



# Spearman and the Cognitive Ergonomics of Health Disparities

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# Today

- Spearman's  $g$  (people) Rejected
- Spearman's  $g$  loading (tasks) Neglected
- Diabetes epidemic (\$\$\$\$) Non-adherence
- Wishful thinking (them) Knowledge, not  $g$
- Realistic strategy (us) Diabetes a  $g$ -loaded job
- Pilot data

Cognitive ergonomics



Exploding health care costs



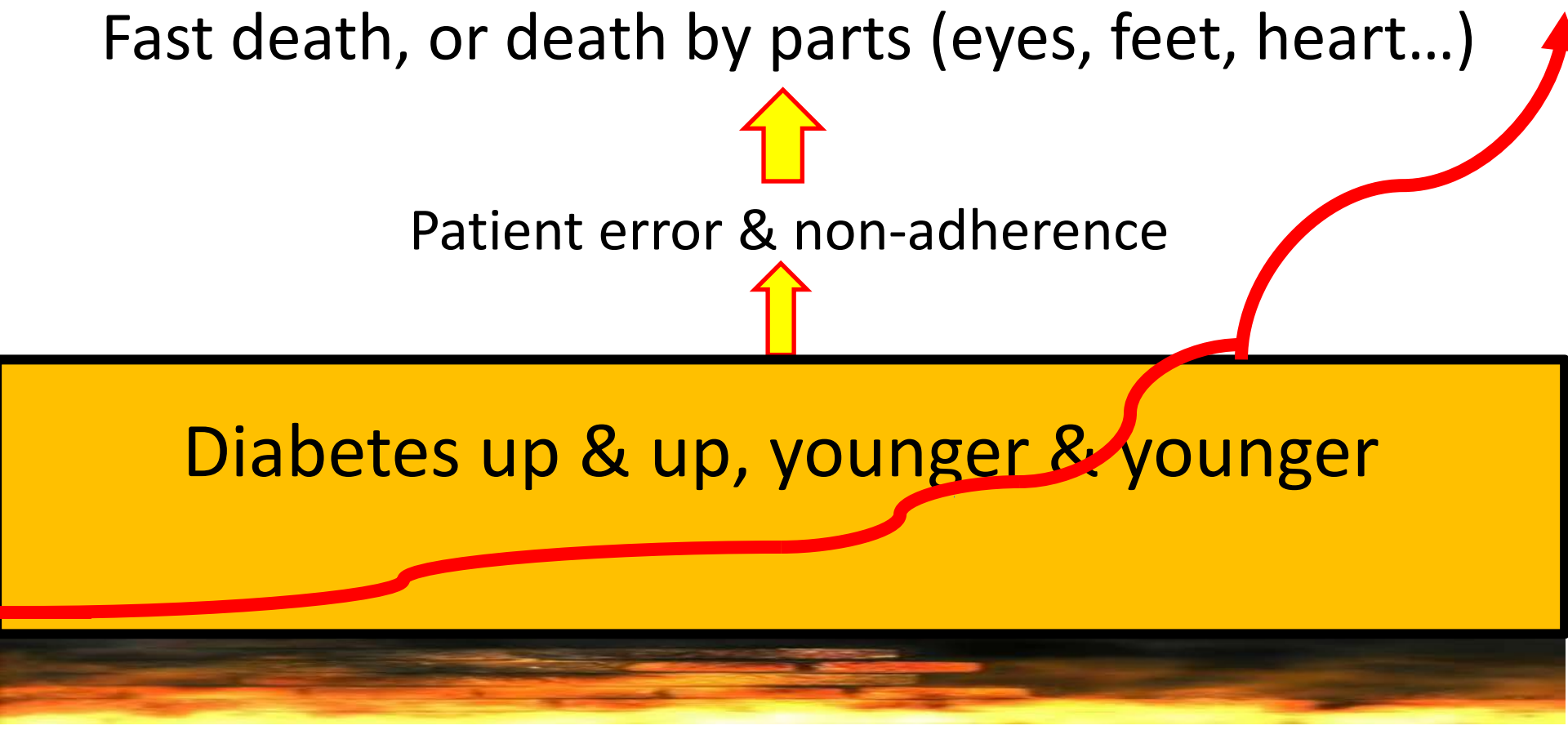
Fast death, or death by parts (eyes, feet, heart...)



Patient error & non-adherence

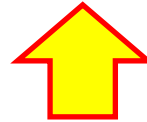


Diabetes up & up, younger & younger





Exploding health care costs



Fast death, or death by parts (eyes, feet, heart...)

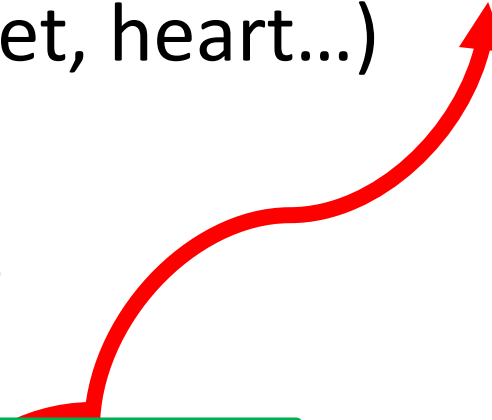


Patient error & non-adherence



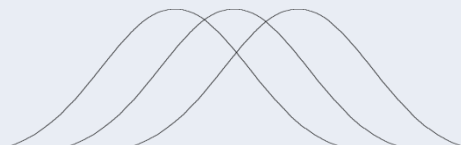
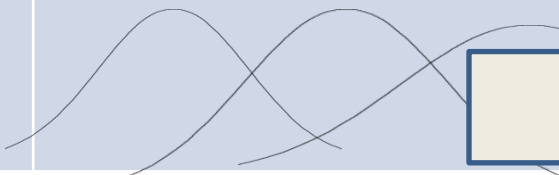


**Current health policy?**

Access to care + Motivate + Educate



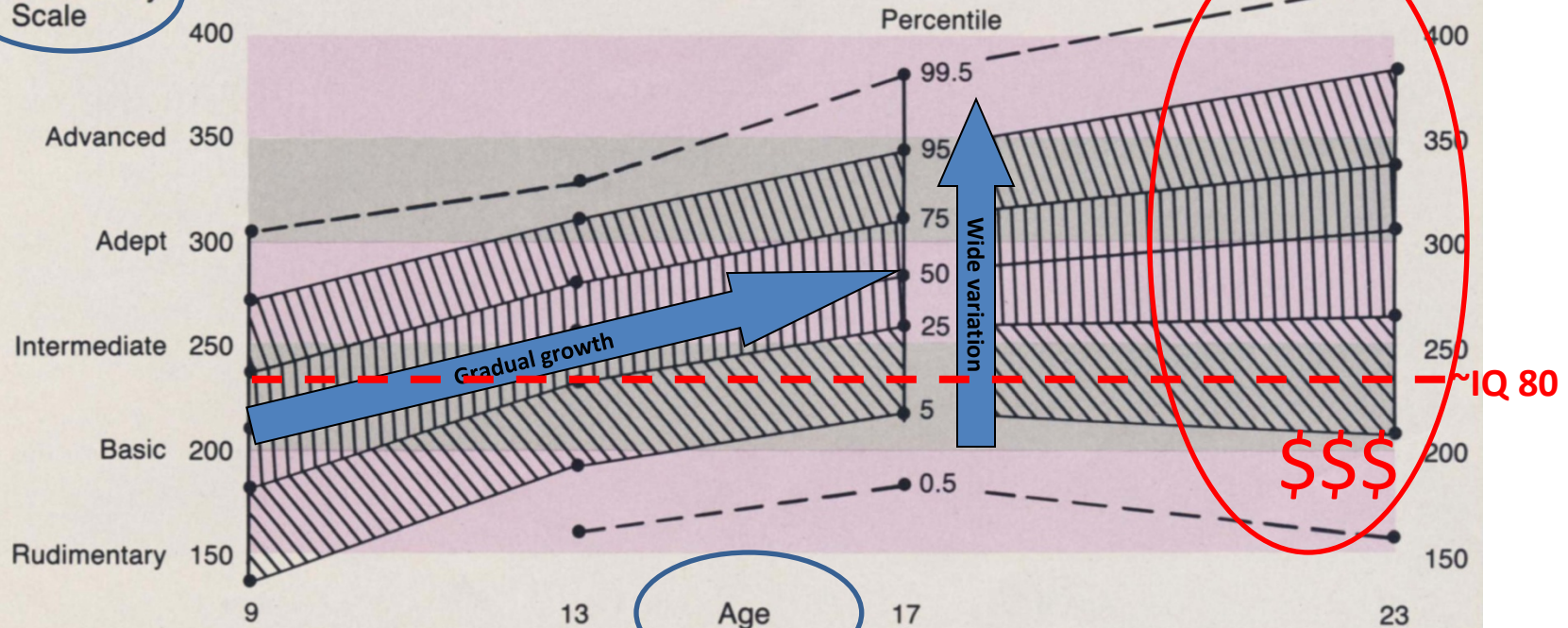
# 'Enlightened' Opinion

Individual differences =	"Inequalities"	Opinion
Inputs	 <div data-bbox="691 414 1346 528"> <p>"Low literacy among highly educated too"</p> </div>	Bad
Inputs		Unacceptable
Outcomes T1		Bad
Outcomes T2	 <div data-bbox="1124 1216 1779 1330"> <p>"See, it can't be g!"</p> </div>	Back-sliding

# The reality

FIGURE 1.  
Total Groups, 1984 In-School Assessment,  
Plus Young Adult Data, 1985

Reading  
Proficiency  
Scale



Source: Derived from *The Reading Report Card*, pp. 65-71.

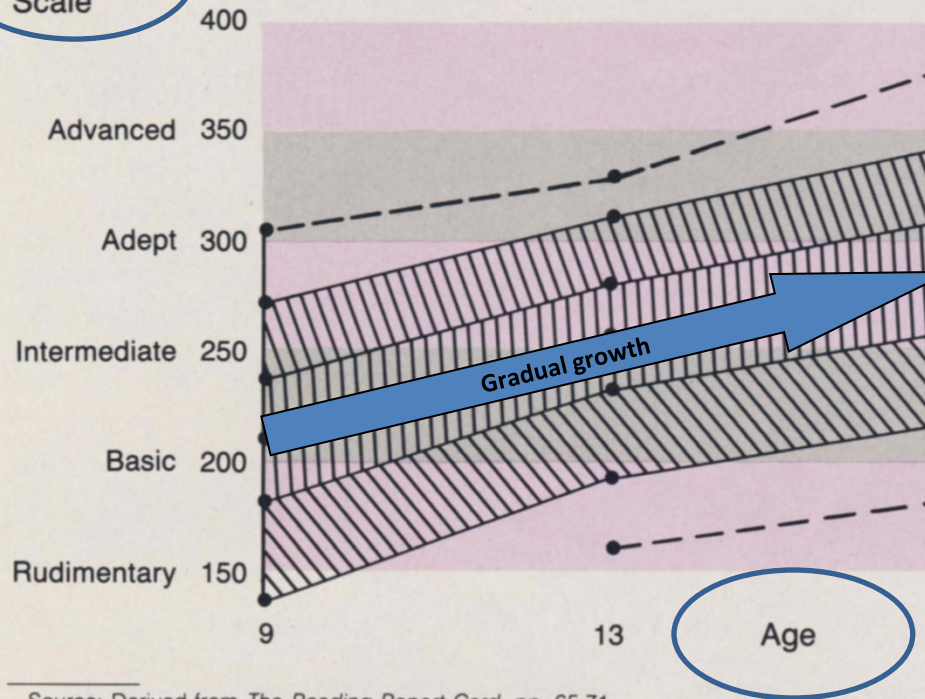
John B Carroll



# Resolute ignorance about $g$

FIGURE 1.  
Total Groups, 1984 In-School Assessment,  
Plus Young Adult Data, 1985

Reading  
Proficiency  
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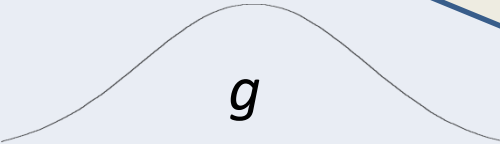
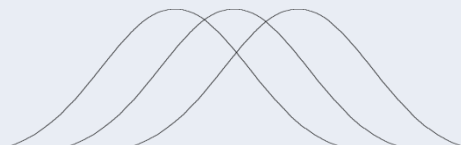
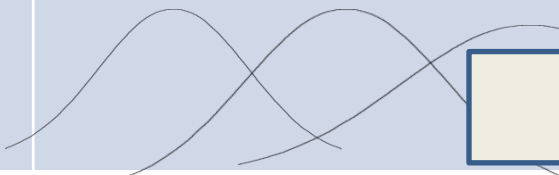


Source: Derived from *The Reading Report Card*, pp. 65-71.

Health policy &  
practice?

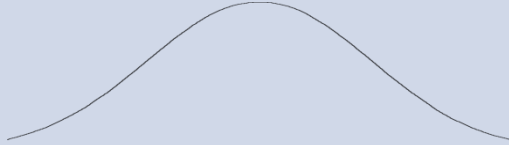
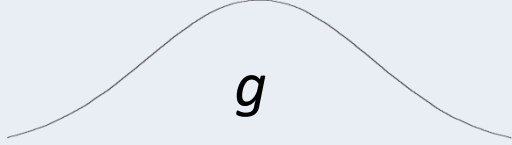


No see  
No hear  
No say  
No insult  
**So, patients die**

# ‘Enlightened’ Opinion

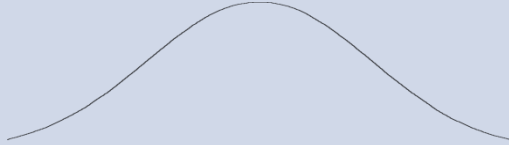
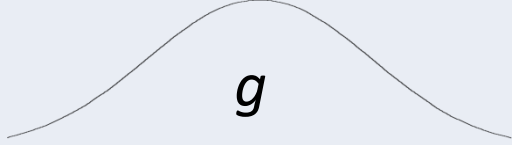

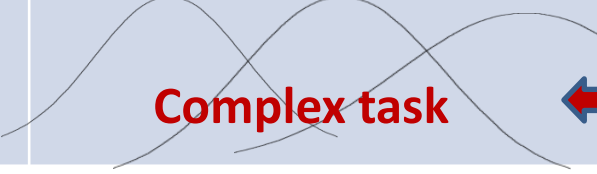
Individual differences	“Inequalities”	Opinion
Inputs	 <div data-bbox="691 414 1346 528" data-label="Text"> <p>“Low literacy among highly educated too”</p> </div>	Bad
Inputs	 <p><i>g</i></p>	Unacceptable
Outcomes T1		Bad
Outcomes T2	 <div data-bbox="1124 1216 1779 1330" data-label="Text"> <p>“See, it can’t be <i>g</i>!”</p> </div>	Back-sliding



# Neglected—the patient’s job

Individual differences	“Inequalities”	Opinion
Inputs		Bad
Inputs		Unacceptable
Job to be done	Complexity ( <i>g</i> loading)	Much is inherent
Outcomes T1		Bad
Outcomes T2		Back-sliding

# Neglected—the patient's job

Individual differences	"Inequalities"	Opinion
Inputs		Bad
Inputs		Unacceptable
Job to be done	Complexity ( <i>g</i> loading)	Much is inherent
Outcomes T1		<div> <i>g</i> levels meet <i>g</i> loadings </div>
Outcomes T2		

## Current Strategy

Access to care + Motivate + Educate



Patient error & non-adherence

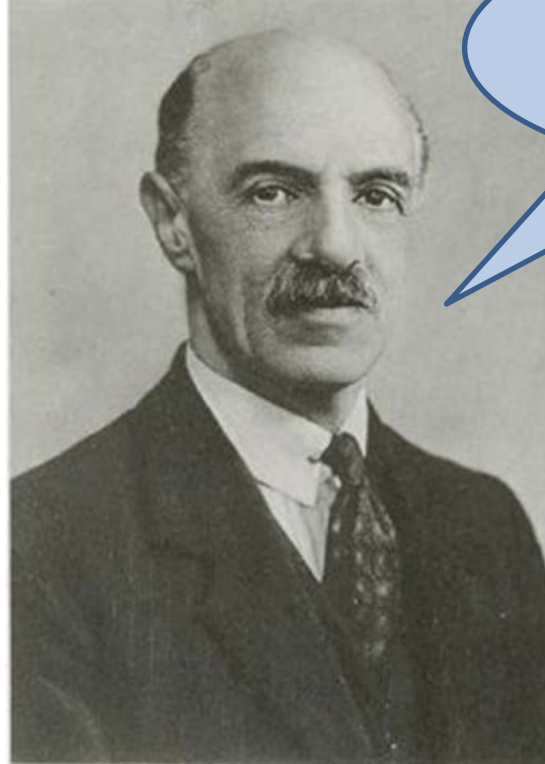
Disparities generator



$g$  loadings rise;  $g$  levels won't

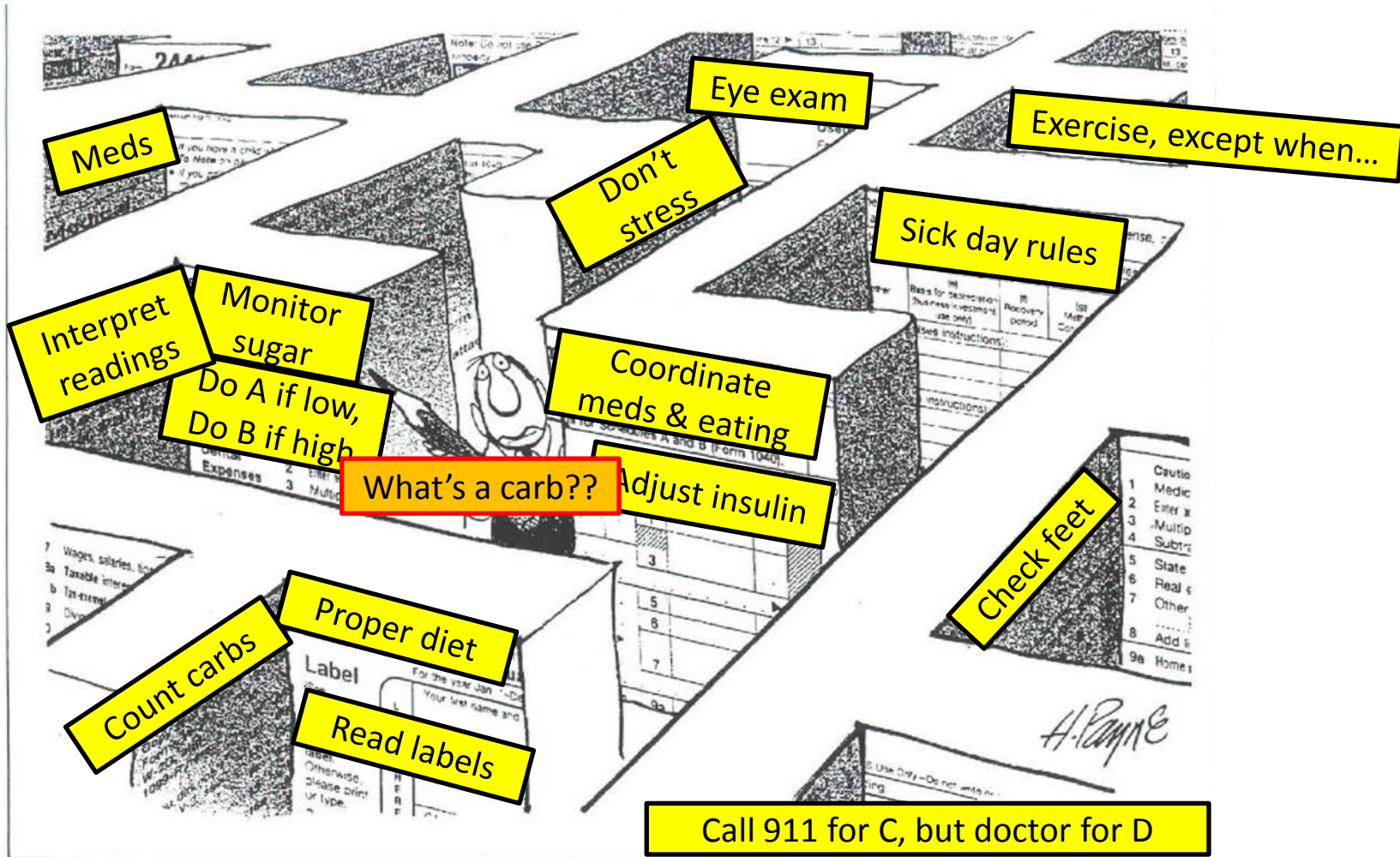
**Neglected Reality**

No hope? So, give up??? **No!!**



It's the *g* loadings,  
stupid!!

# The patient's reality



System no longer on auto-pilot

# The health provider's reality

My blood sugar is 154 over 90.

I don't eat sugar any more. Just pasta.

Eye exam

Exercise, except when...

Don't

It's low fat, so it's healthy.

Interpret readings

Monitor sugar

Do A if low, Do B if high

I skipped lunch so I could have a big dinner.

What's a carb??

Adjust insulin

You mean I have to *measure* stuff?!

Check feet

Never tested my sugar because I never figured out my meter.

Count carbs

Read labels

Can I still eat donuts?

Factor for D

Patient fails to take control

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

# AADE7™ + 1

## Teaching to take control



CORE TASKS IN DIABETES SELF-CARE	
<b>EAT HEALTHY DIET</b>	Eat correct serving sizes Identify foods with carbs Eat on schedule
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Cognitive overload

## Self-management education today

- Serial by topic
- Abstract
- Decontextualized
- Fast
- Concentrated
- One-size-fits-all
- No scaffolding
- ~No practice
- ~No assessment



*g*

CORE TASKS IN DIABETES SELF-CARE	
<b>EAT HEALTHY DIET</b>	Eat correct serving sizes Identify foods with carbs Eat on schedule
<b>GET EXERCISE</b>	Recognize signs when to stop Exercise correct amount Time exercise relative to food, meds
<b>MONITOR BLOOD SUGAR</b>	Rec... Use... Mo...
<b>USE MEDICATION CORRECTLY</b>	Take meds in correct amount and time Identify meds that raise blood sugar Respond correctly when dose delayed
<b>SPOT &amp; SOLVE PROBLEMS</b>	Take correct action with sugar too low Follow sick day rules Pla...
<b>REDUCE RISK</b>	Call... Ins... Schedule required eye & dental exams
<b>ADAPT SELF OR SITUATION</b>	Identify barriers to effective self-care Identify stressors that raise blood sugar Recognize signs of depression
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Cognitive complexity

Cognitive interferences

## Neglected job elements

### Core tasks:

- Interdependence
- Criticality
- Responsibility
- Extinguish old habits

### Work conditions:

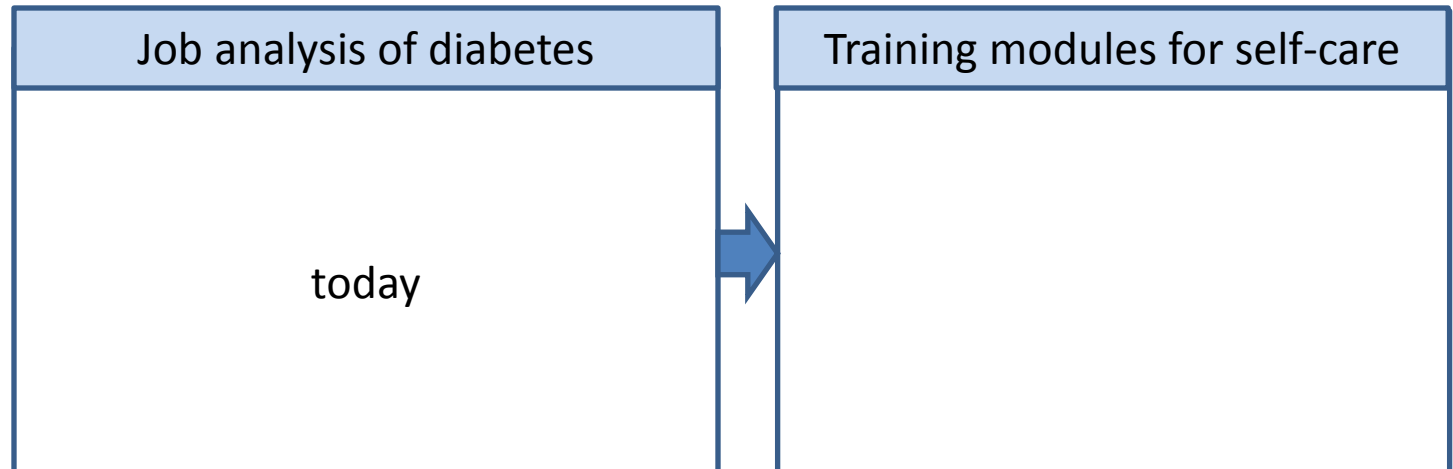
- Time pressure
- Distractions
- Predictability
- Interferences in-situ
- Rest breaks



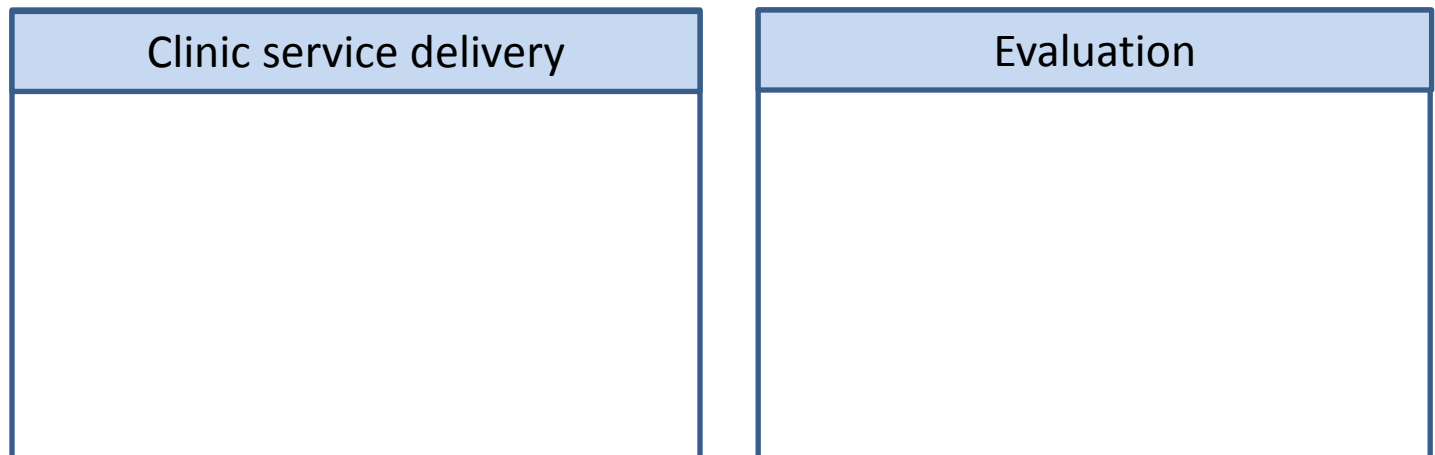
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# Cognitive ergonomics project (9 FQHC clinics)

R & D

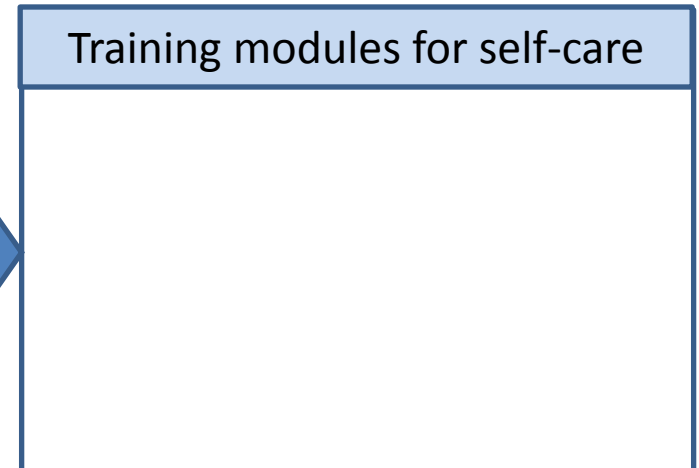
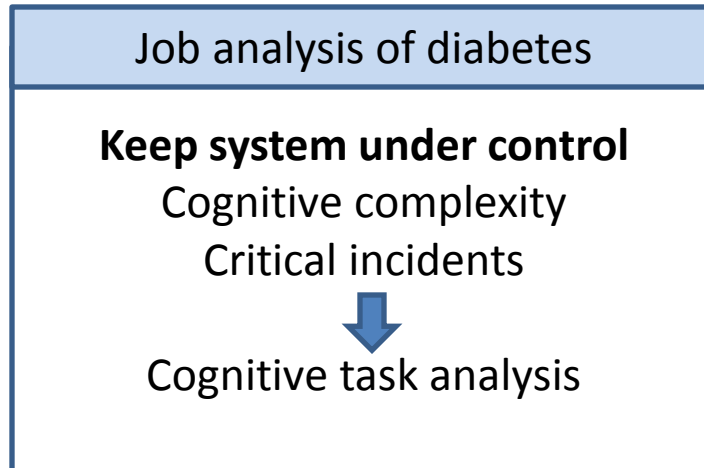


I & E

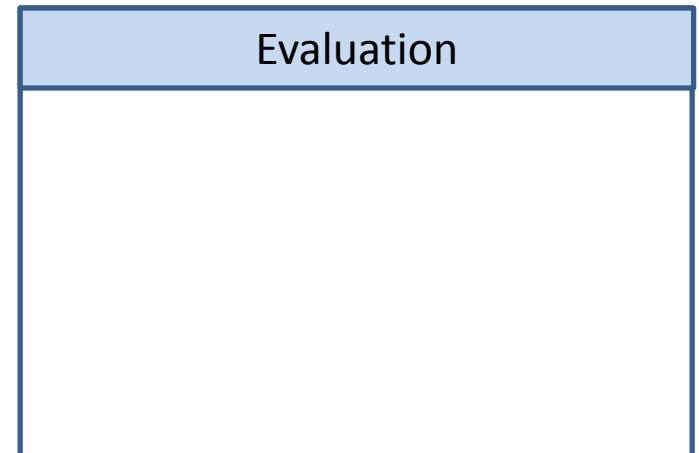
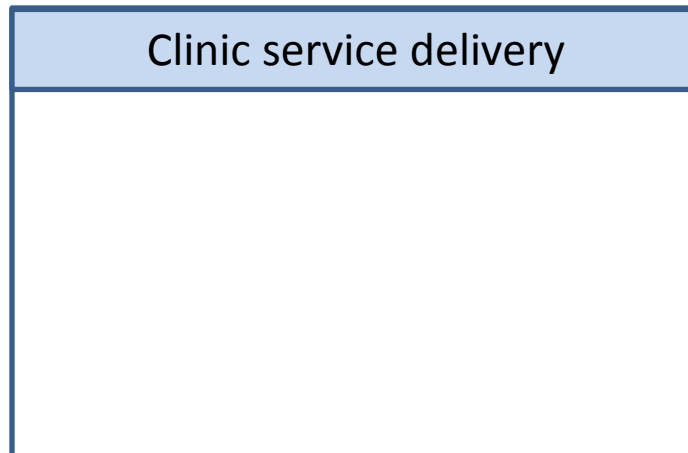


# Cognitive ergonomics project (9 FQHC clinics)

R & D



I & E



# Cognitive ergonomics project (9 FQHC clinics)

R & D

Job analysis of diabetes

**Keep system under control**

Cognitive complexity

Critical

Accident prevention

Cognitive task analysis

Training modules for self-care

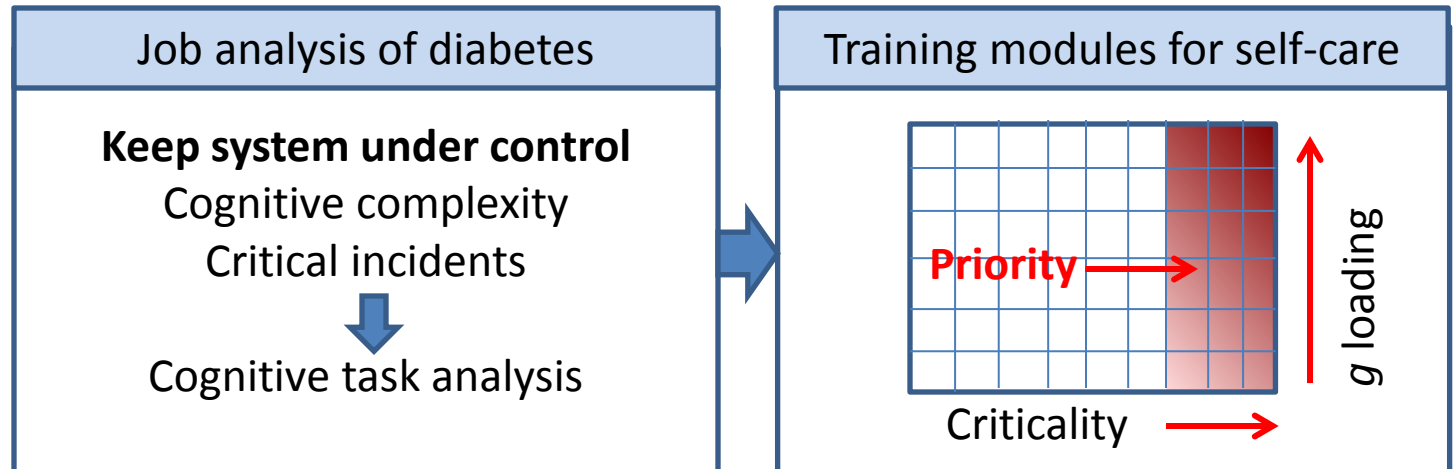
I & E

Clinic service delivery

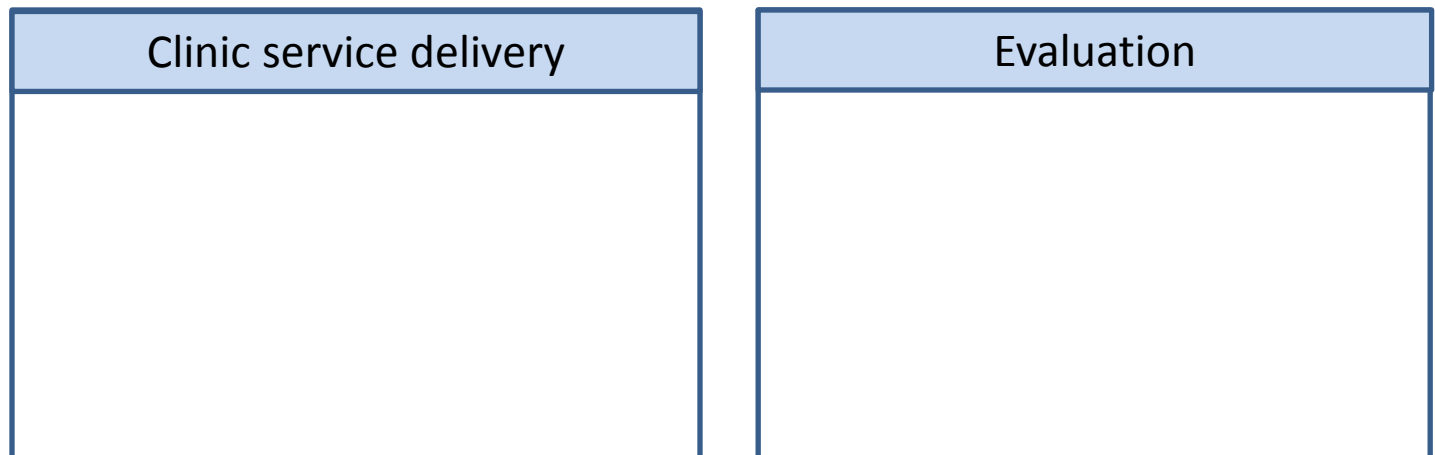
Evaluation

# Cognitive ergonomics project (9 FQHC clinics)

R & D

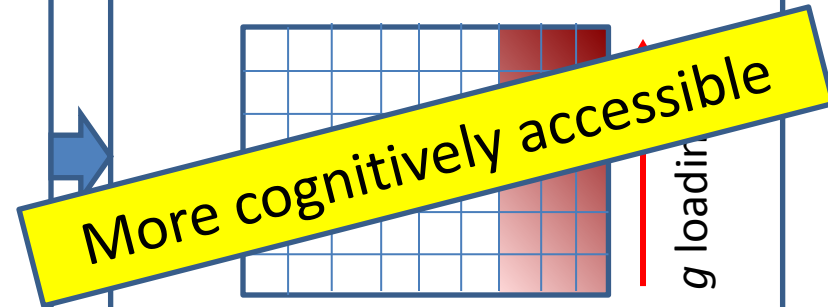
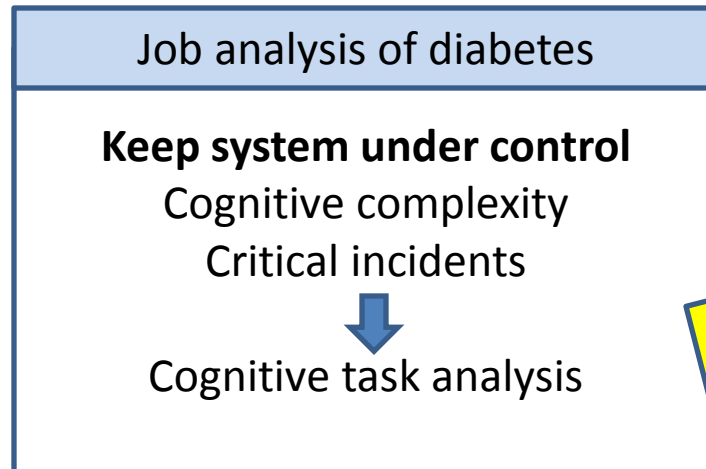


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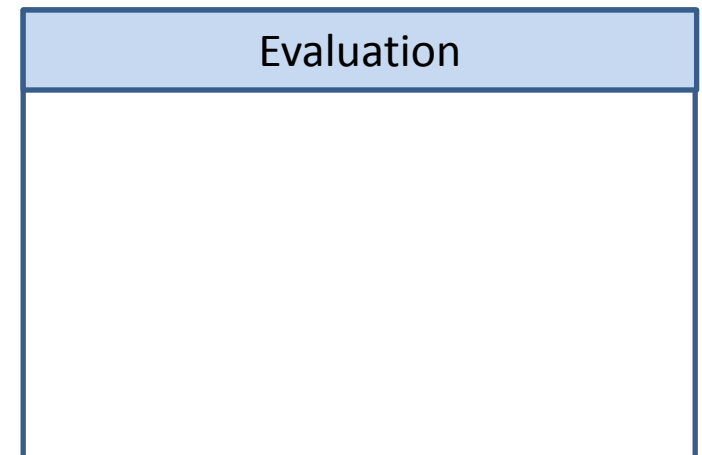
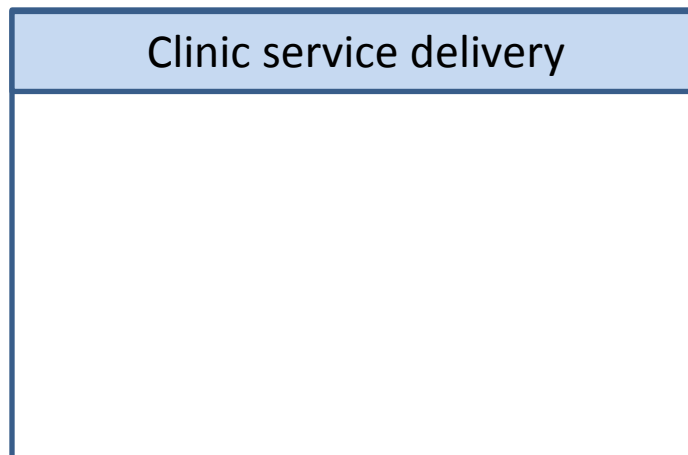


# Cognitive ergonomics project (9 FQHC clinics)

R & D



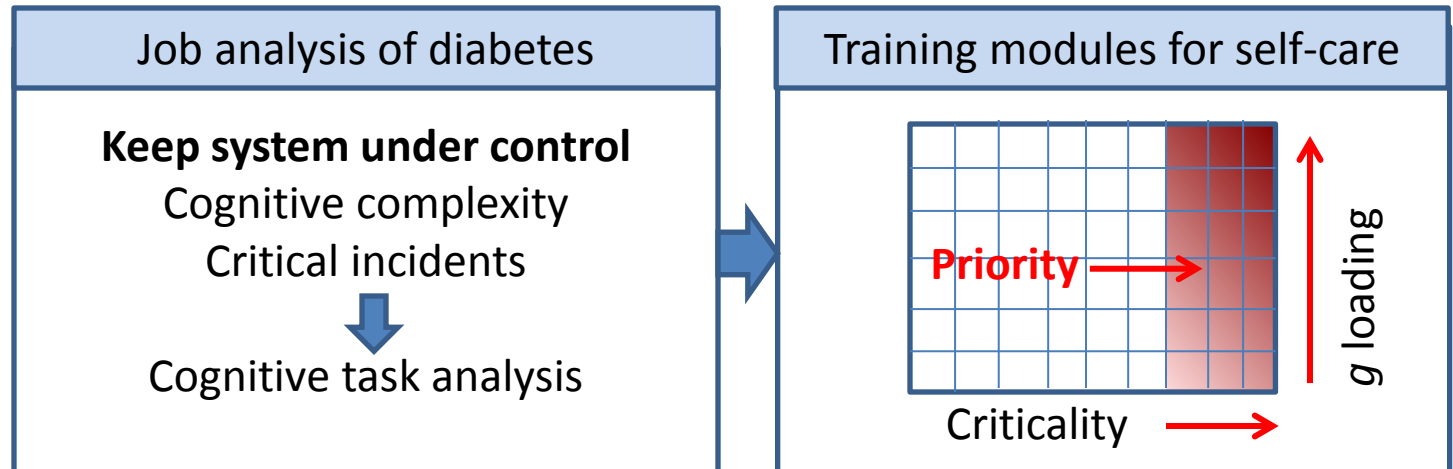
I & E



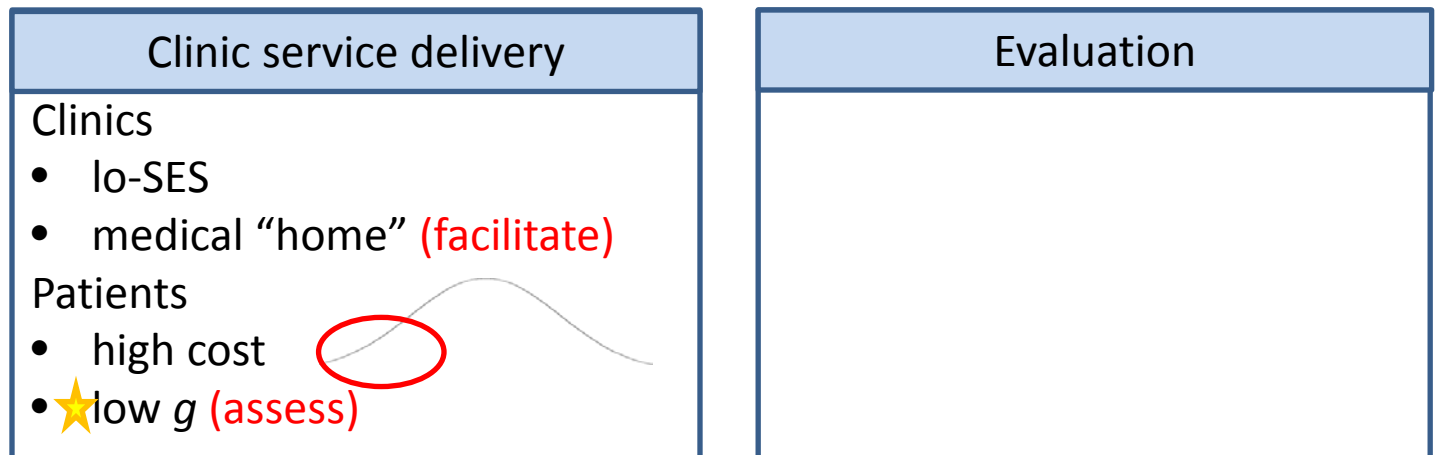


# Cognitive ergonomics project (9 FQHC clinics)

R & D



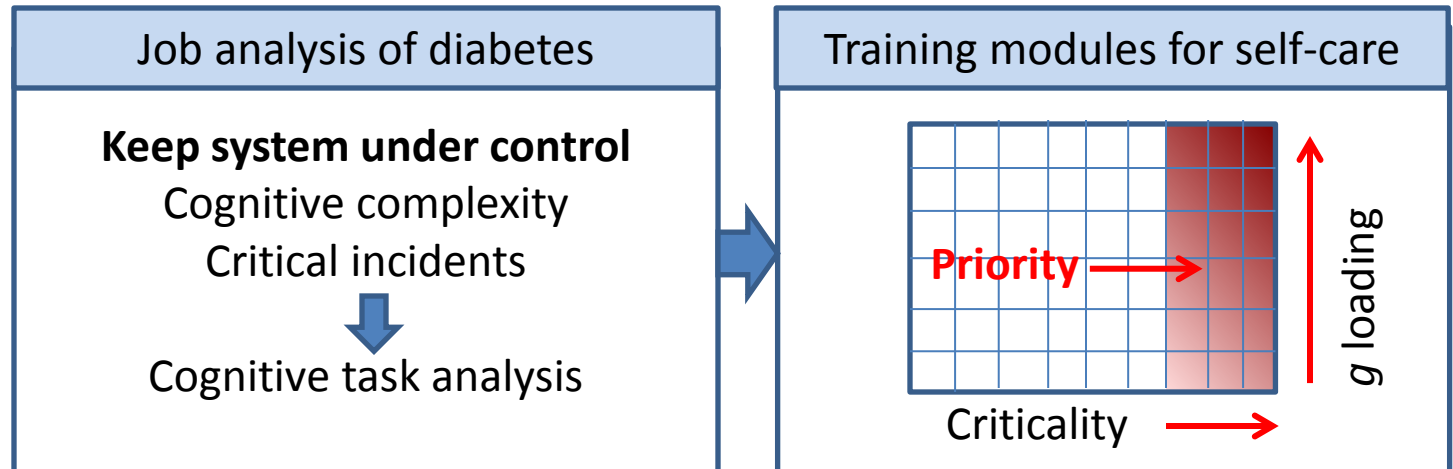
I & E



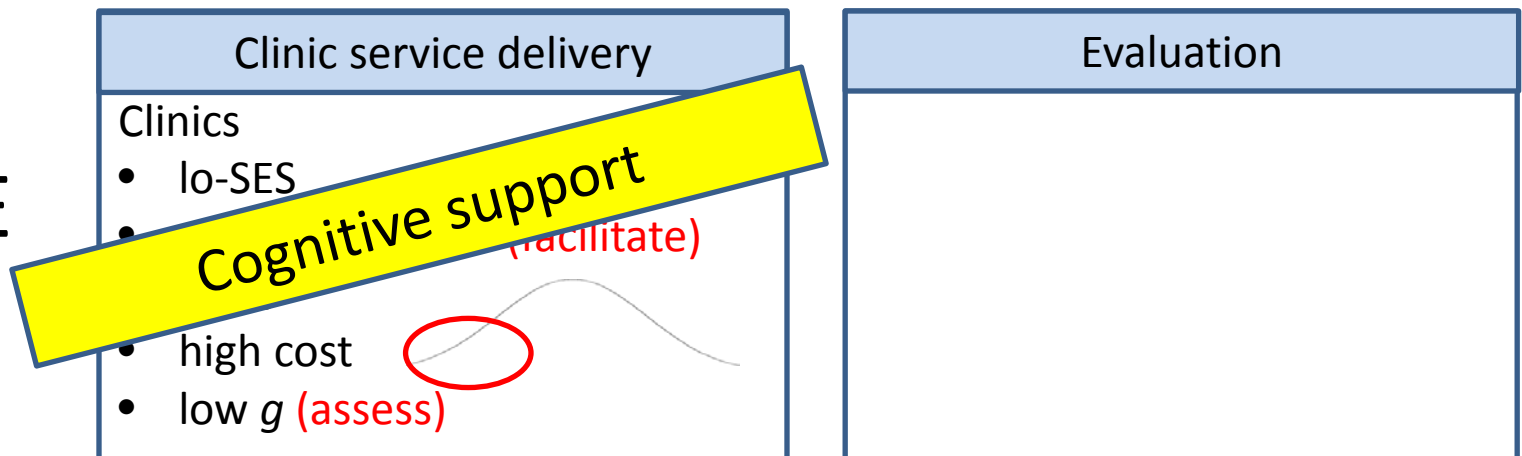
★ Elderly too

# Cognitive ergonomics project (9 FQHC clinics)

R & D

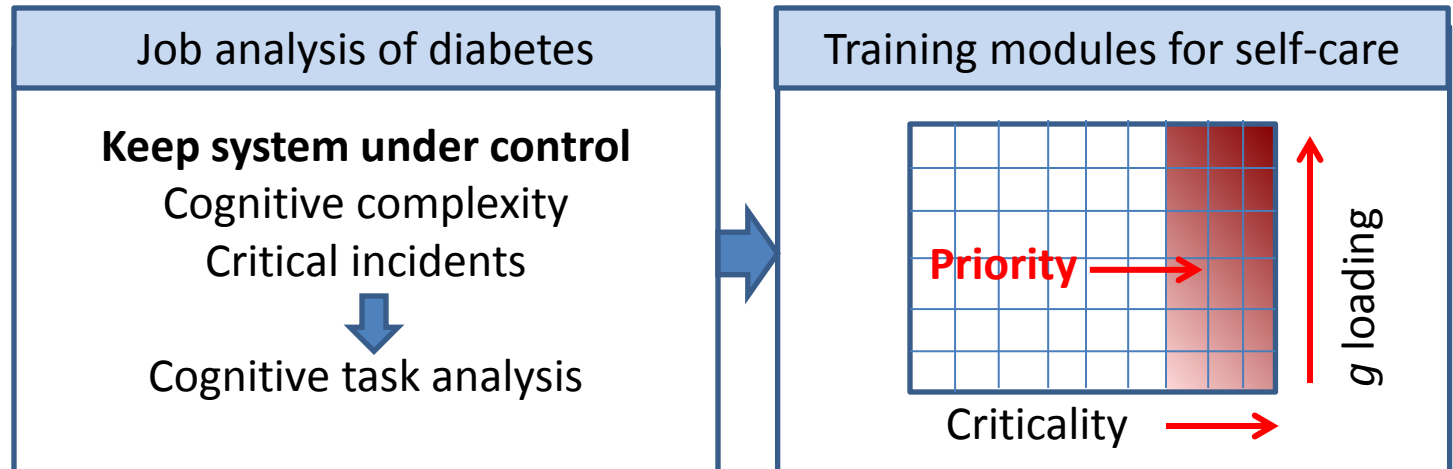


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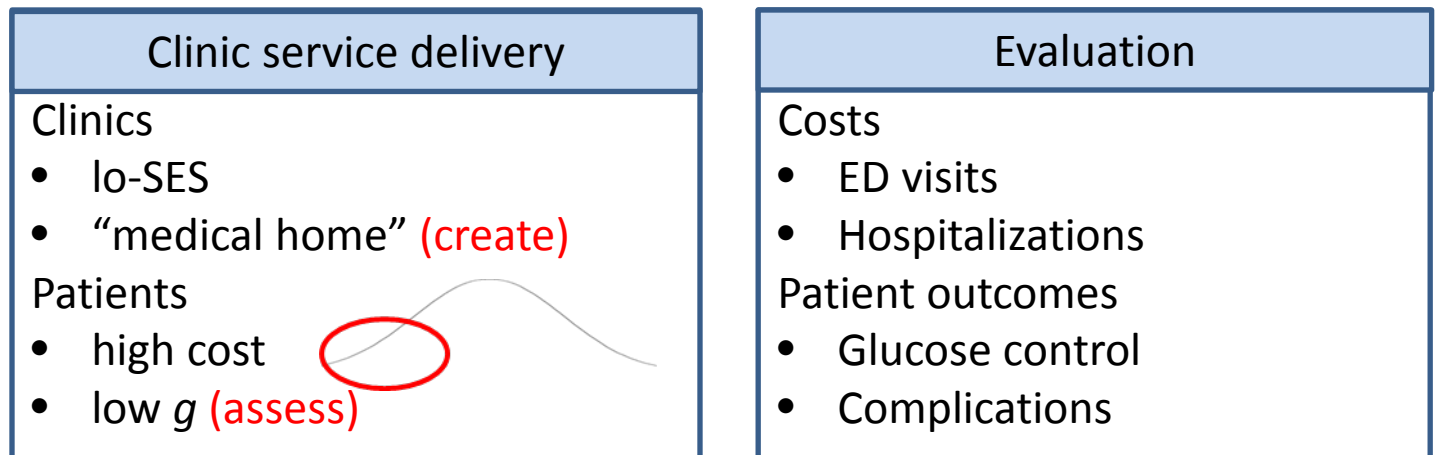


# Cognitive ergonomics project (9 FQHC clinics)

R & D

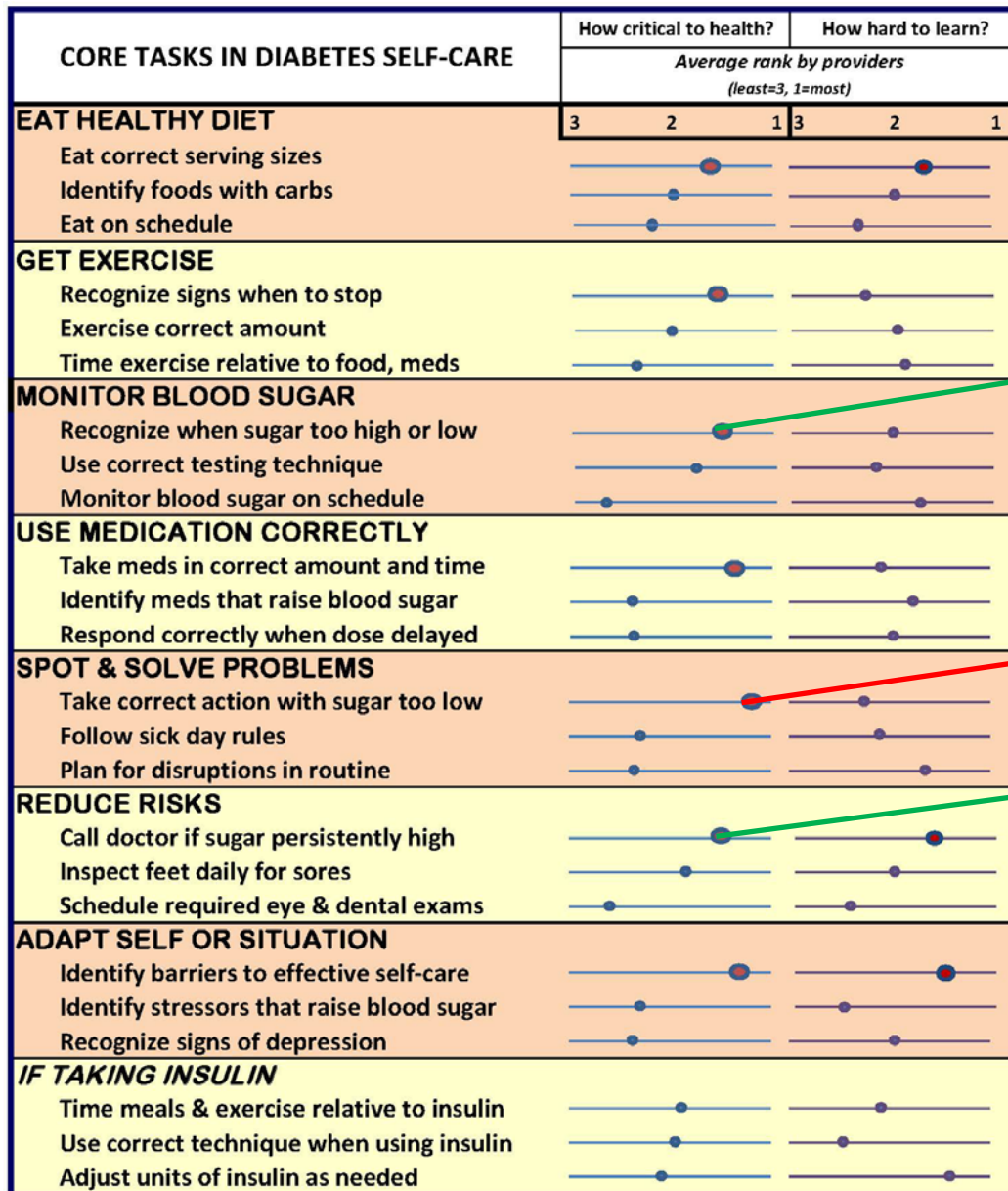


I & E



# Criticality rankings (pilot data)

System unstable,  
restore control



Recognize when sugar  
too high or low

Take correct action  
when sugar too low

Call doctor if sugar  
persistently high

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

# Criticality rankings

CORE TASKS IN DIABETES SELF-CARE	How critical to health?			How hard to learn?		
	Average rank by providers (least=3, 1=most)					
	3	2	1	3	2	1
<b>EAT HEALTHY DIET</b>						
Eat correct serving sizes						
Identify foods with carbs						
Eat on schedule						
<b>GET EXERCISE</b>						
Recognize signs when to stop						
Exercise correct amount						
Time exercise relative to food, meds						
<b>MONITOR BLOOD SUGAR</b>						
Recognize when sugar too high or low						
Use correct testing technique						
Monitor blood sugar on schedule						
<b>USE MEDICATION CORRECTLY</b>						
Take meds in correct amount and time						
Identify meds that raise blood sugar						
Respond correctly when dose delayed						
<b>SPOT &amp; SOLVE PROBLEMS</b>						
Take correct action with sugar too low						
Follow sick day rules						
Plan for disruptions in routine						
<b>REDUCE RISKS</b>						
Call doctor if sugar persistently high						
Inspect feet daily for sores						
Schedule required eye & dental exams						
<b>ADAPT SELF OR SITUATION</b>						
Identify barriers to effective self-care						
Identify stressors that raise blood sugar						
Recognize signs of depression						
<b>IF TAKING INSULIN</b>						
Time meals & exercise relative to insulin						
Use correct technique when using insulin						
Adjust units of insulin as needed						

Eat correct serving sizes

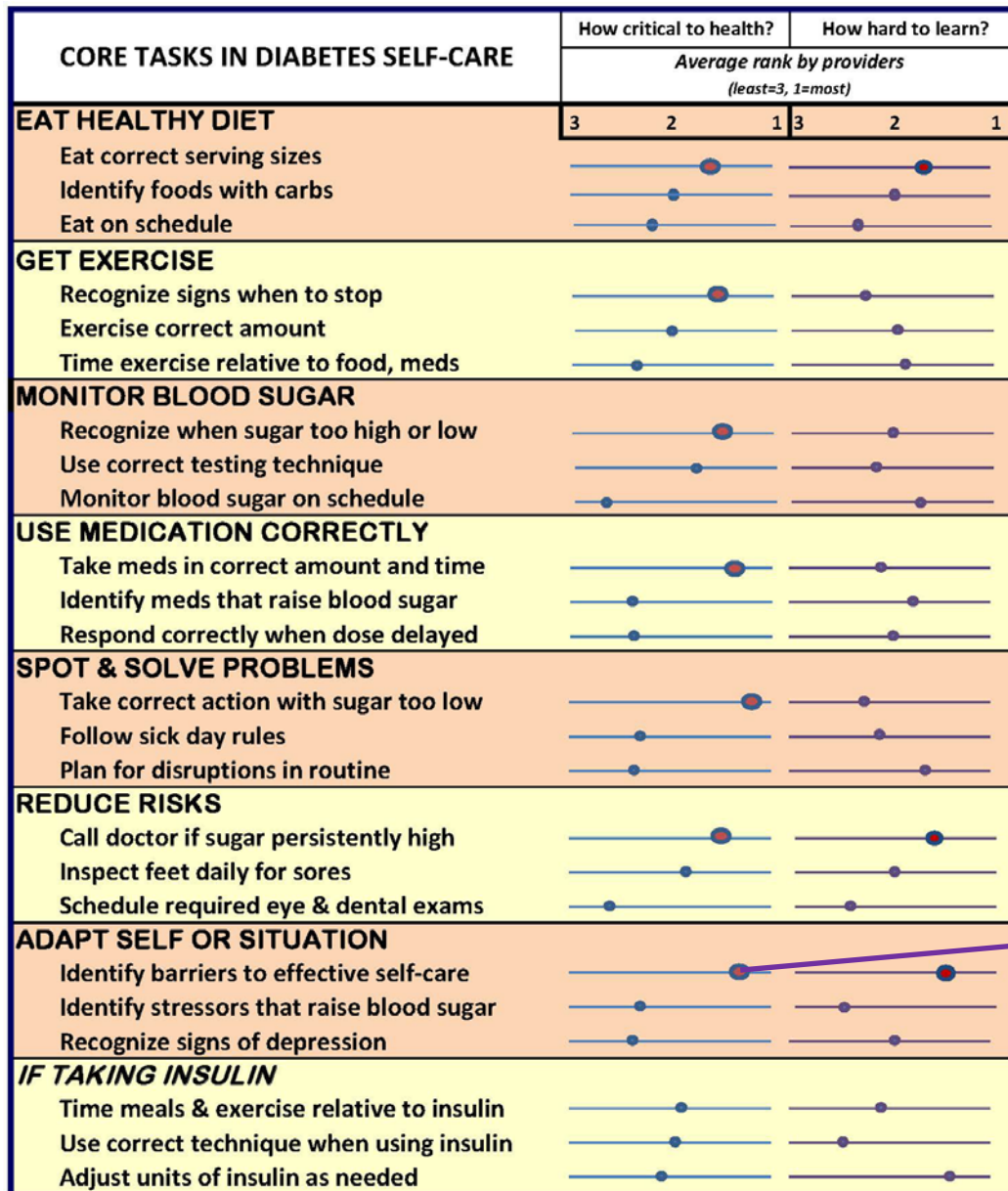
Recognize signs to stop exercise

Take meds in correct amount & time

Maintain system control

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

# Criticality rankings



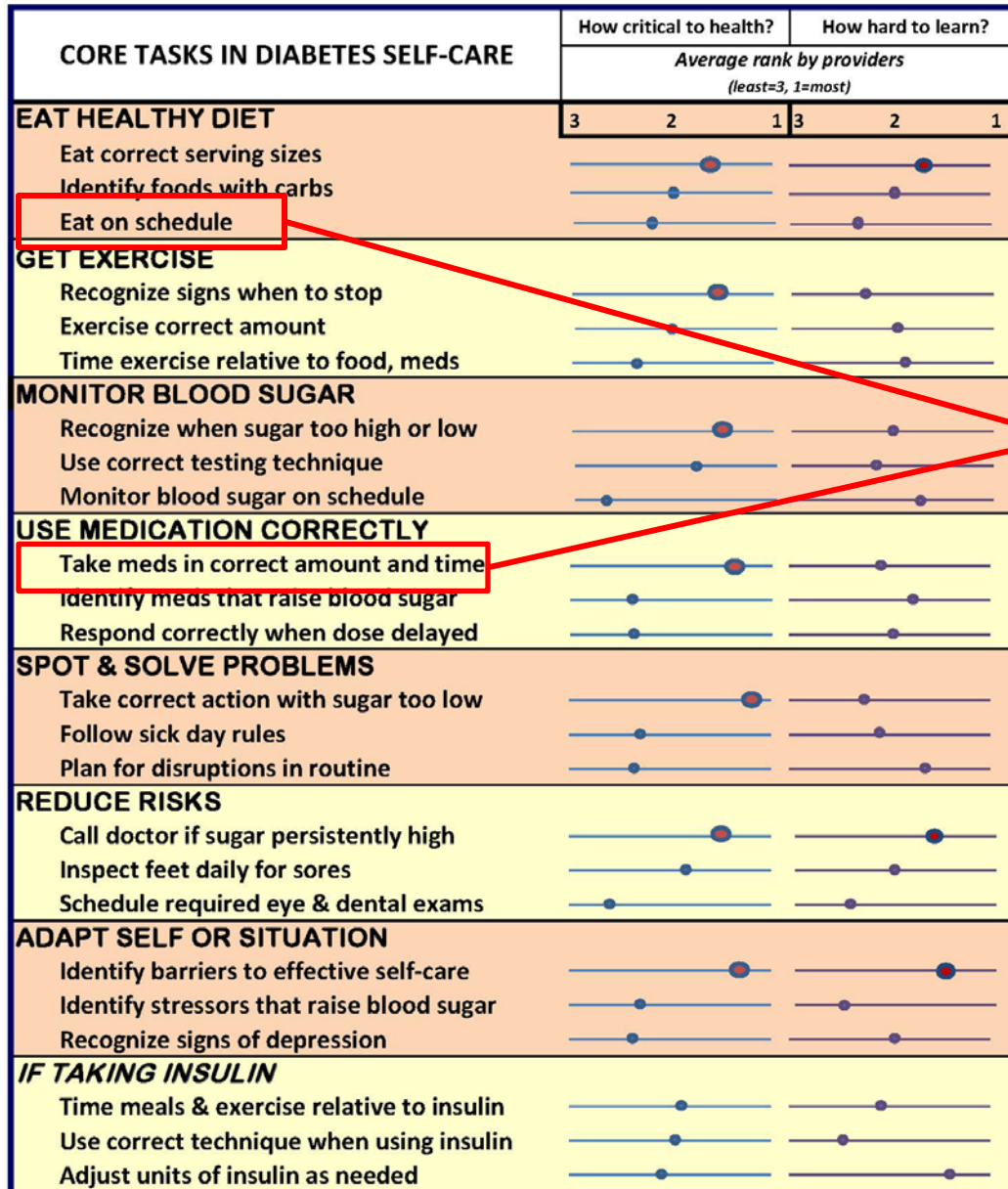
Identify hazards

Identify barriers to self-care

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



# Critical incidents

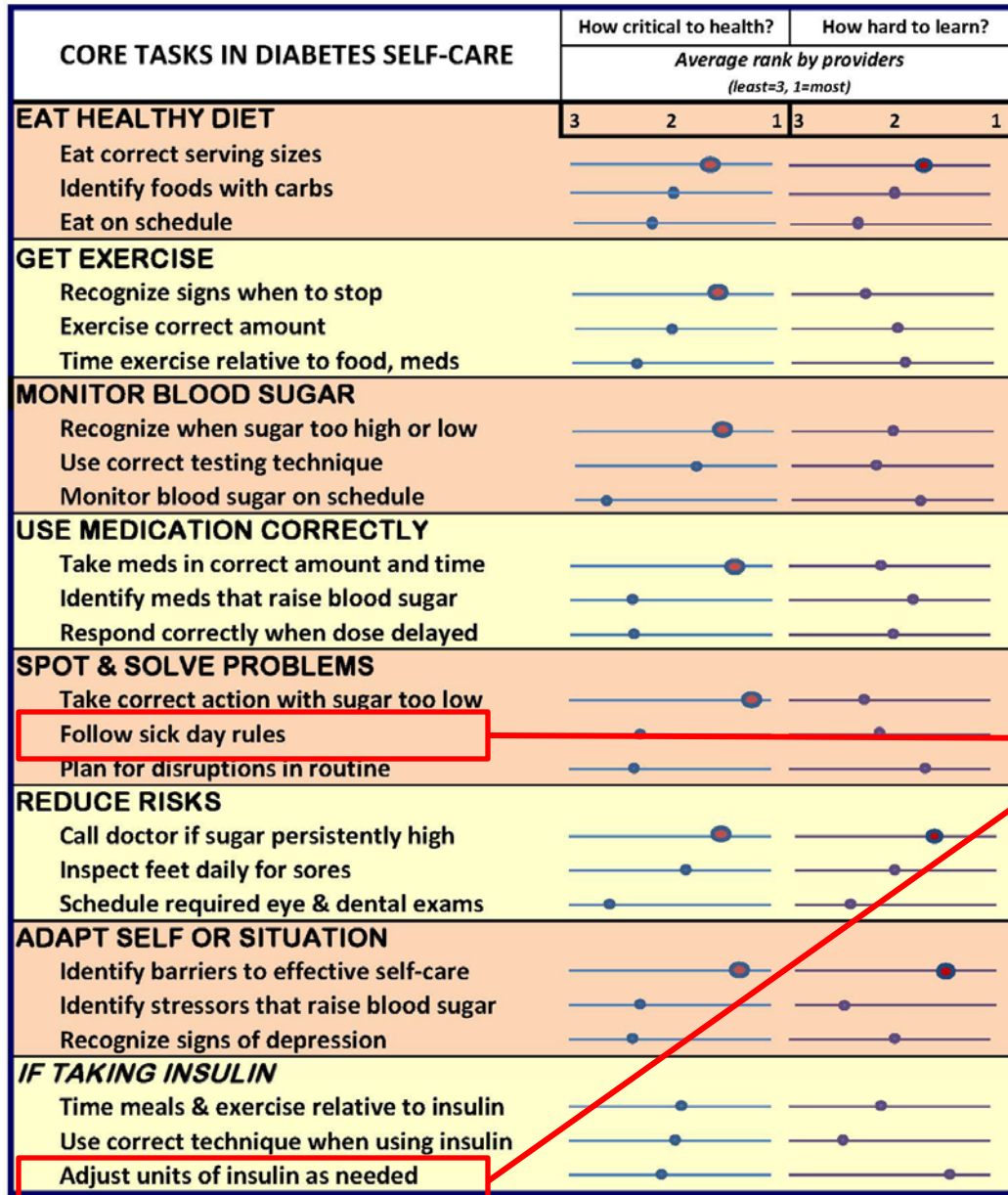


Took meds on time,  
—but delayed meal → BG crash  
—but ate only a salad → BG crash

Causal nexus  
(food, meds, blood sugar)



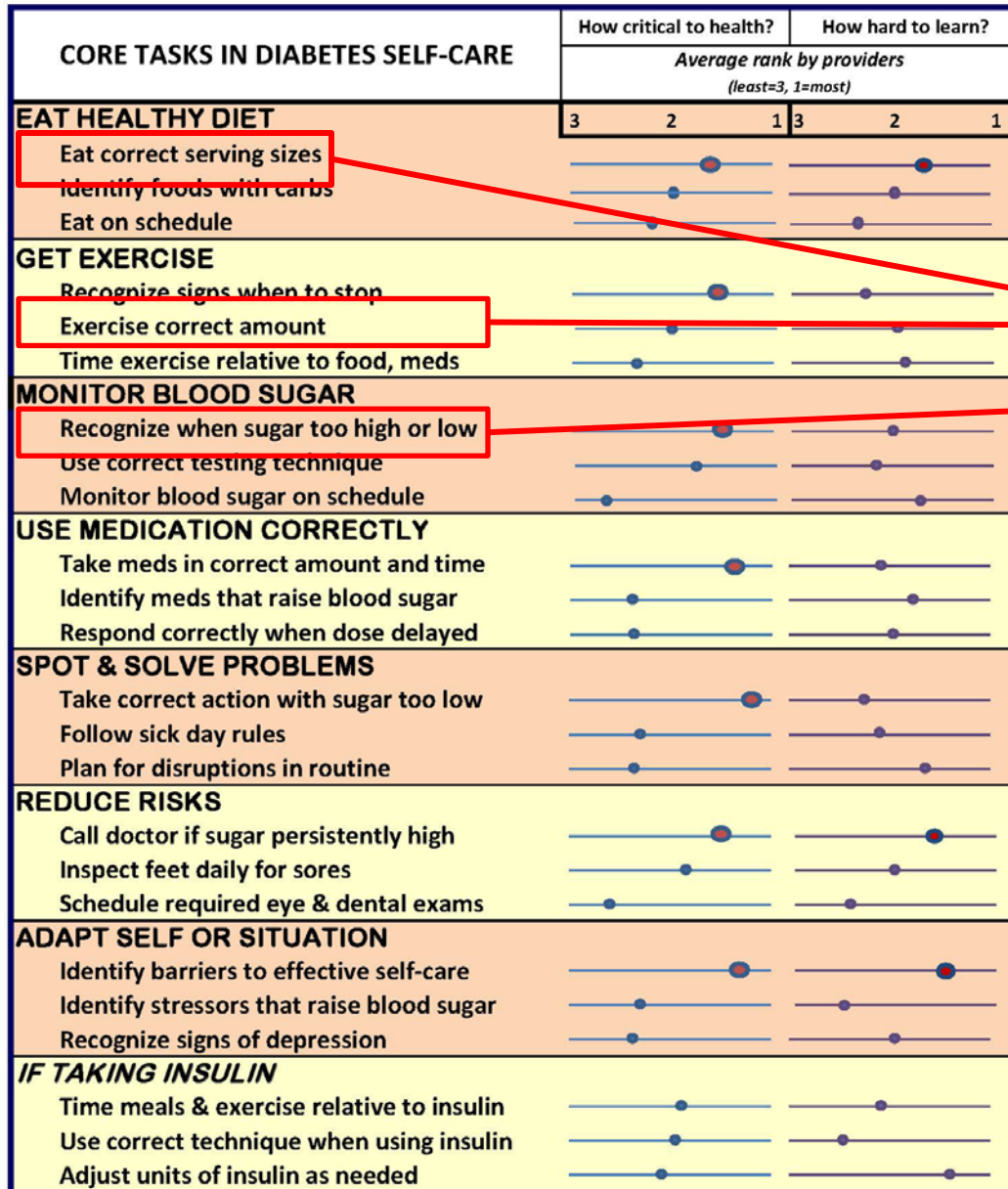
# Critical incidents



Sick & not eating,  
—so took no insulin (T1)→DKA  
—but took same dose→BG crash

Shift rule when  
conditions change

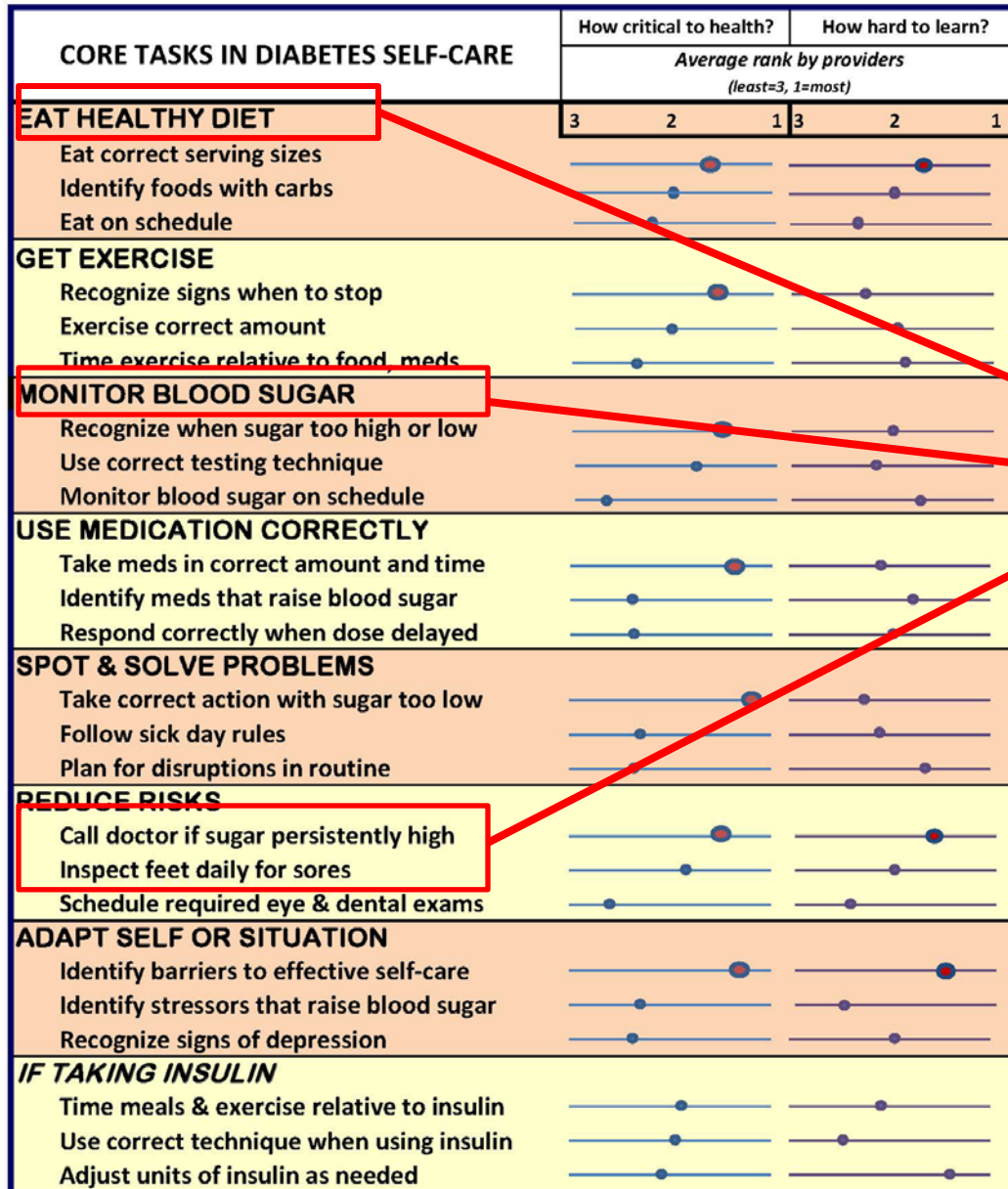
# Critical incidents



Ate prophylactically to “prevent” low blood sugar, did not test blood sugar, got no exercise,  
 → chronic high sugar  
 → incubating, unseen damage

One cause  
 One effect  
 One tactic

# Critical incidents

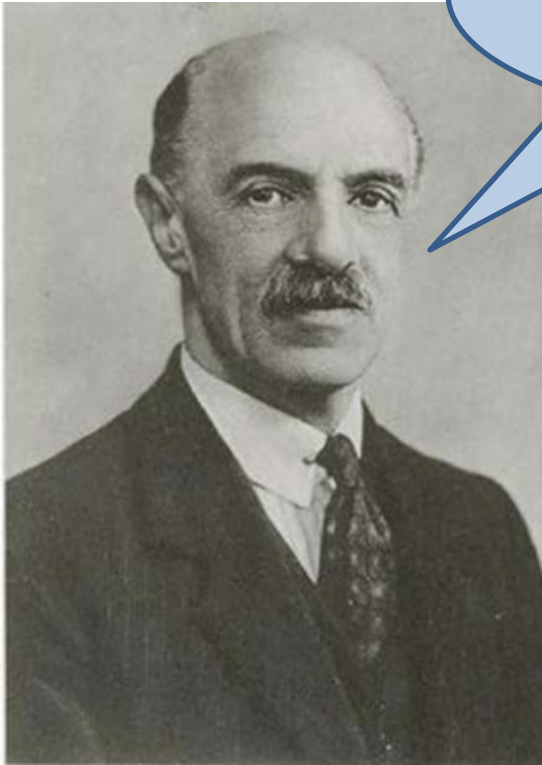


Did not control diet  
 → chronic high sugar  
 → poor wound healing  
 Feared treatment  
 → hospitalized for necrotic foot

One goal  
 (avoid immediate pain)

One tactic  
 (avoid medical treatment)

1. When cognitive budget is small,  
spend it wisely.



High  $g$  loadings  
are expensive.

2. Focus on critical tasks
3. Teach  $g$ -efficiently
4. Supply  $g$  support

Advice and questions?