Introduction:
"This recorded seminar, Exercise and Physical Activity for All Ages, is presented by Ralph LaForge, Exercise Physiologist at Duke University Medical Center, Endocrine Division. He is also a consultant to the IHS Diabetes Division. Mr. LaForge discusses recent, important findings from clinical exercise trials, the ACSM and ADA physical activity guidelines for prediabetes and diabetes, information on the new realities of exercise and weight loss and pediatric exercise guidelines. Practical strategies and resources are provided."

Ralph LaForge, MS:

"So, what I would like to just start with, Jan had reminded me to give everyone something they can take back to their clinics. You know, the new reality is get your diabetes patients to move and whether they lose weight or not, the activity itself, as we'll see, has risk reduction potential; probably as much, and in some cases, more than if they actually have associated weight loss. And not that we don't want weight loss, but I'm saying that it's going to be easy to get the patients to move than to adhere to the high threshold of caloric expenditure required for significant weight loss.

A very large amount of data over the last few years shows that exercise provides the best prevention and treatment for insulin resistance in type 2 diabetes, and that's a mouthful. And this even when it's thrown up against a dietary management and not to belittle dietary management at all. We absolutely need this for both weight loss and lipid reduction, blood pressure reduction, etcetera.

But single, if you looked at one behavior and there is some good data behind this, I'm going to show you in the next two slides, we have – in fact, there are two Nobel Prize laureates in this group here that you see on the left – that have shown that exercise is probably the single most important stratagem to reduce risk of recurrent events, hypo and hyperglycemia and of course, mortality due to coronary artery disease.

So some of you probably have seen this slide before, but if you take a patient, or any one of us, if you take any one of us to actually go from 500 calories to 1000 calories or 1500 calories of exercise a week, that is, if you do nothing and then you start walking 5 miles a week, 10 miles a week, 20 miles a week, 25 miles a week, a number of things occur that are important physiologically.

When you go for nothing to just as little as 1,000 calories of exercise a week, which tends to be about ten miles of walking for the average person, a lot of things happen well short of what we would consider significant weight loss. 1,500 calories to 2,000 calories of exercise a week, there is a measurable body fat loss. Of course, I should say, more appropriately, weight loss, there's actually body fat loss back here, but it's not transduced to significant BMI and weight loss, until it gets to the 1,500 to 2,000 and more calories per week threshold.

And then of course, to maintain amount of weight loss, the energy requirements are considerably more for maintaining a new found weight. I remind all of us that, that is trial tested for the last decade or more.

Again, that starting with just going from nothing to just moderate exercise, there is a lot of risk reduction through mechanisms not extremely married to body fat reduction or LDL cholesterol

reduction and to maintain that weight loss considerably more energy expenditure. And this is true whether you have prediabetes, diabetes or you have neither.

Okay, my only real complex slide, but it says so much. This is a three-semester hour course and all I want to tell you, all I want to convey here is that when you contract a muscle intentionally. Especially, at least if it's a moderate level of muscle contraction, be it resistance exercise, yoga, walking, whatnot, as long as it's measurable and intentional, a lot of things occur before you even begin to oxidize fatty acids.

So, what I'm really saying here, and this is actually oversimplified itself, is that a number of metabolic mechanisms occur most noteworthy of which is insulin sensitization well before you begin to oxidize your first gram of fatty acids or even weight loss.

So, the point here is that sort of what we've missed here, is we have sort of based adherence and exercise based on, in some cases lipid reduction and adiposity or weight loss, when we should really be measuring the actual behavior itself, muscle contraction. And this has never been more true than it is today with the research that we have in the last five or six years.

If we ask the question in a very quick way, how much physical activity am I talking about in terms of weekly energy expenditure and weight loss? Now this slide got jumbled up so the columns are completely off.

For diabetes, prediabetes, and pediatric, we don't have caloric expenditures for pediatric that is recommended. We have step counts and hours per day of exercise. So, at least an hour a day of exercise and the new standard is 12,000 steps per day male or female, for kids.

For diabetes and prediabetes, and those with the metabolic syndrome, at least 1,000 calories of exercise a day, that's about 10 or 11, and we actually would say, anywhere from 9-11 miles of walking per day, or I'm sorry per week, 9-11 miles of walking per week for reducing cardiometabolic risk.

For weight loss, note that as we had said earlier, the energy expenditure is considerably more. That would be close to the equivalent, if you we're going to say walking 18-20 miles a week of walking. Of course, the heavier you are, the more calories you burn per mile. So that could be less than 20 calories or 20 miles to be equivalent 2000 calories for someone very overweight.

So, in a very big nutshell, this is sort of the overview of what the guidelines state, and that's not completely new.

Now, what I would like to do now, is run through about eight or nine clinical trials and recent guidelines that support what we're doing and in some ways, we'll brandish new information, again, reinforcing what we are doing with a slightly different angle to rationalize, again what we're doing with exercise.

Rachel Colley and others at Queen's University in Ontario did an incredibly important study earlier this year that's published. In this study, she used an accelerometer, not a pedometer, but accelerometer which measures both steps or muscle contractions and the force. So, this device can actually measure the intensity of moderate to vigorous physical activity, what we called MVA.

She took basically 1,600 kids, 6-19 years of age and recorded just about 10,000 activity days and finalized what the step count should be that would be the equivalent of moderate to vigorous physical activity. Not just walking, but moderate to vigorous physical activity. That happens to be about 12,000 steps per day. That is a standard that's probably going to stand for some time.

So, I thought I would just begin with, with that paper. I think that's very important new standard that I actually have been talked about for several years, but her paper was the best to qualify that.

Here is another paper that basically did the same thing but for adults. Catrine Tudor-Locke, Arizona State, handed the Pennington Research Center, Baton Rouge, on 3,500 adults, wanted to look at what is 30 minutes a day of moderate to vigorous physical activity worth in step counts. And as it turns out, it's about 8,000 steps per day on a regular, well-engineered step filtered pedometer, similar to the ones we have been advocating at various seminars for the IHS.

So, 30 minutes per day for an adult of moderate to vigorous physical activity is roughly equivalent when you average both males and females together, about 8,000 steps per day. So, if you are doing 10,000 you are actually exceeding what you really need to do for generalized risk reduction. Of course, for weight loss that's going to be considerably more than 8,000 steps per day, but this is just for to show the minimum for achieving moderate to vigorous physical activity on a daily basis.

Here's a paper that is one of the main reasons why genetics can actually influence exercise generated weight loss through no fault of the lifestyle of the individual.

Now, it's often said that genetics has at least a 30-40% influence on dietary and exercise generated weight loss. A protein that's been around for some years but it more recently has been looked at is called Perilipin 1. This is a protein that surrounds all fat cells, all fat particles and fat cells if you will. And it actually, Perilipin 1 acts by preventing the fat-burning enzyme, hormone-sensitive lipase from entering the fat cells.

So, if you have an overabundance for expressing Perilipin 1 which apparently anywhere from 20-35% of the people do, it actually reduces, it doesn't block, but it reduces your ability to lose weight from energy expenditure.

So, let me just add one little note here educationally, each one of these slides has notes in the notes section of the PowerPoint slide and I'd be glad to send you the slides deck or select slides. If you send me an email, I'll send you this slide and then underneath that slide and the note section is probably eight or nine paragraphs of data, if you want that.

So, I don't want to get in this too much, other than to reinforce data that has been out for some time, but reinforced in two papers this year on how genetics, particularly this particular protein, can actually slow down, through no fault of lifestyle, the ability of exercise to reduce caloric expenditure.

Kevin Hill just finished a paper which is probably the best single paper I have ever read. It's a review paper, "Energy Balance and its Components: Implications for Weight Loss Programs." This is so important that we're going to actually piece it into the best practices guideline for IHS DDTP as soon as I can get this into that paper.

Let me just point out a couple of things that this a review paper that looked at many, many, many, many studies and came up with some new data or new statements, which actually is dispelling some of the popular beliefs we have seen in weight loss for some time. And one of those mythologies, which you shouldn't call it a mythology, but a popular belief that is probably an excessively adhere to believe, that is the impact of exercise training, be it resistance or an endurance exercise or both, on Resting Energy Expenditure is negligible for weight loss.

There are studies that show accumulated energy expenditure is after a given dose of exercise that project maybe a pound or two of additional weight loss over the course of a year. But when you look at all the data, Resting Energy Expenditure does elevate slightly as a result of an acute

workout or a training effect, if you will, but it's negligible in terms of using this, it's a major rationale for weight loss.

The other mythology is the origin of the 3,500 calories per pound of pure fat. In terms, one pound of fat takes about 3,500 calories to oxidize a full pound of adipose tissue, which would be about 35 miles of walking, and that's also misapplied. It actually is – you can lose a good bit more weight, of course, in walking 35 miles in a pound than just doing it for 3,500 calories for a pound of fat.

It's a fundamental error because no time period in the studies that actually guessed at that amount, specified for their intervention.

So again, if you're using this as a very general way to educate patients on how energy rich a pound of fat is, that's fine. I think, I don't think I'd use it to draw any conclusion by projected weight loss. Hopefully, you're not doing that.

Here is another paper, Larry Black and others at Arizona State University, basically looking at two levels of resistance training. Modern Intensity Resistance Training where the 1RM max is about 65% of one repetition maximum, or high intensity where they were repeatedly doing upper and lower body muscular movements at 85% of their maximum capacity for each particular repetition.

And as you can guess, this is about the third paper in the last four or five years that has shown that yes, it is actually true that insulin sensitization for prediabetes or even diabetes patients, higher intensity protocols result in greater insulin sensitization; about 30% greater when the resistance to the exercise is relatively high.

The thing you have to remember with high-intensity resistance training is injury propensity goes up, as well. Musculoskeletal injuries are definitely in direct proportion to the weight load that is applied to the patient.

Now here is another paper by Jim Hawley and others who have been talking about this for years. This is basically a spinning exercise intervention, 10x60 seconds on a stationary cycle at 90% of Heart Rate max (HRmax) looking at Insulin sensitization, insulin signaling, reducing fasting plasma glucose, etcetera. And I won't go through all the details. This is the only page I'll show you on this study.

The issue here is that yes, high-intensity anaerobic, spinning types of, or even running, high-intensity running, will increase insulin sensitization, especially at this heart rate.

The problem with this, of course, is you've got patients with prediabetes or diabetes who are already at risk for exercise generated cardiovascular complications and that risk is quite proportionate to the intensity of exercise.

So, they do caution that if you've a very well patient, who otherwise is fairly fit, doing high-intensity repeat intervals can actually help improve insulin sensitization and reduce fasting plasma glucose, but they have to be fit enough to do it.

And there's another caution here. If they're going to do this much exercise at this intensity, they better have convective cooling, a nearby fan to keep them from overheating, which is very important for at risk metabolic type patients.

Here's another paper by van Dijk and others that basically reinforces the both resistance and endurance training reduce the prevalence of hyperglycemia in individuals with diabetes or impaired fasting glucose.

So, what they're saying here, whether it's endurance exercise like walking, running or swimming, 45 minutes in this case of cycling at 50% of their maximum work capacity versus, or resistance exercise 45 minutes of lat pulls, chest press, leg press, 3-5 sets of 10 reps of 55-75% of 1RMax that both are equivalent at reducing about, and it doesn't say it here but it does in the notes, 30-35% fasting glucose or hyperglycemia.

So, one is not better than the other. In fact, probably the real issue between these two is just the total energy expenditure. At 45 minutes I would venture to say these were both worth about 350 calories each. It's the total caloric expenditure, that's probably most related to the hyperglycemia rather than the differential between the mode of exercise.

Okay, how about this paper by Segerström and others in Sweden and Stockholm, "Impact of Exercise Intensity and Duration on Insulin Sensitivity on Women with Type 2 Diabetes." Now, this is a very telling paper. It's not a large trial; it's only 22 women with type 2 diabetes. But it reinforces with for the first time in an extremely well-controlled paper that basically says that improvement in insulin sensitization is most related to the exercise intensity or the load of exercise, whereas, A1c is mainly related to the training volume, or the total caloric expenditure.

In other words, A1c is more tied to the caloric value of the workout, the long walk on the beach, the long hike, the long easy bike ride, whereas insulin sensitization is a little bit more tied to the intensity of the load of the heart rate. And of course, what this transduces to is that a mix of both is probably ideal.

But that is an important, for the first time, I think that is new information to see it reinforced that training volume or total caloric expenditure of the workout are per week or per month is more related to the A1c reduction which, for most diabetologists, endocrinologists that's the key issue right there, A1c.

One other finding in this paper: the metabolic effects of training may be seen in the absence of improved exercise capacity. A long walk on the beach, for instance, that burns maybe 400 or 500 calories or a high long hike, because it's a fairly low intense activity, is probably not going to generate much weight loss, I'm sorry, generate much increase in aerobic power or VO2 max.

That's why when you're measuring fitness like VO2 max predicted fitness from various sub-max tests, I'm not sure that we need to put all of our marbles in the fitness parameters. We need to put our marbles, if you will, to just move parameters. Any indicator, outcomes indicator of the patient moving, whether you measure that by step counts or minutes per day or achievement of certain performance goals, is up to you and the patient.

And finally, here is a paper that got a lot of attention, even CNN talked about this in December this year, published in the *Journal of the American Medical Association* a few months ago that basically looked at unstructured home exercise versus structured exercise for type 2 diabetes patients in terms of reducing A1c.

And basically, and it was a fairly large paper, a very large subject number, more than a 150 minutes per week is associated with greater A1c declines than that of 150 minutes or less.

But notice we're talking about structured exercise. I don't think there is anything sacrosanct about supervising the exercise, except the fact that they will do it. They comply when you see them and they follow your lead. There is probably some compliance fall off when they should be doing it at home. So it would be fairly self-explanatory.

Okay, let me just very quickly review what I just said, so we're on the same page, because this will reinforce what we talk about for the rest of the webinar. So, I'm going to summarize what we just

talked about. Step target for moderate to vigorous physical activity levels for all kids. It's about 12,000 steps a day would be the ideal. 8,000 steps per day is a good proxy for 30 minutes of moderate to vigorous physical activity for adults.

Genetic factors play a role maybe as much as 40% in exercise-generated weight loss. From a practical point of view, the benefit of acute exercise and Resting Energy Expenditure is negligible. This includes the post-exercise oxygen consumption that you consume in the immediate hour or two after exercise, not that it doesn't exist, it's just negligible from a weight loss prediction perspective.

It appears that exercise intensity is more related to insulin sensitization whereas total exercise volume, that is total daily energy expenditure regardless of the intensity, is related to the A1c.

Higher intensity exercise generates somewhat greater insulin sensitization than moderate intensity exercise, but it can be risky. Choose your patients wisely, and one way you do that is my last slide in this webinar.

A single 45-minute dose of exercise, whether it would be aerobic or resistance training can decrease hyperglycemia 30-35% for up to 24 hours.

And although this went slightly off the slide here, structured exercise training is more effective than unstructured of course, and especially if they're getting at least a 2.5 hours of moderate level exercise per week.

Now let's talk a bit about some consensus guidelines on exercise and prediabetes and diabetes. As you probably heard me say before, I've said this probably virtually every single time I've talked in just about any seminar, is the level of exercise per week in terms of caloric expenditure per minutes per week to reduce risk of diabetes or reduce risk of a first heart attack or a recurrent heart attack is somewhat lower than weight loss. It's pretty obvious, isn't it? Okay.

So, we're not saying that this is not important. What we're saying is that there are other things that happened from that third or fourth slide I showed earlier. There are metabolic mechanisms that are directly tied to metabolic risk reduction that are not completely wedded to either cholesterol reduction or weight loss itself.

One of the real issues as we all should know by now is that modern world makes it very easy to out-eat exercise and nearly impossible to out-exercise excessive eating. Boy! Isn't that the truth?

To this day, and I have just kind of gone round and round with my own colleagues here at Duke University, but I finally gave away, because I think my colleagues are right or at least most of them, is that dietary intake of total calories is probably the chief issue with weight gain. But for the maintenance of new found weight, of course, exercise has to be part of the equation.

Let's talk about the joint ACSM/ADA Diabetes and Exercise Guidelines. I am just going to hit some high points. In randomized control trials, about one hour daily of exercise, a moderate aerobic exercise produces at least as much fat loss, and notice I did not say weight loss; fat loss. Either waist circumference changes, a more proper appropriate sub-scapular or triceps skinfold reduction, as equivalent caloric restriction with result greater insulin action.

So, what we're seeing here, and what I think I have mentioned this before in previous seminars, is that one hour of exercise will reduce adiposity. It may not reduce a lot of a scale weight or BMI.

The other advantage I think exercise has it's a great insulin sensitizer unlike particular dietary strategies, but not to in any way belittle dietary strategies. It's just that you have immediate insulin sensitization, by definition, with acute exercise.

Another evidence statement for this joint consensus guideline is a combination of aerobic and resistances exercise training may be more effective in improving blood glucose than either alone. However, we need more data to substantiate that. Four papers say that's true, two papers say there wasn't any added reduction in blood glucose control with adding resistance exercise. So we still need a few more experimental trials to reinforce or confirm this.

Exercise intervention studies showing the greatest effects on blood glucose control have all involved supervision, as we had said earlier. This comes from probably the largest trial to support that and that is the "Italian Diabetes and Exercise Study" published two years ago.

The optimal volume of exercise to achieve sustained major weight loss is probably much larger than the amount required to achieve improved blood glucose control and cardiovascular health. This is another way of saying that just get your patients to move, okay, get them to move.

I think the first tier outcome should be the actual behavior itself. The second tier outcomes would be glucose control, of course, and then the third tier outcomes, possibly the actual amount of weight loss, etcetera.

Finally, in addition to aerobics training persons with type 2 diabetes should undertake moderate-to-vigorous resistance training at least 2-3 days a week. What they mean by moderate-to-vigorous here is essentially, a moderate would be 50% of one repetition maximum resistance; vigorous would be anything approaching 70-75% of 1 RM max, just to give you an idea what we mean by moderate-to-vigorous, from strength training standpoint.

One last guideline that you may already know about is that patients that have had type 2 diabetes for more than a decade are going to have what they call chronotropic incompetence. They're going to have about 10-15 as much as 20% lower heart rate response for any given level of works. So heart rate is not a great predictor in those that have had type 2 diabetes for some time; a great predictor of actually VO2 max, keep this mind; the same with blunted systolic blood pressure response.

I'd say that's sort of good in the sense that they don't get systolic hypertension with moderate-to-vigorous exercise. But keep in mind, when you're comparing type 2 diabetic that's been that for over a decade, you're not going to have the same responsivity in those two parameters.

The same thing with VO2 max; aerobic power is going to be somewhat blunted. We can talk about the mechanisms for that in another time. The same also with anhydrosis that is they also have inadequate sweat response. That's one reason you want convective cooling for any stationary exercise class that type 2 diabetes or those with insulin resistance that are going to be engaging in an indoor stationary type of workout. They need convective cooling big time, as evidenced right here.

I can't tell you how many times I've been to fitness centers just general fitness centers and seen these incredible workouts, and here's a spinning class, with actually no provision for cross-current ventilation. Keep in mind, cross-current ventilation for type 2 diabetic is the only means they're going to be able to use to reduce evaporative heat loss. You need something moving across the beads of sweat. You can't have stagnant air doing that, otherwise you're going to overheat very quickly.

So just get your patients to move. I think most of you have more ideas about how to do this than I do, but I will share with you a few things that I've learned over the years and what we have done in the Cherokee Nation and several tribes and the Eastern Aleutian Tribes, etcetera that have worked very nicely over the last few years.

Let me just very quickly talk about some pediatric guidelines. I won't go through all of these in detail. This is the CDC 2012 guidelines. One hour a day mixed between aerobics, muscular strengthening activities, and bone strengthening activities.

The next slide shows some practical things kids can do, from some of the vigorous intensity muscle strengthening and bone strengthening. The CDC, on their website, has a great litany of practical suggestions for kids that are 6 to 19 years of age, especially in the 6 to 13 years of age bracket.

The International Society for Pediatric and Adolescent Diabetes is probably the best single set of clinical guidelines for working kids with type 1 or type 2 diabetes that I know of. Let me just say a couple of things about those guidelines, and I think most of you probably are aware of this, but it's especially important to plan for the long duration or intense aerobic exercise. Hypoglycemia, especially with type 1 diabetes, is almost inevitable for any activities left in longer than half an hour.

Young people with type 1 diabetes have been found to have decreased aerobic capacity, as measured by VO2 max. So keep in mind they may have a lower sweat rate, you definitely have to start a more shallow in the intensity and the duration and you do have to watch thermic environments for the heat, humidity index is higher than what it would be normally.

Also, what these guidelines say is that if you are going to be using regular or soluble insulin like Novolin or Actrapid or one of those, they are most likely timed for hypoglycemia, would lead two or three hours after injection, versus when you are using rapidly acting analog insulin. The most likely time for hypoglycemia is going to be 40-90 minutes later.

So that's something you should keep in mind in terms of the time when kids will express some of the hypoglycemic symptoms that they often do.

Finally, just to reinforce that you understand this, avoid exercise if blood glucose is below 100 milligrams per deciliter or about 300 check ketones if blood glucose is greater than 50. Take 15 grams of carbohydrates or approximately that for every 30 minutes of exercise, that's like a small apple, small pear, a couple of dates. You should all know by now what about 15 grams is, if you are working with kids with type 1 diabetes.

Check blood glucose every 30-60 minutes during the exercise program and using legs for injections, especially with running, avoid using the legs or avoid injecting into a site where the skeletal muscle is actually going to be uptaking the glucose. Okay, so avoid the active muscle if at all possible.

Okay, now, let's get to a more fun part in the next 10 minutes and we'll close out here. This is something that has worked for me, especially patients who have a hard time going to a fitness center, but they've got a home environment, the "H" stands for Home or the pueblo or wherever they coexist there in the community.

Having them walk about a mile to and from a location where there is variable terrain, either high school or college or junior college bleachers or a trail where they have undulating terrain. The reason I am trying to add some gravitational force is that when any given body weight uses terrain or gravity for walking, you're going to burn 30-50% more calories per step for any given speed.

So one 60-minute loop of walking a casual mile to a location in that location, perhaps 30-40 minutes of stair climbing, we are not in any hurry to do that; we're just talking about using a modest pace, using your body weight against gravity to burn more calories. This would break up the monotony of being inside, you get full spectrum sunlight, a lot of vitamin D synthesis, and you've expended at least 300 calories. If their BMI is over 35, this is probably closer to 500 calories, as I will explain here in a minute.

Here is another very prominent exercise prescription we've been using through years in the Cherokee Nation and a number of other tribes, as well as patients that I work with.

On Monday, Wednesday, and Friday, for example, the days where they're too tired to go to the fitness center, if they can just put 20 minutes in each of those days and not all at one time of just a modest pace walk; in other words, five four-minute at work walks. Five four-minute walks, Monday, Wednesday, and Friday and then one weekend day have their spouse drive them an hour-and-a-half to two to three hours from home, drop them off, give them a canteen of water with maybe a dilute glucose solution, and maybe a couple of pieces of fruit, and sayonara, we'll see you in couple of hours.

Now you don't start with two hours; you start with more like 80-90 minutes. But what we're doing here is they've got about 400 calories worked off here and 1,200 during here and that's one way to give them over to 1,500 calorie, 1,600 calorie threshold for significant weight loss. It's that one what we call LSD workout a week, long, slow distance.

So, one day of the week, Saturday morning when it's cool, especially in the Southwest, or any place in this country, would be the day. The magic is this work out right here. But you can't do this and nothing for the rest of the week that will be almost dangerous, not to have at least some training effect or some minimal activity throughout the week.

Here is a very important point. I'll hope most of us have understood by now, overweight and obese prediabetes and diabetes patients expend more calories for a given walking workout than those who are normal weight.

Many papers have shown this, but one of the classic one is that even walking may represent a difficult exercise modality for obese, especially type 2 diabetic patients. Where that patient it might be 56% of their maximum aerobic capacity, most of the rest of us were about two-and-a-half miles an hour were only 35% of max, but the range can be anywhere; it can be from 65-98% difference.

So, some people that BMI is greater than 40 are already at close of 100% of the aerobic capacity. Keep that in mind when you're doing what you think is moderate activity to them, they're above lactate threshold. They're making a lot of lactate, they're hyperventilating, they're dyspneic and they're exhausted and that's something that has to be understood depending on their level of adiposity and BMI.

Here is another stratagem that is being worked with all the new data on sitting time and mortality and metabolic risk. Regardless of how fit you are otherwise, sitting time has a lot to do with metabolic syndrome and insulin resistance. So, what we have here is Workplace Energy Expenditure.

Five minutes per hour if you are immobilized or non-ambulatory like this fellow, five minutes on the hour is a new Pennington Biomedical Research data, supports five minutes on the hour. This would be in a seven-hour shift about 35 minutes at three or four calories per minute, and if they use stairs, maybe a few more calories than that. That would be about 100-140 total calories per day. That is very significant. In fact, that's equivalent to close to 10-20 milligrams to metformin. They work very similar.

As you've heard probably from me before, muscle contractions work almost identical as how metformin works. They're both AMP kinase activators in the muscle and consider exercise to be metformin equivalent.

And then finally, let me just call your attention. Most of you probably looked at the Quick Guide Cards section of the DDTP IHS website. If you pick the Physical Activity tab, you'll open up to here. I'm just going to talk about very briefly a couple of tabs there.

One is Systematic Clinical Pedometry. CDE is now to be certified as the CDE now have four exam questions on their exam on pedometry because of the growing dataset for pedometry has been a good measure of not just step count, but muscle contractions and a metformin equivalent.

One thing I'd like to call your attention on this website is also a form: it's a pediatric seven-day step activity assessment. This just assesses where the child is. What it does is it measures two full schooldays to two full weekend days, their total step count. So they just record two full schooldays and two weekend days and then bring the pedometer, record that and bring the pedometer and the sheet back to you, and it gives you a baseline of where to start from.

Now University of Nebraska has what to do with that data in terms of how much walking, how active they should be when they actually start a program using the pedometer from Week 1 through Week 6. And this actual form is on the IHS Best Practices for weight loss and cardiometabolic risk document on the website. This is a great resource, again, on the DDTP best practices for weight loss website; this form is one of the references on that site.

If you're going to use a pedometer, make it official, just like you would scrip: patient name, the therapeutic code. Here at Duke, we have nine therapeutic codes for clinical pedometry. In this case, it might be weight loss, which is going to be more step counts. In other case, it might be just insulin resistance risk reduction, it's going to be fewer step counts, etcetera, write in the type of pedometer. And actually, they get their pedometer here from the pharmacy. They're given the prescription signed by the MD and the pharmacist makes a few bucks on it and gives it out when they bring the form with them to the pharmacy. That makes it official and I'm trying to get FDA approval as a medical device, but I'm still about two years away of having clinical, well-engineered pedometers approved as a medical device.

Another item on the Quick Guide Cards section in the IHS DDTP website is Pedometer Trekking. Basically, in or around a pueblo or wherever your patients live, it takes a few months to put this together. But to plan out 3-10 customized paths or trails that are known step counts and you're the one that validates the step count for each trail.

So what you're doing here? When you prescribe exercise, you're prescribing the trail, the preconceived trail. Give the trail a name. This we'll call it Level 1, 2, 3, and 4 trail and the Level 1 trail might be a half to a mile and a half long over variable terrain, as you increase the levels. And they would do this like once or twice a week amongst other activities, of course. This gives a little more credence and believability and more creativity to the exercise prescription where you're actually prescribing a known step count for a given distance in the trail. And the trails, of course, can increase in distance by level, of course, and increase in difficulty in terms of having terrain or stair steps throughout the trail, whatnot.

In most of the IHS medical facilities and where you live, you have access to terrain that it's just nearly ideal for this, weather permitting.

Finally, just to point out a couple of resources, probably the best single resource I have ever seen for physical education kids is the PE Central website. The PE Central website, it has more activities that are upgraded every month than I have ever seen. These are activities that actually been trial tested in the schools and at home.

The other one has also won the best practices document for weight loss is the IHS Physical Activity kit. This activity kit is chockfull of activities, in fact, there are Physical Activity Kit trainers

distributed through the west and you are probably very near one. Again, this is on the website that you see here.

The activities on that Physical Activity Kit include eight books from a very young to senior citizens and resource books. I would call your attention to that as a great resource; more than I have at Duke University.

And finally, finally, I would just like to ensure that we all understand whether, for instance, they are getting 1,500 calories a week in their work, not likely, but let's say, they generate 1,500 calories in their work or in gardening or whatever versus 1,500 calories in an actual planned workout at a fitness center from a diabetic or prediabetic or insulin resistance perspective in terms of the biological benefits that really isn't going to be much difference at all. So keep in mind, it doesn't absolutely have to be a fitness center directed activity. The more we can weave in domestic chores, etcetera, the better off.

And in fact, you've heard this from me before, but there are so many great trials that support this. The first types of activity, beyond just fitness center activity, being asked, if not more important and more compliant than a fitness center type activities in terms of reducing hypoglycemia, insulin resistance, and obesity. And on the DDTP website, the Quick Guide Card section on Household-Community Circuit training, where this is a form at the provider or the health educator writes in six or eight activities, always starting with very mild activity and every two or three minutes rotating to another level where they are in a circuit and after 90 minutes, you have got 400 or 500 calories spent.

And guess what, you have got 400 or 500 calories spent and you have got something accomplished. Now, can you say that about walking for 35 minutes on a treadmill or a stationary bicycle? I don't think so.

And one of the last things I wanted to say, I keep saying, I know this is my next to the last slide. There is one quick way from a laboratory perspective to assess how well their lifestyle is doing. I don't know, I don't -- this thing is blocking my view here.

But no, that non-HDL cholesterol is probably the best single laboratory measure that is the most responsive to any lifestyle change and that it should be calculated already on a lipid panel or you can calculate it yourself that is total cholesterol minus HDL that leaves over all the lipids that are oxidized by exercise, is the most responsive laboratory parameter of compliance with dietary exercise or generalized lifestyle measures.

And I'll close with this; this is a just a reminder that any patient with diabetes who is just going to be starting a program, whether it's moderate or vigorous and they have been previously sedentary for a decade or longer, do require a stress EKG first.

Thank you so much and again, I'll close with just get your patients to move and move often. You too! Thank you!"

Total Duration: 49 Minutes