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Improving Inpatient Glycemic Control: Expert Insights CME

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Target Audience

This activity is intended for hospital physicians, hospitalists, diabetologists, endocrinologists, nurse practitioners, nurses, physician assistants, and diabetes educators. There are no prerequisites.

Goal

The goal of this activity is to provide healthcare clinicians with expert perspectives on current best evidence and treatment guidelines with a focus on identifying and achieving specific glycemic targets using evidence-based means in hospitalized patients who have hyperglycemia with or without diabetes.

Learning Objectives

Upon completion of this activity, participants will demonstrate the ability to:

1. Apply clinical practice guidelines and current evidence to improve inpatient management of hyperglycemia
2. Evaluate strategies to overcome barriers to optimizing inpatient glycemic control
3. Identify appropriate treatment options for achieving optimal glycemic targets safely and effectively
4. Implement practices to improve the continuum of diabetes care from hospitalization through discharge and transition to outpatient care

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Received grants for clinical research from: sanofi-aventis; Takeda Pharmaceuticals North America, Inc.; Merck & Co., Inc.

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Improving Inpatient Glycemic Control: Expert Insights CME

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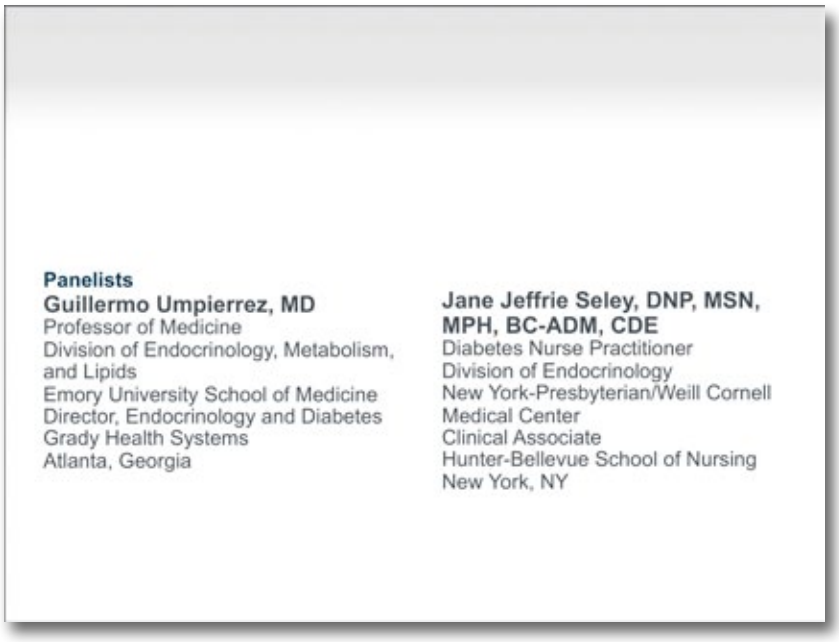
Welcome and Introduction

Slide 1.

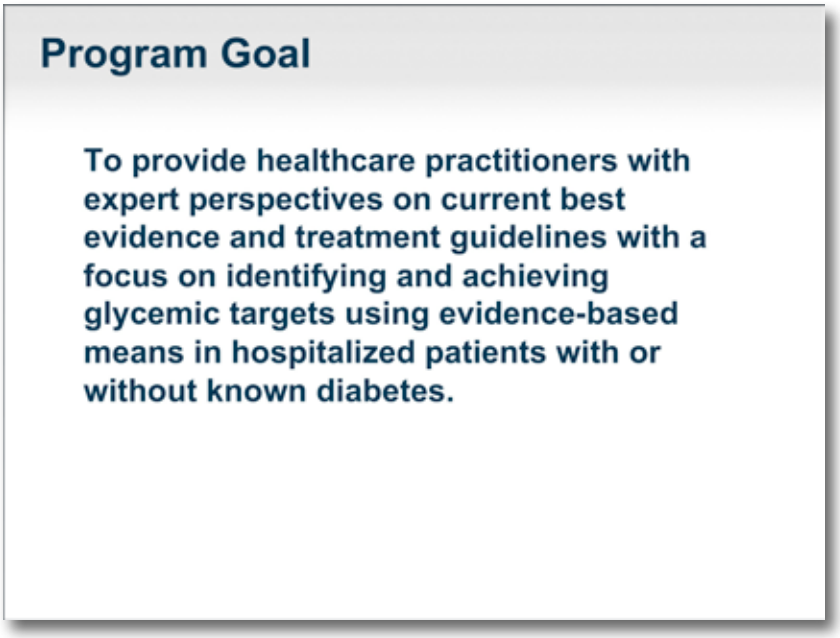
Annabelle Rodriguez, MD: Hello and welcome to this CME-certified roundtable panel discussion titled *Improving Inpatient Glycemic Control: Expert Insights*. I'm Dr. Annabelle Rodriguez, Director of the Diabetes and Cholesterol Metabolism Center at Johns Hopkins Bayview Medical Center and Associate Professor of Medicine at the Johns Hopkins University School of Medicine in Baltimore, Maryland.



Slide 2.

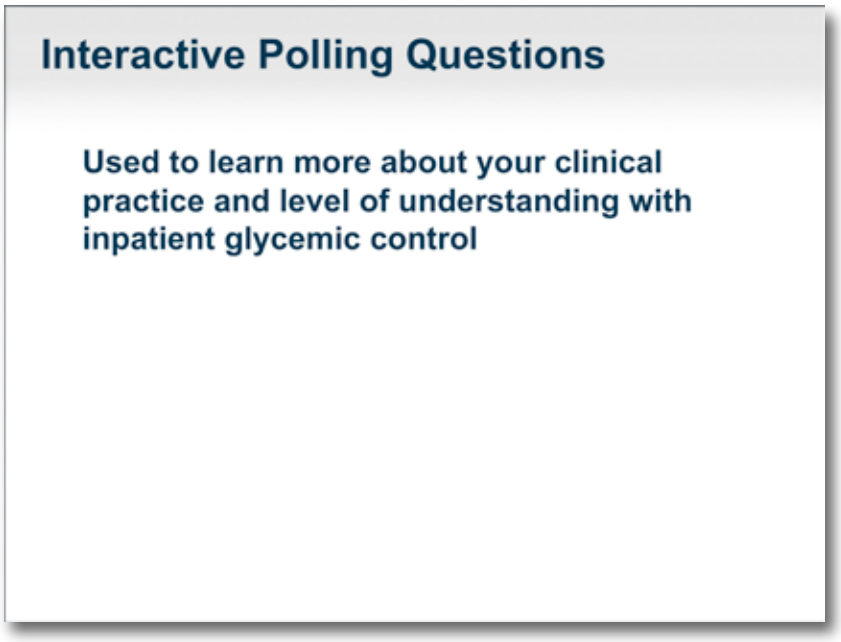
I'm pleased to be joined today by my 2 colleagues, Dr. Guillermo Umpierrez, Professor of Medicine at Emory University School of Medicine and Director of the Diabetes and Endocrinology Grady Health System in Atlanta, Georgia. I would also like to welcome Dr. Jane Jeffrie Seley, a doctor of nursing practice, Diabetes Nursing Practitioner, and Diabetes Educator at New York Presbyterian Weill Cornell Medical Center in New York. It's a pleasure to have you here today.

Jane Jeffrie Seley, DNP, MSN, MPH, BC-ADM, CDE: Thank you.



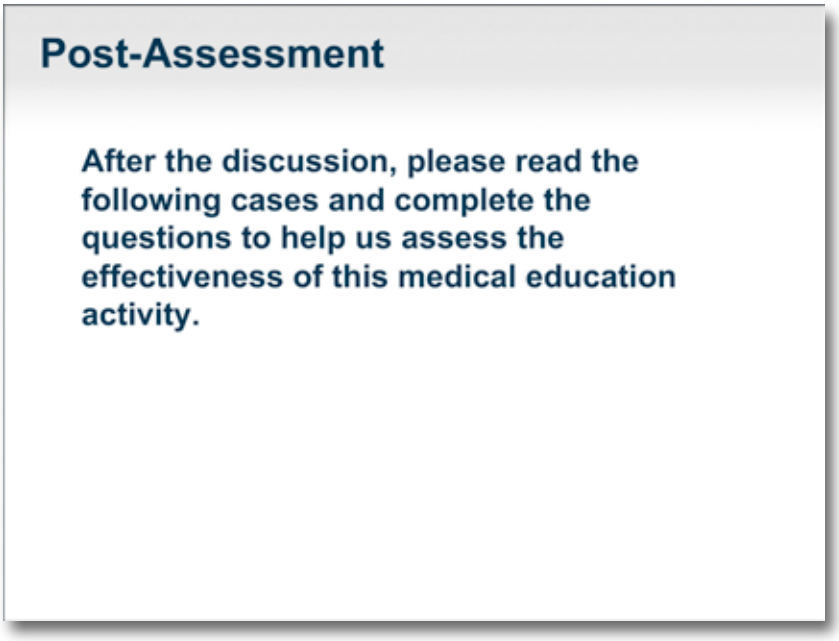
Slide 3.

Dr. Rodriguez: The goal of today's discussion is to provide expert perspectives on current best evidence and treatment guidelines with a focus on identifying and achieving specific glycemic targets using evidence-based means in hospitalized patients with or without known diabetes.



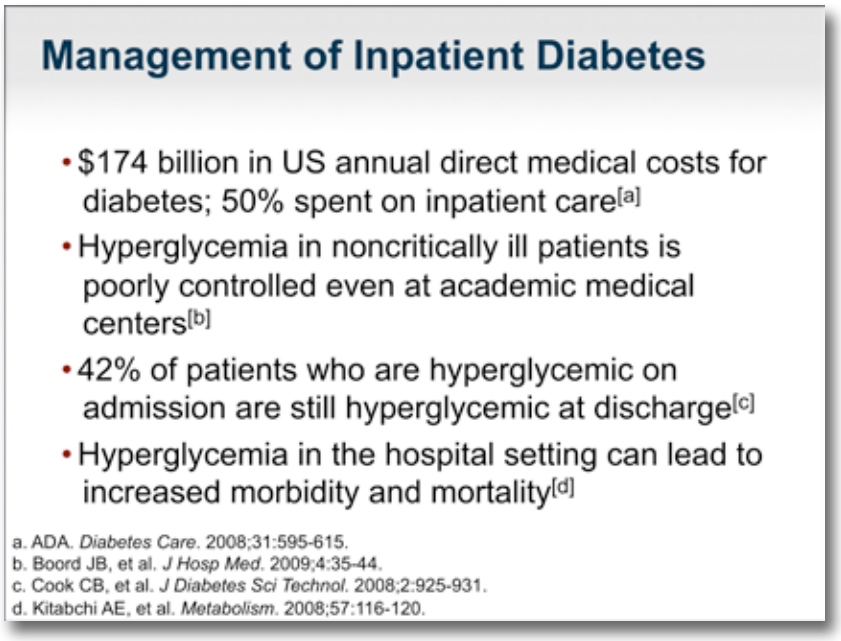
Slide 4.

We will also be using interactive questions to learn more about your clinical practice and level of understanding of inpatient glycemic control.



Slide 5.

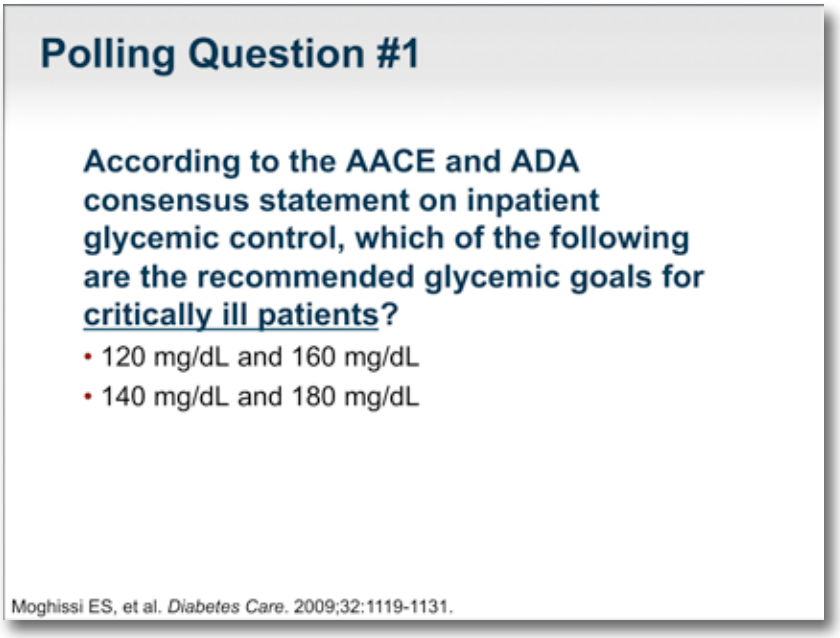
At the end of the discussion, I invite you to take a few moments to read the following cases and complete the questions to help us assess the effectiveness of this medical education activity.



Slide 6.

To begin our discussion, I would like to discuss the need to improve management of inpatient diabetes. What we know based on data from the American Diabetes Association (ADA) in 2008 is that there is over $174 billion spent in direct medical costs for diabetes with 50% of that spent on inpatient care. As you are all aware, there is a high prevalence of hyperglycemia in noncritically ill patients and they are poorly controlled, even among academic medical centers. Forty-two percent of patients who are glycemic at the time of admission remain hyperglycemic following discharge, and there have been studies to look at this 3 months after discharge. The clinical consequences of hyperglycemia in the hospital setting can lead to increased morbidity and mortality, so there is a pressing need for clinicians to focus on improving inpatient glucose control.

Polling Question #1



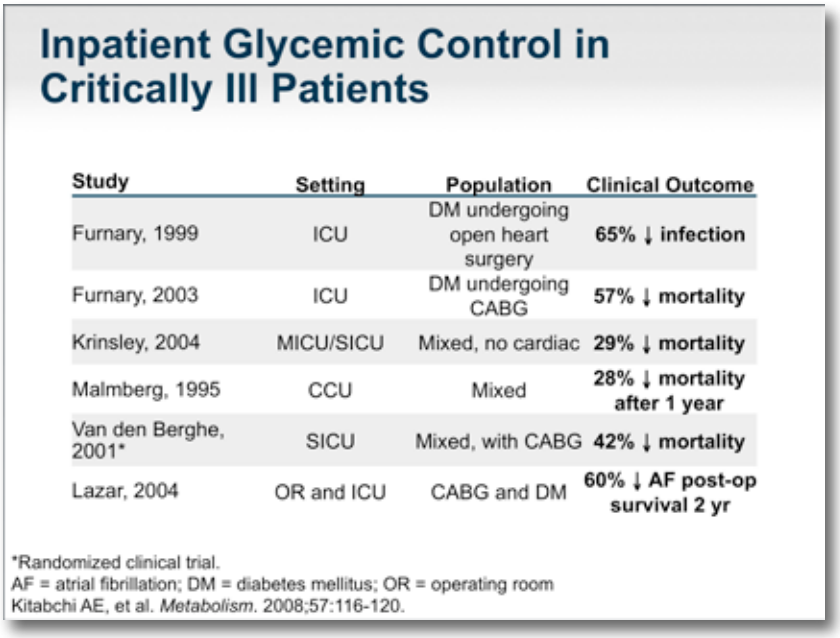
Slide 7.

Before I turn the discussion to Dr. Umpierrez, let's pause for our first polling question.

According to the American Association of Clinical Endocrinologists (AACE) and ADA consensus statement on inpatient glycemic control, which of the following are the recommended glycemic goals for critically ill patients?

- ◯ 120 mg/dL and 160 mg/dL
- ◯ 140 mg/dL and 180 mg/dL

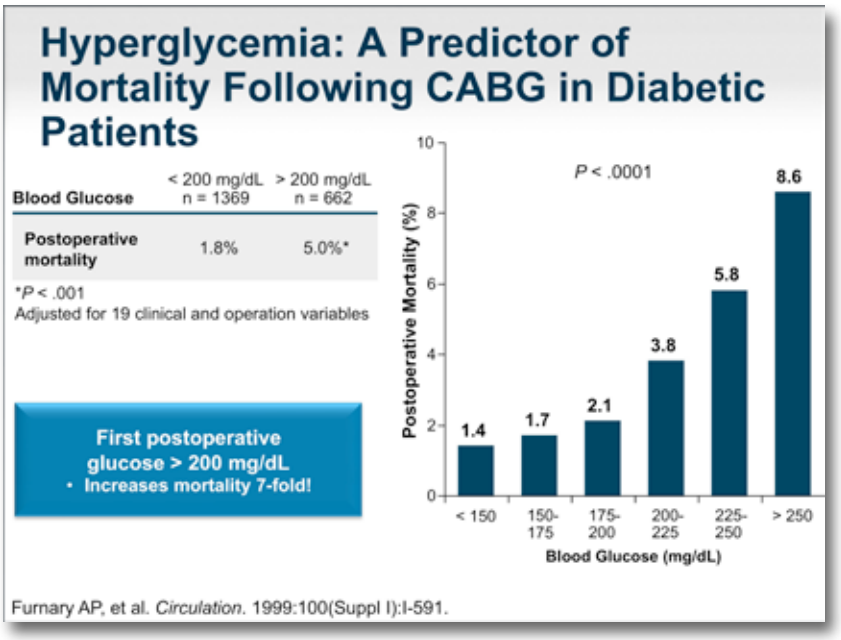
Inpatient Glycemic Control in Critically Ill Patients



Slide 8.

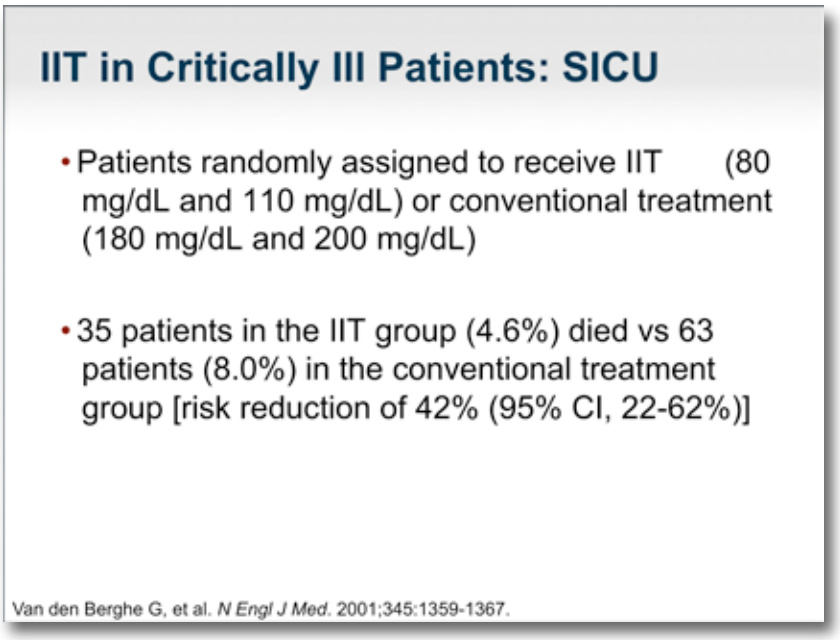
Dr. Umpierrez, can you discuss some of the data that have contributed to the recommended targets for inpatient glycemic control?

Guillermo Umpierrez, MD: Thank you, Annabelle. Inpatient glycemic control has been the center of attention in the hospital setting and for physicians, in general, during the last decade. Historic controlled studies (mainly observational studies and a few prospective randomized studies) show, from 2001 to 2008 in the intensive care unit (ICU) and the non-ICU surgical medical patients, improvement of glycemic control decreases complication rates. This slide shows the data showing decreased morbidity, infections, and complications.



Slide 9.

Here is a study by Tony Furnary (a cardiovascular surgeon), which was completed in patients undergoing coronary artery bypass surgery (CABG). It shows that increasing blood glucose concentrations from < 150 mg/dL to 200 and 250 mg/dL increased complications and mortality. Having a blood glucose level > 200 mg/dL during the first day of surgery increased mortality by 7-fold.



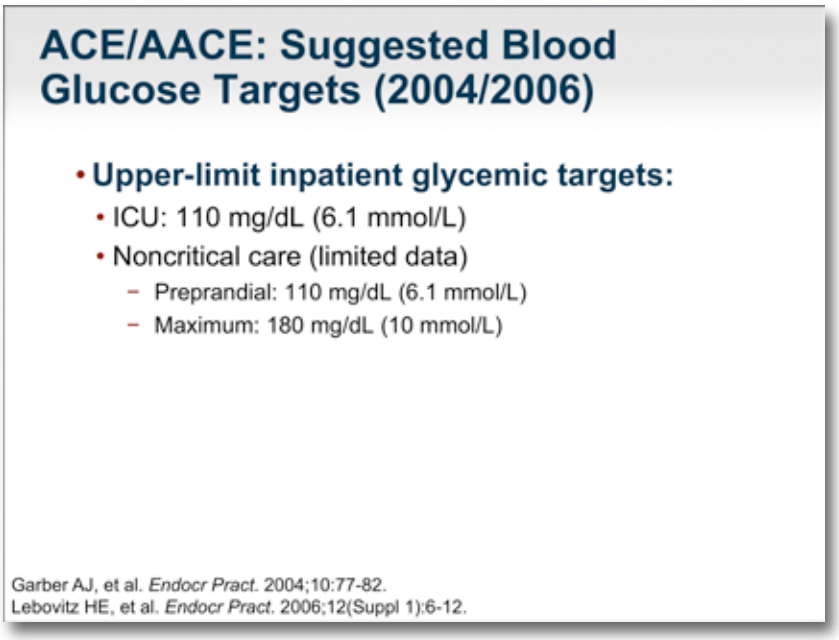
Slide 10.

We all are familiar with this landmark study from Dr. Greet Van den Berghe showing improvement of glycemic control with intensive insulin therapy (IIT). In this study, 70%-80% of patients undergoing cardiovascular surgery showed a decrease in mortality above 40% using a [maintenance of blood glucose] range of 80-110 mg/dL compared with less tight control of approximately 180 mg/dL.

Dr. Rodriguez: Dr. Seley, do you feel that clinicians understand these data and realize the importance of managing inpatient hyperglycemia?

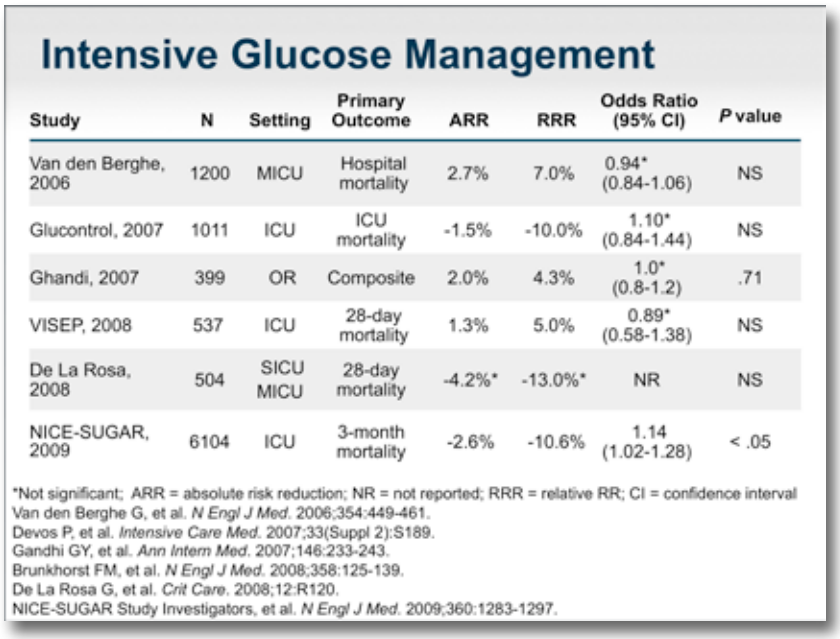
Dr. Seley: I am still getting a lot of resistance when talking to people about tight glycemic control or better glycemic control, because they are very fearful of things such as hypoglycemia. They think that it probably is better to do that, but they don't really know how they can do that.

Dr. Rodriguez: Do you think there are controversies about targets for glycemic control from some of the data, such as the differences in the cardiac ICU and the mobile ICU? Do you think that is contributing to some of the confusion?



Slide 11.

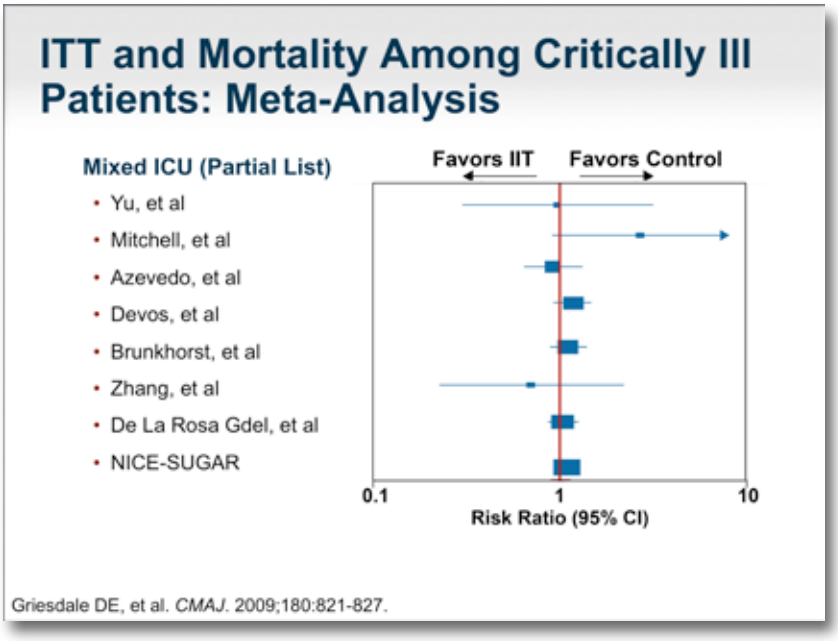
Dr. Umpierrez: I agree that there is a lot of controversy and, perhaps, the major controversy started with the previous guidelines from the American College of Endocrinology (ACE) and ADA. In 2004, based primarily on Dr. Van den Berghe studies, the ACE and ADA recommended a blood glucose target of 80-110 mg/dL, or to at least keep the blood glucose < 110 mg/dL. In the noncritical care area without major data, they recommended a very tightly controlled preprandial blood glucose of < 110 mg/dL.



Slide 12.

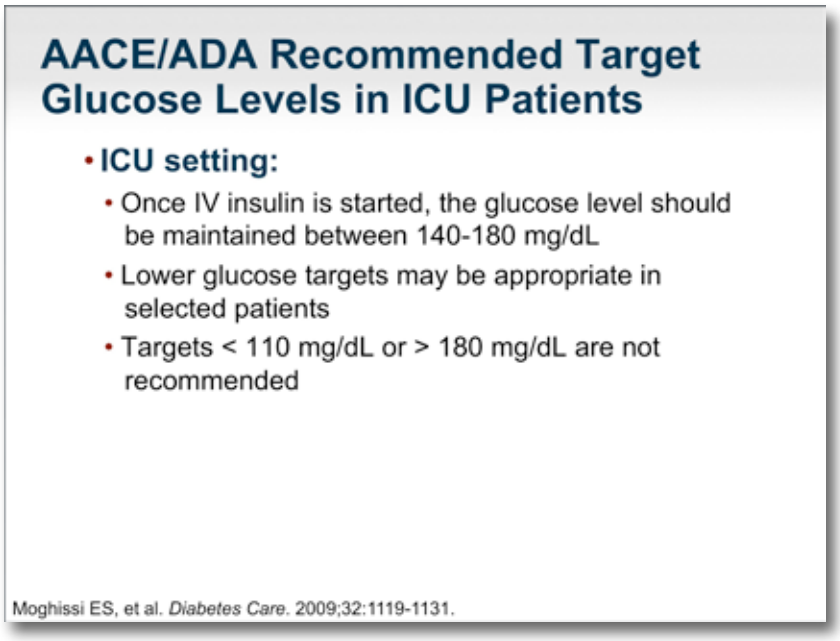
What happened in the last few years is that several studies have shown that inpatient glycemic control to very tight levels of < 110 mg/dL have not resulted in improvement in clinical outcomes. Data from Van den Berghe in 2006 and several other studies show that there is no significant difference in improvement in mortality if you tightly control the blood sugar level to < 110 mg/dL or if you keep the blood glucose between 140-180 mg/dL.

Dr. Rodriguez: Can you speak of the hypoglycemia that Jane was speaking about and some of the fears that the clinicians might have about that? Do you think that was more prevalent in this group when they had the tight control of less than 110 mg/dL?



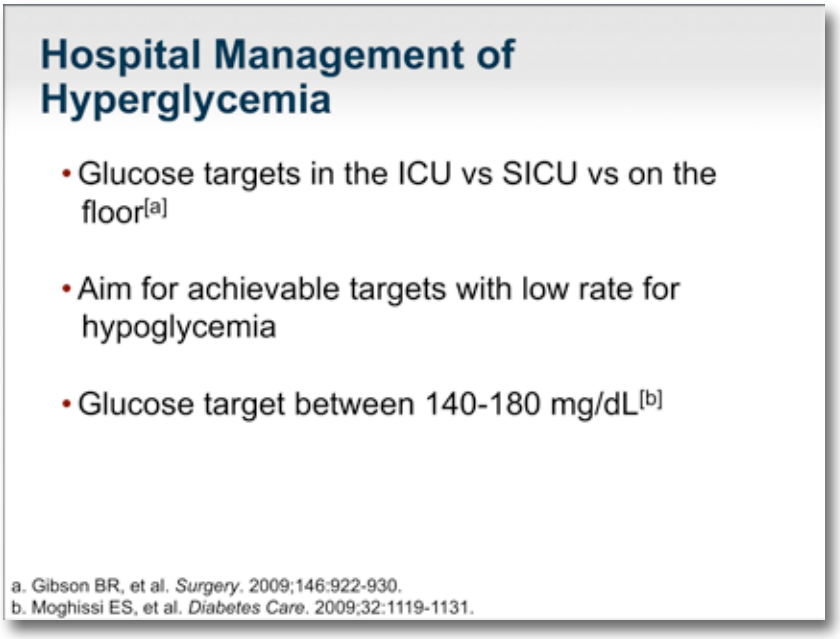
Slide 13.

Dr. Umpierrez: Indeed, this is the major problem we have right now in the hospital. This slide, a meta-analysis of several studies that were published all the way up to the Normoglycemia in Intensive Care Evaluation-Survival Using Glucose Algorithm Regulation (NICE-SUGAR) study, summarizes and answers your question. It clearly shows that if you tightly control or try to achieve a glycemic control to a range of 80-110 mg/dL, there is a 6-fold increase in hypoglycemia, so this is what has led us to change the goals.



Slide 14.

Right now, we have revised 2009 goals and recommendations from the ADA and AACE that were based on 2 factors. One is that blood glucose < 110 mg/dL did not improve outcome but increased the risk for hypoglycemia. Therefore, current goals recommend keeping blood glucose between 140-180 mg/dL for most patients in the ICU. There is a subgroup where glucose targets between 110-140 mg/dL are allowed; however, we don't know if 110-140 mg/dL is better than 140-180 mg/dL. What we do know is that blood glucose < 110 mg/dL is not recommended because of the risk for hypoglycemia. In addition, levels > 180 mg/dL, according to the ADA and AACE, are not recommended because of the increased risk for symptomatic diabetes and complications.



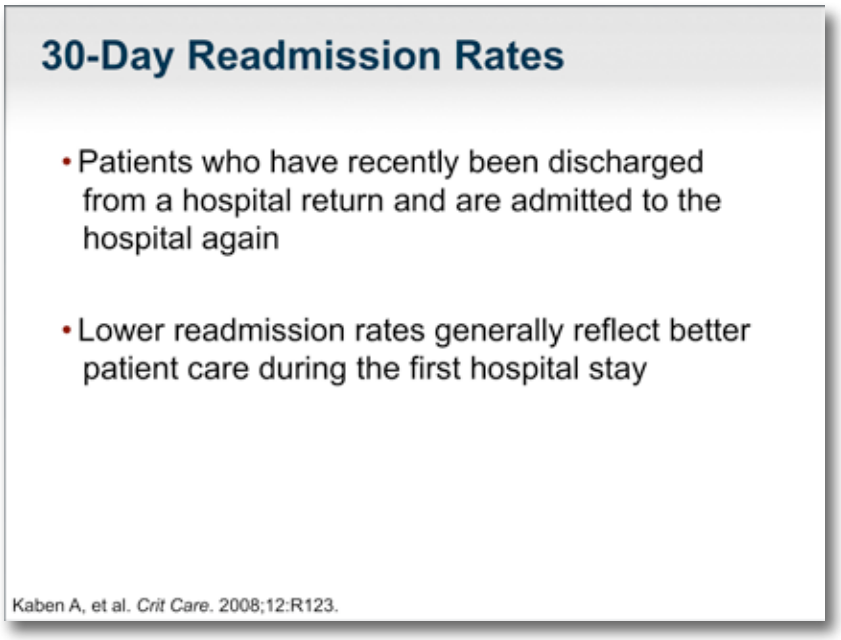
Slide 15.

Dr. Rodriguez: What is your sense about the settings of where the patients are in hospital, whether it is on the floor, the ICU, or even the surgical ICU (SICU)? Do you have a sense that clinicians understand targets for glycemic control? Would they say, for instance, "I understand that in the ICU the targets should be this but on the floor, perhaps, we have a looser target."? Do you get that sense at all?

Dr. Seley: That is such an important question you asked because one of the things we really need to get out there to each unit and each type of patient is what is the right target for that population. As such, each of our ICUs is very different; they each have their own similar and achievable targets with low rates for hypoglycemia. On the floors, we are going by the AACE/ADA recommendations. However, I watch the hypoglycemia and hyperglycemia rates throughout the house and intervene in that particular unit, which may not be doing such a great job. It is very important that each unit be aware of what their appropriate target is.

Dr. Rodriguez: What do you think, Guillermo, about differences of glycemic targets depending on where the patient is occupied? For example, in the ICU or SICU vs being out on the floor?

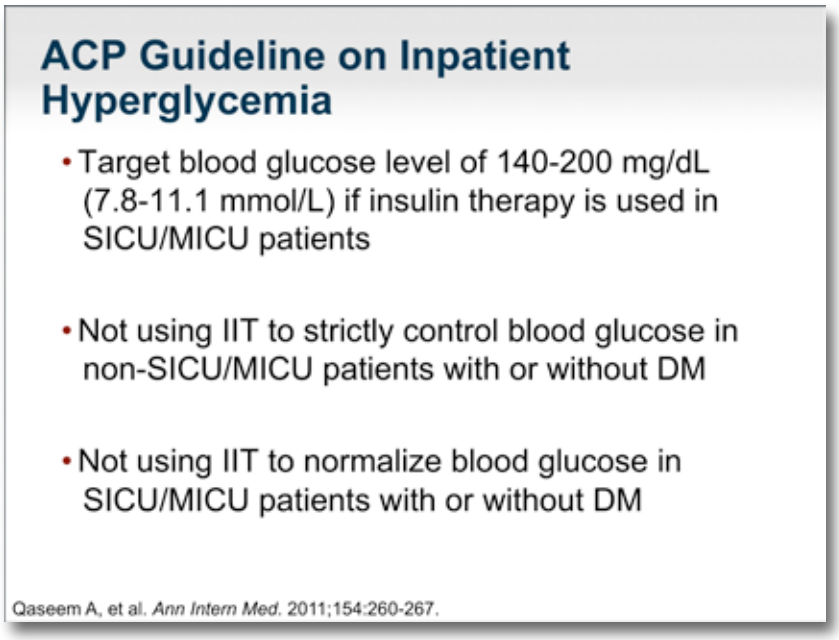
Dr. Umpierrez: I believe that in most medical institutions, for patients who have multiple complications, the target blood glucose is 140-180 mg/dL, or mid-100 mg/dL for most patients. There is increasing evidence that, perhaps, for surgical patients or patients with CABG, a lower blood glucose target may be indicated. However, we don't have data. Studies have been conducted comparing lower blood glucose targets for surgery vs higher blood glucose targets but in medical patients, perhaps, a safe, conservative blood glucose target in the mid-100 mg/dL is indicated.



Slide 16.

Dr. Rodriguez: I just have one more question based on the differences in targets and populations. What is your sense, Jane, of infection in terms of control vs all-cause mortality or 1-year mortality? Sometimes we deal with what is happening during the current hospitalization and what we can do to decrease infections rather than worry about what the all-cause mortality is going to be either 30 days later or a year later post-hospitalization.

Dr. Seley: That is a great question. I worry all the time about 30-day readmission rates. Patients who go to the emergency department (ED) or back into the hospital is something that is being tracked now, and it is going to have financial implications for hospitals, so I get a lot of support when I do anything that can lower those rates. It is very important when we look at a patient's glycemic control in the hospital and transition them to a discharge plan that we have some kind of plan in mind that is going to follow them for the next 30 days and beyond.



Slide 17.

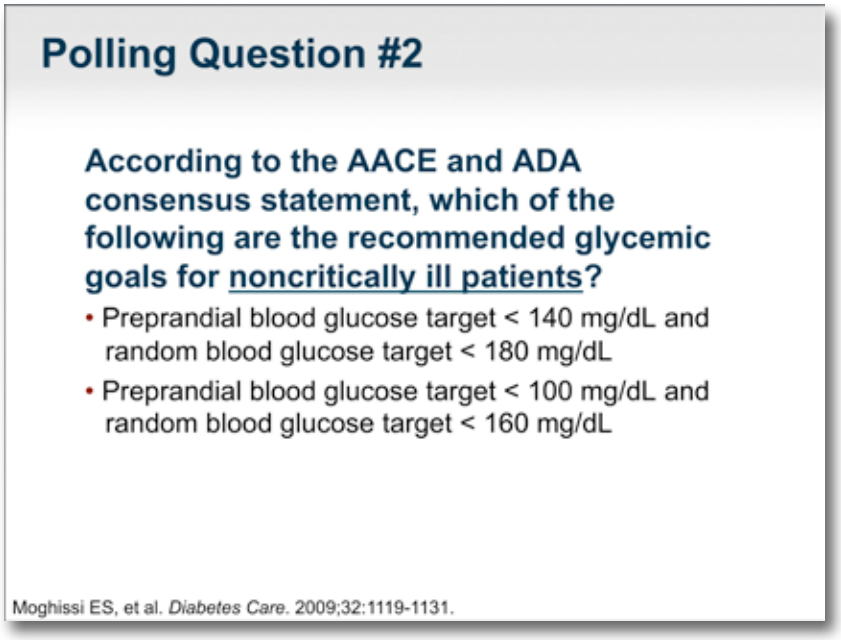
Dr. Rodriguez: Wonderful. Guillermo, are there other guidelines, as well? What about the American College of Physicians (ACP) guidelines? Do you think that they discourage use of IIT? What about the target blood glucose of 140-200 mg/dL, do you agree or disagree with this?

Dr. Umpierrez: These are the guidelines that were published in the Annals of Internal Medicine a couple of months ago. This group of researchers looked at the evidence and did a systematic review.[1] They tried to confirm the conclusion from the ADA and AACE that tight glycemic control is not indicated for most patients in the hospital, and indeed, they recommended a blood glucose level somewhere between 140-200 mg/dL as an attempt to prevent hypoglycemia. There are no good data if the blood glucose should be between 100-140 mg/dL or 140-200 mg/dL, but this group of 3 investigators recommended 140-200 mg/dL. Several letters to the editor have complained about that.[2-4] We, myself and many others, are concerned that perhaps allowing the blood glucose to go all the way to 200 mg/dL in many institutions may increase the risk for infections and complications. I think that for critical care patients, utilizing a range of somewhere around mid-100 mg/dL is the ideal target for blood glucose control, if we can do it in a safe way with a low rate of hypoglycemia.

Dr. Rodriguez: I agree with you. I think those are the right targets and those are the numbers that we use, as well, at our institution at Hopkins Bayview. That is probably the optimum range where you would have best function for neutrophils and decreased infection rates, and at the same time you can avoid too many episodes of severe hypoglycemia. Jane, do you have any thoughts about the ACP guidelines?

Dr. Seley: I think they were coming from a different place than people in endocrinology might be coming from. They were looking more at the reality that many institutions are not doing a good job at getting people under 300 mg/dL so when they set a goal of 200 mg/dL, to them, that was tremendous success over what is currently going on. I see some positives in what they are saying, although, the message becomes distorted and I get pushback from people who say, "Well, ACP said you can go as far as 200 mg/dL and that is fine." It is not fine, but it is a work in progress.

Polling Question #2



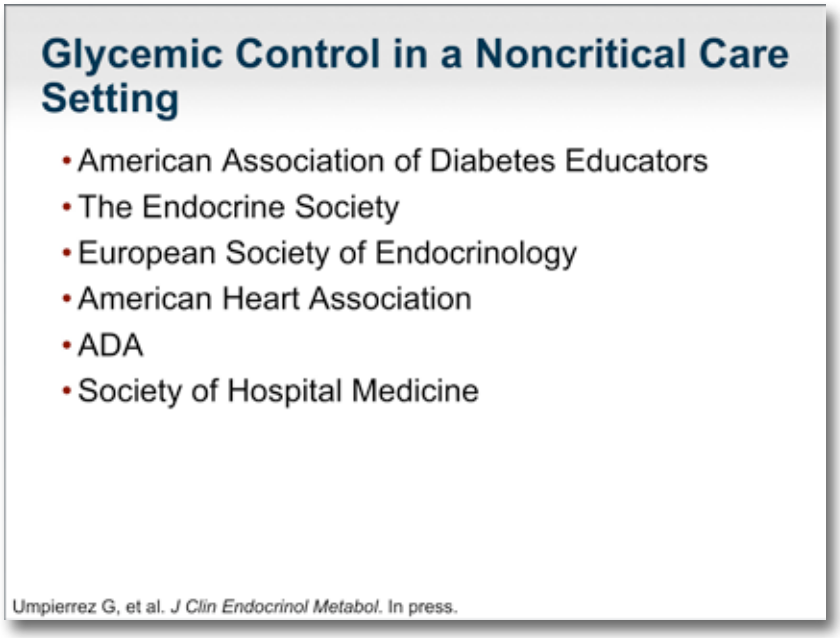
Slide 18.

Dr. Rodriguez: Let's pause for a second polling question.

According to the AACE and the ADA consensus statement, which of the following are the recommended glycemic controls for noncritically ill patients?

- ◯ Preprandial blood glucose target < 140 mg/dL and random blood glucose target < 180 mg/dL
- ◯ Preprandial blood glucose target < 100 mg/dL and random blood glucose target < 160 mg/dL

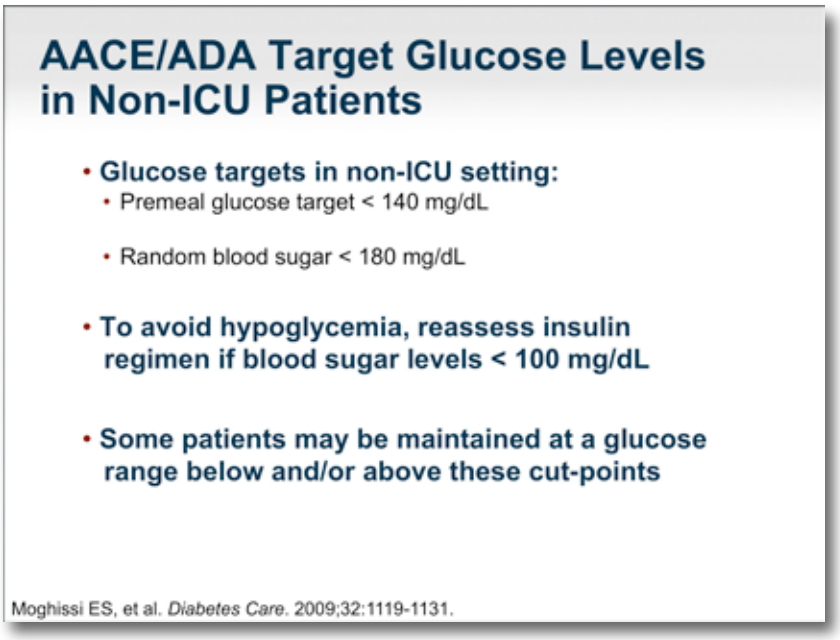
Inpatient Glycemic Control in Noncritically Ill Patients



Slide 19.

Guillermo, do you have any thoughts?

Dr. Umpierrez: For non-ICU patients, we have been working with a number of different societies [to develop clinical practice guidelines]. Jane Seley is a member of some of these societies. Representatives from the American Association of Diabetes Educators, the Endocrine Society, the European Society of Endocrinology, American Heart Association, ADA, and the Society of Hospital Medicine are trying to put together some clinical guidelines that should be published in the next few months.



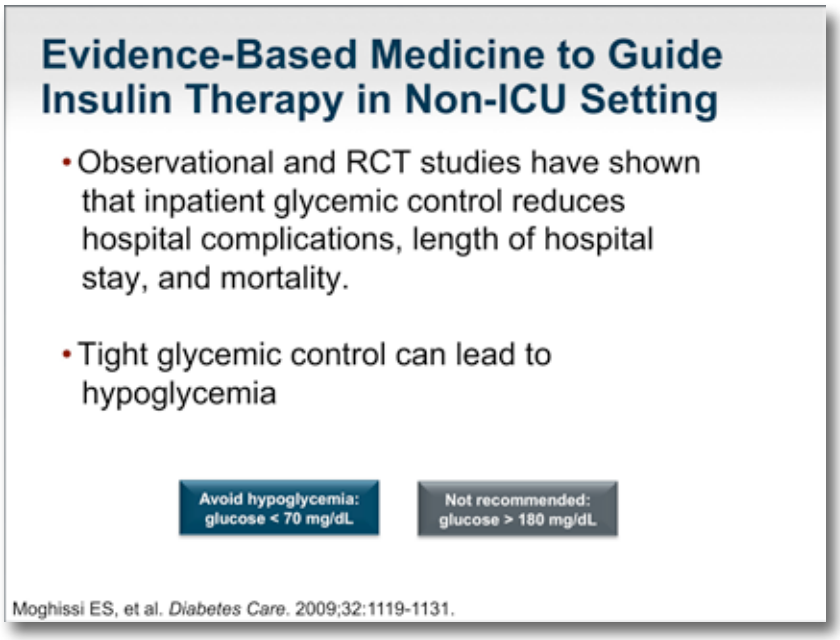
Slide 20.

In these guidelines, we are going to follow the recommendation from the ADA/AACE that recommended, again, a target blood glucose level before meals of < 140 mg/dL and a random blood glucose level in the hospital of < 180 mg/dL, but we are going to emphasize very clearly that first you have to individualize the targets. In chronically ill patients with multiple comorbidities, perhaps a high 100 mg/dL target should be indicated, but there are other patients with diabetes where a blood glucose between 80-120 mg/dL is okay as long as we can prevent hypoglycemia and aim for a safe and achievable blood glucose target.

Dr. Rodriguez: Jane, do you have any thoughts on that?

Dr. Seley: We also know that certain patients are at high risk for hypoglycemia, and those are the patients we need to be more careful with. If a patient has had an episode of hypoglycemia the likelihood of having another one is much greater, but if someone has never had hypoglycemia in the hospital then we can bring the target lower. Therefore, we have to be more sensible in our practice.

Dr. Rodriguez: Guillermo, do you have a sense of guidelines that can help practitioners, our colleagues, regarding use of insulin therapy?



Slide 21.

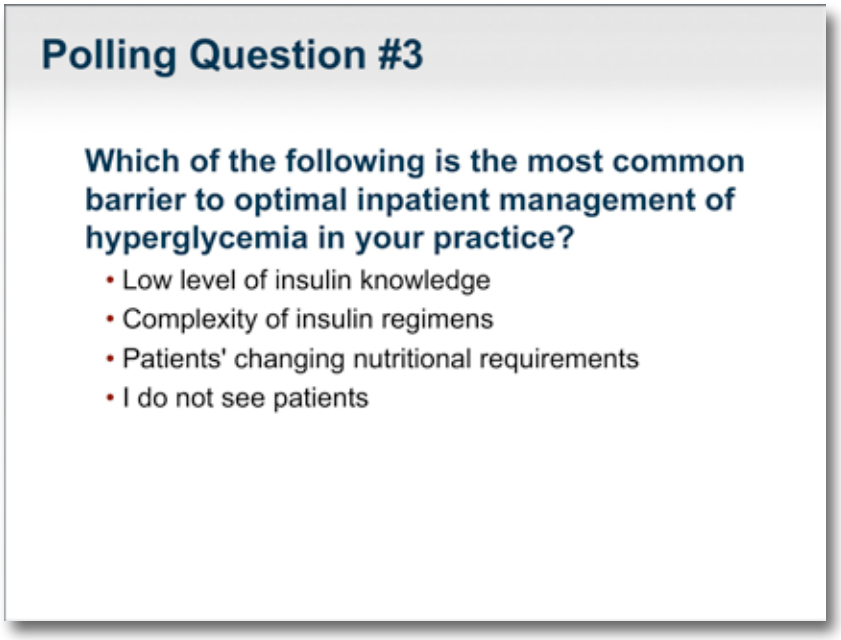
Dr. Umpierrez: We cannot take any one of these guidelines as the final document. More evidence is coming. We now have good evidence that both in the ICU and non-ICU, complications can be prevented. You don't only have to look at mortality as the outcome measure. It is true for those in the ICU that that is the primary outcome, but there are other conditions that you may improve in these patients, such as infection rate, length of hospital stay, or type of complication that have not yet been reported in some of these major trials.

What we have come to realize is that 10 or 20 years ago, we paid very little attention, but there has been a big movement during the last 5-10 years to try to achieve tight glycemic control. Maybe we were too glucose-centric and are now realizing that, perhaps, we should not push too hard because we are getting too much hypoglycemia, which we know is associated with complications.

Dr. Rodriguez: Absolutely. I agree with that.

Dr. Seley: I also think that it came upon us so quickly. Ten years ago, we really didn't have the tools to do the work. Now when we talk amongst ourselves, we figured out some really great strategies that we can employ to make a difference and get us safely to goal. Whereas, 5 years ago we were making it up as we went along, so this is really going to change things.

Polling Question #3



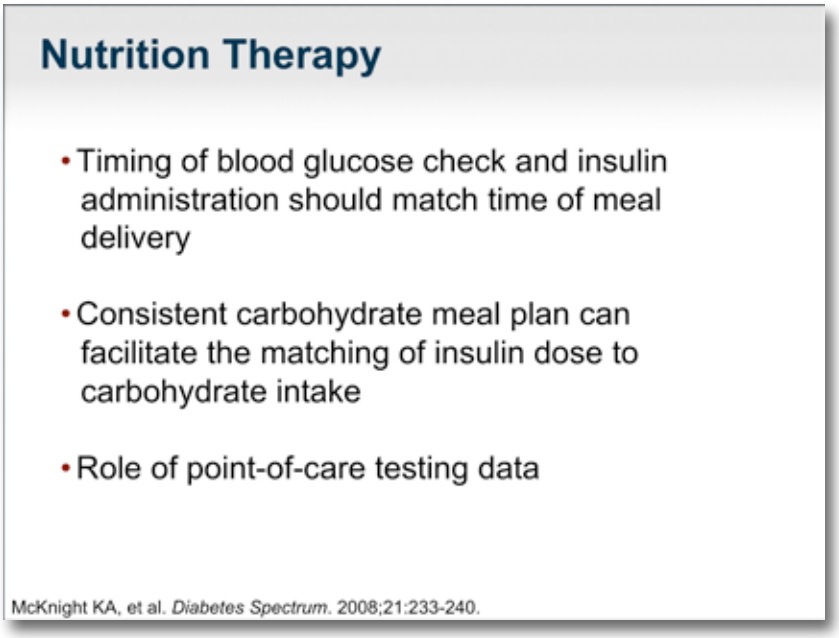
Slide 22.

Dr. Rodriguez: That's a good point. Now let's pause for our last polling question.

Which of the following is the most common barrier to optimum inpatient management of hyperglycemia in your practice?

- ◯ Low level of insulin knowledge
- ◯ Complexity of insulin regimens
- ◯ Patients' changing nutritional requirements
- ◯ I do not see patients

Barriers to Inpatient Glycemic Control



Slide 23.

Jane, what are some of the barriers to inpatient glycemic control that you commonly encounter?

Dr. Seley: I like to say "So many barriers and not enough time." Timing is everything. If we don't properly coordinate when the nurse does the fingerstick test to obtain the blood sugar reading, which will determine the insulin dose with when the meal tray is delivered, then all bets are off. We would tell a patient at home to do all of these things at the right time, but in the hospital setting amazing things can happen. For example, many people aren't aware that night nurses like to take blood sugars between 5:00 and 6:00 in the morning, so the trays are not coming then. Therefore, that mismatch between the timing of the fingerstick test, the insulin, and the meal can cause havoc. The best insulin orders won't work because of that.

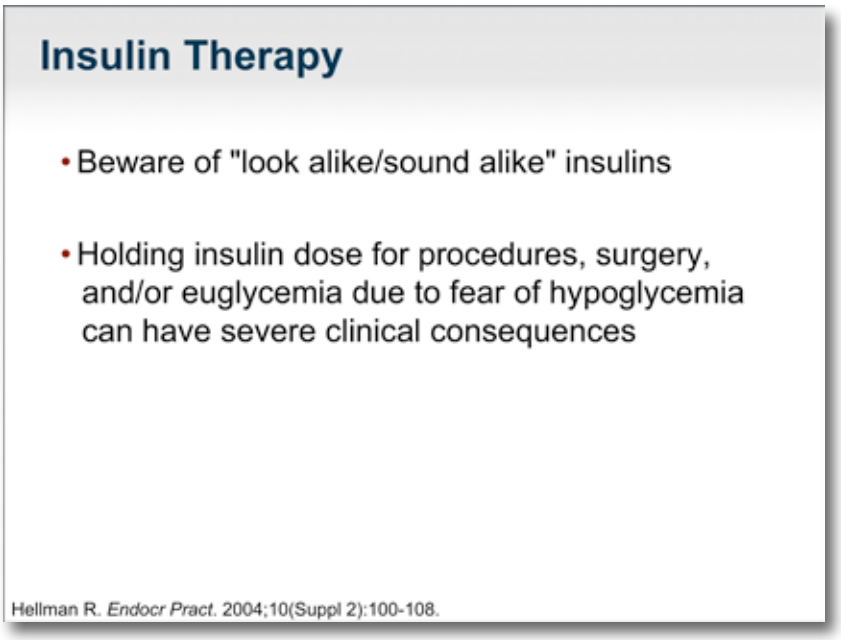
Another thing that is interesting is each hospital makes their own decision on how they are going to serve their meals and what kind of diet a patient with diabetes or hypoglycemia is going to get. There is some misconception that if the person doesn't have diabetes they shouldn't have their carbohydrates counted, but I can walk into the room and find the patient drinking juice and eating cake, and I'm giving them insulin to lower their blood sugar because they don't have diabetes. That is never going to work, so we have to be careful about all these kinds of things that can go on.

Dr. Rodriguez: We experienced something pretty similar to what you described about the timing issue. At the shift change between 7:00-7:30 AM, the fingersticks were done quite early so when the tray came at 7:30-8:00 AM, they were acting on data that were old. We took steps, actually, to show that to our nursing staff, and they quickly made adjustments, which was to everyone's benefit. Did you intervene in a similar fashion, as well? Have you been able to make those kinds of changes so that people are aware of the impact of timing the fingerstick test to actual insulin [administration], especially before breakfast?

Dr. Seley: Breakfast is the main problem because lunch and dinner are not at a change of shifts, but breakfast is almost always at a change of shifts. One of the things you can do to validate [the blood sugar] is to look at point-of-care testing data. You can see exactly when people are checking blood sugars. I will call the manager of the unit and say, "You know, this patient had hypoglycemia or hyperglycemia. Their blood sugar was done at 5:00 AM and their tray came at 8:00 AM." They'll say, "Oh, no, that can't be," but I will issue a report and show them, so you can use point-of-care testing reports to show when the sugars are being done and then you can actually change the policy. I have a written policy that no blood sugar can be done more than 1 hour before the meal tray.

Dr. Rodriguez: That's wonderful.

Dr. Seley: That really has made a difference.

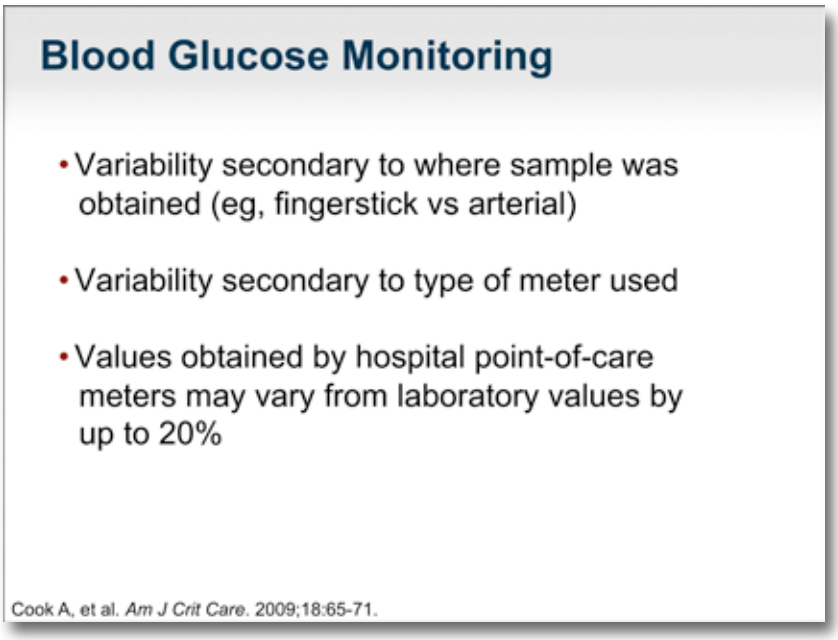


Slide 24.

There are so many variables with insulin therapy. Insulins that sound similar (eg, Humalog® [Eli Lilly and Company, Indianapolis, IN] and NovoLog® [Novo Nordisk, Princeton, NJ]) are very confusing to people, so making a pharmacy decision that, perhaps, you have only 1 insulin in each category on formulary will reduce your errors. Holding insulin is a common practice that nurses like to do and health staff encourages them to do it, but many times they are holding basal insulin for someone, for example, with type 1 diabetes, which is very serious.

Dr. Rodriguez: Right, absolutely.

Dr. Seley: That is an education process that is really important.

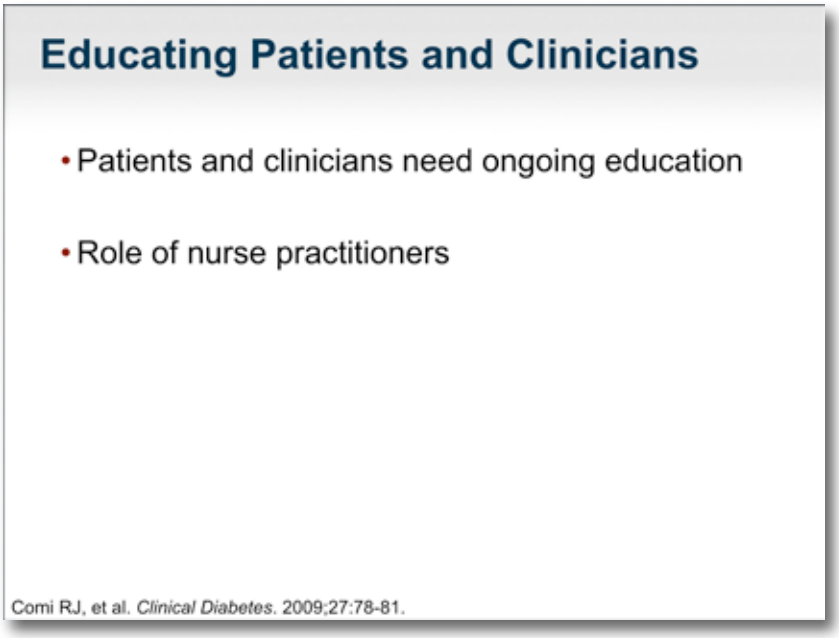


Slide 25.

Dr. Seley: Healthcare professionals, interestingly enough, have the common misconception that whatever that blood glucose meter says must be correct. You could be looking at a patient with a blood sugar of 42 mg/dL who is talking, joking, and looking terrific, but something is not right with that picture. Healthcare professionals have to understand that that blood sugar can be as much as 20% from the actual value, and they need to check it again. They should use the lab if they need to confirm it. You really need to think about where they got that sample from. Don't flip-flop samples; do a fingerstick test one time and use arterial blood the next time. That could result in another 15% variability. Also, using different meters is a new thing now. A lot of institutions have brought in multitesting meters that can do a blood gas analysis and many other things. If you use that equipment one time and the next time you use the point-of-care glucose meter, you, again, have variability. This can really affect the insulin dose if you don't stay consistent with the source of the sample and the meter that you use to do the test. A lot of people don't think about that, and I think that's important.

Dr. Rodriguez: Yes, that's true.

Inpatient Glycemic Control in Critically Ill Patients



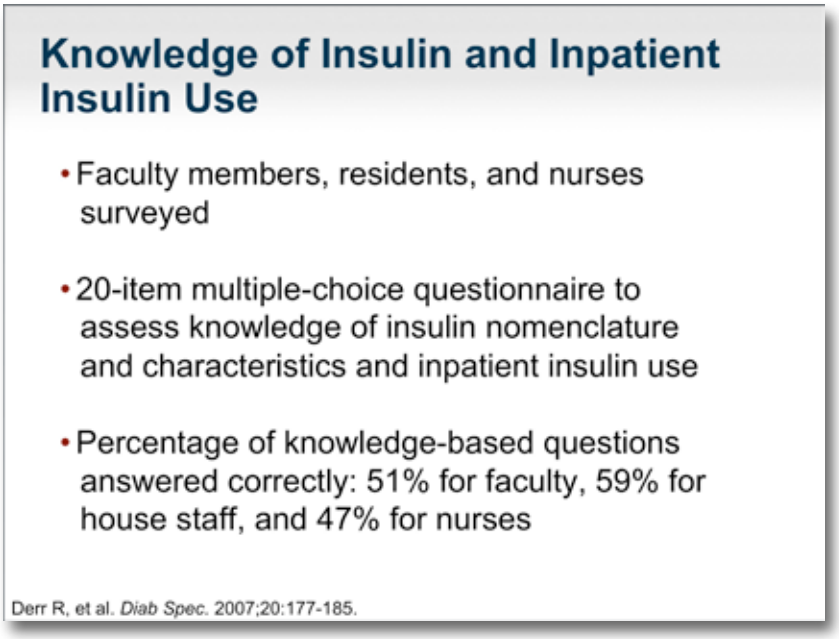
Slide 26.

Dr. Seley: I also wanted to say that everyone needs education about diabetes. I know I constantly need education about diabetes, and this is all I do. There is constantly new information. We are reading articles every minute that give us new ideas, so there needs to be some kind of process for ongoing education for all healthcare professionals in institutions who take care of people with diabetes. The pharmacy needs to learn more about the new insulins. Even social workers who are doing discharge planning need to know more about what is going on and what the goals are, so that is really important.

Dr. Rodriguez: Guillermo, do you have any thoughts to add to that?

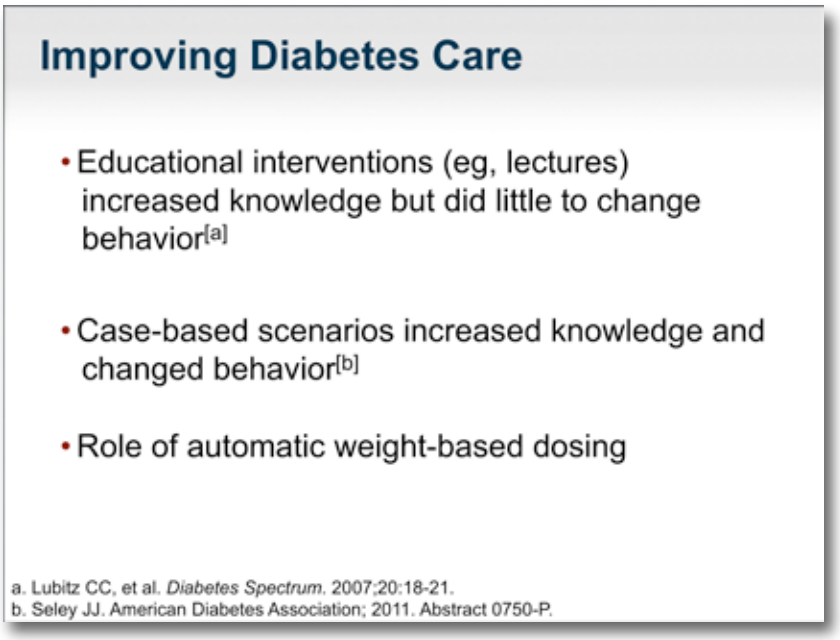
Dr. Umpierrez: No, I agree that we are constantly learning. We have been on this crusade to improve glycemic control for the last 15-20 years. We have made tremendous progress, but there is still much work to be done.

Dr. Rodriguez: Both of you know that I am a strong advocate for using nurse practitioners. I am actually not a big fan of protocols or automated methods to adjust insulin and handle issues around hypoglycemia. A lot of it was based on a study that we did that was published in 2007 in which we conducted a survey.



Slide 27.

It was a 20-question survey to both nurses at various stages in their career, healthcare practitioners, medical students, the house staff from the first time they interned to when they were residents, general practitioners, and even specialists, and we specifically asked them questions. It was an anonymous survey, so no one would get their feelings hurt. We wanted to get a sense of what their knowledge and education level was, because I feel that oftentimes we place the blame on the patient and perhaps healthcare providers could do a better job of being educated about the basic aspects of insulin, insulin mechanics, and insulin usage. What we found was really disappointing, actually. The pass rate on the examination was pretty low. It was in the 50s, about 53%. When we did a follow-up, the percentage remained the same. This has, therefore, been one of our main missions, and that is to do educational curriculum for house staff and nursing, so that they can really understand some of the finer points and some of the basic things about insulin management, so that patients don't get into trouble with hypoglycemia.

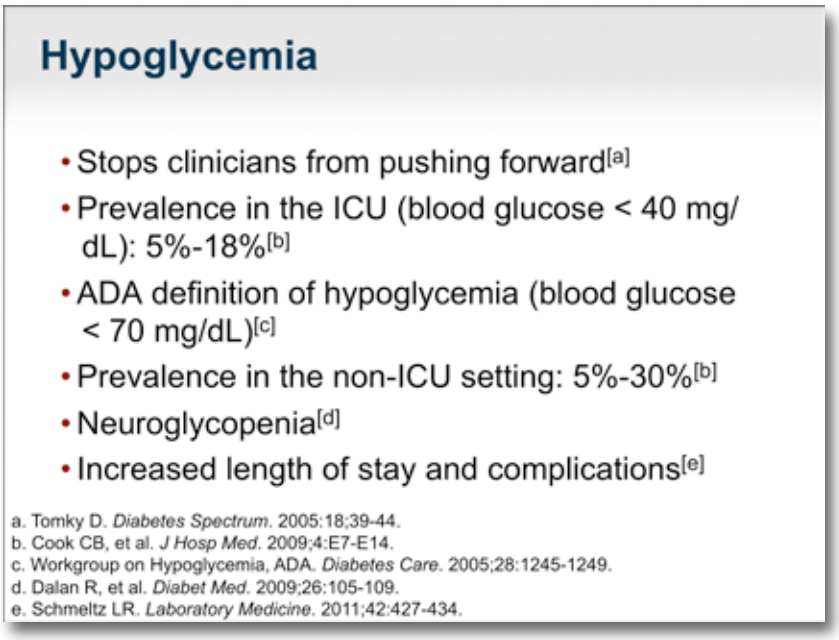


Slide 28.

Dr. Seley: I have had several experiences with that. I first did a study with medical and surgical interns and residents. I gave them a multiple-choice test asking them diabetes questions about insulin, etc, in the hospital. The pretest scores were awful, but then I did an intervention (a lecture) and the post-test scores were greatly improved. Unfortunately, it didn't seem to clinically affect their behavior. Therefore, I did a study more recently with nurse practitioners where I used case scenarios as the pretest. The intervention was case scenarios similar to those they would encounter in the hospital. The post-test 2 months later was more case scenarios, and we saw a tremendous improvement, which made me feel more confident because these were real stories of the kinds of patients they would take care of. We have to think about our medical education and really try to focus more on practical case scenarios, so people can take that information and go back to their next patient and apply what they have learned.

Dr. Rodriguez: I agree with you because we sampled the house officers after the second follow-up and asked them what the best way to educate them is. Should we be doing things that are Web-based or centered around noontime (ie, didactic lectures)? The number 1 preference was actually cases. They wanted to hear about real-life stories, and how they could improve the management of that patient. They remembered more from patient encounters, so I couldn't agree with you more. Our health staff agreed that cases were the way to go.

Dr. Seley: We do disagree on one thing, though. I created a very structured order set that auto-calculated what the basal and the bolus insulin doses should be, which I found miraculous. People would accept a basal insulin dose that came up where they were pretty much always starting people on 10 U, and suddenly it would be a weight-based sensitivity-based dose and 29 U would come up, and they would have no qualms about it. They would simply accept it and go ahead with it. Patients are getting to goal much sooner by using automatic weight-based dosing, so there is no mystery to it. It is done quickly and easily. They like to use the order set because everything diabetes related is in one place. The meal plan, the fingerstick monitoring, everything is preselected that can be, and there is very little for them to do. Our hypoglycemia and hyperglycemia rates have really changed since we have done that.

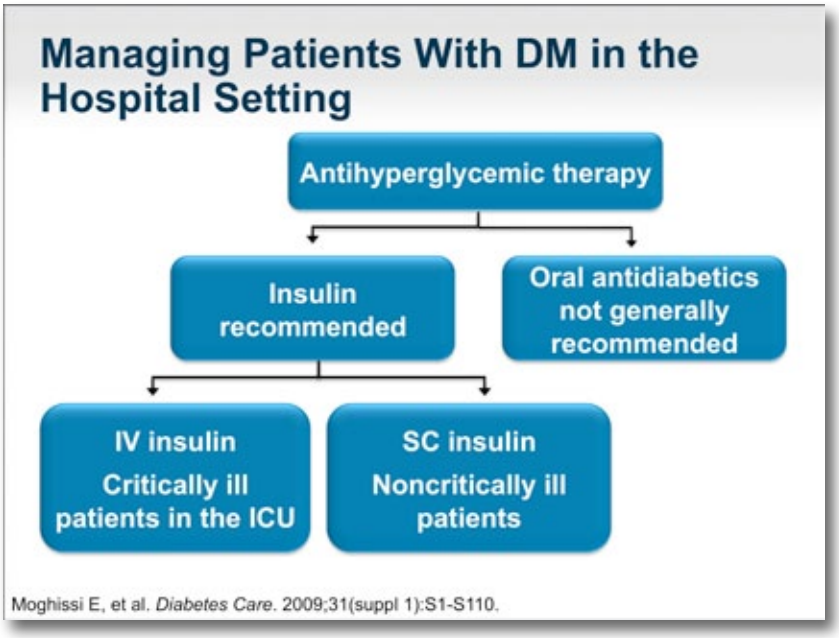


Slide 29.

Dr. Rodriguez: Let's talk about hypoglycemia then. What do you think the impact of hypoglycemia is on clinicians in terms of being a little bit more aggressive in hitting targets, Guillermo?

Dr. Umpierrez: Hypoglycemia is common and, unfortunately in the ICU, occurs in 5%-18% of the patients. We have to take into consideration what the true definition of hypoglycemia is though. In clinical trials, hypoglycemia is defined as a blood glucose < 40 mg/dL. The ADA defines hypoglycemia as a blood glucose < 70 mg/dL. For myself, a clinician, I consider hypoglycemia not at 40 mg/dL but at 70 mg/dL, so if you look at those ranges in the ICU up to one third of the patients will develop hypoglycemia, and this is remarkably high. In the non-ICU setting, the reported rate of hypoglycemia is somewhere between 5%-30%. Hypoglycemia happens because I think we have been too aggressive with insulin management. Patients in the hospital eat very little. If you are sick, you don't feel like eating, so you have to adjust the insulin dose, especially the prandial dose. We have to learn more about that. Hypoglycemia is associated with complications. Not only neuroglycopenia, short periods of hypoglycemia, but there are a couple of studies suggesting that there is an increased length of stay and perhaps of serious complications. Approximately 2% of patients have significant neuroglycopenia and may be associated with seizures and loss of consciousness, so we have to avoid the hypoglycemia.

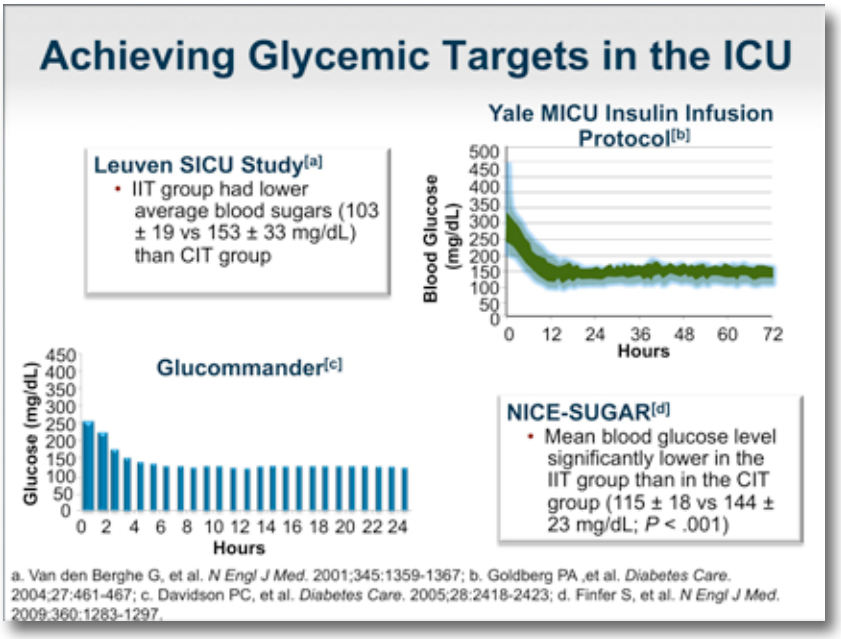
Insulin Therapy



Slide 30.

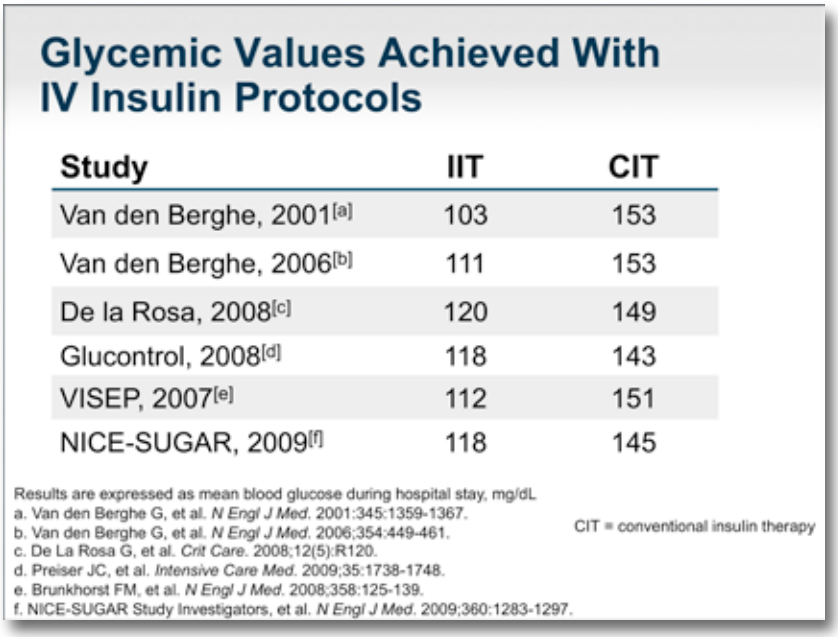
Dr. Rodriguez: That is a good point, Guillermo. Can you speak a little bit more about insulin guidelines and protocols (ICU vs non-ICU setting)?

Dr. Umpierrez: I believe most of us agree that insulin is the way to manage patients in the hospital. The recommendation from all of these societies when using insulin is that you should consider if the patient is in the ICU or non-ICU. Oral agents are not generally recommended because there are not much data available, so we don't know how safe and effective they are in the hospital setting. If you have somebody in the ICU, you should use continuous insulin infusion (intravenous) when they are not eating, and when they are on the floor or are eating, subcutaneous insulin infusion should be the way to go.



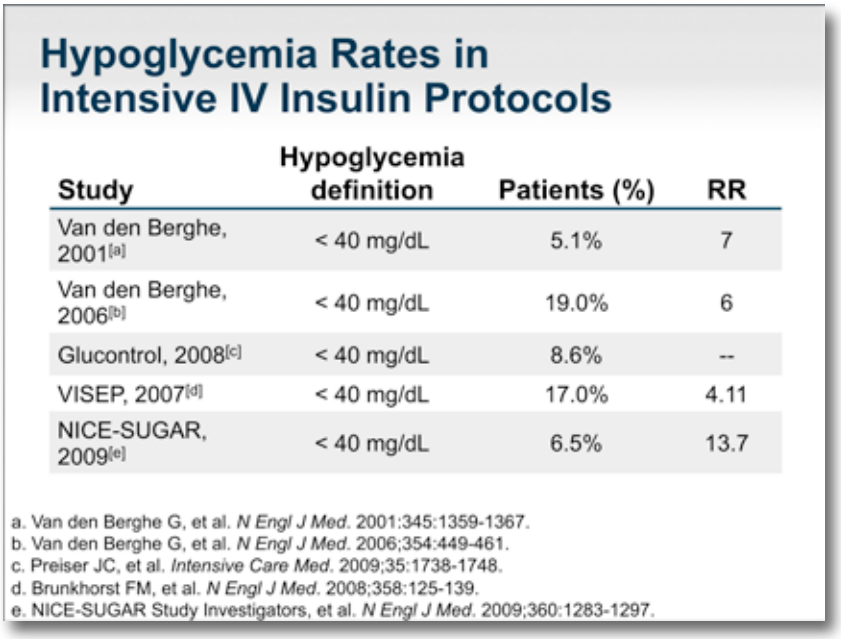
Slide 31.

If you look at the different studies of continuous insulin infusion protocols, it works. On this slide, we have 4 different studies, the Van den Berghe data on the top left, the Yale protocol on top right, the Glucommander, an electronic or computerized insulin device in the lower left, and in the lower right, data from NICE-SUGAR. If you look at the results, they all work very well.



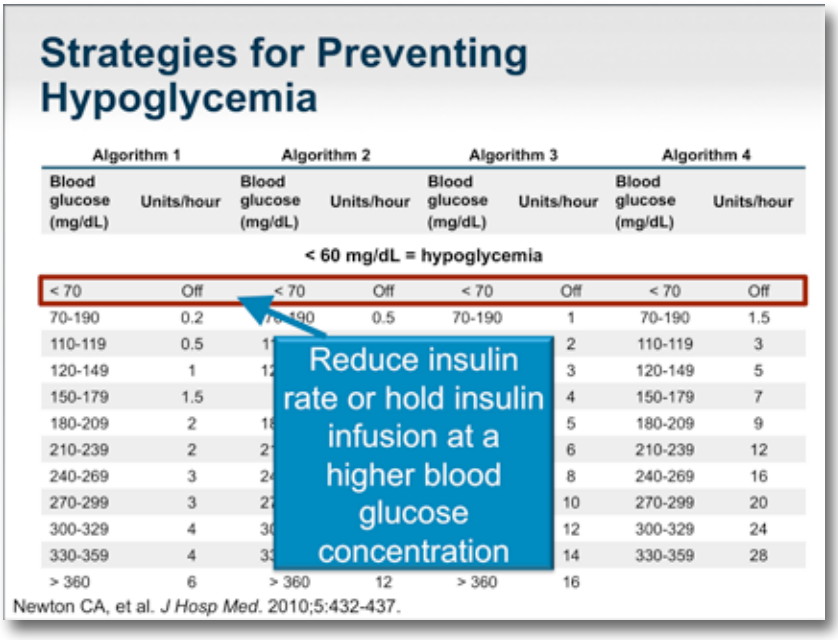
Slide 32.

Indeed, these data show that with intensive glycemic control IIT, when you target a glucose between 80-110 mg/dL, you get a blood glucose of 100-120 mg/dL. To the right, with conventional insulin therapy, you can get a blood glucose of 140-160 mg/dL, so this shows that if you set up your goal that usually goes well.



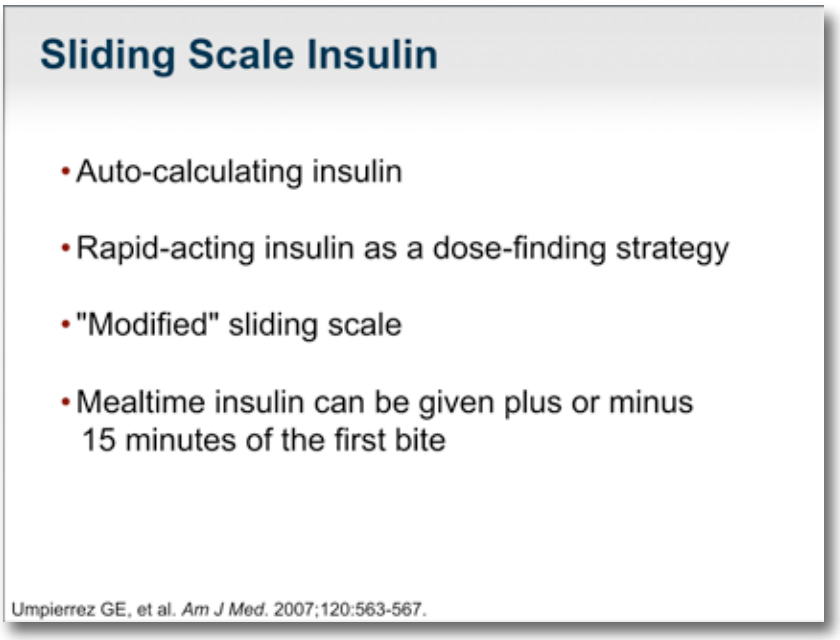
Slide 33.

The concern that we have is hypoglycemia, which we mentioned earlier, where these patients have a blood glucose < 40 mg/dL. This was reported in up to 18% of patients, which is unacceptable. This is the main reason why we switched the glucose goal.



Slide 34.

This slide shows, what I believe is the major problem for physicians who are in the ICU, which is that most of the protocols until recently (there are many institutions that have not modified the protocol) continue to infuse insulin until the blood glucose level is < 80 and < 70 mg/dL. These patients are already hypoglycemic before they turn off the drip. A way to decrease hypoglycemia is to significantly increase the rate of infusion when the blood glucose is < 120 mg/dL or < 90 mg/dL. Very few patients should be on a continuous insulin infusion. There are exceptions, like in type 1 diabetes, but for the majority of patients, having a blood glucose target in the mid-100 mg/dL should prevent hypoglycemia.



Slide 25.

Dr. Rodriguez: Jane, as we start to think about the ICU and protocols that we are all familiar with, the other favorite use of insulin is the sliding scale. What are your thoughts about sliding scale insulin? Are you in favor of it? Would you like to see it modified, or should it be eliminated altogether?

Dr. Seley: I have been trying to avoid the use of sliding scale insulin by using an order set that has the basal insulin calculation integrated. I find that when the insulin is auto-calculated, people are more likely to order both a long- and short-acting insulin. I do, however, in some patients, look at their blood sugar and if they don't need that much help or are insulin naive, or I have nothing to go on, I might use a rapid-acting insulin for the first 24 hours as a dose-finding strategy. However, everyone knows that after 24 hours they are going to be hearing from me if they leave someone who needs significant insulin on just rapid-acting insulin.

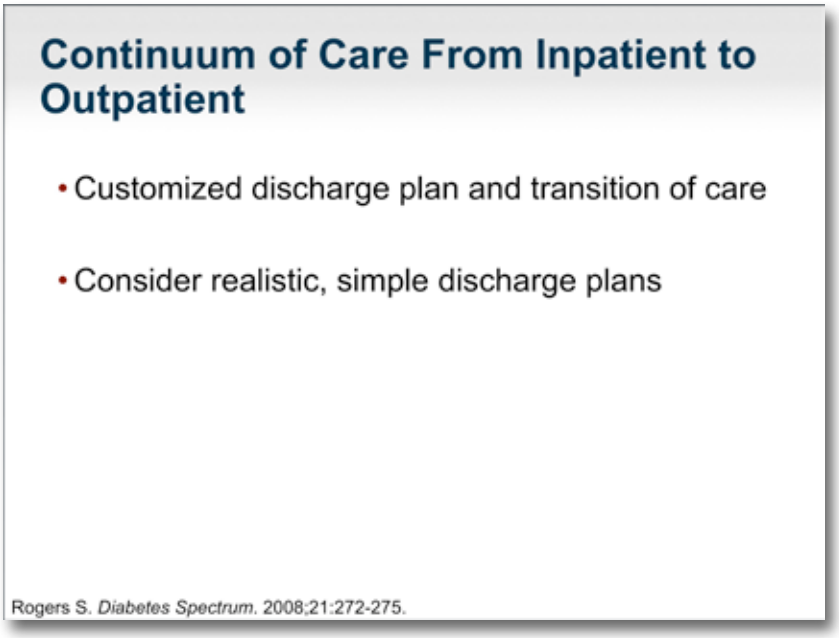
Dr. Umpierrez: So you use rapid-acting insulin as corrective doses?

Dr. Seley: Right.

Dr. Rodriguez: We use a nutritional rapid-acting insulin and the sliding scale insulin with the idea that we will keep it in place, but we call it a modified sliding scale because we only want an intervention for correction if the sugars are quite high. It is really practical because when we have attempted to get rid of the sliding scale, the nursing staff calls the house officer around midnight and wonders what to do with this blood sugar, and they automatically revert back to the sliding scale because sometimes it is easy and practical. Since we have gone on this campaign to educate them about having a basal insulin, a nutritional basal, and how they can modify these based on peoples' consumption of a meal, it seems to be working pretty well. You can give the rapid-acting insulin right after they have finished a meal.

Dr. Seley: Our policy actually says you can give the mealtime insulin plus or minus 15 minutes of the first bite because the nurse walks in and the patient started eating and thinks they should just withhold that insulin, so that is very important to communicate that message.

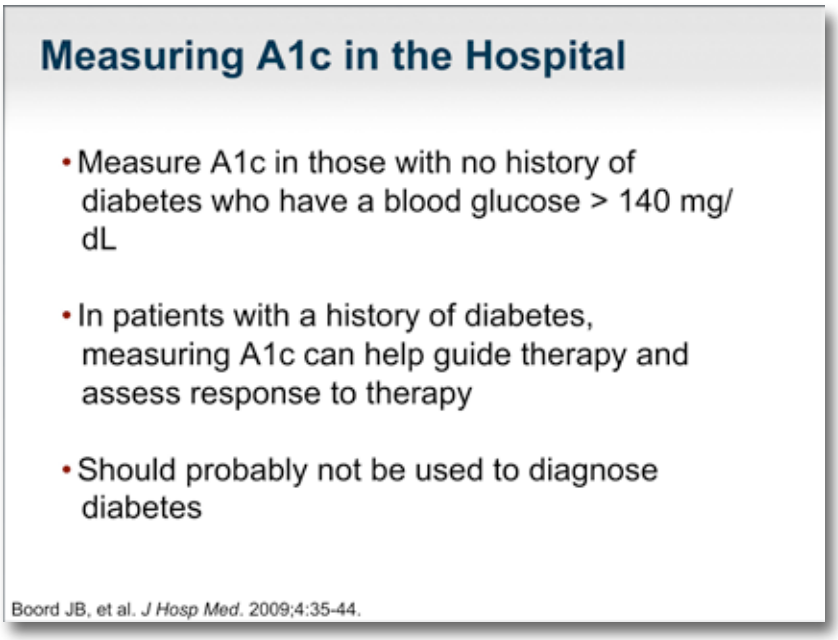
Continuum of Care From Inpatient to Outpatient



Slide 36.

Dr. Rodriguez: Let's talk about the transition and the 30-day discharge, which you mentioned earlier. We think that one of the strengths and reasons why we have a dedicated diabetes team is because we showed significant reductions in 30-day readmission rates by using a customized discharge plan and transition of care where we called patients and followed up with them to make sure that they were doing well. We also knew how to convert them from, for example, that insulin drip to subcutaneous insulin and discharged them on a combination of medications and insulin. What are your thoughts about that continuum of care from inpatient to outpatient?

Dr. Seley: One of the most important things to consider is that we have to be very realistic with the plan we are sending the patient home with, so that we don't set them up for failure. What I commonly see, which is disturbing to me, is clinicians assuming that the 89-year-old patient who can barely see, English is his second language, and whose reading and number skills aren't that great can calculate an insulin dose and check his blood sugar before every meal [at home] just because he was doing great on basal bolus in the hospital. I walk in the room and think it's ridiculous [to think this], but other people don't always think that way. We have to be very realistic in what we send people home with. It is better to send them home on a simple plan that they can follow than a complicated plan that they are going to mix up and get into trouble. That is really an important message.



Slide 37.

Dr. Rodriguez: Guillermo, what are your thoughts about measuring the A1c in the hospital? I will ask that to you too, Jane.

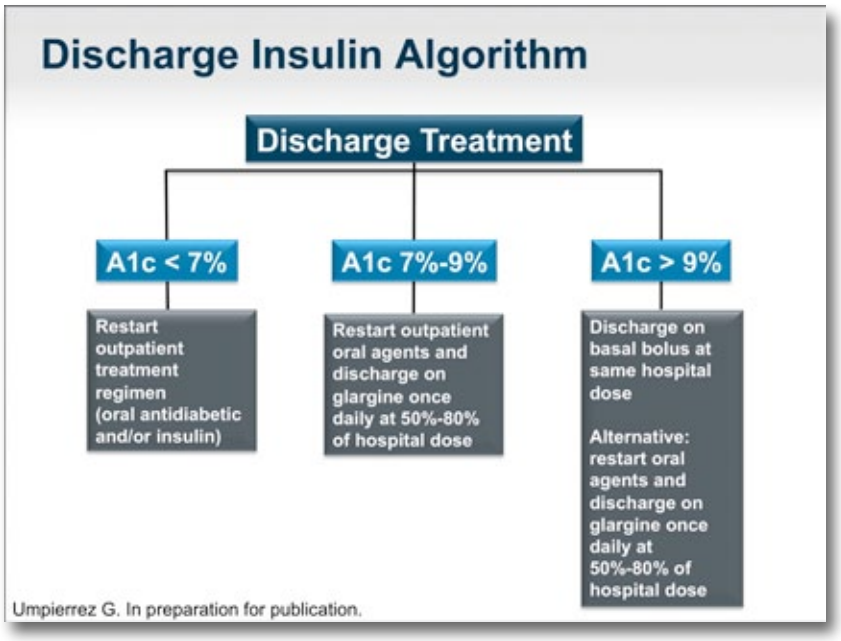
Dr. Umpierrez: I believe that everybody who has hyperglycemia should have their A1c tested. For those patients who do not have a history of diabetes who have a blood glucose 140 mg/dL [Editor's note: Speaker misspoke, he meant to indicate "greater than."] the guidelines recommend measuring A1c. If the A1c is > 6.5% or 7.0% that patient has diabetes, but he or she didn't know that they were diabetic. In those patients with diabetes, the mean A1c as an average in this country is somewhere around 8.1%-8.9%. Outside this country, it is above 9% and 10%, especially in underdeveloped countries. In these cases, the A1c will allow the physician to assess the patient's response to the therapy that they came in on and hopefully will guide the therapy in the hospital and when the patient goes home. The recommendations are to measure A1c in everybody with a blood glucose > 140 mg/dL in those with no history of diabetes. In those with a history of diabetes, measuring A1c will help guide therapy and assess response to therapy.

Dr. Seley: It is really helpful when you are taking care of a patient who was on oral antidiabetic agents before they came into the hospital. They have taken significant amounts of insulin during their stay and you want to send them home on insulin, but you are getting a pushback from them. [The patient indicates that he or she] is just fine on the oral agents but then unfortunately, I show them their A1c to show them they were not fine on their oral agents, so the A1c can be very compelling in sending the patient home on the right treatment.

Dr. Umpierrez: If somebody comes to the hospital, a patient with known diabetes, and their A1c is < 7.0% that is telling me that whatever regimen the patient came in with is effective. Therefore, we usually send the patient home with the same therapy that they came in on. If the A1c is somewhere between 7%-10%, we usually start oral agents, usually metformin, and send the patient home with a single dose of basal therapy, which is a simple approach. For those who have very uncontrolled diabetes, patients with hyperglycemic emergencies, we usually send them home on a basal-bolus regimen. Jane was telling us how to manipulate or how to prescribe a regimen that is easy to follow, and I think that A1c plays a substantial role in helping us guide therapy.

Dr. Rodriguez: I agree with both of you, and that has been our experience as well. Initially, there was some resistance [to measuring A1c] because people would say, "Well, we have an A1c from a few months ago" but, oftentimes, patients don't have an A1c or we don't have access to those data. The A1c then becomes very influential for the teams to decide on what therapies [to start] if people were poorly controlled and whether to use combination oral agents and insulin. I agree with you completely, and I think that A1c is helpful.

Dr. Umpierrez: One caveat that is very important to recognize is that I don't think A1c should be used to diagnose diabetes in the hospital. It should be used to guide your therapy. If you order an A1c on everybody, it is not cost effective. The sensitivity of this test is so low that it shouldn't be done to diagnose diabetes, but in those patients with hyperglycemia, it is quite effective because there are many circumstances that can affect A1c, such as anemia and transfusions. We have to take into consideration all of these comorbidities and factors that may alter the interpretation of A1c.



Slide 38.

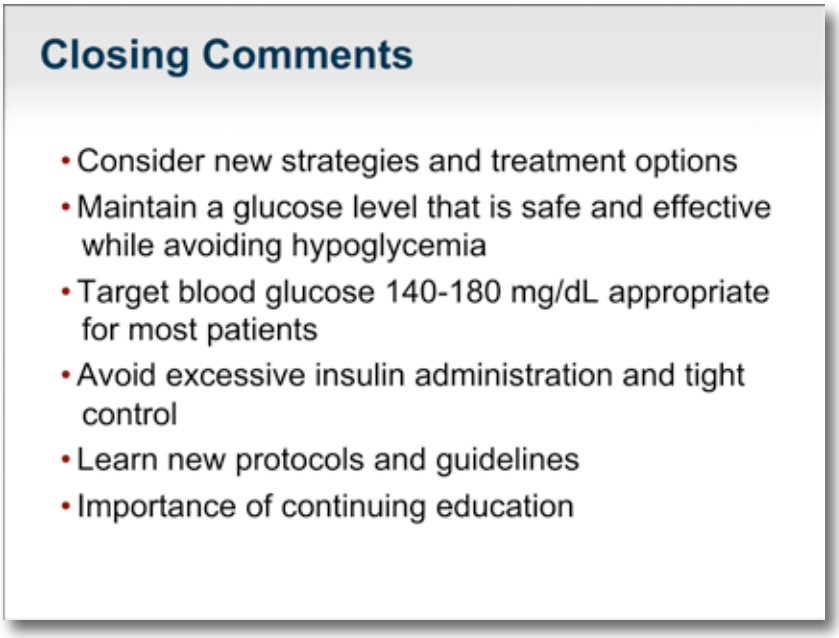
Dr. Rodriguez: Can you describe a discharge insulin algorithm that you might use?

Dr. Umpierrez: We are doing the following studies right now. We should be done very soon. This is the protocol that we have followed in the Emory University system during the last few years in that we take into consideration the A1c. As I mentioned before, if the patient comes in with an A1c < 7.0%, the patient should go home on whatever he or she came in on, whether it be insulin, oral agents, or diet. If the A1c is between 7%-9%, we usually send the patient home with metformin and we give 50%-80% of the basal insulin dose. If the basal insulin is okay in the hospital, we send the patient home with half the dose. If they are in the hospital and the glucose remains high, we give 80% of the basal dose and send the patient home on metformin. If the A1c is > 9% or 10%, you have 2 or 3 options. One is to send the patient home on basal-bolus like glargine or, perhaps, a combination of insulin. Neutral protamine Hagedorn and regular insulin are also used and are as effective as basal insulin analogs in controlling blood glucose. There may be an increased incidence of hypoglycemia in some circumstances but, of course, these could be a good option for patients who could not buy or afford the use of insulin analogs.

Dr. Rodriguez: Jane, what are your thoughts about that in terms of a discharge insulin algorithm?

Dr. Seley: I really want to stress that the simplest plan is the plan that works, so if everyone understands how to transfer a basal-bolus regimen to something that the person can support based on the A1c, this is perfect. I think that your algorithm is wonderful and I am going to copy it, if you don't mind.

Closing Comments



Slide 39.

Dr. Rodriguez: I would like to now summarize our session, which has been really wonderful. It has been lovely to spend the afternoon here with you. Jane, what are some concluding thoughts that you would like for the audience to take away? What are 3 key points that you would love for them to remember?

Dr. Seley: I would like people to keep in mind that taking care of patients in the hospital with hyperglycemia and diabetes is not a science but an art. The more we try and experiment with different kinds of strategies and treatments, the better we are going to be. It is a work in progress and a moving target. We are always learning new things, but it is really important that we talk to each other. Forums like this are really great, and we can bounce ideas off of each other in terms of what works and what doesn't work.

Dr. Rodriguez: Excellent. What about for you, Guillermo?

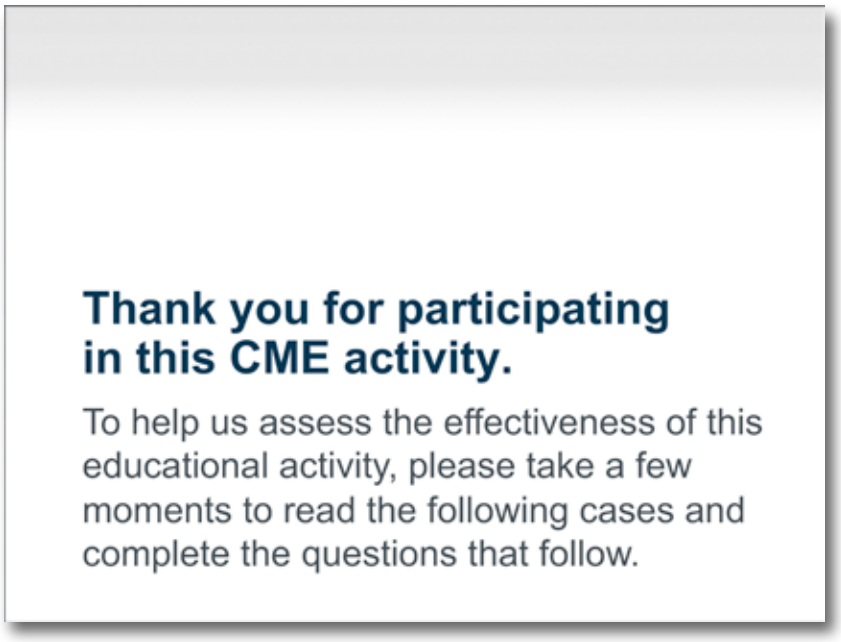
Dr. Umpierrez: The first key point is that glycemic control is important. We have different messages from different guidelines and societies, but maintaining a glucose level that is safe and effective, while avoiding hypoglycemia, should be the goal both for patients in the ICU and non-ICU. Maintaining a blood glucose of 140-180 mg/dL, according to the Society of Critical Care Medicine, is appropriate for most patients. It should decrease complications in the hospital. Second, we should avoid hypoglycemia, and the way to avoid hypoglycemia is to avoid excessive insulin administration and tight control. Third, we have to continue to learn new protocols and guidelines and follow them, because the way we are going to decrease complications and readmissions will not only be in maintaining glucose control in the hospital but in transitioning them to home.

Dr. Rodriguez: I agree with all the points that you both have raised in the concluding remarks. I would lend a voice to how important it is for healthcare providers to become educated, to understand the importance of why it is important to manage hyperglycemia as a newly diagnosed diabetic patient or someone who has established disease, to not be afraid to use insulin therapy, to call upon resources that their institutions have (diabetes educator, nutritionist, endocrinologist), and to remember it is of utmost importance to help that patient overcome acute issues such as infection and decrease all-cause mortality in the long term.

Again, thank you very much. It has been a great pleasure to be with you today.

Dr. Seley: Thank you.

Dr. Umpierrez: Thank you.



Slide 40.

Dr. Rodriguez: Thank you for participating in this CME activity. To help us assess the effectiveness of this educational activity, please take a few moments to read the following cases and complete the questions that follow.

Post-Assessment: Measuring Educational Impact

In your experience, which of the following is the most significant barrier to optimal inpatient glycemic control? (select only 1)

- ◯ Conflicting/disputed evidence for blood glucose (BG) level targets
- ◯ Perceived detriment of hyperglycemia and/or hypoglycemia
- ◯ Timing of BG check and matching insulin administration to time of meal delivery
- ◯ Variations in accuracy of BG based on meter used, where sample was obtained, etc
- ◯ Erratic oral intake by hospitalized patients

Case #1: A 26-year-old woman with type 1 diabetes, diabetic neuropathy, chronic right foot ulcer, and well-controlled asthma presents to the emergency department (ED) complaining of fevers, shortness of breath, and productive cough for 2 days. Outpatient medications include insulin glargine 22 U nightly, insulin lispro 6 U 3 times daily before meals, and albuterol metered-dose inhaler as needed for wheezing. Vital signs show a temperature of 39.3°C orally, blood pressure 102/52 mm Hg, heart rate 120 beats/min, respiratory rate 26 breaths/min, oxygen saturation 85% on room air, and weight 80 kg. Auscultation of the lungs reveals markedly decreased breath sounds in the left base but no wheezing. Pedal pulses are 2+, and there is a shallow 2-cm ulcer on the right hallux with surrounding erythema. Chest x-ray demonstrates dense left lower lobe consolidation. ECG shows sinus tachycardia. Lab values are as follows: white blood cell (WBC) count 19.7 x 103/dL, creatinine 1.3 mg/dL, BG 270 mg/dL, serum bicarbonate 24 mEq/L, anion gap 10, and serum ketone is undetectable. Her tachypnea worsens and intubation is performed. Blood and sputum cultures are obtained, intravenous (IV) fluids and broad-spectrum antibiotics are initiated, and she is admitted to the medical intensive care unit. IV insulin is initiated with dose adjustment per hospital insulin infusion protocol.

Which of the following would be your target BG range for this patient? (select only 1)

- ◯ 80-110 mg/dL
- ◯ 100-180 mg/dL
- ◯ 140-180 mg/dL
- ◯ 140-220 mg/dL

Case #1 (cont): Glucose levels are monitored hourly. BG values, measured each hour over the following 4 hours, are: 248 mg/dL, 164 mg/dL, 121 mg/dL, and 68 mg/dL, respectively. Insulin is discontinued per protocol when BG is < 70 mg/dL. One hour later, BG is 38 mg/dL. One ampule of dextrose 50% (D50) is administered and BG improves to 147 mg/dL.

Which of the following would be your next step in the management of this patient? (select only 1)

- ◯ Discontinue IV insulin and begin subcutaneous insulin
- ◯ Reduce insulin rate or hold insulin infusion at a higher BG concentration
- ◯ Discontinue IV insulin and initiate an insulin pump
- ◯ Hold insulin infusion until BG > 200 mg/dL

Case #1 (cont): Over the next 48 hours, the patient's respiratory status improves and extubation is performed. She is transferred to the medical floor 24 hours later, and she is transitioned from IV insulin to subcutaneous insulin glargine and insulin lispro. On hospital day 5, the patient's right foot ulcer appears to have worsened; there is a foul-smelling discharge and increased erythema of the hallux. Podiatry consult is obtained, and her status is nothing by mouth after midnight in anticipation of debridement and possible first metatarsal amputation the next morning. BG at 5:00 PM (30 minutes before dinner) is 108 mg/dL.

Which of the following would you do next? (select only 1)

- ◯ Administer a reduced dose of basal insulin the night before surgery
- ◯ Hold basal insulin the night before surgery
- ◯ Administer the usual dose of basal insulin the night before surgery
- ◯ Discontinue basal insulin and switch to a sliding scale regimen using regular insulin

Case #2: A 54-year-old man with type 2 diabetes and hypertension presents to the ED with swelling, pain, and redness for 3 days in the left lower leg. Medications include aspirin 81 mg daily, valsartan 320 mg daily, metformin 1000 mg twice daily, and glipizide 5 mg twice daily. Temperature is 38.7°C orally, blood pressure 154/92 mm Hg, heart rate 90 beats/min, and weight 62 kg. The left lower extremity demonstrates circumferential erythema from the ankle to the knee with edema and tenderness to palpation. Venous ultrasound of the extremity shows no deep vein thrombosis. WBC count is 14.3 x 103/dL. Creatinine is 1.1 mg/dL, and BG is 230 mg/dL. Leg cellulitis is diagnosed, and the patient is admitted to the medical floor of the hospital for IV antibiotics.

Which of the following would be your target glucose level in this patient? (select only 1)

- ◯ Premeal BG < 120 mg/dL
- ◯ Premeal BG < 140 mg/dL
- ◯ Random BG < 140 mg/dL
- ◯ Random BG < 220 mg/dL

Case #2 (cont): The patient develops nausea from the antibiotics and consumes only liquid. The consulting nutritionist is concerned about inadequate oral intake and recommends a supplemental protein shake with meals to improve caloric intake. You prepare to enter orders for insulin therapy.

Which of the following insulin regimens would you initiate at this time? (select only 1)

- ◯ Basal insulin once-daily dose
- ◯ Bolus insulin divided into 3 doses
- ◯ Bolus insulin divided into 2 doses
- ◯ IV insulin infusion

Case #3: A 71-year-old man with chronic obstructive pulmonary disease (COPD) on home oxygen at 2 L, hypertension, chronic kidney disease stage III, and type 2 diabetes presents to the ED with 3 days of progressive shortness of breath, cough, and increasing sputum production. He was diagnosed with diabetes 1 year prior, at which time his A1c was 6.6%. The patient reports that his diabetes has been "diet-controlled," but his wife indicates he has not really modified his diet and has actually gained weight. Chronic medications include aspirin 81 mg daily, lisinopril 10 mg daily, tiotropium, and fluticasone/salmeterol. He has a 60 pack-year history of tobacco use and quit smoking 1 year ago. On examination, he has a temperature of 38.4°C orally, respiratory rate 22 breaths/min, oxygen saturation 88% on 2 L, and decreased breath sounds throughout all lung fields. Chest x-ray demonstrates hyperexpanded lung fields with no infiltrates. WBC count is 9.7 x 103/dL. Creatinine is 2.2 mg/dL. BG is 197 mg/dL. The patient is admitted to the medical floor of the hospital for treatment of COPD exacerbation. He is started on nebulizers and IV methylprednisolone. A1c on admission was 8.7%.

Which of the following diabetic regimens would you initiate at this time? (select only 1)

- ◯ Insulin only
- ◯ Metformin only
- ◯ Metformin + insulin
- ◯ Sulfonylurea + insulin

Case #3 (cont): The patient's appetite is excellent and, given concern over potentially worsening hyperglycemia with the use of IV corticosteroids, you decide to initiate a basal/bolus insulin regimen. His weight is 92 kg.

Which of the following would be your next step in the management of this patient? (select only 1)

- ◯ Administer a total daily dose (TDD) of insulin of 0.4-0.5 U/kg/day
- ◯ Start insulin at 0.5 units/kg /day, then give half the dose as basal and the other half divided among the 3 meals
- ◯ Administer three fourths of the TDD as basal insulin and one fourth as bolus insulin
- ◯ Administer one fourth of the TDD as basal insulin and three fourths as bolus insulin

To avoid hypoglycemia, which of the following would you do? (select only 1)

- ◯ Avoid basal/bolus insulin unless the patient has uncertain oral intake
- ◯ Never use sliding scale insulin
- ◯ Reassess insulin regimen if BG level falls below 100 mg/dL
- ◯ Reassess insulin regimen if BG level falls below 140 mg/dL

Case #3 (cont): The patient improves over the course of 3 days, BG is well controlled on his inpatient regimen (all values between 140-180 mg/dL), corticosteroids are transitioned from IV to oral (with a planned 5-day taper), and he is ready for discharge home on hospital day 4.

Although the following is unpublished, which diabetic regimen would you prescribe for this patient at discharge? (select only 1)

- ◯ Oral agent(s) only
- ◯ Oral agents(s) and basal insulin at 50%-80% of hospital dose
- ◯ Oral agent(s) and basal insulin at same hospital dose
- ◯ Oral agent(s) and basal/bolus insulin at 50%-80% of hospital dose
- ◯ Oral agent(s) and basal/bolus insulin at same hospital dose
- ◯ Basal insulin at 50%-80% of hospital dose
- ◯ Basal insulin at same hospital dose
- ◯ Basal/bolus insulin at 50%-80% of hospital dose
- ◯ Basal/bolus insulin at same hospital dose

What medical educational format do you consider most helpful in learning medical information? (select only 1)

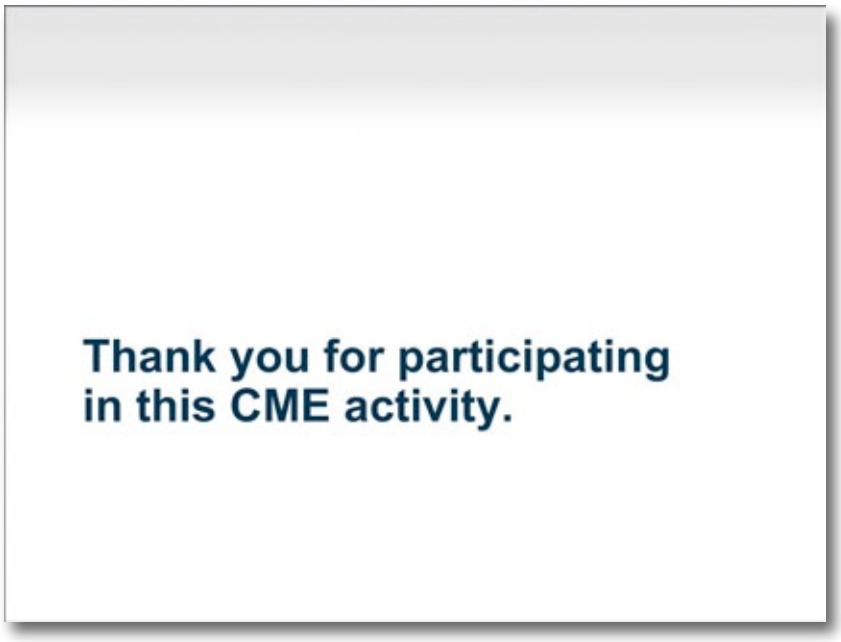
- ◯ Case-based format
- ◯ Webinars
- ◯ Lectures
- ◯ Roundtable discussions with experts
- ◯ Text-based material

How often do you utilize the resources that are available in your hospital, such as certified diabetes educators, for deciding on therapeutic options or nutrition consultants to reinforce total calories? (select only 1)

- ◯ Never
- ◯ Rarely
- ◯ Sometimes
- ◯ Often
- ◯ Always

Please indicate how relevant this CME/CE activity is to your practice: approximately how many patients do you see each week with diabetes?

- ◯ 0
- ◯ 1-10
- ◯ 11-20
- ◯ > 20



Slide 41.

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