THE POINT OF **POSSIBLE**

AADE13

AADE13
ANNUAL MEETING & EXHIBITION
PHILADELPHIA, PA
AUGUST 7–10, 2013

AADE American Association of Diabetes Educators

THE PSYCHOMETRICS

OF

DIABETES SELF-MANAGEMENT

IN

AGING PATIENTS

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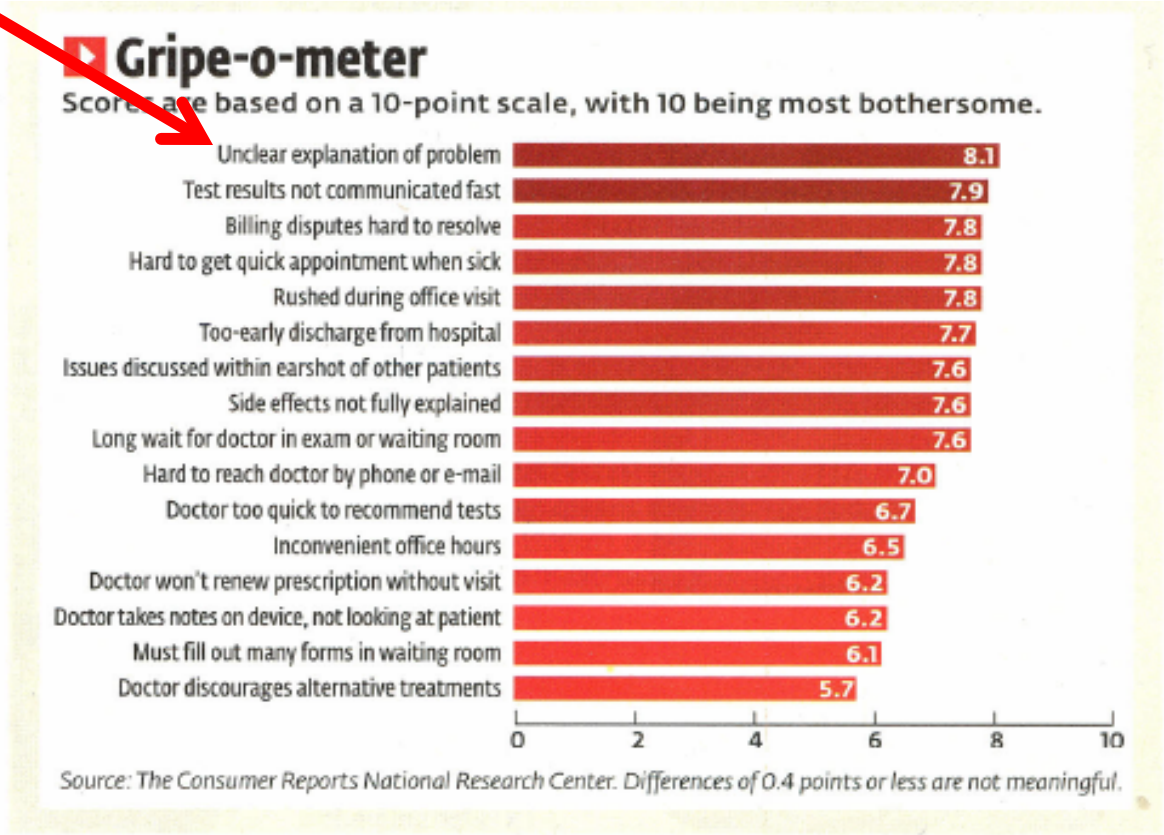
- Why ?
- Who ??
- Cognitive Decline ~ Aging
- Cognitive Demands ~ DSM
  - Critical vs Difficult
- Psychometrics and DSM
- Case Studies
- Re-design DSME

…….Patient complaints

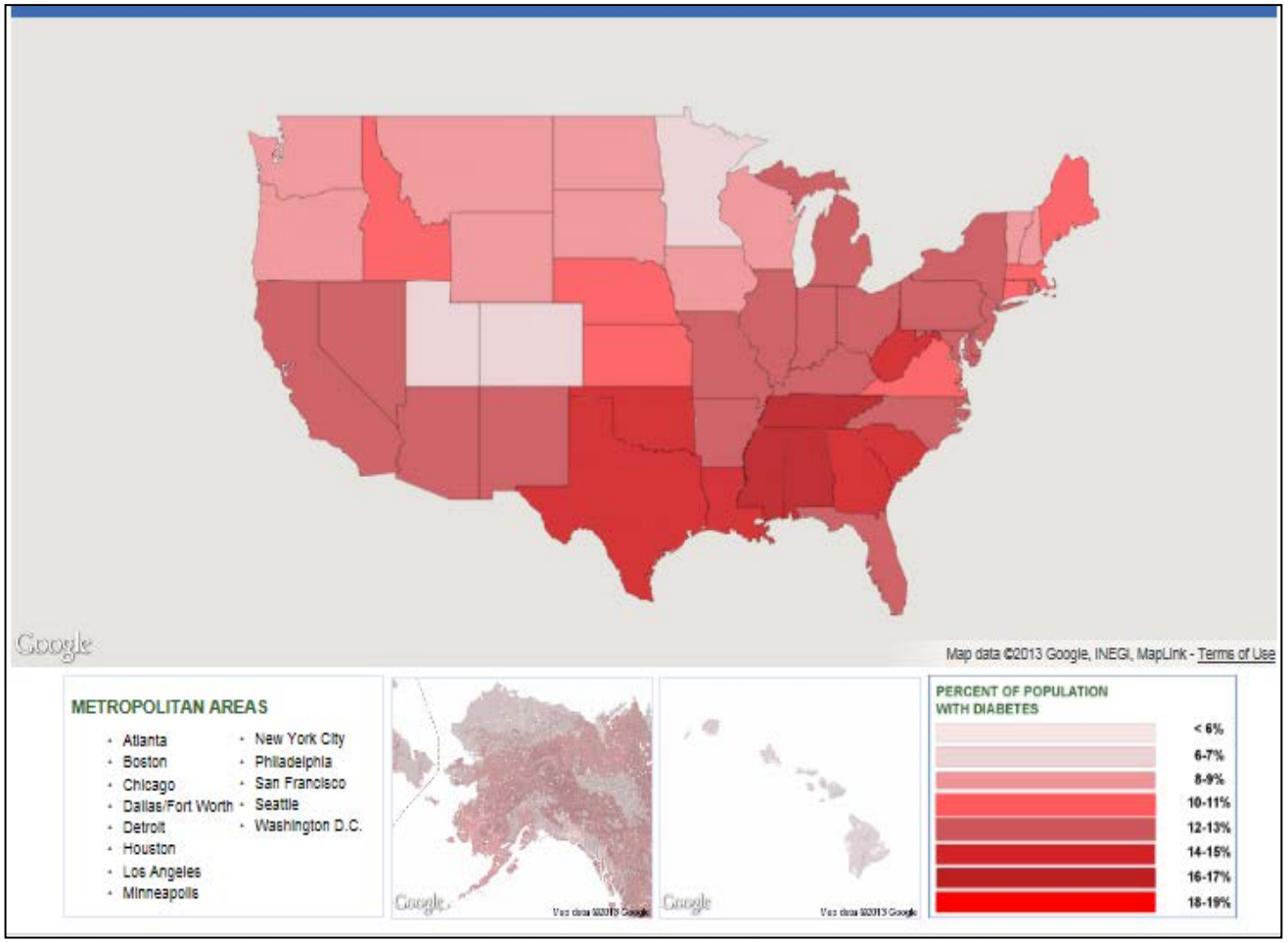


Why

and

Who

2015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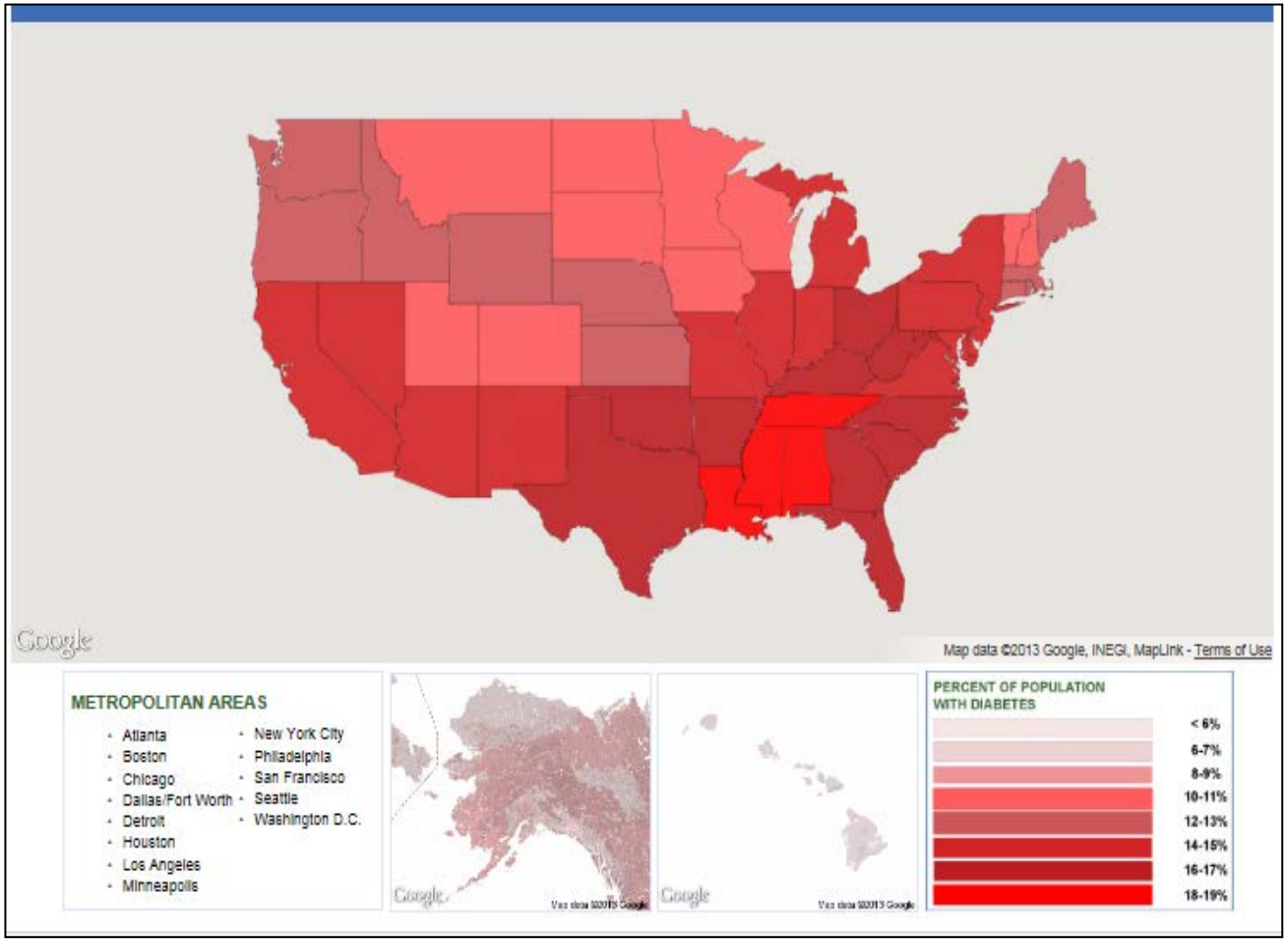
Washington D.C.
PERCENT OF POPULATION WITH DIABETES
< 6%
6-7%
8-9%
10-11%
12-13%
14-15%
16-17%
18-19%

2025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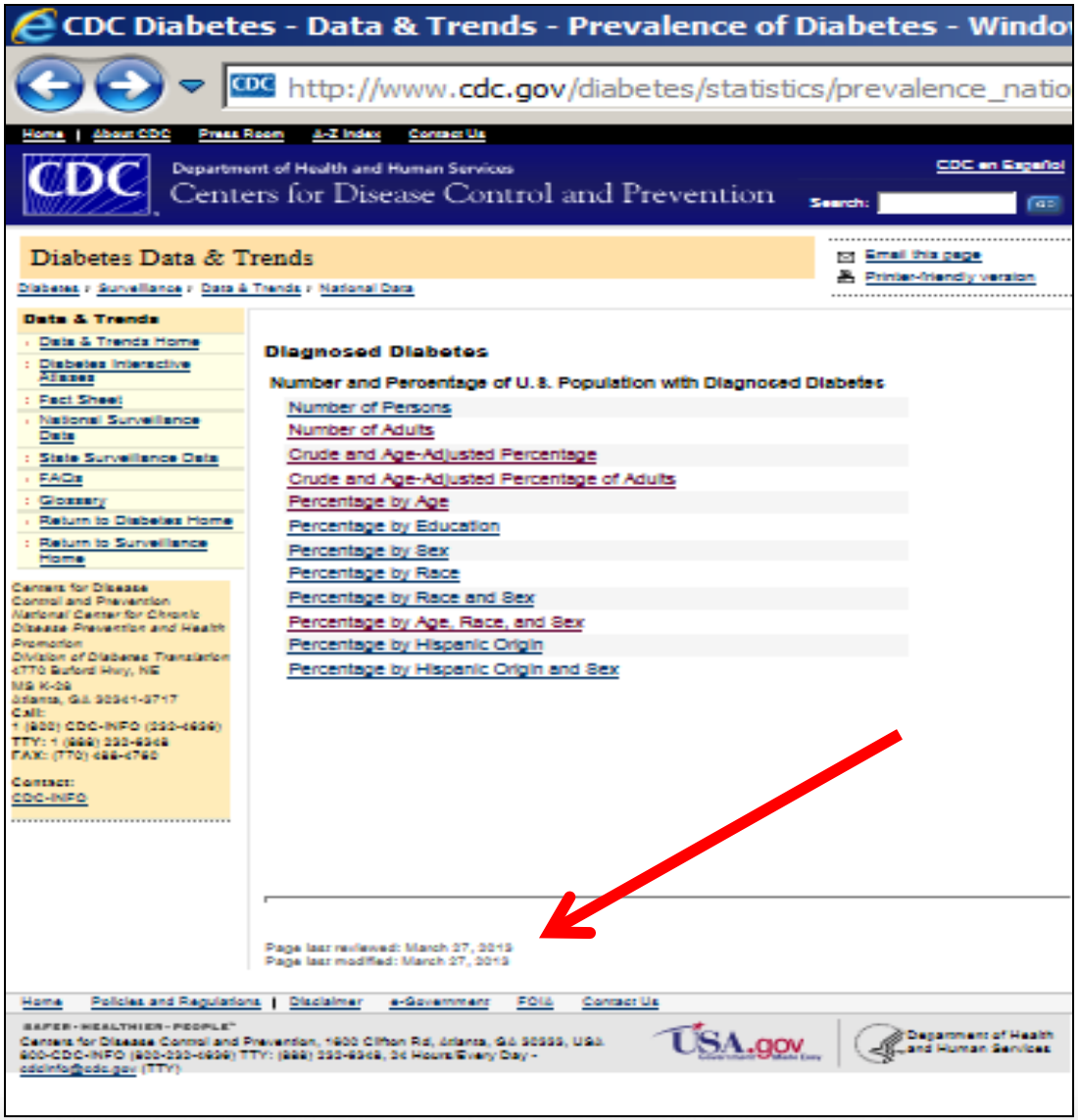
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National Center for Chronic Disease Prevention and Health Promotion
Division of Diabetes Translation
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Atlanta, GA 30341-3717
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1 (800) CDC-INFO (232-4636)
TTY: 1 (888) 232-6348
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Contact:
CDC-INFO
Diagnosed Diabetes
Number and Percentage of U.S. Population with Diagnosed Diabetes
Number of Persons
Number of Adults
Crude and Age-Adjusted Percentage
Crude and Age-Adjusted Percentage of Adults
Percentage by Age
Percentage by Education
Percentage by Sex
Percentage by Race
Percentage by Race and Sex
Percentage by Age, Race, and Sex
Percentage by Hispanic Origin
Percentage by Hispanic Origin and Sex
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USA.gov
Department of Health and Human Services

National Diabetes Fact Sheet, 2011

FAST FACTS ON DIABETES

Diabetes affects 25.8 million people
8.3% of the U.S. population

DIAGNOSED
18.8 million people

UNDIAGNOSED
7.0 million people

All ages, 2010

- Among U.S. residents aged 65 years and older, 10.9 million, or 26.9%, had diabetes in 2010.
- About 215,000 people younger than 20 years had diabetes (type 1 or type 2) in the United States in 2010.
- About 1.9 million people aged 20 years or older were newly diagnosed with diabetes in 2010 in the United States.
- In 2005–2008, based on fasting glucose or hemoglobin A1c levels, 35% of U.S. adults aged 20 years or older had prediabetes (50% of adults aged 65 years or older). Applying this percentage to the entire U.S. population in 2010 yields an estimated 79 million American adults aged 20 years or older with prediabetes.
- Diabetes is the leading cause of kidney failure, nontraumatic lower-limb amputations, and new cases of blindness among adults in the United States.
- Diabetes is a major cause of heart disease and stroke.
- Diabetes is the seventh leading cause of death in the United States.

Citation

Centers for Disease Control and Prevention. National diabetes fact sheet: national estimates and general information on diabetes and prediabetes in the United States, 2011. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2011.

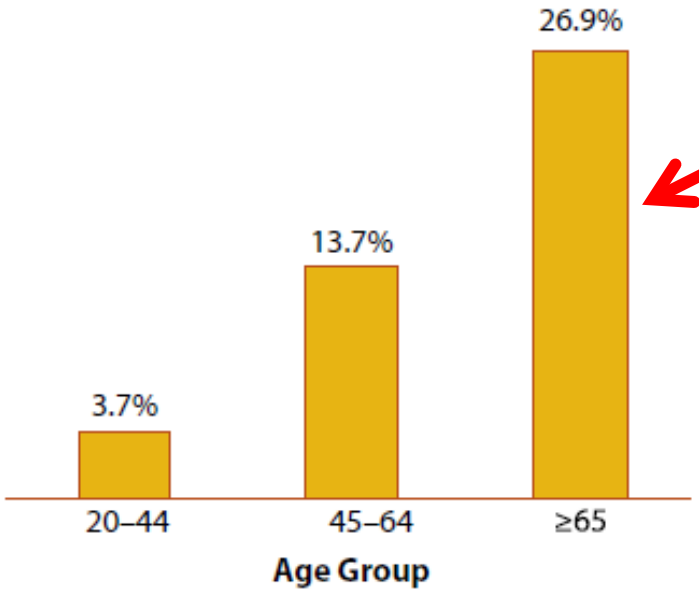
Diagnosed and undiagnosed diabetes among people aged 20 years or older, United States, 2010	
Group	**Number or percentage who have diabetes**
Age ≥20 years	25.6 million or 11.3% of all people in this age group
Age ≥65 years	10.9 million or 26.9% of all people in this age group
Men	13.0 million or 11.8% of all men aged 20 years or older
Women	12.6 million or 10.8% of all women aged 20 years or older
Non-Hispanic whites	15.7 million or 10.2% of all non-Hispanic whites aged 20 years or older
Non-Hispanic blacks	4.9 million or 18.7% of all non-Hispanic blacks aged 20 years or older

Sufficient data are not available to estimate the total prevalence of diabetes (diagnosed and undiagnosed) for other U.S. racial/ethnic minority populations.

2

Diagnosed and undiagnosed diabetes

Estimated percentage of people aged 20 years or older with diagnosed and undiagnosed diabetes, by age group, United States, 2005–2008

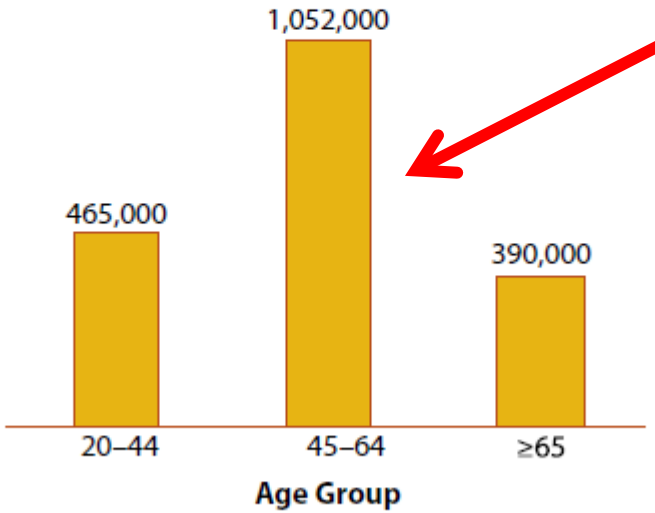


Source: 2005–2008 National Health and Nutrition Examination Survey

New cases of diagnosed diabetes

Estimated number of new cases of diagnosed diabetes among people aged 20 years or older, by age group, United States, 2010

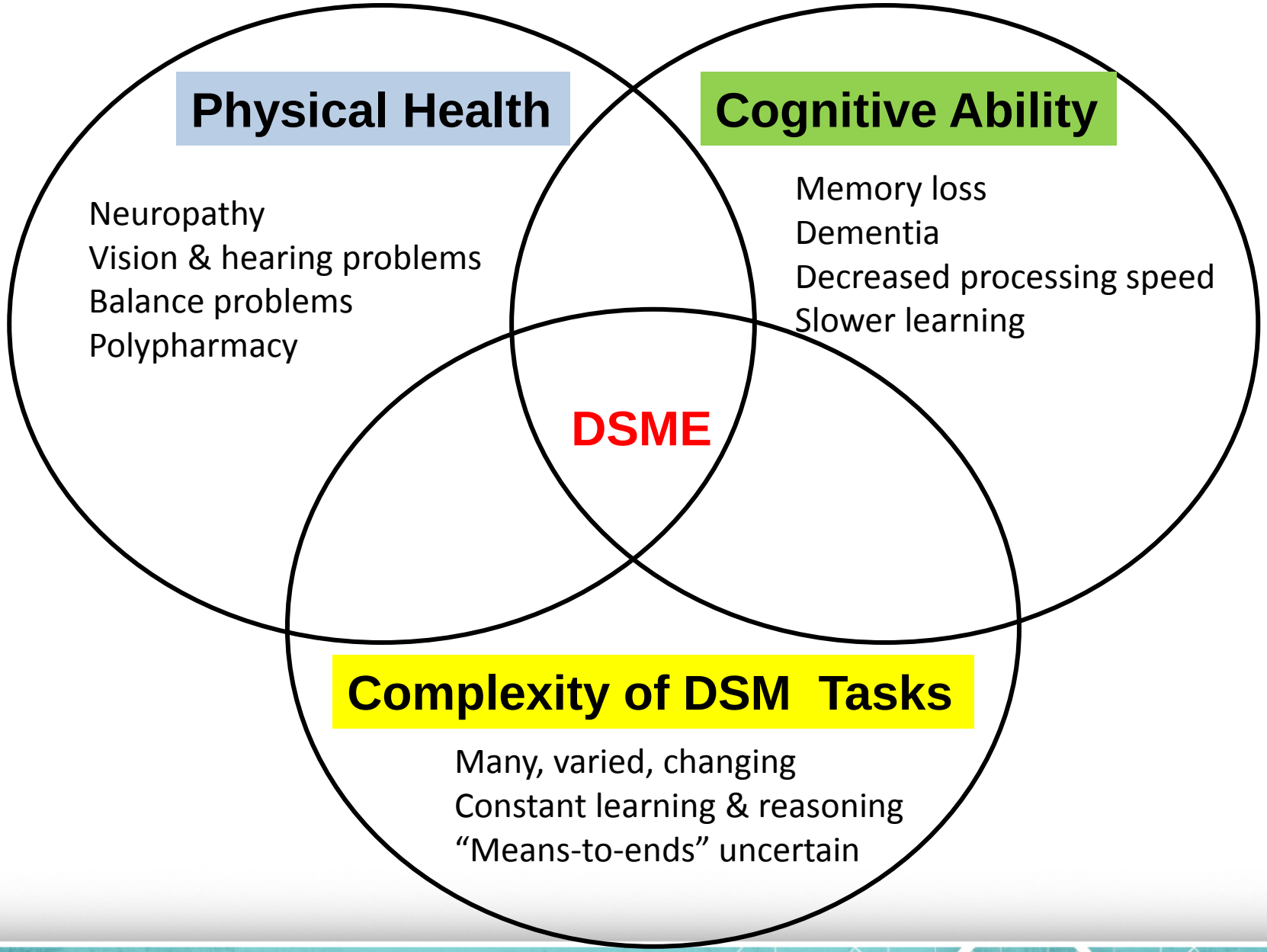
About 1.9 million people aged 20 years or older were newly diagnosed with diabetes in 2010.



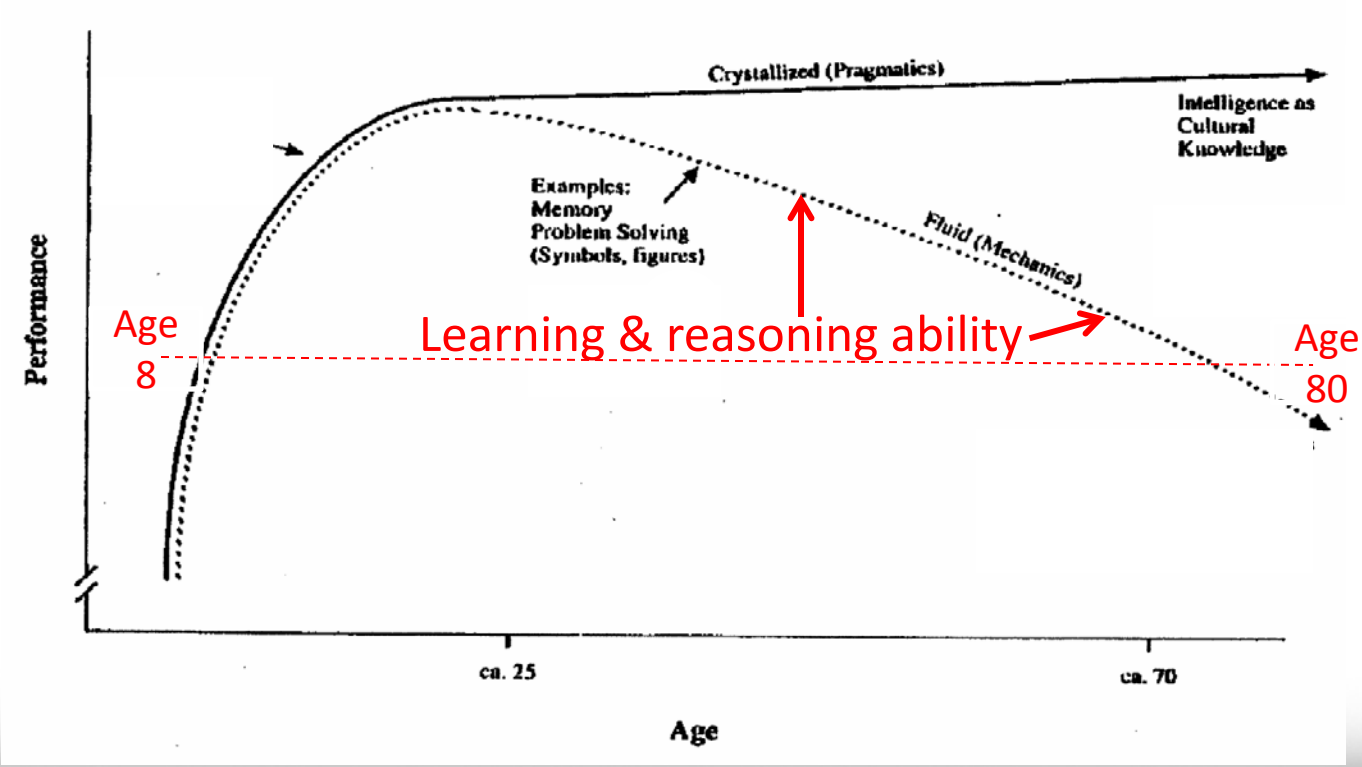
Source: 2007–2009 National Health Interview Survey estimates projected to the year 2010

Pre-Diabetes and Diabetes Trends[1] among Seniors in the United States

U.S. Seniors Diabetes Data and Forecasts	2010	2025
Population	40,229,000	63,907,000
Pre-diabetes	20,115,000	31,954,000
Diagnosed diabetes	7,901,000	12,551,300
Undiagnosed diabetes	2,920,600	4,639,700
Total with diabetes (diagnosed and undiagnosed)	10,821,600	17,191,000
Total with pre-diabetes or undiagnosed diabetes	23,035,600	36,593,700
Complications:		
Visual impairment	1,607,800	2,435,000
Renal failure	20,250	26,700
Leg amputations	27,180	31,400
Annual deaths attributable to diabetes	109,520	135,900
Total annual cost (2010 do...)	$105.7 B	$168.0 B
Annual medical costs	$74.3 B	$118.1 B
Annual nonmedical costs	$31.4 B	$49.9 B


Physical Health
Neuropathy
Vision & hearing problems
Balance problems
Polypharmacy
Cognitive Ability
Memory loss
Dementia
Decreased processing speed
Slower learning
DSME
Complexity of DSM Tasks
Many, varied, changing
Constant learning & reasoning
"Means-to-ends" uncertain

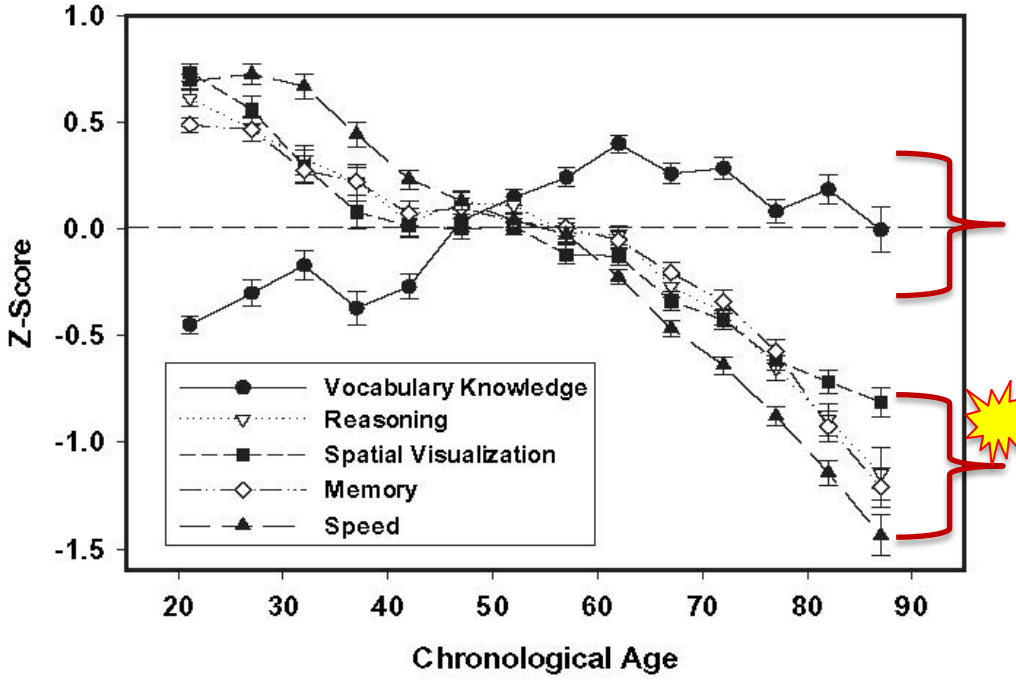
Age-related cognitive decline



Basic cultural Knowledge (G_C)

***g* - Basic information processing (G_F)**

Normal age-related cognitive changes*



"Crystallized" intelligence [past learning]

- Breadth/depth of general knowledge (e.g., language)
- Accrued over lifetime based on fluid intelligence, education, interests

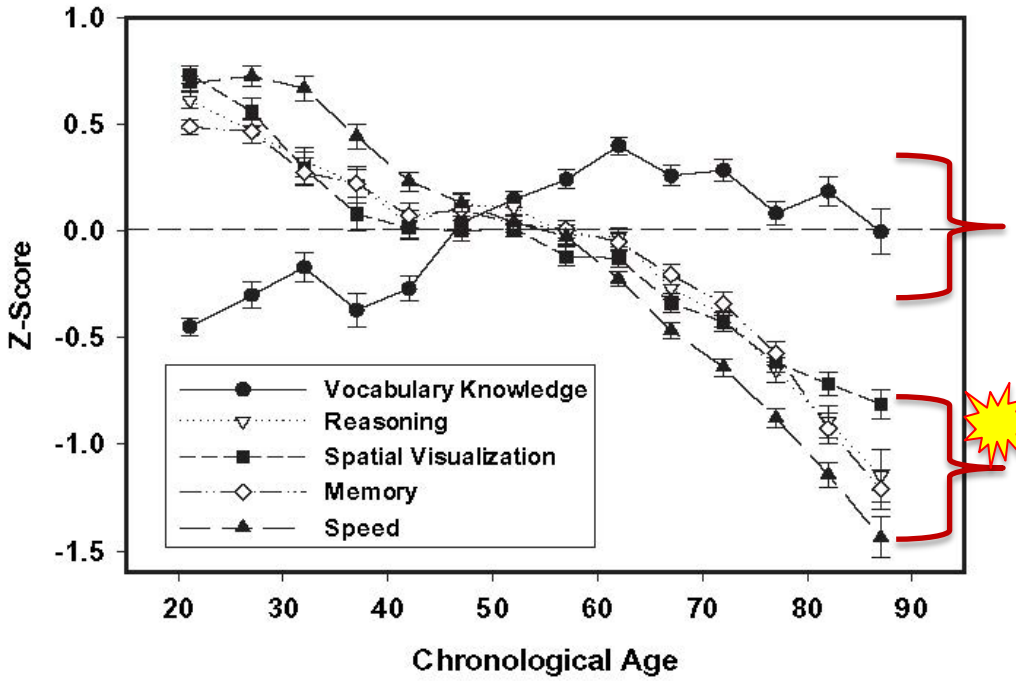
"Fluid" intelligence [on-the-spot learning & reasoning]

- Aptness in processing information (e.g., learning, reasoning, abstract thinking, problem solving)
- Reflects overall integrity of brain (speed, connectedness, etc.)

***This is the norm, but individuals vary a lot around the norm!**

Source: Figure 1 in Salthouse, T. A. (2009). Selective review of cognitive aging, *J of Int Neuropsych Soc, 16*, 754-760.

Normal age-related cognitive changes



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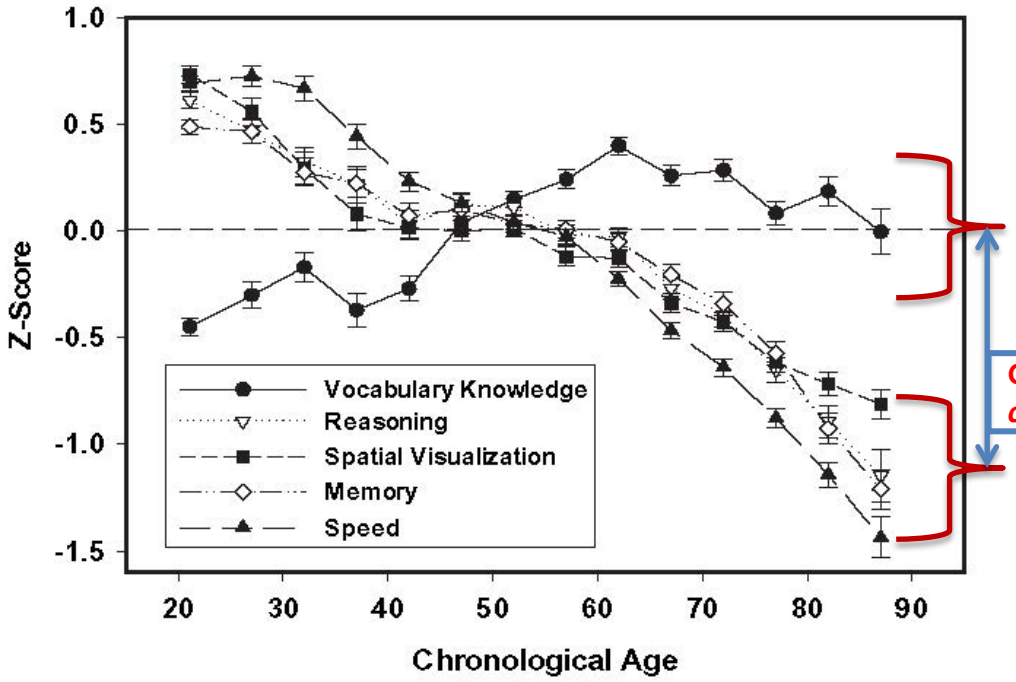
DSM tasks require "fluid intelligence"

Source: Figure 1 in Salthouse, T. A. (2009). Selective review of cognitive aging, *J of Int Neuropsych Soc, 16*, 754-760.

Normal age-related cognitive changes



"Crystallized" intelligence [past learning]

- Breadth/depth of general knowledge (e.g., language)
- Accrued over lifetime based on fluid intelligence, education, interests

Growing gap – *past learning* is faulty guide to *current* cognitive capacity

"Fluid" intelligence [current ability to learn & reason]

- Aptness in processing information (e.g., learning, reasoning, abstract thinking, problem solving)
- Reflects overall integrity of brain (speed, connectedness, etc.)

Source: Figure 1 in Salthouse, T. A. (2009). Selective review of cognitive aging, *J of Int Neuropsych Soc, 16*, 754-760.

Your patient is an elderly professor starting a new meter and/or insulin device

He may be literate

and express understanding *(crystallized intelligence)*,

but that does not guarantee

he can perform

the new DSM task *(fluid intelligence)*.

What do teachers,

nurses,

nuclear plant operators

and

people with diabetes

have in common ??

Their “jobs”
have heavy cognitive burdens
that pile up.

- ✓ Learn and recall relevant information
- ✓ Reason and make judgments
- ✓ Deal with unexpected situations
- ✓ Identify problem situations quickly
- ✓ React swiftly when unexpected
- ✓ problems occur
- ✓ Apply common sense to solve problems
- ✓ Learn new procedures quickly
- ✓ Be alert & quick to understand things

*Job analysis by Arvey (1986)

The challenges in DM self-management

- Diabetes self-management is inherently complex
- Relentless, evolving cognitive demands
- Frequent cognitive overload
- Non-compliance/non-adherence ➡ *High-risk errors*

Patient-centered ***operational*** DSM

Goal: Maintain blood glucose within normal limits

Learn about diabetes in general (At "entry')
- Physiological process
- Interdependence of diet, exercise, meds
- Symptoms & corrective action
- Consequences of poor control

Apply knowledge to own case (Daily, Hourly)
- Implement appropriate regimen
- Continuously monitor physical signs
- Diagnose problems in timely manner
- Adjust food, exercise, meds in timely and appropriate manner

Coordinate with relevant parties (Frequently)
- Negotiate changes in activities with family, friends, job
- Enlist/capitalize on social support
- Communicate status and needs to practitioners

Update knowledge & adjust regimen (Occasionally)
- When other chronic conditions or disabilities develop
- When new treatments are ordered
- When life circumstances change

Conditions of work—24/7, no days off, no retirement

CDEs *recognize*

the cognitive

burdens of DSM

and

instruct to

reduce those

burdens

Improving the literacy level (readability)

of educational materials

does *not* guarantee

comprehension

and/or

compliance

because it does not reduce

***cognitive demands*.**

Readability doesn't make a complex task easy

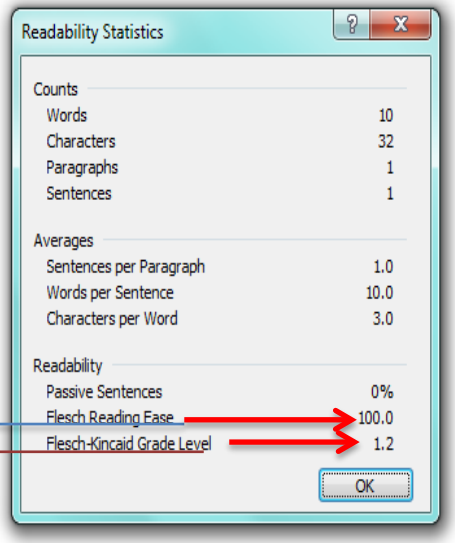
To be or not to be, that is the question.

Ingredients of readability:

- ASW: Average syllables per word
- ASL: Average words per sentence

206.835 - (84.6 * ASW) - (1.015 * ASL)

(0.39 * ASL) + (11.8 * ASW) -15.59



Typical literacy items, by difficulty level

National Adult Literacy Survey (NALS), 1993

NALS difficulty level (& scores)	% US adults (age 65+) peaking at this level	Simulated everyday tasks **Daily self-maintenance in modern literate societies**
5 **(375-500)**	3% ~0%	▪ Use calculator to determine cost of carpet for a room ▪ Use table of information to compare 2 credit cards
4 **(325-375)**	15% 4%	▪ Use eligibility pamphlet to calculate SSI benefits ▪ Explain difference between 2 types of employee benefits
3 **(275-325)**	31% 16%	▪ Calculate miles per gallon from mileage record chart ▪ Write brief letter explaining error on credit card bill
2 **(225-275)**	28% 33%	▪ Determine difference in price between 2 show tickets ▪ Locate intersection on street map
1 **(0-225)**	23% 47%	▪ Total bank deposit entry ▪ Locate expiration date on driver's license

How to minimize errors in DSM

1. Target the most critical tasks

2. Identify complexity (cognitive difficulty) of DSM tasks

3. Deliver instruction based on both complexity of tasks and ability of person.

4. Use integrated devices, “reminders,” telehealth, apps (??)

Critical vs. Difficult

DSM tasks

Survey of Diabetes Health Care Providers

Survey of Diabetes Health Care Providers

"Identifying the most critical challenges in diabetes self-management"

A joint research project of the University of Delaware and the Delaware Division of Public Health
UD School of Education, Linda S. Gottfredson, PhD
UD Center for Disabilities Studies, Eileen Sparling, EdM
DPH Diabetes Prevention and Control Program, Kathy Stroh, MS, RD, CDE

This project's aim is to develop more effective diabetes self-management tools, especially for individuals who also have an intellectual disability. The project's first step is to survey professionals like you who are in a position to report diabetes patients' most difficult challenges in learning and performing essential tasks in self-management.

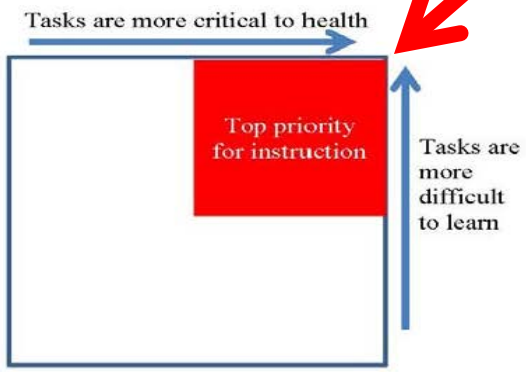
Thank you for your participation. Please know that your name, answers and all other personal information will be kept confidential. Participation is completely voluntary. Data from all participants will be pooled before analysis and reporting. Please contact Eileen Sparling at sparling@udel.edu or 302-831-8802 if you have any questions.

Part I - Characteristics of tasks in diabetes self-management

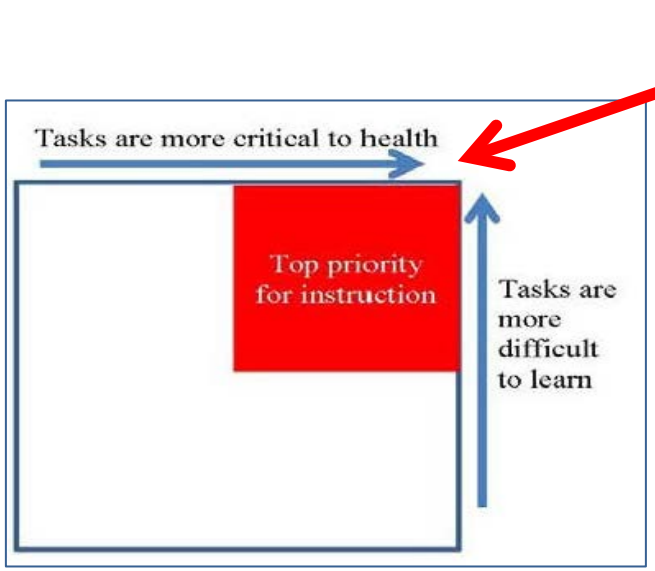
Definitions: Managing one's diabetes is a complex job. Not only is it difficult for patients to learn and perform well, but it can have dire consequences for their health and well-being if not performed well. We are interested in two characteristics of various tasks in diabetes self-management.

- Criticality: How critical is it for patients (or their caretakers) to actually perform this task as required?
- Intellectual difficulty: How difficult is it for patients (or their caretakers) to learn how to perform this task well?

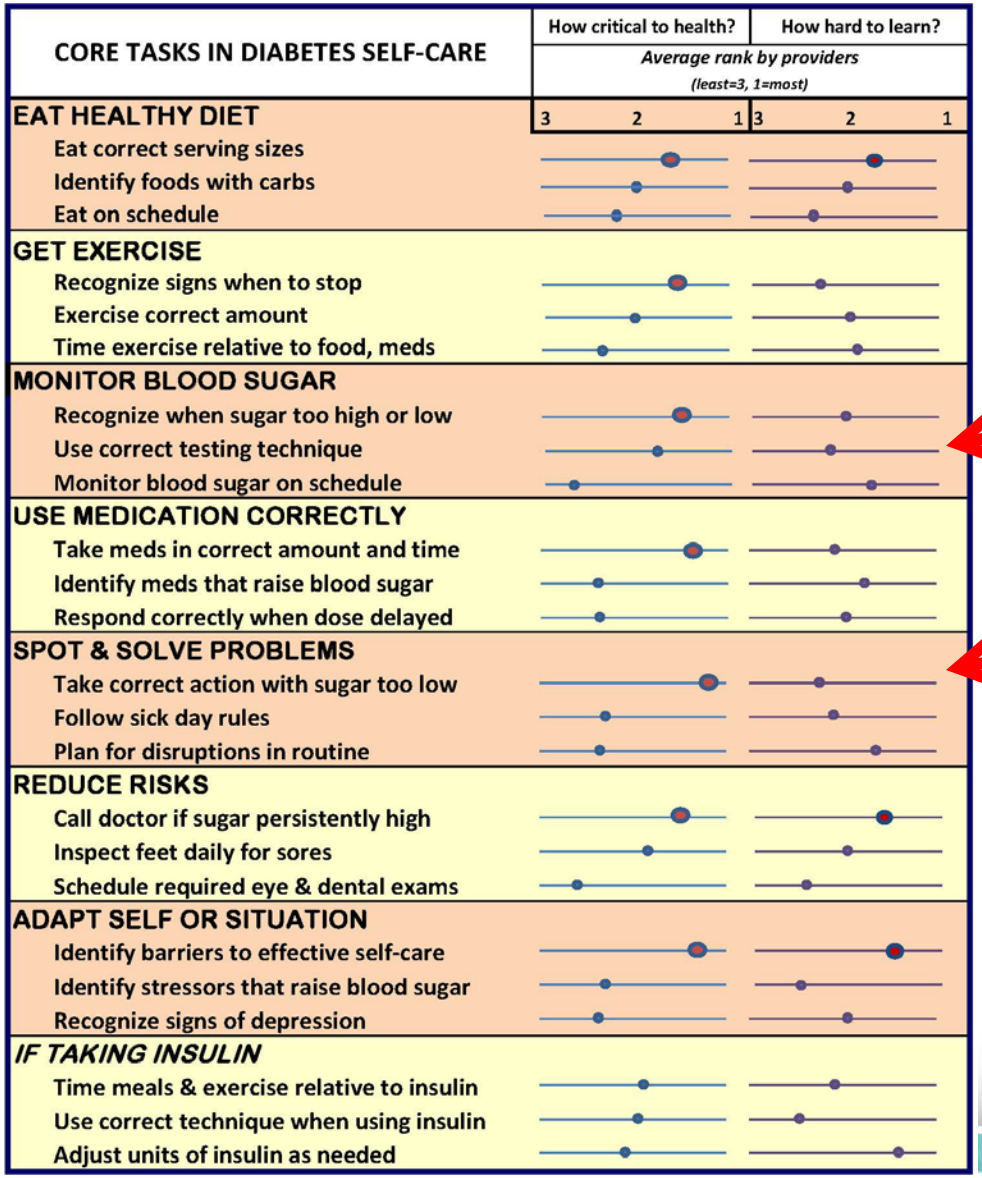
This project's aim is to identify self-management tasks that are both critical and difficult to learn in order to set priorities in instruction.



- More complex tasks generate more cognitive errors
- Aging (more functional deficits) increases the risk of error
- Errors on critical tasks are more dangerous
- Highest risk of harm occurs at intersection of critical and difficult



Rankings of task criticality and difficulty



"1" = ranked most critical/difficult of 3 core tasks

Tasks ranked within 8 categories

?? Do all staff

agree

about

task criticality

and

difficulty ???

Examples of

DSM errors

that may not

seem

“critical” or “difficult”

Changing doses

Changing Doses Can Be Confusing

A woman with newly diagnosed type 2 diabetes mellitus and also on blood pressure and anti-lipid medication was given prescriptions for: glucophage 500mg QD for one week, and then an increase to two 500mg tablets the second week.

On her return appointment, diabetes education was prescribed and the patient was instructed to continue on her other medications. During a review of her treatment regimen during the fourth week after the initial prescription, the patient reported having gastrointestinal side effects.

After questioning the patient further and digging a little deeper, the medical staff discovered that she was taking two 500mg glucophage at bedtime just once weekly.

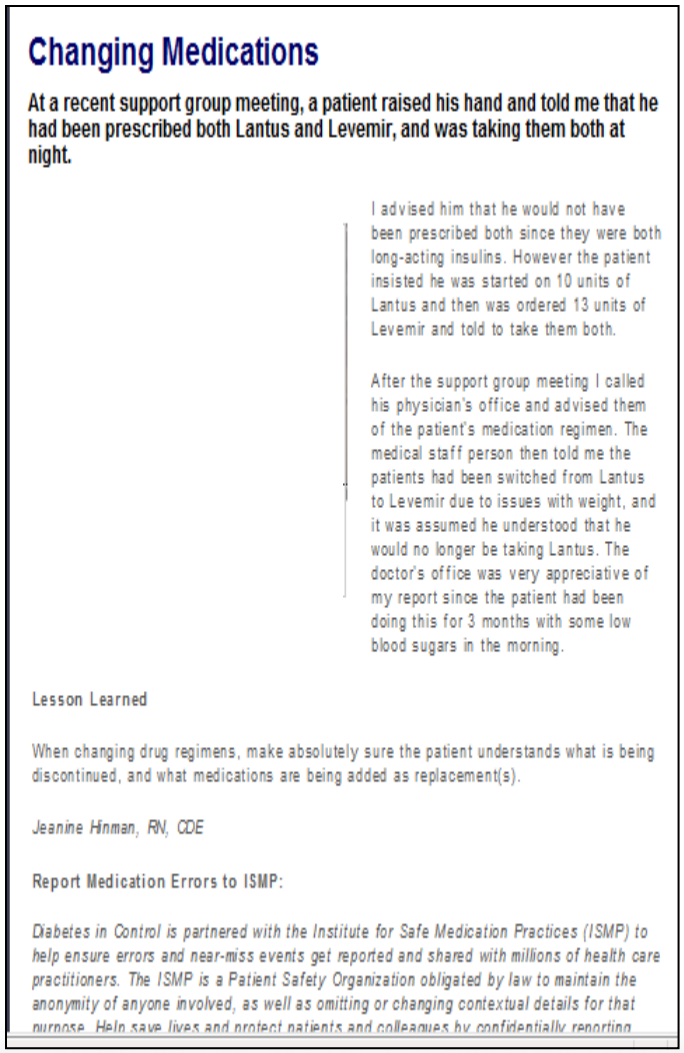
Switching her schedule to one 500mg tablet before breakfast and dinner cut down on the side effects and improved the blood glucose control by the time she returned for more education three weeks later.

Lesson Learned:

Following up with patients whenever there is a change of medication or dosage can help prevent medication errors.

Martha Mendez, RN, MSN, CCRC

Changing insulins – 2 long-acting



Changing Medications

At a recent support group meeting, a patient raised his hand and told me that he had been prescribed both Lantus and Levemir, and was taking them both at night.

I advised him that he would not have been prescribed both since they were both long-acting insulins. However the patient insisted he was started on 10 units of Lantus and then was ordered 13 units of Levemir and told to take them both.

After the support group meeting I called his physician's office and advised them of the patient's medication regimen. The medical staff person then told me the patients had been switched from Lantus to Levemir due to issues with weight, and it was assumed he understood that he would no longer be taking Lantus. The doctor's office was very appreciative of my report since the patient had been doing this for 3 months with some low blood sugars in the morning.

Lesson Learned

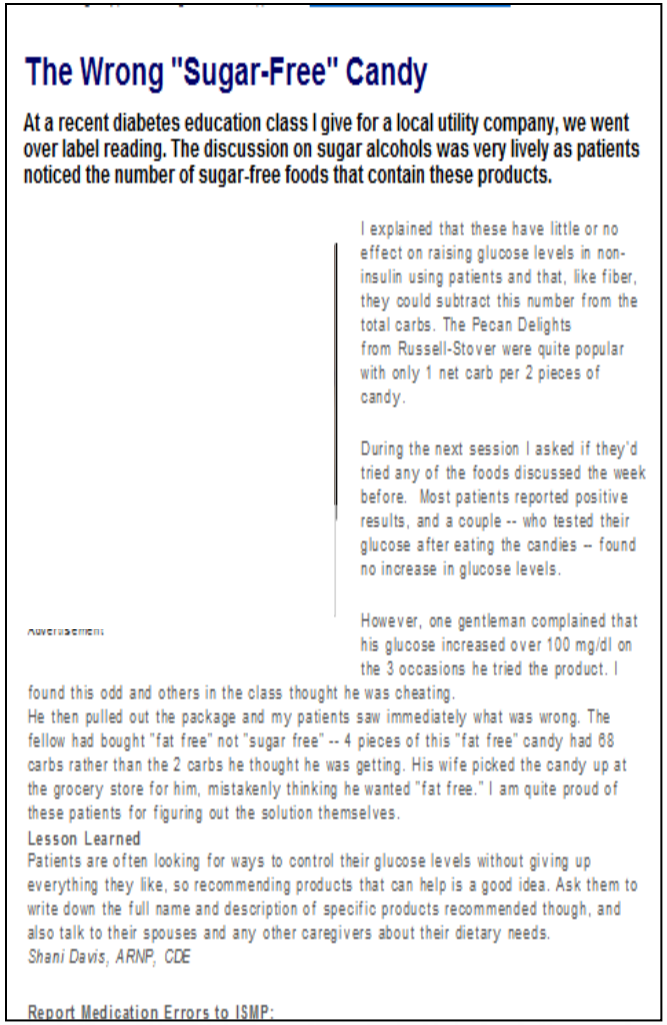
When changing drug regimens, make absolutely sure the patient understands what is being discontinued, and what medications are being added as replacement(s).

Jeanine Hinman, RN, CDE

Report Medication Errors to ISMP:

Diabetes in Control is partnered with the Institute for Safe Medication Practices (ISMP) to help ensure errors and near-miss events get reported and shared with millions of health care practitioners. The ISMP is a Patient Safety Organization obligated by law to maintain the anonymity of anyone involved, as well as omitting or changing contextual details for that purpose. Help save lives and protect patients and colleagues by confidentially reporting

Sugar-free candy



The Wrong "Sugar-Free" Candy

At a recent diabetes education class I give for a local utility company, we went over label reading. The discussion on sugar alcohols was very lively as patients noticed the number of sugar-free foods that contain these products.

I explained that these have little or no effect on raising glucose levels in non-insulin using patients and that, like fiber, they could subtract this number from the total carbs. The Pecan Delights from Russell-Stover were quite popular with only 1 net carb per 2 pieces of candy.

During the next session I asked if they'd tried any of the foods discussed the week before. Most patients reported positive results, and a couple -- who tested their glucose after eating the candies -- found no increase in glucose levels.

Advertisement

However, one gentleman complained that his glucose increased over 100 mg/dl on the 3 occasions he tried the product. I found this odd and others in the class thought he was cheating.

He then pulled out the package and my patients saw immediately what was wrong. The fellow had bought "fat free" not "sugar free" -- 4 pieces of this "fat free" candy had 68 carbs rather than the 2 carbs he thought he was getting. His wife picked the candy up at the grocery store for him, mistakenly thinking he wanted "fat free." I am quite proud of these patients for figuring out the solution themselves.

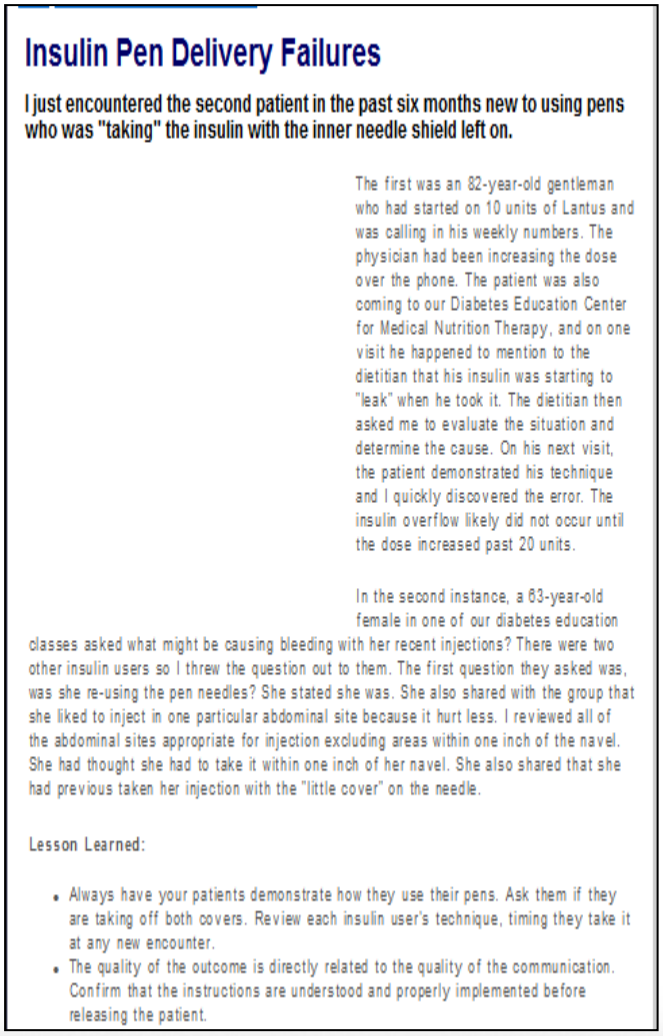
Lesson Learned

Patients are often looking for ways to control their glucose levels without giving up everything they like, so recommending products that can help is a good idea. Ask them to write down the full name and description of specific products recommended though, and also talk to their spouses and any other caregivers about their dietary needs.

Shani Davis, ARNP, CDE

Report Medication Errors to ISMP:

Insulin pen



Insulin Pen Delivery Failures

I just encountered the second patient in the past six months new to using pens who was "taking" the insulin with the inner needle shield left on.

The first was an 82-year-old gentleman who had started on 10 units of Lantus and was calling in his weekly numbers. The physician had been increasing the dose over the phone. The patient was also coming to our Diabetes Education Center for Medical Nutrition Therapy, and on one visit he happened to mention to the dietitian that his insulin was starting to "leak" when he took it. The dietitian then asked me to evaluate the situation and determine the cause. On his next visit, the patient demonstrated his technique and I quickly discovered the error. The insulin overflow likely did not occur until the dose increased past 20 units.

In the second instance, a 63-year-old female in one of our diabetes education classes asked what might be causing bleeding with her recent injections? There were two other insulin users so I threw the question out to them. The first question they asked was, was she re-using the pen needles? She stated she was. She also shared with the group that she liked to inject in one particular abdominal site because it hurt less. I reviewed all of the abdominal sites appropriate for injection excluding areas within one inch of the navel. She had thought she had to take it within one inch of her navel. She also shared that she had previous taken her injection with the "little cover" on the needle.

Lesson Learned:

- Always have your patients demonstrate how they use their pens. Ask them if they are taking off both covers. Review each insulin user's technique, timing they take it at any new encounter.
- The quality of the outcome is directly related to the quality of the communication. Confirm that the instructions are understood and properly implemented before releasing the patient.

Grams vs. grams on label

Diabetes Disaster Averted #11: Label Literacy

I am a dietitian working as a diabetes educator. I often work with patients on insulin, and teach insulin to carb ratios and correction factors....

Patients need to be able to read food labels and know portion size in order to dose their mealtime insulin correctly. I often get referred patients who have had some education about food choices and carbs and I help them determine these ratios.

I was reviewing a patient's food logs and insulin dose, and I questioned the amount of carbohydrate he had stated for a particular food item, as it seemed high. I quickly found out the patient was actually looking at the weight of the food item in grams instead of looking at Total Carbohydrates grams on the food label.

The patient had erroneously calculated a higher insulin dose based on weight grams not carb grams. Luckily, he experienced no hypoglycemia.

Now I make sure to point out to patients the difference in serving weight and Total Carbohydrates, and to use only the value next to Total Carbohydrates (adjusting for serving size).

He has not been the only patient who gets confused by this.

Marilyn Baker, MS, RD, CDE

Take home message:

In addition to looking at weight grams patients often use the % of daily allowance as the amount of carbs they eat. And even the most experienced counter can make a big mistake. It is always good to remind your patients exactly what they should be looking for on the label each time you see them.

Diabetes Disaster Averted #60: Helping Patients Decipher Nutrition Labels

I had a patient who came in for instruction on carbohydrate counting in order to dose his insulin based on his carbohydrate intake. I instructed him on the use of food lists and food labels. When the patient returned for follow-up, his doses of insulin did not correlate with the amount of carbohydrate in some of his foods....

I asked him where he got the amount of carbohydrate in a particular food. It turns out he was using the weight of the food in grams listed at the top of the food label (e.g., 56 grams), rather than the amount listed next to Total Carbohydrates (24 g). His blood sugars were still elevated, so luckily he had not experienced any hypoglycemia. We again reviewed how to read a food label, and the patient was able to calculate the correct amount of carbohydrate.

Lesson learned:

Never assume a patient knows how to read a food label. Now I point out the difference between the weight in grams and the total carbs.

Marilyn Baker, MS, RD, CDE

Patient-centered ***operational*** DSM

Goal: Maintain blood glucose within normal limits

Learn about diabetes in general (At "entry')
- Physiological process
- Interdependence of diet, exercise, meds
- Symptoms & corrective action
- Consequences of poor control

Apply knowledge to own case (Daily, Hourly)
- Implement appropriate regimen
- Continuously monitor physical signs
- Diagnose problems in timely manner
- Adjust food, exercise, meds in timely and appropriate manner

Coordinate with relevant parties (Frequently)
- Negotiate changes in activities with family, friends, job
- Enlist/capitalize on social support
- Communicate status and needs to practitioners

Update knowledge & adjust regimen (Occasionally)
- When other chronic conditions or disabilities develop
- When new treatments are ordered
- When life circumstances change

Conditions of work—24/7, no days off, no retirement

Insights on error from psychometrics

Science of accurately *measuring* differences in *cognitive performance* (in training, education, jobs, etc.)

Studies error: kinds, number, sources, consequences, control

1. Device error (test accuracy)
2. Person error (cognitive mistakes)
3. Task demands (cognitive burden)
4. Compounding of device & person errors increases with age
5. Criticality of errors increases with age

Applies to diabetes self-management

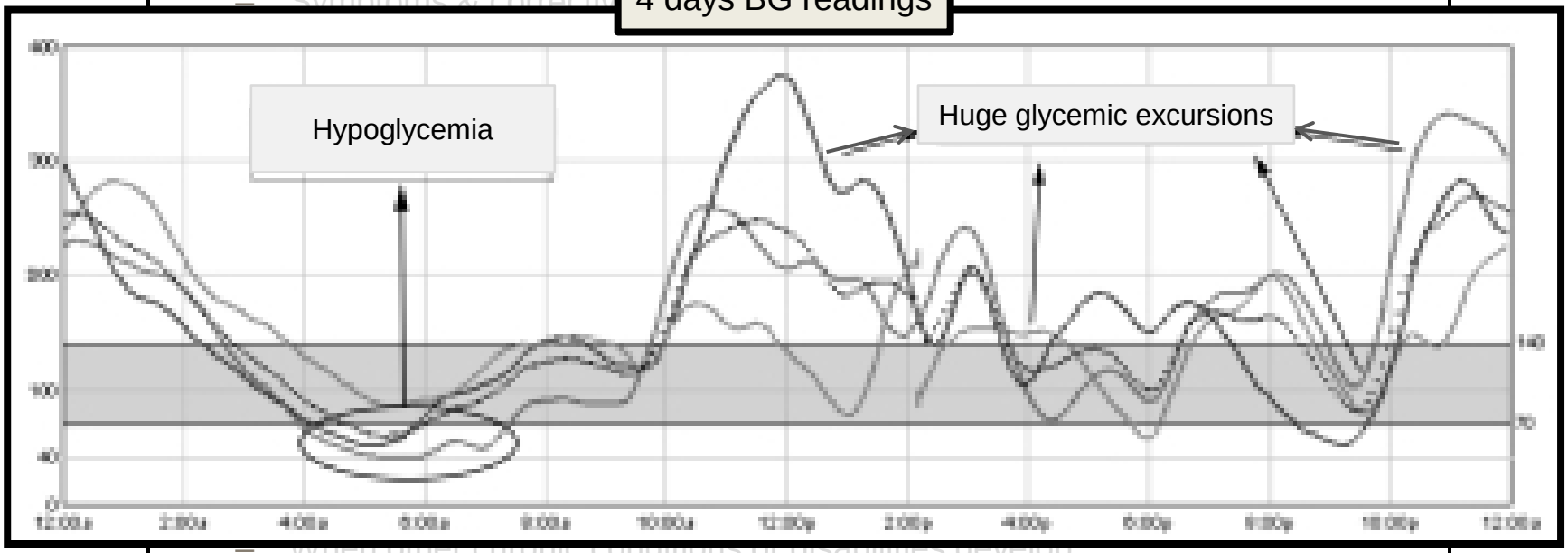
Sample patient's operational challenge

Goal: Maintain blood glucose within normal limits

Learn about diabetes in general (At "entry')

- Physiological process
- Interdependence of diet, exercise, meds
- Symptoms & corrective

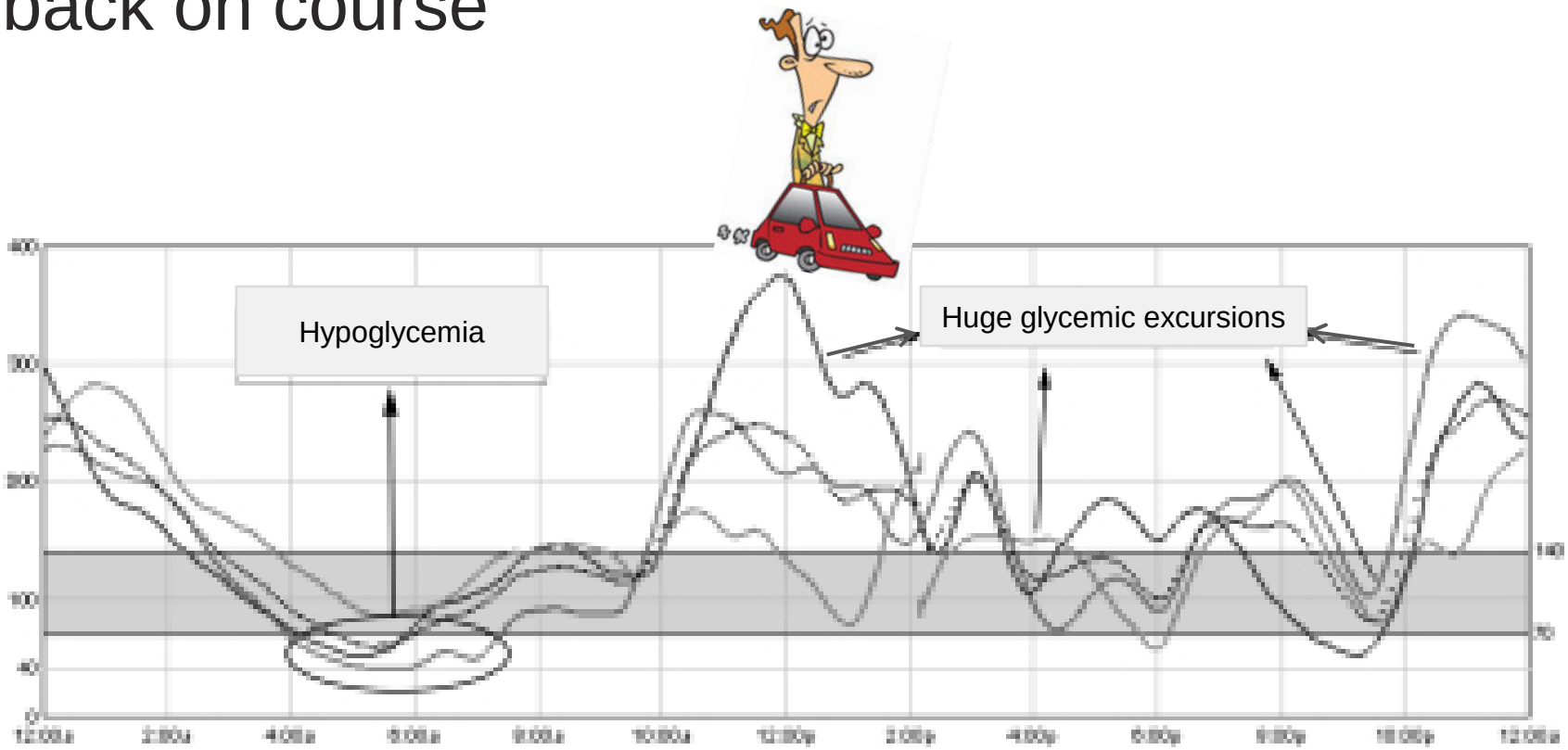
4 days BG readings



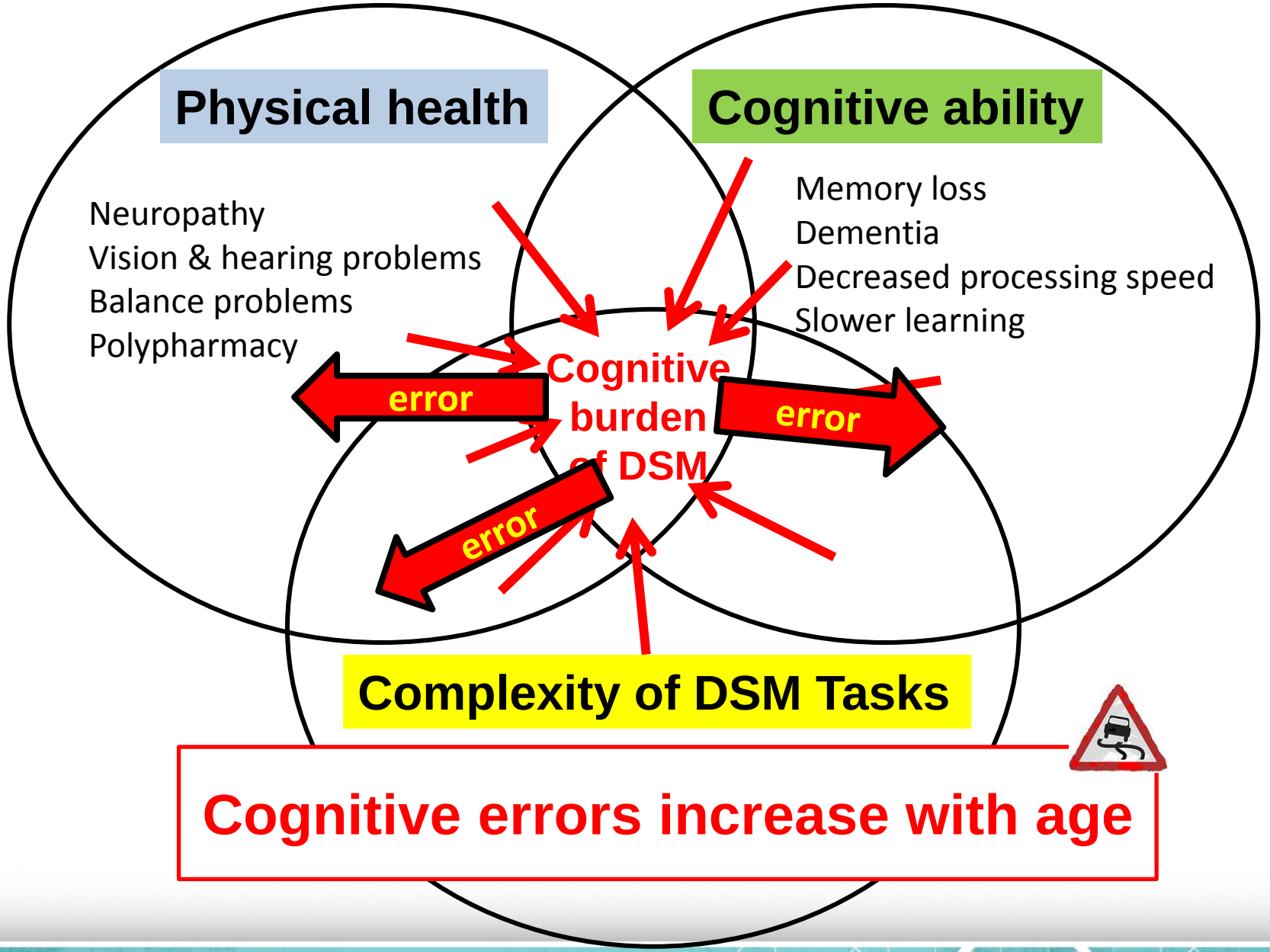
- When other chronic conditions or disabilities develop
- When new treatments are ordered
- When life circumstances change

Conditions of work—24/7, no days off, no retirement

Must prevent being knocked off course—or get back on course



- Preventing/minimizing excursions is *cognitive* process
- 24/7 job for patient



Cognitive errors increase with age

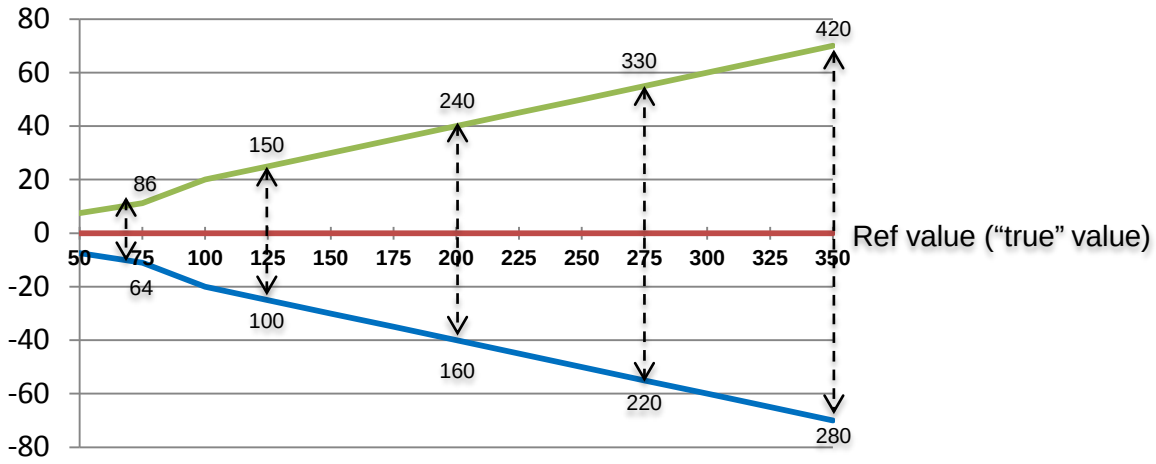
Psychometrics and DSM

1. Device error (test accuracy)
2. Person error (cognitive mistakes)
3. Task demands (cognitive burden)
4. Compounding of device & person errors
5. Criticality of errors

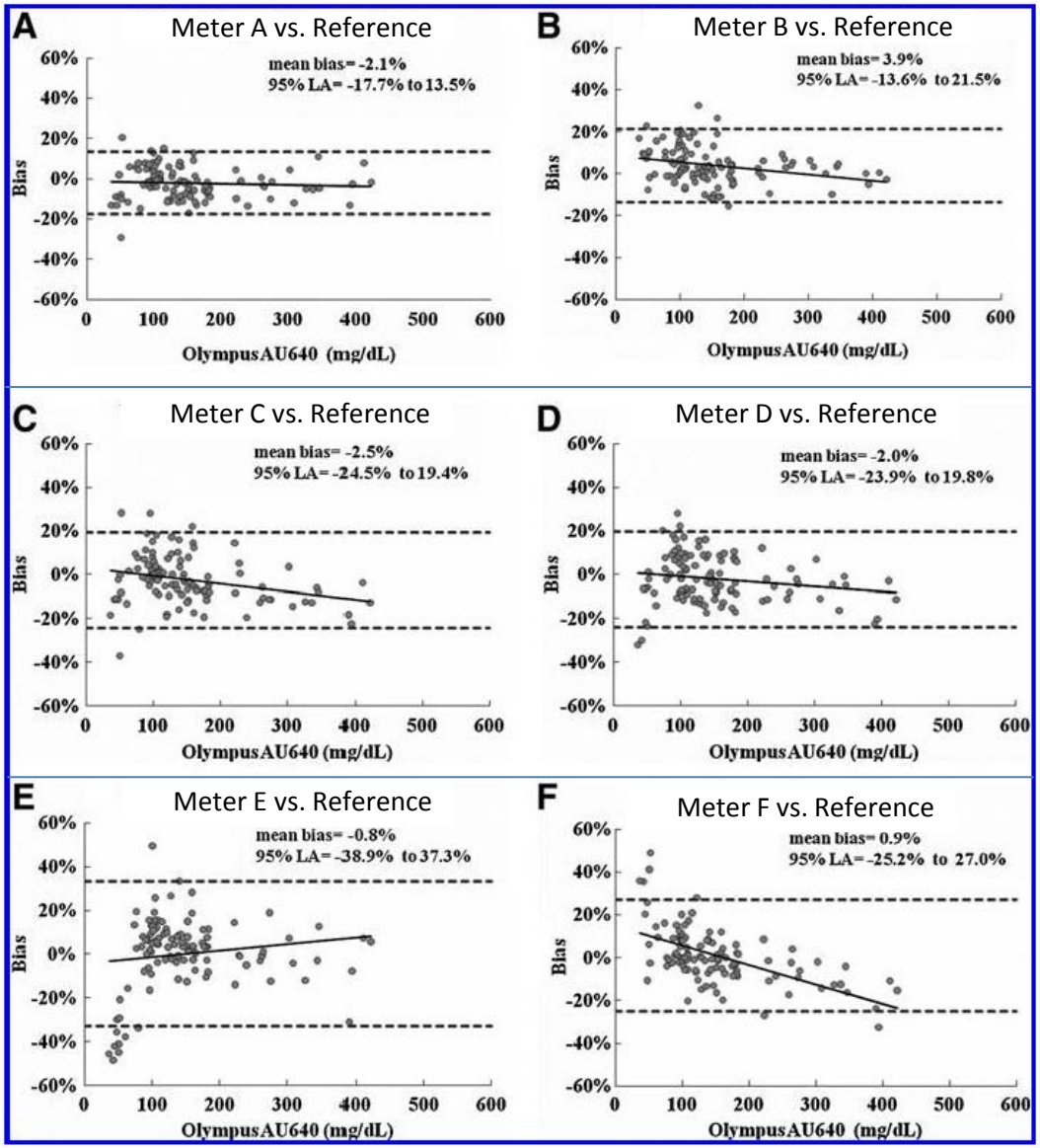
FDA standards for BG monitor accuracy

- Current FDA standards

  ≥95% of meter readings within 20% of lab reference value (within 15% for BG <75)



Sample results on BG meter accuracy



All evaluated under controlled conditions

Accuracy profiles differ

Kuo et al. (2011). Accuracy of 7 meters.

Under controlled conditions

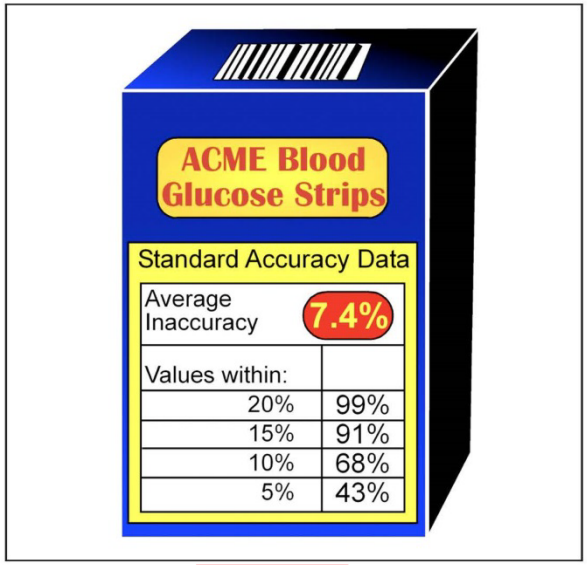


Figure 4. Example of a hypothetical label for blood glucose strips that would give meaningful data about the accuracy of the system and allow consumers to compare the value of systems.

But patients don't live in controlled conditions

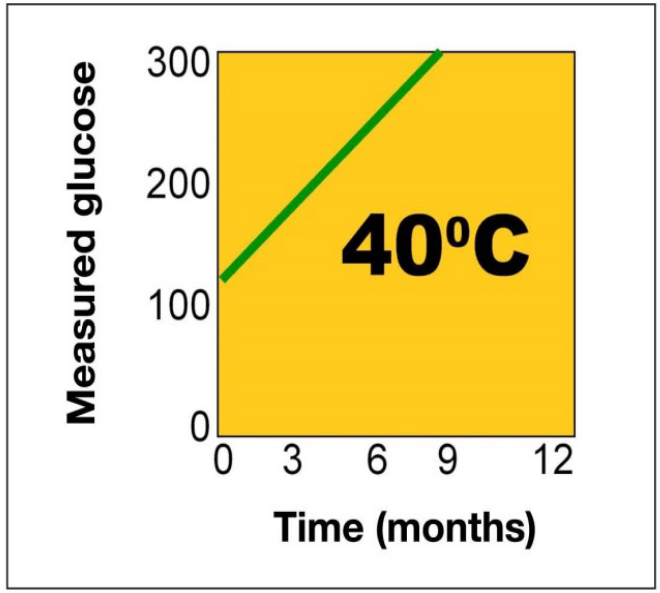


Figure 7. Effect of temperature on strip accuracy. Glucose strips are fragile and must be stored for limited time under specific conditions. Shown here is the effect of storing strips at 40 °C (104° Fahrenheit) for an extended time.

Source: pp. 905, 906 in Ginsberg, B. H. (2009). Factors affecting blood glucose monitoring: Sources of errors in measurement. *Journal of Diabetes Science and Technology*, *3*(4), 903-913.

Psychometrics and DSM

1. Device error (test accuracy)
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User errors can degrade BG readings

(effect electrochemical reactions in monitor)

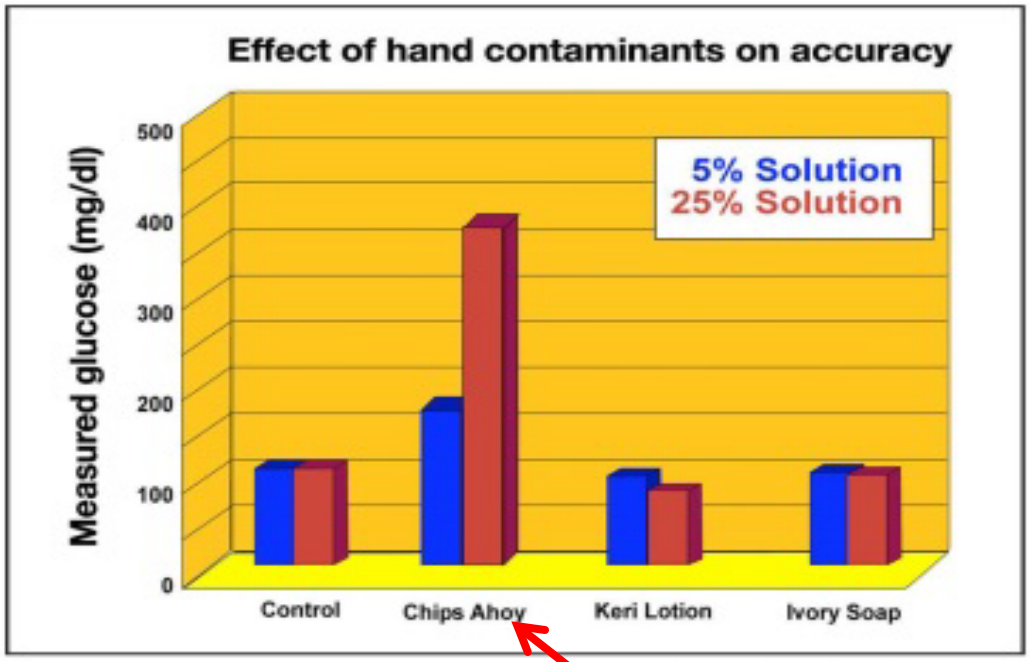


Figure 15. Sugary substances such as cookies (Chips Ahoy) raised glucose readings substantially. Lotions had only a minor effect and soap had almost none.

Source: p. 910 in Ginsberg, B. H. (2009). Factors affecting blood glucose monitoring: Sources of errors in measurement. *Journal of Diabetes Science and Technology*, *3*(4), 903-913

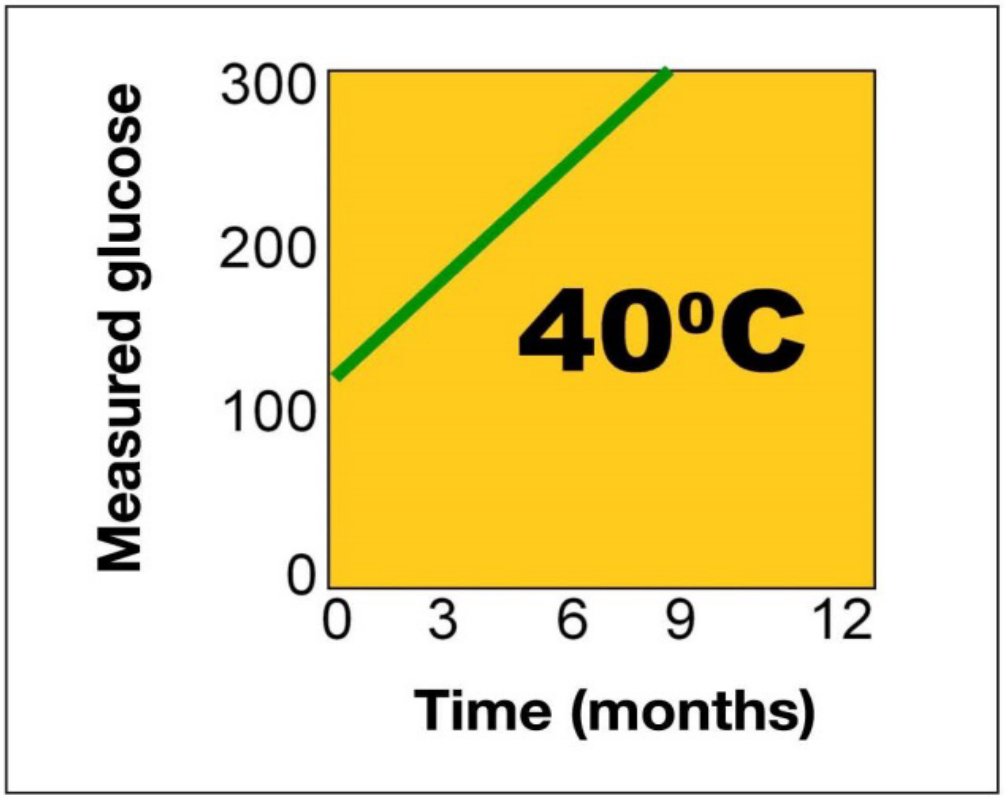


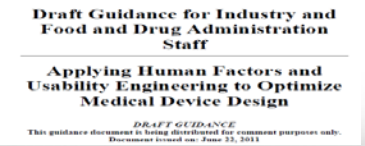
Figure 7. Effect of temperature on strip accuracy. Glucose strips are fragile and must be stored for limited time under specific conditions. Shown here is the effect of storing strips at 40 °C (104° Fahrenheit) for an extended time.

Factors that affect patient's use of devices

The ability of a user to operate a medical device depends on his or her personal characteristics, including:

- Physical size, strength, and stamina,
- Physical dexterity, flexibility, and coordination,
- Sensory abilities (i.e., vision, hearing, tactile sensitivity),
- Cognitive abilities, including memory,
- Medical condition for which the device is being used,
- Comorbidities (i.e., multiple conditions or diseases),
- Literacy and language skills,
- General health status,
- Mental and emotional state,
- Level of education and health literacy relative to the medical condition involved,
- General knowledge of similar types of devices,
- Knowledge of and experience with the particular device,
- Ability to learn and adapt to a new device, and
- Willingness and motivation to use a new device.

THESE same factors affect the use of information


Draft Guidance for Industry and Food and Drug Administration Staff

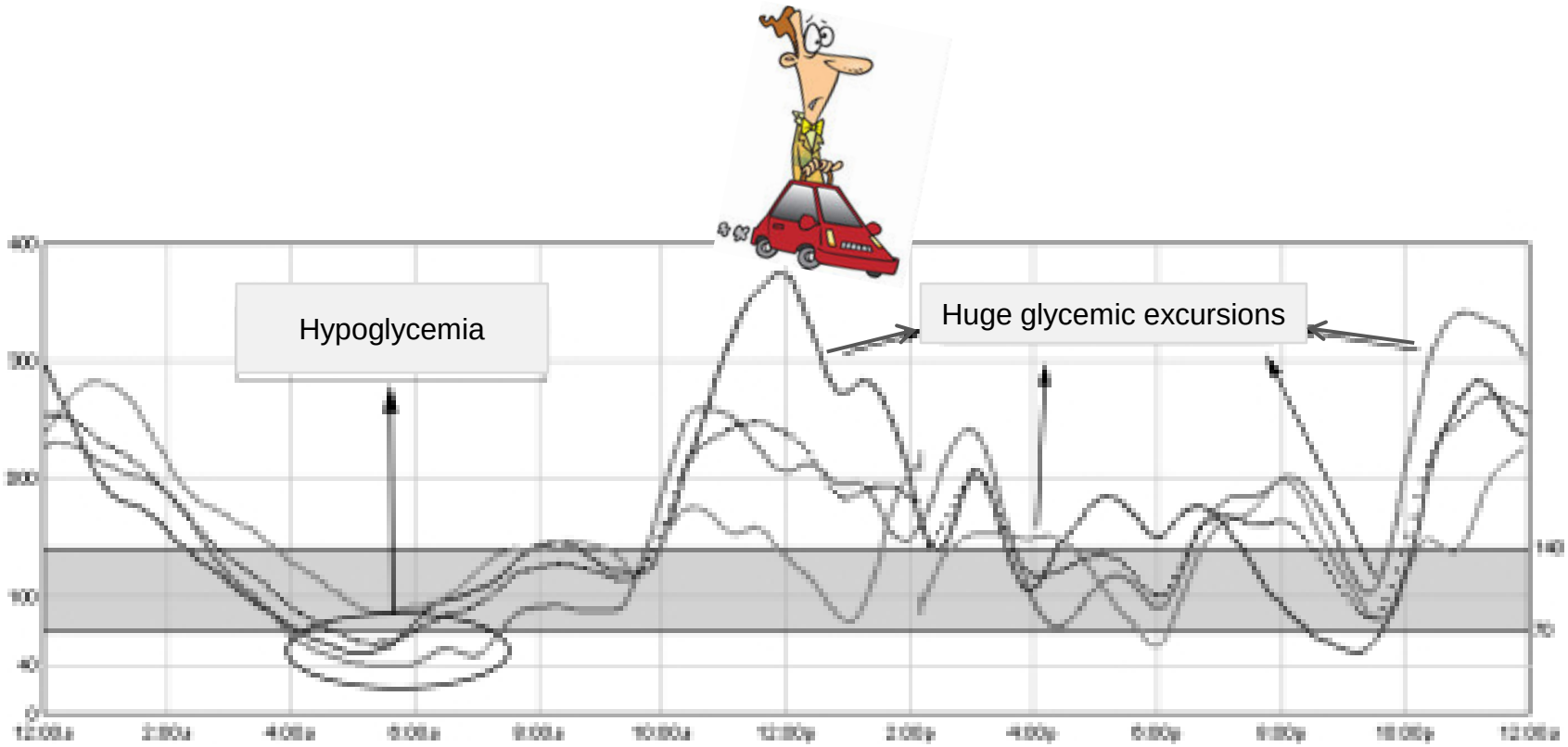
Applying Human Factors and Usability Engineering to Optimize Medical Device Design

DRAFT GUIDANCE

This guidance document is being distributed for comment purposes only.

Document issued on: June 22, 2011

Patients must act to keep BG within healthy limits



- Preventing/minimizing excursions is *cognitive* process
- Spotting hazards  is *cognitive* process
- 24/7 job for patient

Psychometrics and DSM

1. Device error (test accuracy)
2. Person error (cognitive mistakes)
3. Task demands (cognitive burden)
4. Compounding of device & person errors
5. Criticality of errors

Complexity invites error in using devices

Figure 2. Use-Related Hazards, Device Failure Hazards, and Their Intersection.

Use-related hazards occur for one or more of the following reasons:

- Device use requires physical, perceptual, or cognitive abilities that exceed the abilities of the user;
- The use environment affects operation of the device and this effect is not recognized or understood by the user;
- The particular use environment impairs the user's physical, perceptual, or cognitive capabilities when using the device to an extent that negatively affects the user's interactions with the device;
- Device use is inconsistent with user's expectations or intuition about device operation;
- Devices are used in ways that were not anticipated; or
- Devices are used in ways that were anticipated but inappropriate and for which adequate controls were not applied.

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COMPLEXITY ALSO INVITES ERROR IN USING information

Cognitive complexity

invites error in using

device/information,

such as

meters, food labels,

insulin, Rx

Patient's interface with label—cognitively complex

Macaroni and Cheese

Nutrition Facts

Serving Size 1 cup (228g)
Servings Per Container 2

Amount Per Serving

Calories 250	Calories from Fat 110
	% Daily Value*
Total Fat 12g	**18%**
Saturated Fat 3g	**15%**
Cholesterol 30mg	**10%**
Sodium 470mg	**20%**
Total Carbohydrate 31g	**10%**
Dietary Fiber 0g	**0%**
Sugars 5g	
Protein 5g	
Vitamin A	**4%**
Vitamin C	**2%**
Calcium	**20%**
Iron	**4%**

* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	60g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Psychometrics and DSM

1. Device error (test accuracy)
2. Person error (cognitive mistakes)
3. Task demands (cognitive burden)
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CORE TASKS IN DIABETES SELF-CARE
EAT HEALTHY DIET
Eat correct serving sizes
Identify foods with carbs
Eat on schedule
GET EXERCISE
Recognize signs when to stop
Exercise correct amount
Time exercise relative to food, meds
MONITOR BLOOD SUGAR
Recognize when sugar too high or low
Use correct testing technique
Monitor blood sugar on schedule
USE MEDICATION CORRECTLY
Take meds in correct amount and time
Identify meds that raise blood sugar
Respond correctly when dose delayed
SPOT & SOLVE PROBLEMS
Take correct action with sugar too low
Follow sick day rules
Plan for disruptions in routine
REDUCE RISKS
Call doctor if sugar persistently high
Inspect feet daily for sores
Schedule required eye & dental exams
ADAPT SELF OR SITUATION
Identify barriers to effective self-care
Identify stressors that raise blood sugar
Recognize signs of depression
IF TAKING INSULIN
Time meals & exercise relative to insulin
Use correct technique when using insulin
Adjust units of insulin as needed

Cognitive complexity

Cognitive interferences (drains)

Cognitive overload

All increase cognitive load

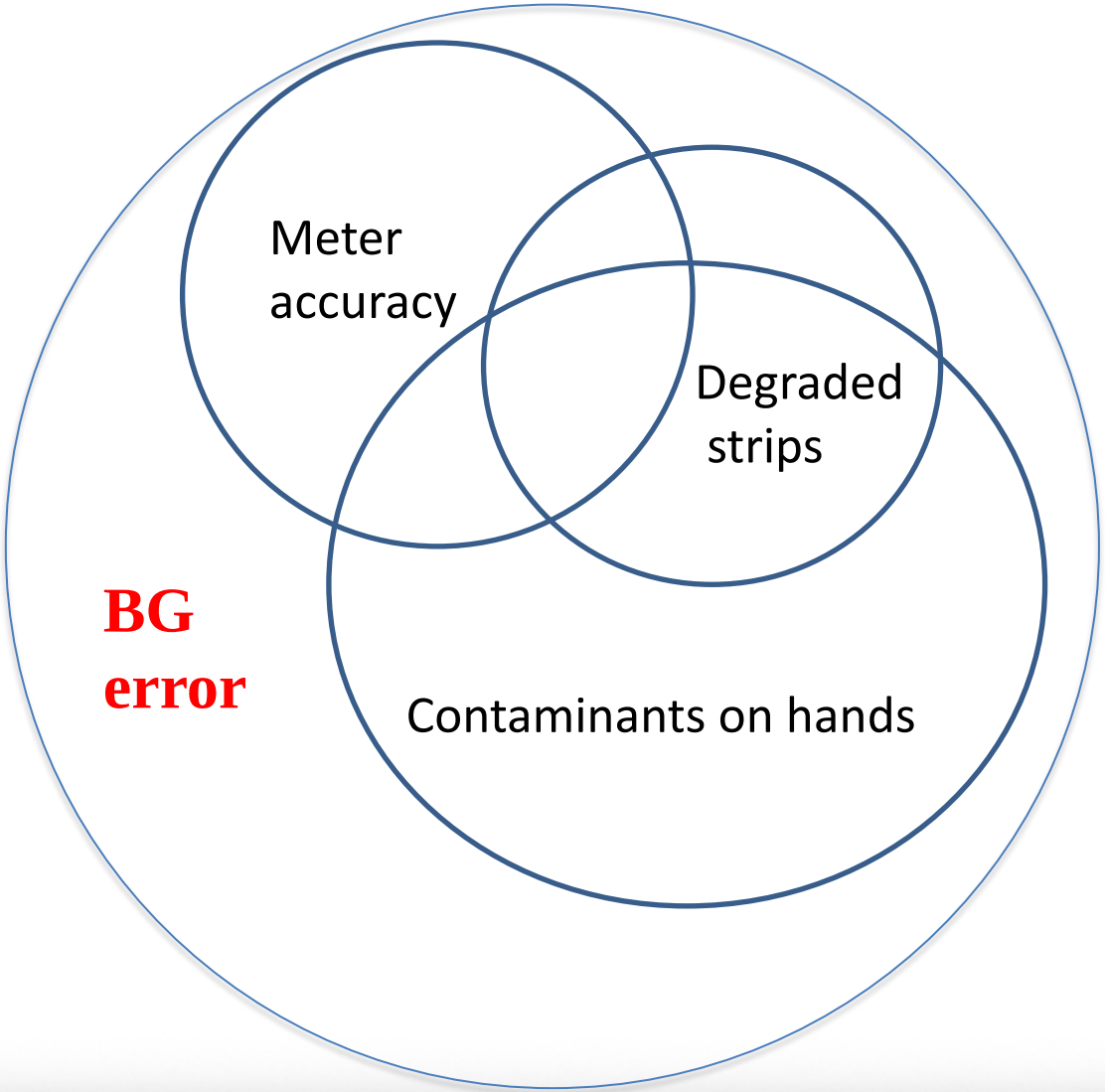
Core tasks:

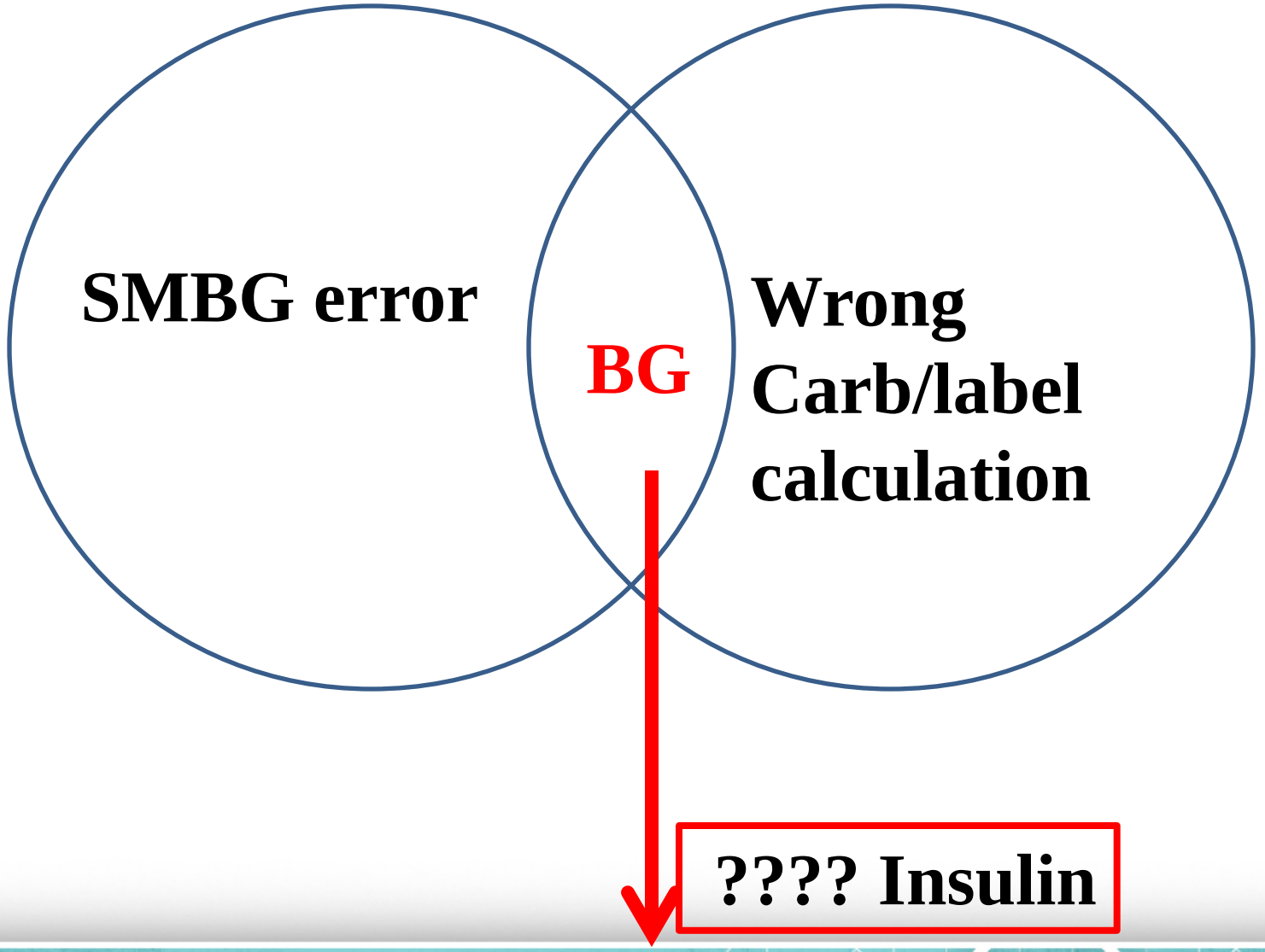
- Interdependence
- Multi-step
- Must extinguish old habits
- "If-then" decisions

Work conditions:

- Time pressure
- Distractions
- Unpredictability
- Interruptions

Intersecting hazards *magnify* (not just add to) BG error




SMBG error
BG
Wrong Carb/label calculation
???? Insulin

Psychometrics and DSM

1. Device error (test accuracy)
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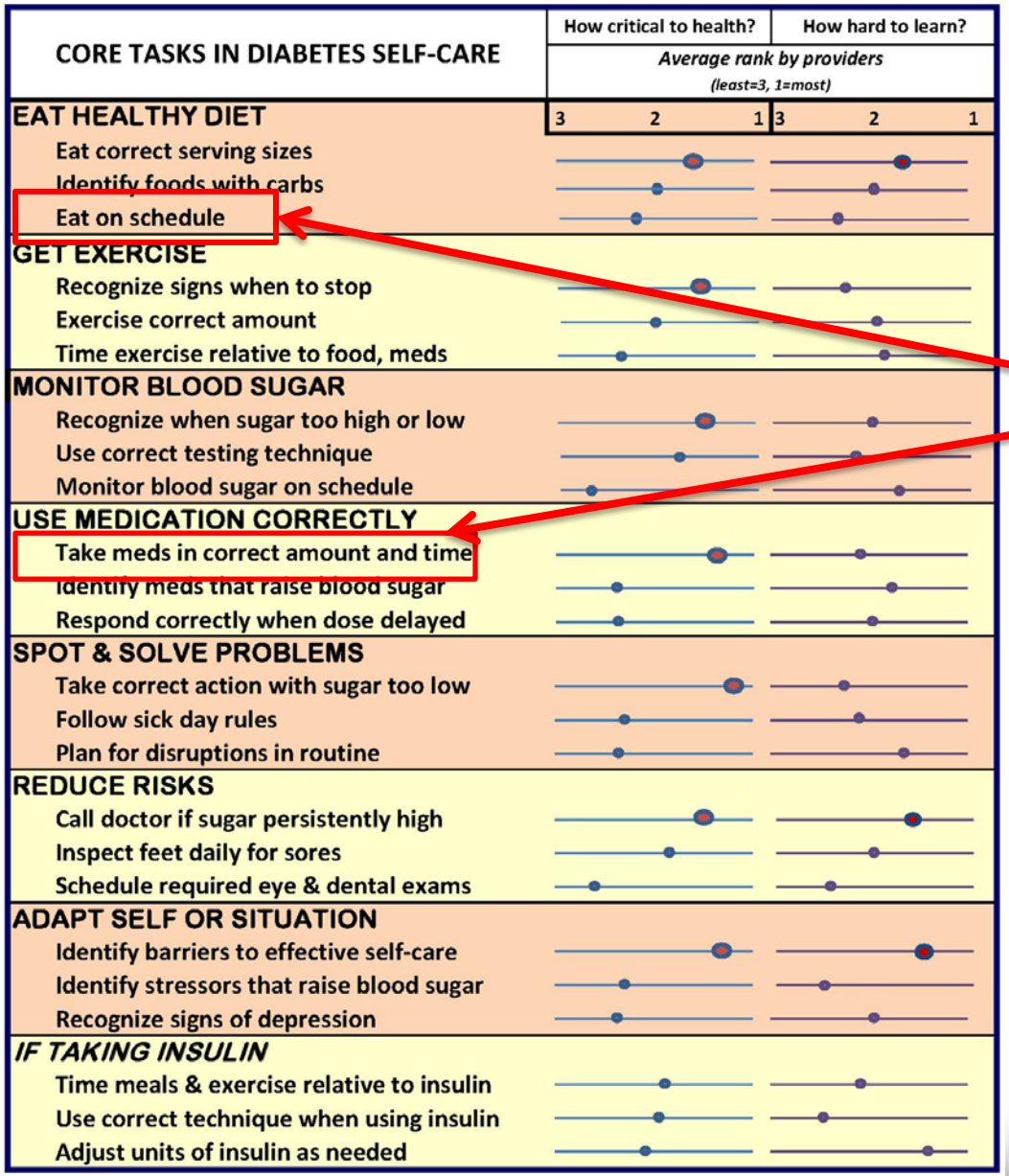
Critical Errors

And

Critical Incidents



From 30 diabetes health providers (MD, RN, RNP, RD, CDE, other)

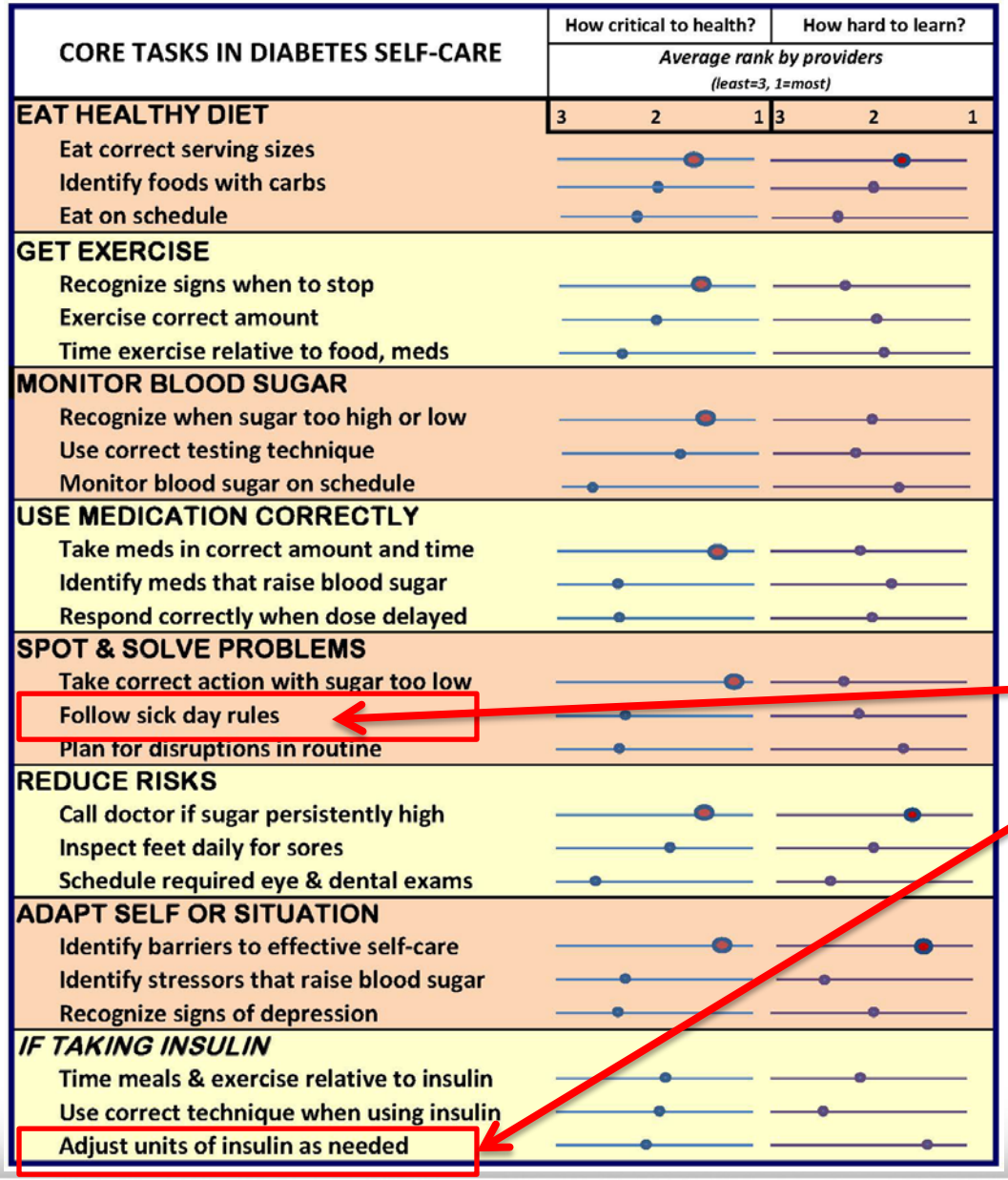
Survey reports of "critical incidents"

Took Rx on time:

- but delayed meal → hypoglycemia
- or ate only a salad

Critical Error:

Did not understand causal nexus:
food, Rx, blood sugar

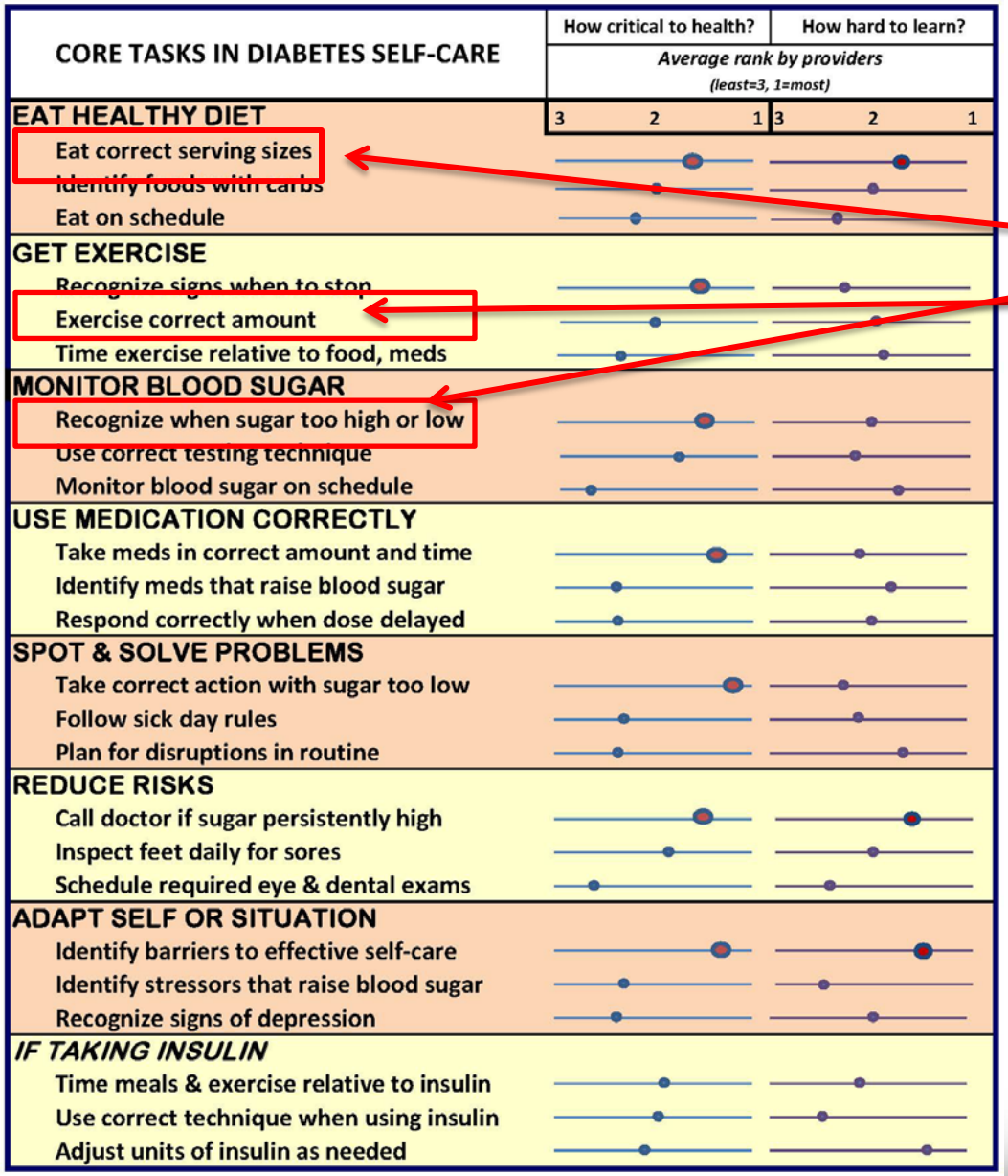


Sick, not eating/vomiting:

- no insulin or ➡ DKA
- took same dose risked hypo

Critical Error:
Did not shift rule when conditions changed

From 30 diabetes health providers (MD, RN, RNP, RD, CDE, other)



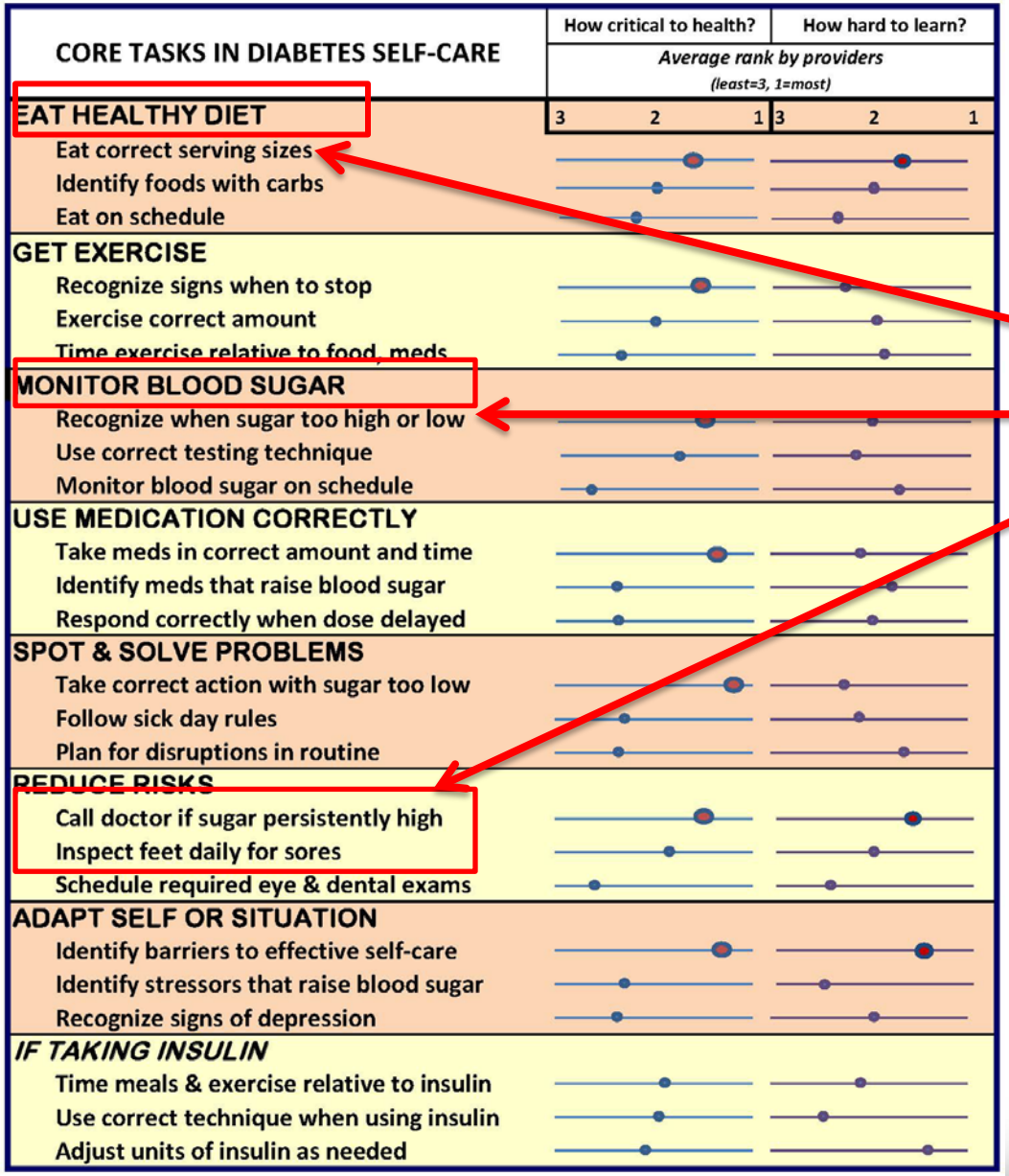
Eating to prevent hypoglycemia, not testing blood glucose, no physical activity:

- chronic high sugar ➡ Brain damage

Critical Error:

Could grasp only
one cause,
one effect,
one tactic at a time

From 30 diabetes health providers (MD, RN, RNP, RD, CDE, other)



Did not control diet
chronic high sugar
poor wound healing
Feared pain of treating
necrotic foot nearly lost foot

Critical Error:
One goal
(avoid immediate pain)
One tactic
(avoid medical treatment)

From 30 diabetes health providers (MD, RN, RNP, RD, CDE, other)

Teaching to reduce

critical errors

in DSM

Bloom's Taxonomy of Learning Objectives

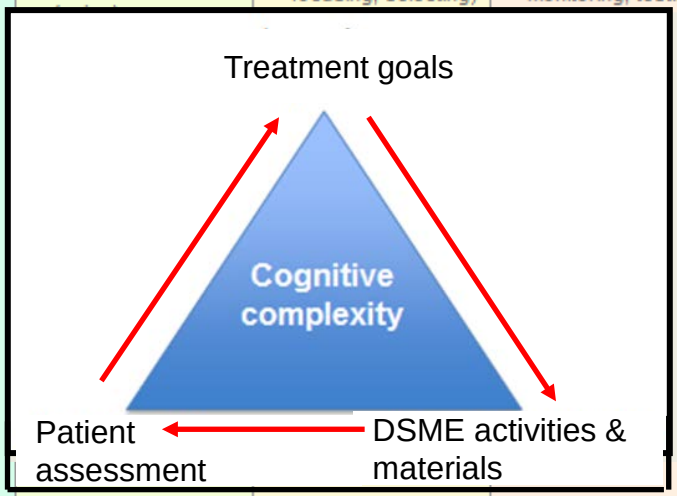
(2001 revision)

Bloom's levels = continuum of cognitive complexity

Table 1. The cognitive processes dimension — categories, cognitive processes (and alternative names)

lower order thinking skills → higher order thinking skills

remember	understand	apply	analyze	evaluate	create
recognizing (identifying) recalling (retrieving)	interpreting (clarifying, paraphrasing, representing, translating) exemplifying (illustrating, instantiating) classifying (categorizing, subsuming) summarizing (abstracting, generalizing) inferring (concluding, extrapolating, interpolating, predicting) comparing (contrasting, mapping, matching) explaining (constructing models)	executing (carrying out) implementing	differentiating (discriminating, distinguishing, focusing, selecting)	checking (coordinating, detecting, monitoring, testing)	generating (hypothesizing) planning (designing) producing (construct)



(Table 1 adapted from Anderson and Krathwohl, 2001, pp. 67–68.)

What are we asking the patient to do ???????

- Identify

Memorize

Recognize

Measure

Calculate

Repeat

- . Collect

Identify Pattern

Modify

Predict

Interpret

Distinguish

Compare

Cause/Effect

Make observations

- Use concepts to solve non-routine problems

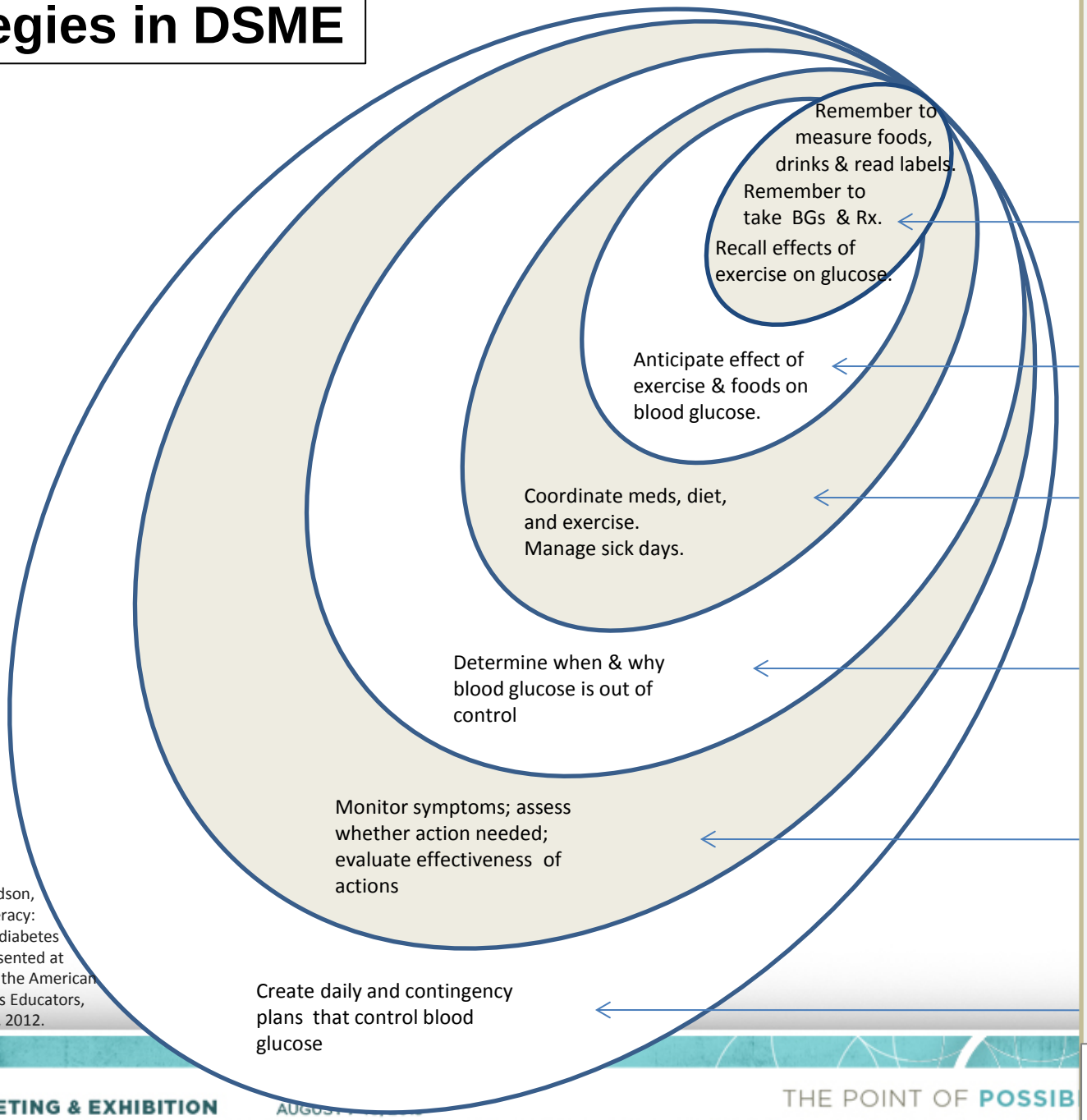
Draw conclusions

Connect

- Apply Concepts

Create

Strategies in DSME



Bloom's taxonomy of educational objectives (cognitive domain)*

Simplest tasks

1. **Remember**
   recognize, recall, Identify, retrieve
2. **Understand**
   paraphrase, summarize, compare, predict, infer
3. **Apply**
   execute familiar task,, apply procedure to unfamiliar task
4. **Analyze**
   distinguish, focus, select, integrate, coordinate
5. **Evaluate**
   check, monitor, detect inconsistencies, judge effectiveness
6. **Create**
   hypothesize, plan, invent, devise, design

Most complex tasks

*Revised 2001: Anderson, L. W., & Krathwohl,D. R. *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives.* NY: Addison Wesley Longman.

Bloom's Taxonomy is the basis

for effective DSME

with elderly patients,

because it focuses on

the *complexity of the learning.*

Psychometrics and DSM

1. Device error (test accuracy)
2. Person error (cognitive mistakes)
3. Task demands (cognitive burden)
4. Compounding of device/INFORMATION & person errors
5. Criticality of errors

Complexity invites error in using devices

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COMPLEXITY ALSO INVITES ERROR IN USING information

Changing doses can be confusing

Changing Doses Can Be Confusing

A woman with newly diagnosed type 2 diabetes mellitus and also on blood pressure and anti-lipid medication was given prescriptions for: glucophage 500mg QD for one week, and then an increase to two 500mg tablets the second week.

On her return appointment, diabetes education was prescribed and the patient was instructed to continue on her other medications. During a review of her treatment regimen during the fourth week after the initial prescription, the patient reported having gastrointestinal side effects.

After questioning the patient further and digging a little deeper, the medical staff discovered that she was taking two 500mg glucophage at bedtime just once weekly.

Switching her schedule to one 500mg tablet before breakfast and dinner cut down on the side effects and improved the blood glucose control by the time she returned for more education three weeks later.

Lesson Learned:

Following up with patients whenever there is a change of medication or dosage can help prevent medication errors.

Martha Mendez, RN, MSN, CCRC

Complexity of task/opportunity for error:

Patient must recognize that this is an **addition** to the Rx schedule.
Inference was assumed.
Patient had "literal thinking".

DSME:

Remember to clarify "Addition"
Explicit instructions about what to remember.
Do not assume that patient can infer new Rx schedule.
Confirm instructions.

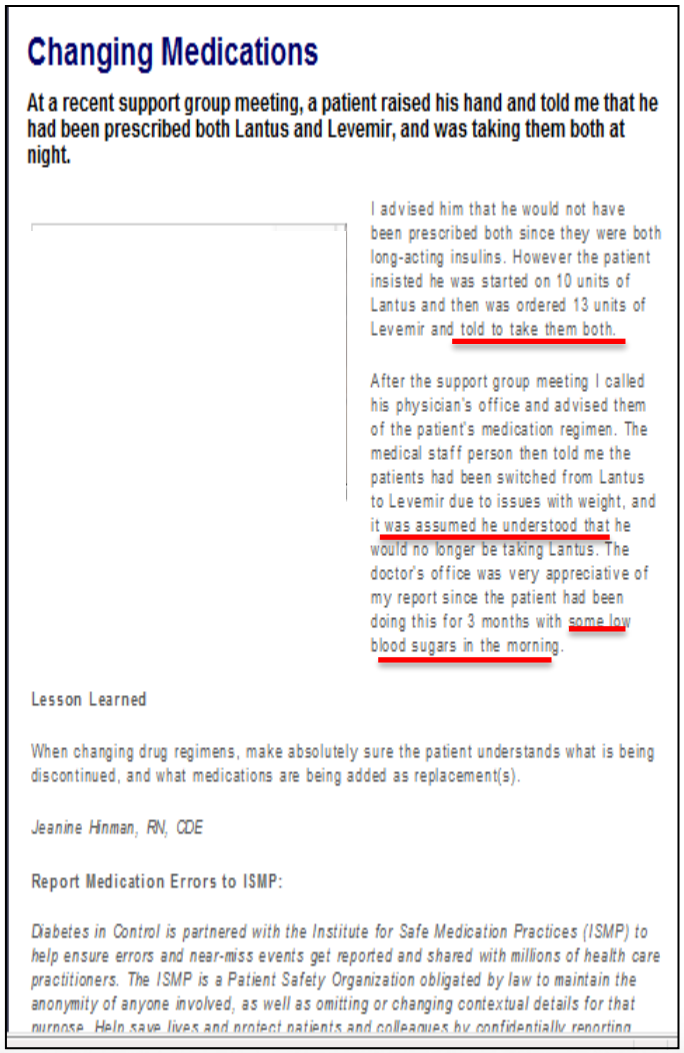
Source of error:

Person error (cognitive mistakes)
Task demands (cognitive burden

DIABETES IN CONTROL.COM
News and Information for Medical Professionals

Diabetes Disaster Averted series:
http://www.diabetesincontrol.com/articles/practicum

Changing insulins – 2 long-acting



Changing Medications

At a recent support group meeting, a patient raised his hand and told me that he had been prescribed both Lantus and Levemir, and was taking them both at night.

I advised him that he would not have been prescribed both since they were both long-acting insulins. However the patient insisted he was started on 10 units of Lantus and then was ordered 13 units of Levemir and told to take them both.

After the support group meeting I called his physician's office and advised them of the patient's medication regimen. The medical staff person then told me the patients had been switched from Lantus to Levemir due to issues with weight, and it was assumed he understood that he would no longer be taking Lantus. The doctor's office was very appreciative of my report since the patient had been doing this for 3 months with some low blood sugars in the morning.

Lesson Learned

When changing drug regimens, make absolutely sure the patient understands what is being discontinued, and what medications are being added as replacement(s).

Jeanine Hinman, RN, CDE

Report Medication Errors to ISMP:

Diabetes in Control is partnered with the Institute for Safe Medication Practices (ISMP) to help ensure errors and near-miss events get reported and shared with millions of health care practitioners. The ISMP is a Patient Safety Organization obligated by law to maintain the anonymity of anyone involved, as well as omitting or changing contextual details for that purpose. Help save lives and protect patients and colleagues by confidentially reporting

<u>Complexity of task/opportunity for error:</u>

Patient did not recognize that the change
in Rx = subtract 1 Rx,
add different Rx.
Inference assumed.

DSME: Patient understands types of insulin.
Stop current insulin.
Start different insulin.
Assess hearing loss.

Do not assume that patient can infer changed Rx.

Source of error:
Person error (cognitive mistakes)
Task demands (cognitive burden)

Substituting

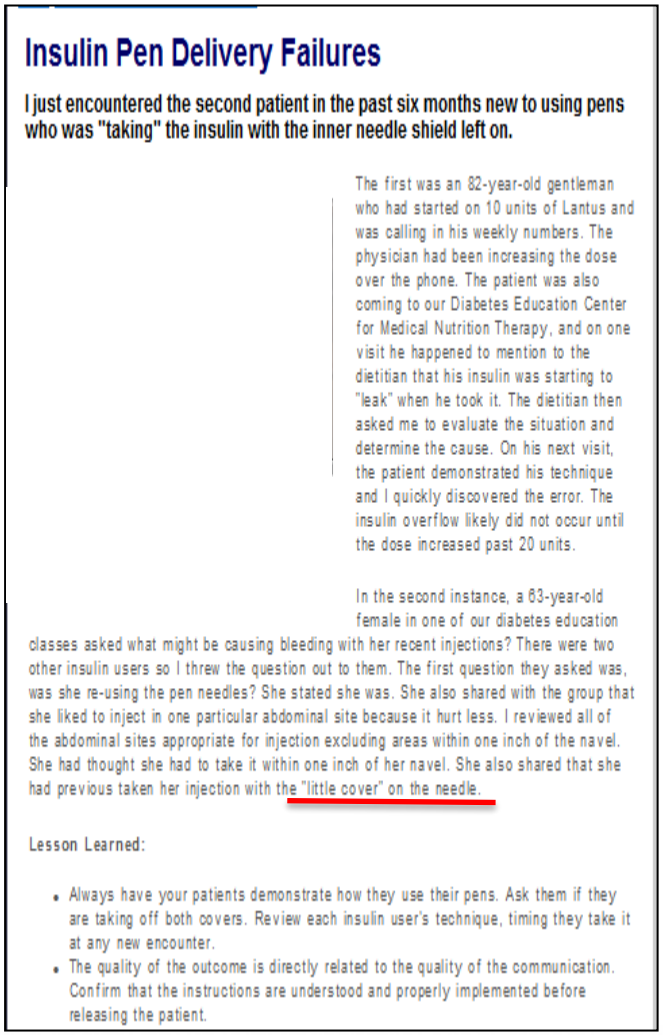
is more complex

than

adding or

subtracting something.

Insulin pen



Insulin Pen Delivery Failures

I just encountered the second patient in the past six months new to using pens who was "taking" the insulin with the inner needle shield left on.

The first was an 82-year-old gentleman who had started on 10 units of Lantus and was calling in his weekly numbers. The physician had been increasing the dose over the phone. The patient was also coming to our Diabetes Education Center for Medical Nutrition Therapy, and on one visit he happened to mention to the dietitian that his insulin was starting to "leak" when he took it. The dietitian then asked me to evaluate the situation and determine the cause. On his next visit, the patient demonstrated his technique and I quickly discovered the error. The insulin overflow likely did not occur until the dose increased past 20 units.

In the second instance, a 63-year-old female in one of our diabetes education classes asked what might be causing bleeding with her recent injections? There were two other insulin users so I threw the question out to them. The first question they asked was, was she re-using the pen needles? She stated she was. She also shared with the group that she liked to inject in one particular abdominal site because it hurt less. I reviewed all of the abdominal sites appropriate for injection excluding areas within one inch of the navel. She had thought she had to take it within one inch of her navel. She also shared that she had previous taken her injection with the "little cover" on the needle.

Lesson Learned:

- Always have your patients demonstrate how they use their pens. Ask them if they are taking off both covers. Review each insulin user's technique, timing they take it at any new encounter.
- The quality of the outcome is directly related to the quality of the communication. Confirm that the instructions are understood and properly implemented before releasing the patient.

<u>Complexity of task/opportunity for error:</u>

The device use is inconsistent with her expectations or intuition about device operation. (cf FDA list)

DSME: Assume that patient has preconceptions about insulin device.
Deconstruct steps for using pen.
Demonstrate use.

Source of error:
Person error (cognitive mistakes)
Task demands (cognitive burden)

.

These tasks were low complexity.

Cognitive complexity was minimal.

But

tasks were difficult for these patients,

because their

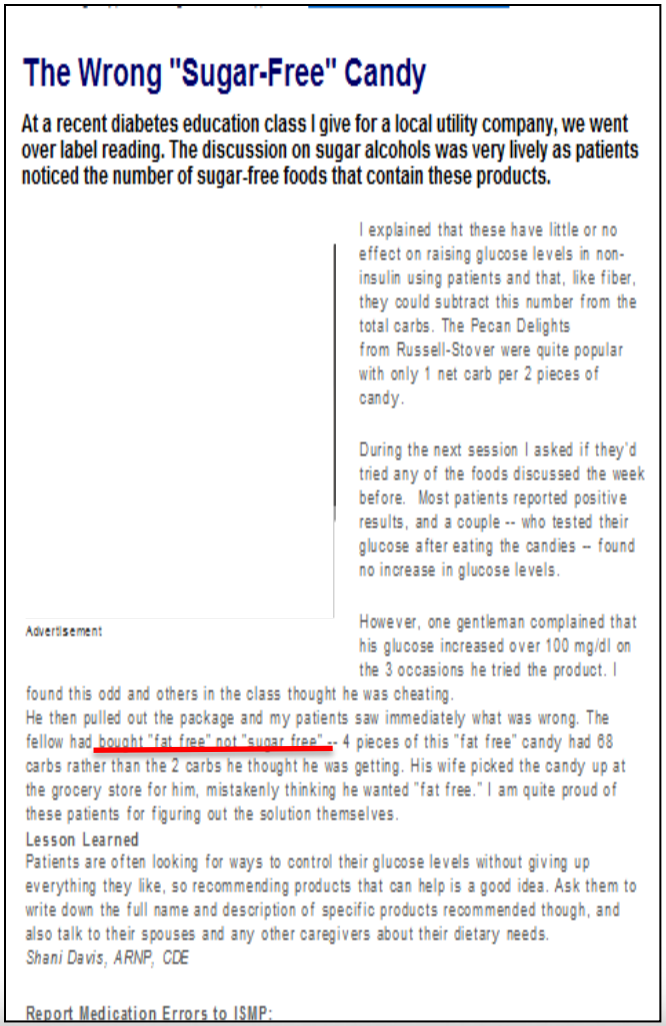
cognitive abilities were declining.

Typical literacy items, by difficulty level

National Adult Literacy Survey (NALS), 1993

NALS difficulty level (& scores)	% US adults (age 65+) peaking at this level	Simulated everyday tasks **Daily self-maintenance in modern literate societies**
5 **(375-500)**	3% ~0%	▪ Use calculator to determine cost of carpet for a room ▪ Use table of information to compare 2 credit cards
4 **(325-375)**	15% 4%	▪ Use eligibility pamphlet to calculate SSI benefits ▪ Explain difference between 2 types of employee benefits
3 **(275-325)**	31% 16%	▪ Calculate miles per gallon from mileage record chart ▪ Write brief letter explaining error on credit card bill
2 **(225-275)**	28% 33%	▪ Determine difference in price between 2 show tickets ▪ Locate intersection on street map
1 **(0-225)**	23% 47%	▪ Total bank deposit entry ▪ Locate expiration date on driver's license

Sugar-free candy



The Wrong "Sugar-Free" Candy

At a recent diabetes education class I give for a local utility company, we went over label reading. The discussion on sugar alcohols was very lively as patients noticed the number of sugar-free foods that contain these products.

I explained that these have little or no effect on raising glucose levels in non-insulin using patients and that, like fiber, they could subtract this number from the total carbs. The Pecan Delights from Russell-Stover were quite popular with only 1 net carb per 2 pieces of candy.

During the next session I asked if they'd tried any of the foods discussed the week before. Most patients reported positive results, and a couple -- who tested their glucose after eating the candies -- found no increase in glucose levels.

Advertisement

However, one gentleman complained that his glucose increased over 100 mg/dl on the 3 occasions he tried the product. I found this odd and others in the class thought he was cheating.

He then pulled out the package and my patients saw immediately what was wrong. The fellow had bought "fat free" not "sugar free" -- 4 pieces of this "fat free" candy had 68 carbs rather than the 2 carbs he thought he was getting. His wife picked the candy up at the grocery store for him, mistakenly thinking he wanted "fat free." I am quite proud of these patients for figuring out the solution themselves.

Lesson Learned

Patients are often looking for ways to control their glucose levels without giving up everything they like, so recommending products that can help is a good idea. Ask them to write down the full name and description of specific products recommended though, and also talk to their spouses and any other caregivers about their dietary needs.

Shani Davis, ARNP, CDE

Report Medication Errors to ISMP:

Complexity of task/opportunity for error:

Caregiver (wife) did not recognize the difference between sugar free & fat free.

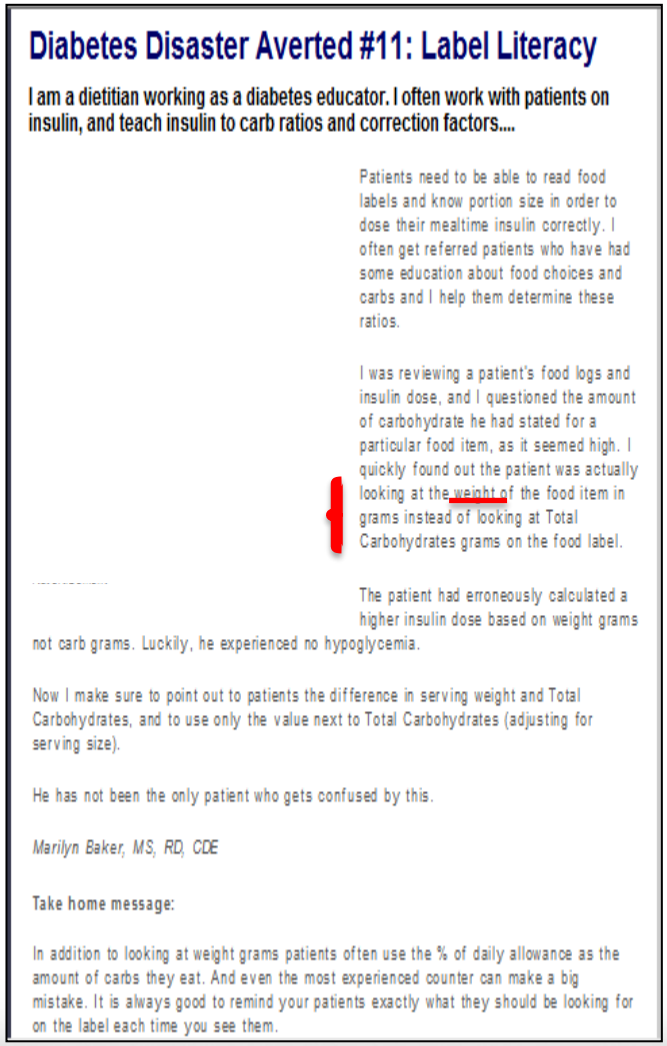
Patient did not examine label or did not recognize error.

Error was "contagious".

DSME: Deconstruct label.
Recognize that label is complex.
Review "Sugar-free" vs "Fat-free".
Include family in DSME.

Source of error:
Person error (cognitive mistakes)
Task demands (cognitive burden)
Compounding of device/information & person errors

Grams vs. grams on label



Diabetes Disaster Averted #11: Label Literacy

I am a dietitian working as a diabetes educator. I often work with patients on insulin, and teach insulin to carb ratios and correction factors....

Patients need to be able to read food labels and know portion size in order to dose their mealtime insulin correctly. I often get referred patients who have had some education about food choices and carbs and I help them determine these ratios.

I was reviewing a patient's food logs and insulin dose, and I questioned the amount of carbohydrate he had stated for a particular food item, as it seemed high. I quickly found out the patient was actually looking at the weight of the food item in grams instead of looking at Total Carbohydrates grams on the food label.

The patient had erroneously calculated a higher insulin dose based on weight grams not carb grams. Luckily, he experienced no hypoglycemia.

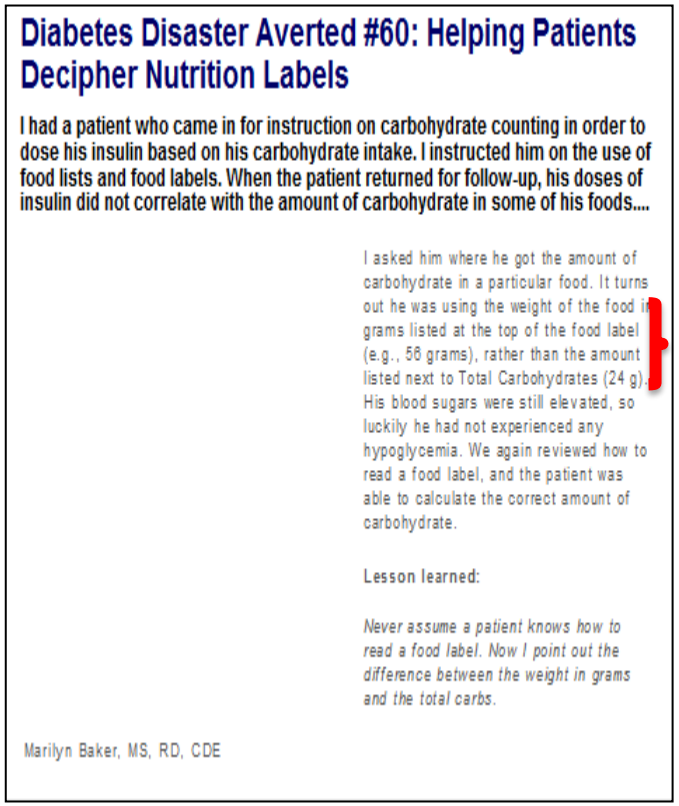
Now I make sure to point out to patients the difference in serving weight and Total Carbohydrates, and to use only the value next to Total Carbohydrates (adjusting for serving size).

He has not been the only patient who gets confused by this.

Marilyn Baker, MS, RD, CDE

Take home message:

In addition to looking at weight grams patients often use the % of daily allowance as the amount of carbs they eat. And even the most experienced counter can make a big mistake. It is always good to remind your patients exactly what they should be looking for on the label each time you see them.



Diabetes Disaster Averted #60: Helping Patients Decipher Nutrition Labels

I had a patient who came in for instruction on carbohydrate counting in order to dose his insulin based on his carbohydrate intake. I instructed him on the use of food lists and food labels. When the patient returned for follow-up, his doses of insulin did not correlate with the amount of carbohydrate in some of his foods....

I asked him where he got the amount of carbohydrate in a particular food. It turns out he was using the weight of the food in grams listed at the top of the food label (e.g., 56 grams), rather than the amount listed next to Total Carbohydrates (24 g). His blood sugars were still elevated, so luckily he had not experienced any hypoglycemia. We again reviewed how to read a food label, and the patient was able to calculate the correct amount of carbohydrate.

Lesson learned:

Never assume a patient knows how to read a food label. Now I point out the difference between the weight in grams and the total carbs.

Marilyn Baker, MS, RD, CDE

Grams vs. grams on label

Complexity of task/opportunity for error:

Patient did not recognize the correct location for CHO grams.
Label is inherently complex.

DSME: Identify correct location for CHO grams.
Differentiate weight in grams vs Total CHO.
Locate total CHO.

Do not assume that patient understands label !

Source of error:

Person error (cognitive mistakes)
Task demands (cognitive burden)
Compounding of device/information
& person errors.

Patient's interface with label—cognitively complex

Label ambiguities

invite

consequences/additional

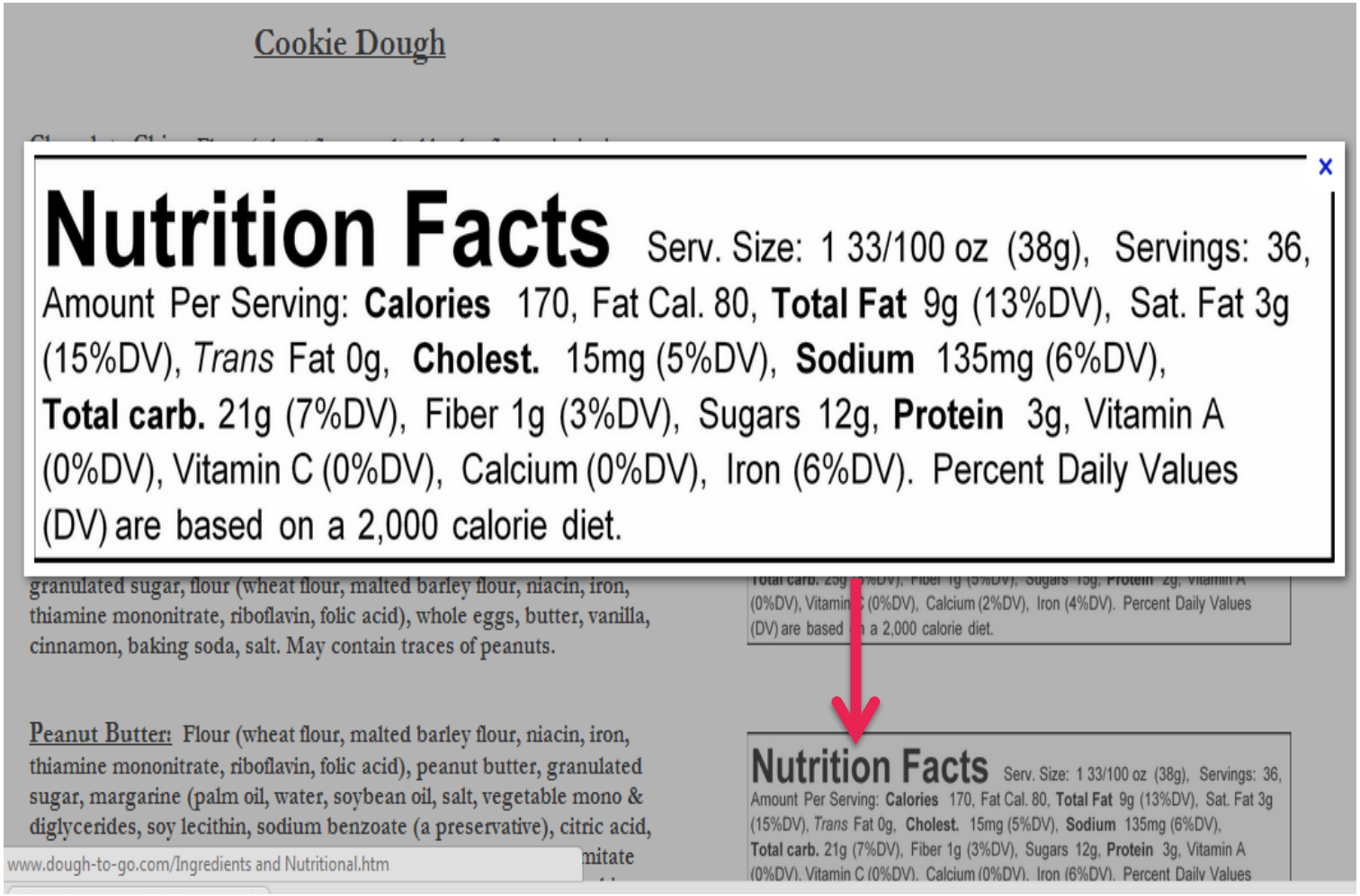
errors,

e.g. inaccurate

measuring,

Rx dose,

interpretation of BGs.



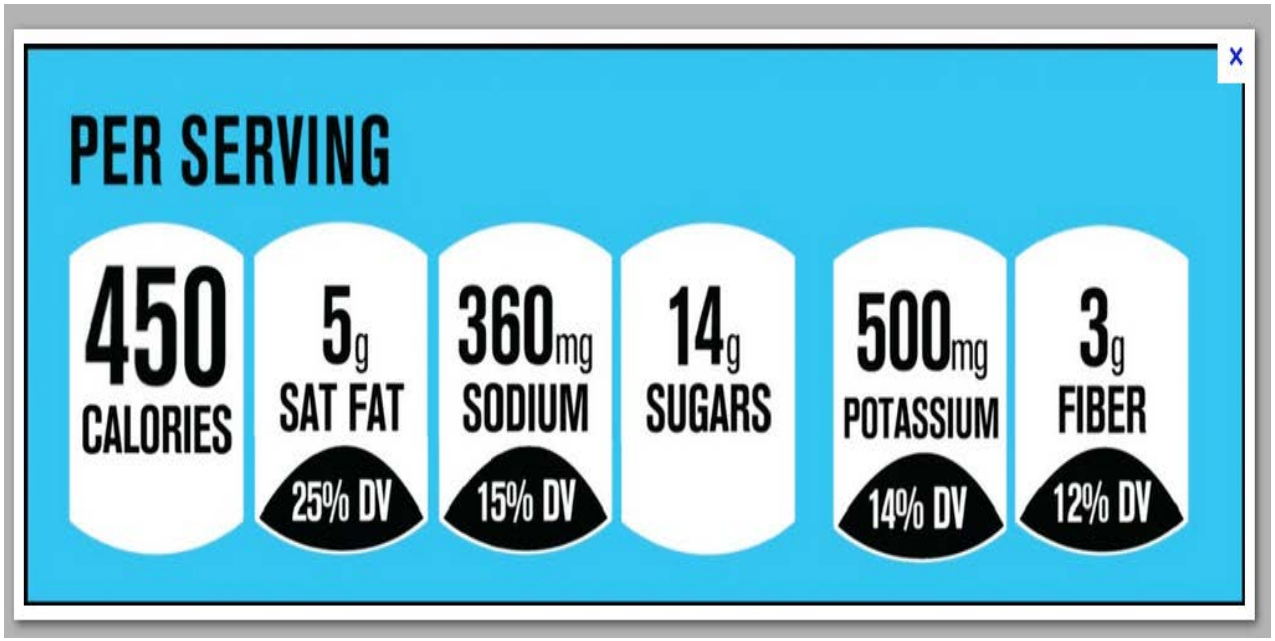
Opportunities for error:

Format = confusing display of information.

No clear distinction between items.

Opportunities for error:

Irrelevant information.



Opportunities for error:

Confusion between 2 locations for nutrition information.

Supplement Facts

Serving Size: 2 Tablespoons (12g) Servings Per Container: 37

Amount Per Serving		% DV
Calories 46	Calories from Fat 37	
Total Fat	4.14 g	6.4%
Polyunsaturated Fat	3.5 g	**
Trans Fat	0 g	**
Omega-3 Fatty Acids	2.74 g	**
Omega-6 Fatty Acids	0.76 g	**
Omega-9 Fatty Acids	0.25 g	**
Total Carbohydrate	4.5 g	1.8%
Dietary Fiber	4.14 g	17%
Soluble Fiber	0.42 g	**
Insoluble Fiber	3.7 g	**
Sugars	0 g	5.7%
Protein	2.54 g	
Thiamin	0.09 mg	1.3%
Riboflavin	0.02 mg	1.8%
Folate (folic acid)	12 mcg	3%
Calcium	92 mg	8.6%
Iron	0.95 mg	5.4%
Magnesium	46 mg	11%
Selenium	<0.01 mg	
Copper	0.2 mg	10%

Percent Daily Values are based on a 2,000 calorie diet.
**Daily Value not established.

Ingredients: Salvia Hispanica seed, hull
Suggested Use: 12 - 60 grams per day (2 - 8 tablespoons). *Purisalv* can be consumed in whole or ground form, or be topically added or mixed into any food or recipe. *Purisalv*'s neutral flavor and nutrient-rich qualities will enhance the nutritional value of your favorite meals without changing the taste

Better, but……..

Pros:

- Fewer items
- Single vertical list
- Major headings stand out

Macaroni and Cheese

Nutrition Facts

Serving Size 1 cup (228g)
Servings Per Container 2

Amount Per Serving

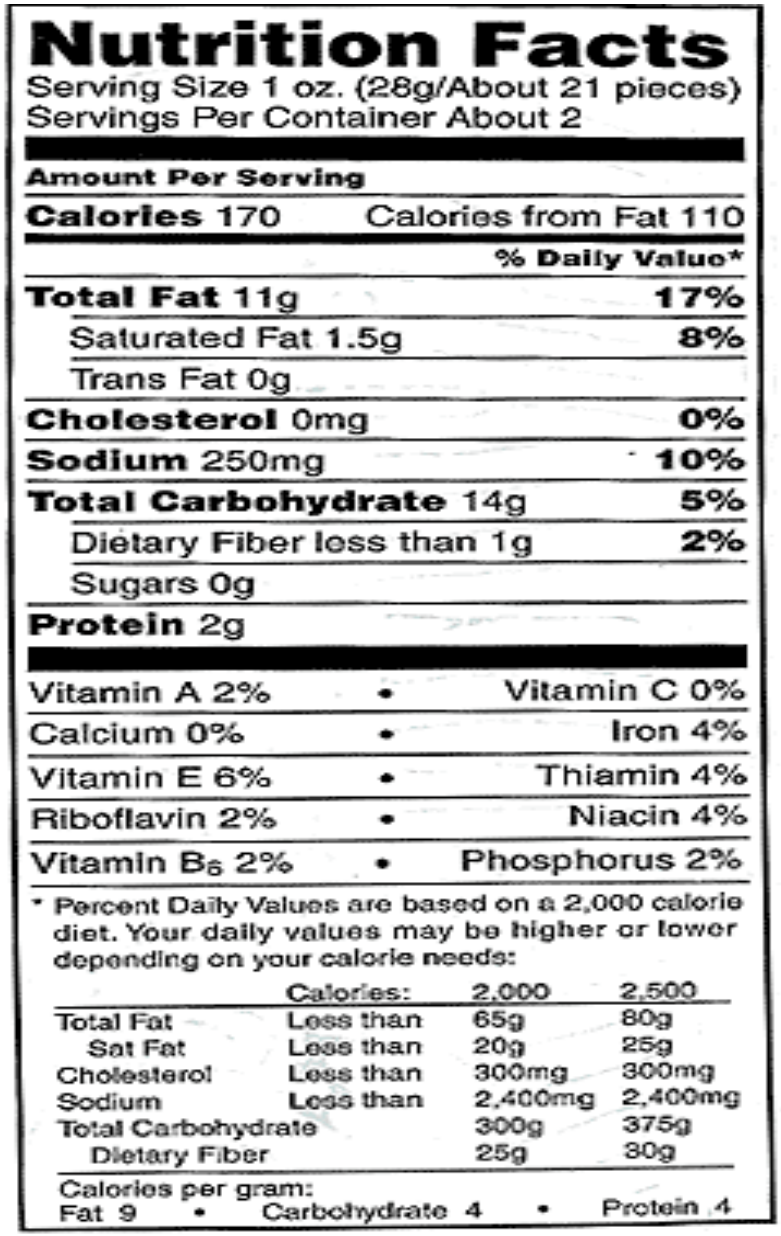
Calories 250	Calories from Fat 110
	% Daily Value*
Total Fat 12g	**18%**
Saturated Fat 3g	**15%**
Cholesterol 30mg	**10%**
Sodium 470mg	**20%**
Total Carbohydrate 31g	**10%**
Dietary Fiber 0g	**0%**
Sugars 5g	
Protein 5g	
Vitamin A	**4%**
Vitamin C	**2%**
Calcium	**20%**
Iron	**4%**

* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Cons:

- Lots of irrelevant info
- Seemingly inconsistent info



Nutrition Facts

Serving Size 1 oz. (28g/About 21 pieces)
Servings Per Container About 2

Amount Per Serving	
Calories 170	Calories from Fat 110
	% Daily Value*
Total Fat 11g	**17%**
Saturated Fat 1.5g	**8%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 250mg	**10%**
Total Carbohydrate 14g	**5%**
Dietary Fiber less than 1g	**2%**
Sugars 0g	
Protein 2g	

Vitamin A 2%	•	Vitamin C 0%
Calcium 0%	•	Iron 4%
Vitamin E 6%	•	Thiamin 4%
Riboflavin 2%	•	Niacin 4%
Vitamin B_6 2%	•	Phosphorus 2%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Bloom's taxonomy of educational objectives (cognitive domain)

Simplest tasks

1. **Remember**
   recognize, recall, Identify, retrieve
2. **Understand**
   paraphrase, summarize, compare, predict, infer,
3. **Apply**
   execute familiar task,, apply procedure to unfamiliar task
4. **Analyze**
   distinguish, focus, select, integrate, coordinate
5. **Evaluate**
   check, monitor, detect inconsistencies, judge effectiveness
6. **Create**
   hypothesize, plan, invent, devise, design

Most complex tasks

Location of relevant CHO gms

Carb vs non-carb ??
Sequence of label
Total CHOs = imp;
"Sugars" not = Total CHOs
Volume vs wt

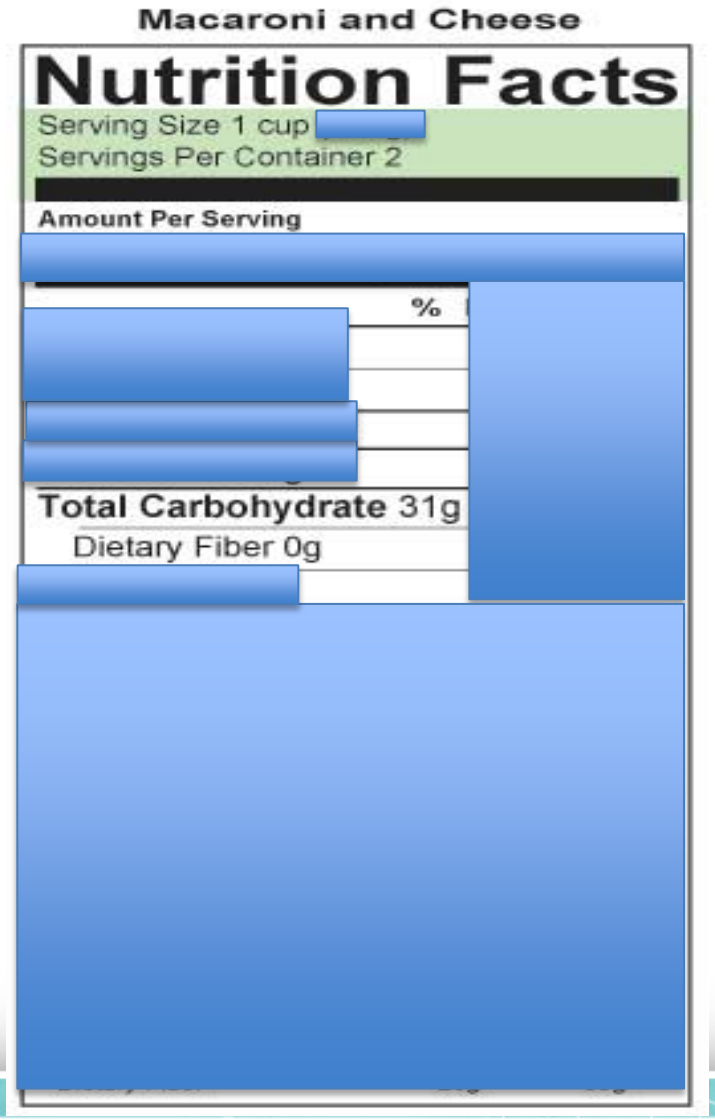
How many CHO gms in 1 serving ?
Subtract fiber gms from CHO gms

Distractors
CHOs vs Fiber vs Fat

Part of meal vs snack OK?
CHOs in intended serving ?
CHOs vs Fat/Chol vs Na

Plan a meal or snack

Food label revision…



DSME must include

cognitive accessibility of

information & materials.

Even if the DSM "job" did not get more complex,

cognitive decline makes it more difficult.

CDEs *recognize*

the cognitive

burdens of DSM,
especially in the elderly

and

instruct to

reduce those

burdens

Thank you.

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