs are trending up, how quickly should they see a change, and if not, then what is the next step if their LFTs remain high?

Carol S. Ireton-Jones, PhD, RD, CNSC: In my experience, the LFTs have changed, or liver enzymes have changed fairly quickly within, they start to decrease within two weeks and continue to decrease. But the one thing I always want to remind is your home PN patients are on this therapy because they may be stable, but something else is going on. So, they may have increases in their liver enzymes, not reflective of the nutrition support regiment. You might not want to alarm, you might just want to look at the rest of the patient because of course it is never just the nutrition. It is the nutrition, the catheter care, what they just ate or have been binging on, oral intake; there is a lot of things. I think it goes down relatively quickly over a month or so, a month or less, but it may rise again and that may not mean that this oil is not working, it is probably something related to the patient's dose.

Beth Taylor, DCN, RDN-AP, LD, CNSC: I would kind of highlight that because it does not, the liver enzymes are just a lab value. It has to be interpreted, looking at the patient as a whole. Like as Todd mentioned in his case, you can do everything right, you can do everything you can to prolong that person's life, but they still have a disease or an issue. It may make a difference for a patient if their liver enzymes go down, if that is really the case, but it could be if it is disease progression. Sometimes you do not know because it is multi-factorial. The next one I had is there was a question about pediatrics. This was an adult thing, but we will say that Smof is not officially approved, it is not labeled, it would be off label to use it in pediatrics. Almost everything pediatrics do I think is off label. Meds. They never have any meds. Am I right, Todd? But we are not going to talk too much about the pediatric world right now. Most of them we kind of

said. What if someone comes in and they have hypertriglyceridemia? Let us say I have got that ICU patient, I know what I would do, let us say their triglycerides are 600. What would you do, when would you consider giving lipids, and as that kind of corrects, would you start with the four-oil or would you start with the soy if you know they are only going to use TPN for maybe 10 days? Or would you just never give any? Any thoughts, Todd?

Todd W. Canada, PharmD: If I had to make a decision about a patient like this, you would probably want to do it in the context of looking at how long they are going to be on parenteral nutrition? What are the risks associated with us providing something that would actually worsen their hypertriglyceridemia? If they were admitted, for example, with acute pancreatitis, that is probably in the best regard for their underlying disease state. But some of the things that you could consider doing is once they get into maybe the second week of parenteral nutrition, just maybe giving a one-time dose of the soy bean oil base to meet those essential fatty acid needs in a relatively simple way. Yes, you may have one day of exposure to hypertriglyceridemia, but you have hopefully met their essential fatty acids needs for that time period.

Beth Taylor, DCN, RDN-AP, LD, CNSC: I would agree. That person with high triglycerides you are not going to want to give any type of lipids a lot. Plus, you are going to look and say are they getting another lipid source like propofol. If you have not talked to your physicians out of using a lot of propofol, then they are still going to get some essential fatty acid through the propofol. But if they are truly hypertriglyceridemia,

you would try to limit lipids overall and withhold and just try to meet that need. Our last question, we will wrap it up because we kind of said this a few times about essential fatty acid deficiency. How worried are we if the tetraene to triene ratio is off, or what are we looking for signs and symptoms?

Carol S. Ireton-Jones, PhD, RD, CNSC: I love that question. I love it particularly because when you mention the signs and symptoms of essential fatty acid deficiency, it is dry and flaky skin, and I have noticed that during the winter all long-term home PN patients believe they have essential fatty acid deficiency because they have dry flaky skin. But the challenge is that dry flaky skin is a quite dry flaky skin. It is not just winter skin. Peeling nails, many other clinical symptoms, and then there are biochemical parameters as well. I think it is extremely hard to get an essential fatty acid deficiency. Most patients' triene tetraene ratios have been within normal limits. There will, I will caution you, that as you start to use a four-oil lipid emulsion and you look at the triene tetraene ratio and then you begin to look at the byproducts DHA and EPA, they are going to look very different. So, just as you are looking at your triene tetraene ratio, you can still evaluate it the same way, but some of the components may look different in your fatty acid profile. But if a patient is not receiving any lipid in their parenteral nutrition, maybe it was missed, then they could have an essential fatty acid deficiency, and in the changeover from soy oil to a multioil, I think that is where it gets a little tenuous. And so again, if they have received 6% of their total calories, 8% of their total calories from soy oil, you can be fairly sure that their triene tetraene ratio is normal. So,

as you transition them over, as long as you provide the 15% or more of calories from multioil, you should be fine.

Beth Taylor, DCN, RDN-AP, LD, CNSC: . Thank you for your time and attention. Thank you to the people at home.