

DIABETES MANAGEMENT IN LONG TERM CARE FACILITIES

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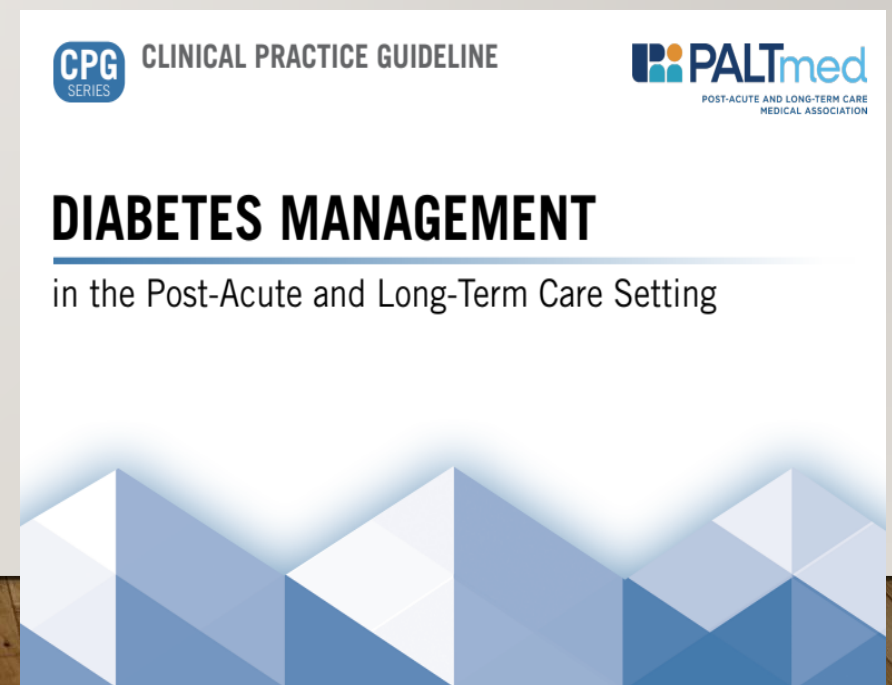
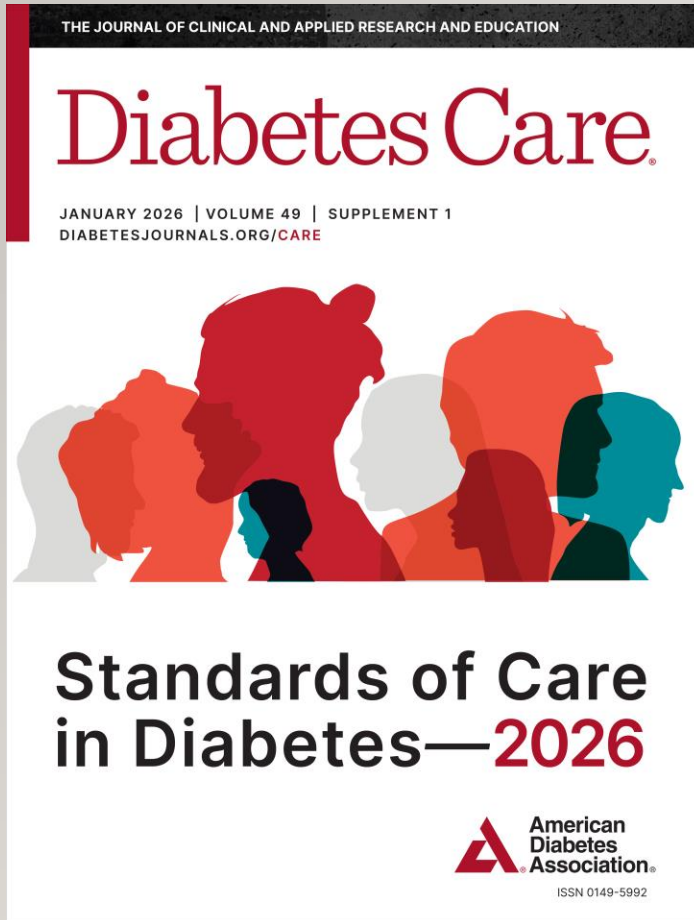
DISCLOSURES

External Industry Relationships *	Company Name	Role
Equity, stock, or options in biomedical industry companies or publishers	None	None
Board of Directors or officer	None	None
Royalties from Emory or from external entity	None	None
Industry funds to Emory for my research	AbbVie	PI
Other	None	None



OBJECTIVES

- DM Prevalence In LTCF
- Discuss Glycemic Targets
- Discuss Diabetes Medications Use In LTCF
- Discuss DM Technology In LTCF





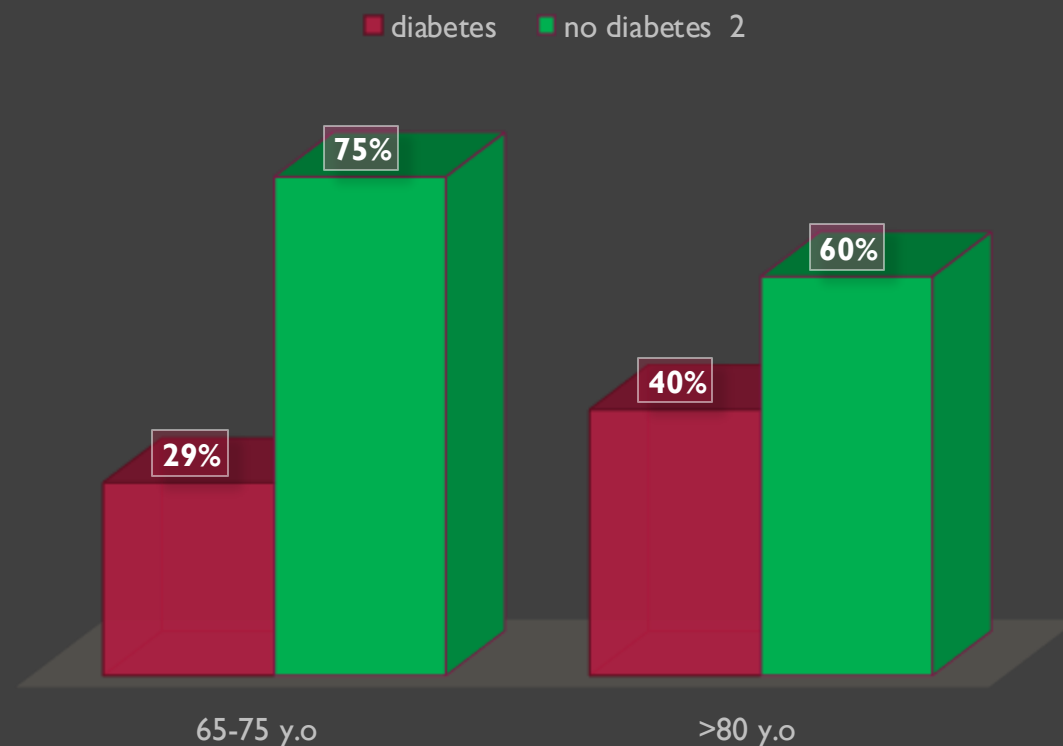
Epidemiology

- ~ 10,000 baby boomers turns 65 every day
- Life expectancy at age 65 went from 11.9 years (1900-1902) to 19.1 years in 2010 (Census Bureau report)
- Older adults are projected to outnumber children under age 18 for the first time in U.S. history by 2034, (Census Bureau projections)

Older adults with DM

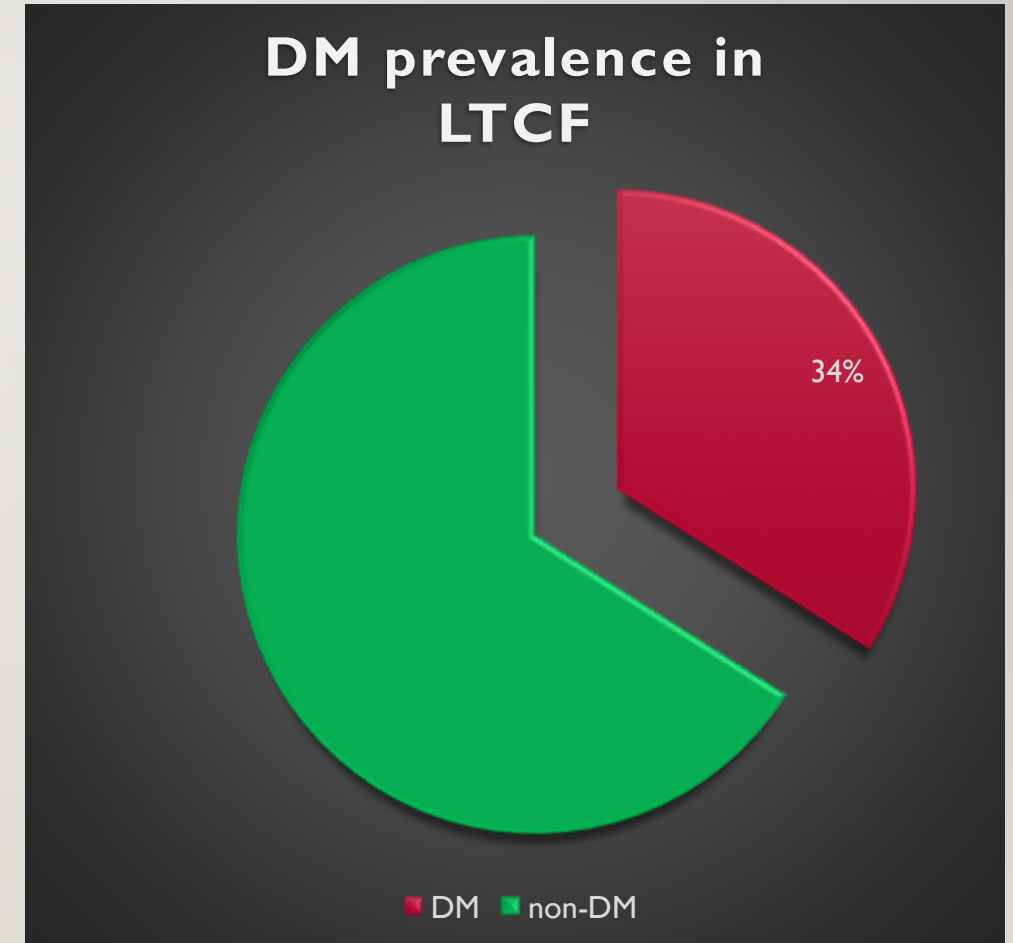
- Will reach 26.7 million by 2050 (vs. ~11 million 2018, 16.5 million currently)

DM PREVALENCE AMONG OLDER ADULTS



DM PREVALENCE IN LTCF

- The number of LTCF in 2016 was 15,600 (*National Center for Health Statistics*)
- Housing 1.3 million residents
- Around 86% are 65 years of age or older





Economic Burden of Diabetes in Older Adults

1 Diabetes Costs Continue to Rise

Total U.S. Diabetes-Related
Healthcare Expenditures



 **+\$167.9B**
(+68%)
increase
since 2012

2 Healthcare Resources

Adults ≥65 years utilize



Hospital Admissions



Long-Term Care Facility Utilization



Medication Prescriptions



3 Significant Impact on Long-Term Care Costs

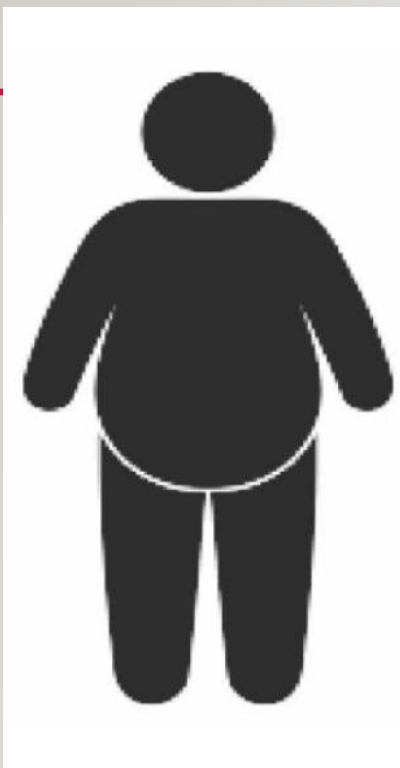


> \$13 BILLION

Diabetes-attributable nursing home costs
for LTCF residents aged 65–84 years (2013)



FRAILITY AND GLYCEMIC METRICS



Sarcopenic obese frail phenotype
hyperglycemia



Anorexic malnourished frail phenotype
hypoglycemia

Characteristics and health status of person with diabetes

	Rationale	Reasonable A1C goal*	Reasonable CGM goals	Fasting or preprandial glucose	Bedtime glucose	Blood pressure	Lipids
Healthy (few coexisting chronic illnesses, intact cognitive and functional status)	Longer remaining life expectancy	<7.0–7.5% (<53–58 mmol/mol)	TIR 70–180 mg/dL (3.9–10.0 mmol) of ≥70%, and TBR ≤70 mg/dL (≤3.9 mmol/L) of ≤4%	80–130 mg/dL (4.4–7.2 mmol/L)	80–180 mg/dL (4.4–10.0 mmol/L)	<130/80 mmHg	Statin, unless contraindicated or not tolerated
Complex/intermediate (multiple coexisting chronic illnesses† or two or more ADL impairments or mild to moderate cognitive impairment)	Variable life expectancy. Individualize goals, considering: • Severity of comorbidities • Cognitive and functional limitations • Frailty • Risk-to-benefit ratio of diabetes medications • Individual preference	<8.0% (<64 mmol/mol)	TIR 70–180 mg/dL (3.9–10.0 mmol) of ≥50% and TBR <70 mg/dL (<3.9 mmol/L) of <1%	90–150 mg/dL (5.0–8.3 mmol/L)	100–180 mg/dL (5.6–10.0 mmol/L)	<130/80 mmHg	Statin, unless contraindicated or not tolerated
Very complex/poor health (PALTC or end-stage chronic illnesses‡ or moderate to severe cognitive impairment or two or more ADL impairments)	Limited remaining life expectancy makes benefit minimal	Avoid reliance on A1C; glucose management decisions should be based on avoiding hypoglycemia and symptomatic hyperglycemia		100–180 mg/dL (5.6–10.0 mmol/L)	110–200 mg/dL (6.1–11.1 mmol/L)	<140/90 mmHg	Consider likelihood of benefit with statin

DIABETES MEDICATIONS

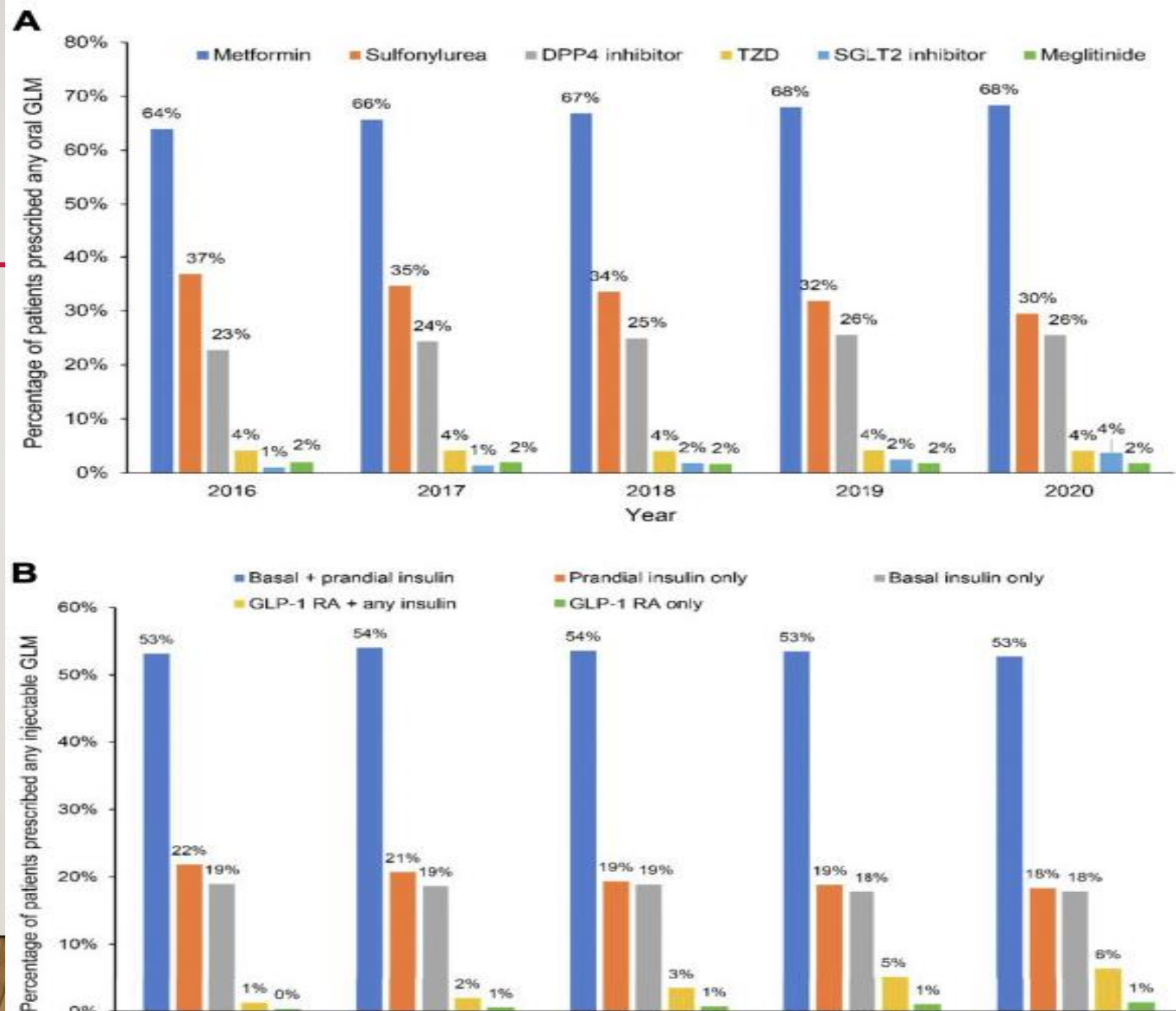
PRACTICAL POINTS



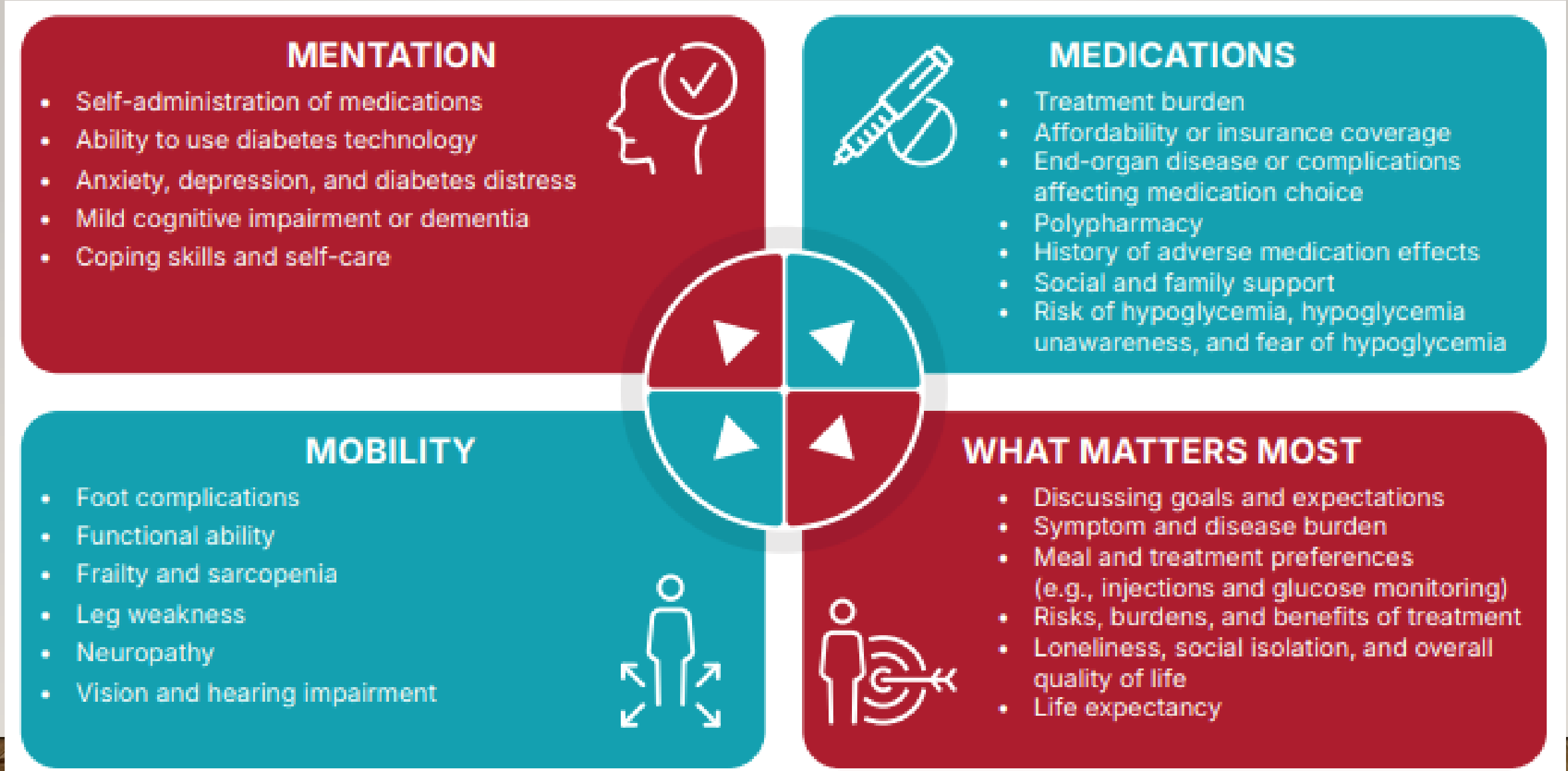


MEDS IN LTCF

- Prescriptions for glucose-lowering medications for LTC resident with T2D
- 71,200 to 120,861 residents
- United States LTCF (2016-2020),
- excluding palliative or hospice care

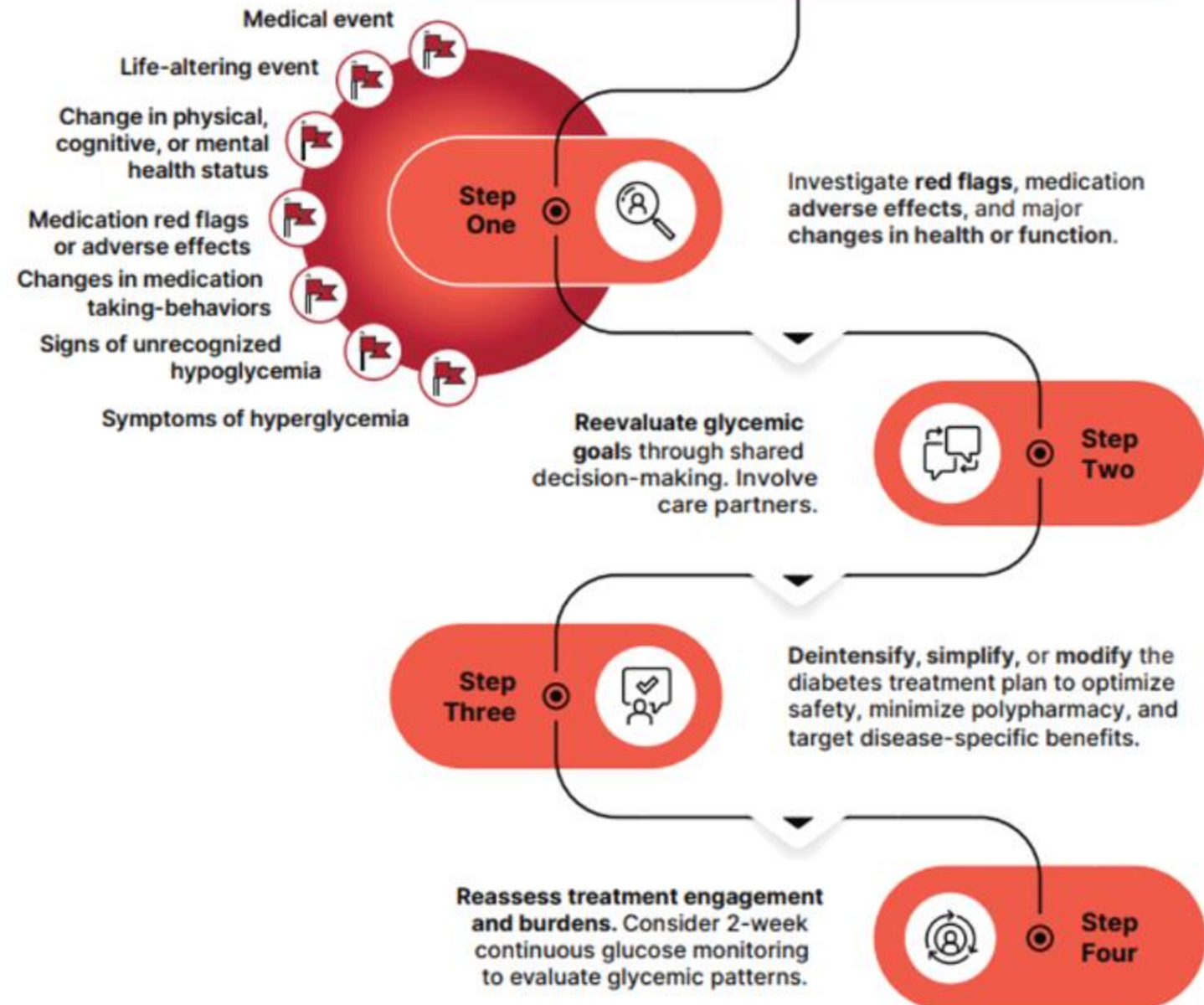


4MS FRAMEWORK OF AGE-FRIENDLY HEALTH SYSTEMS





Assess for difficulty with current diabetes treatment plan in older adults



LIFESTYLE MANAGEMENT

- Optimize nutrition and protein intake

Inadequate nutritional intake, particularly inadequate protein intake, can increase the risk of sarcopenia and frailty in older adults

- Encourage regular exercise:
 - aerobic activity
 - weight-bearing exercise
 - resistance training
- Weight loss (e.g., 5–7%) should be considered for its benefits on quality of life, mobility and physical functioning, and cardiometabolic risk factor control

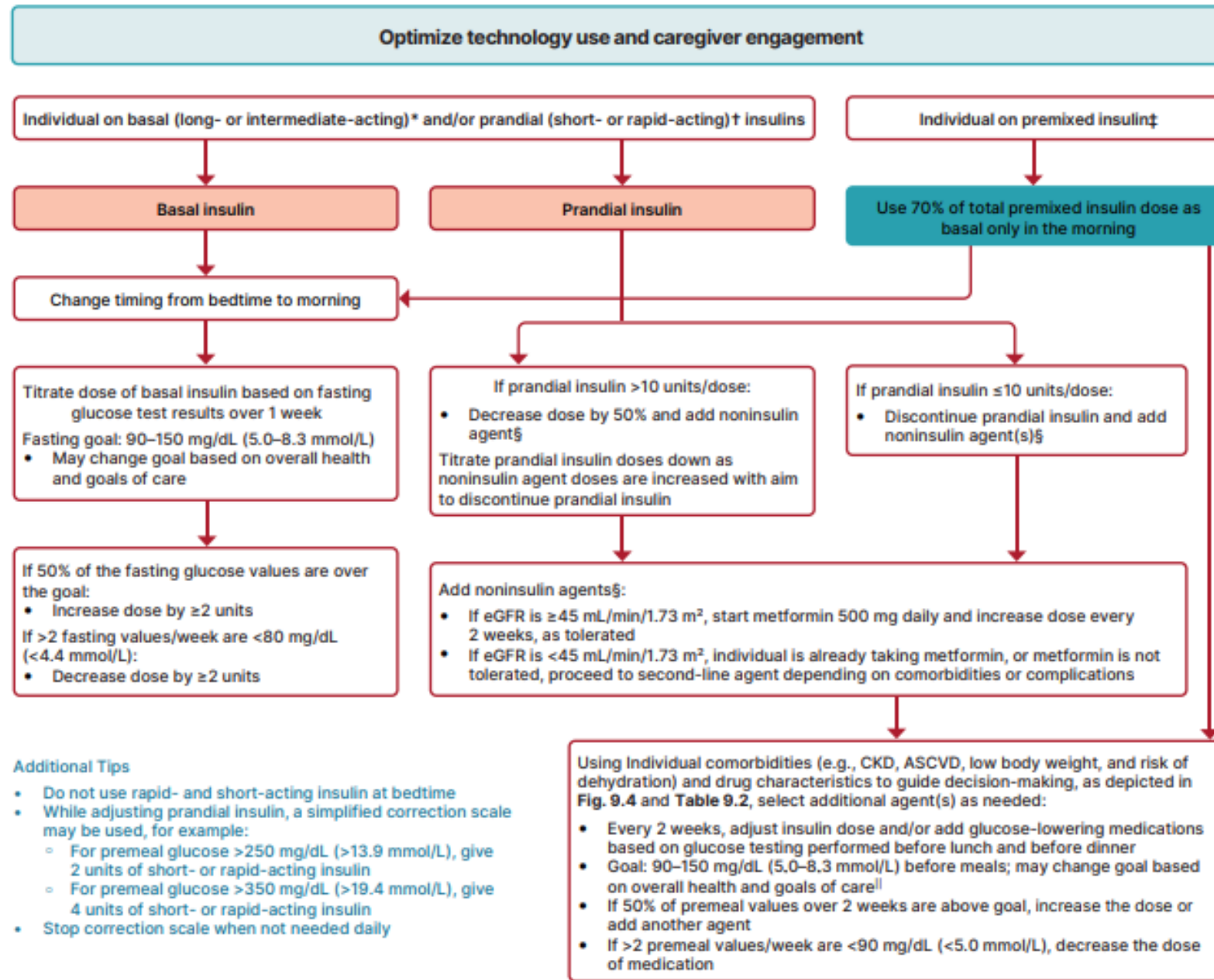
INSULIN

- The increased risk of hypoglycemia due to antidiabetic agents is a major concern when considering treatment options in older adults
- Insulin is the antidiabetic agent most often responsible for hypoglycemia

Characteristics Desired in Insulin Regimens

- Lower risk of hypoglycemia
- Once daily dosing
- Easy to administer

Simplification of complex insulin therapy in people with type 2 diabetes on insulin



SIMPLIFICATION OF INSULIN REGIMEN IN OLDER ADULTS

- 65 T2DM adults 65 years or older
- Using 5-day period of continuous glucose monitoring (CGM)

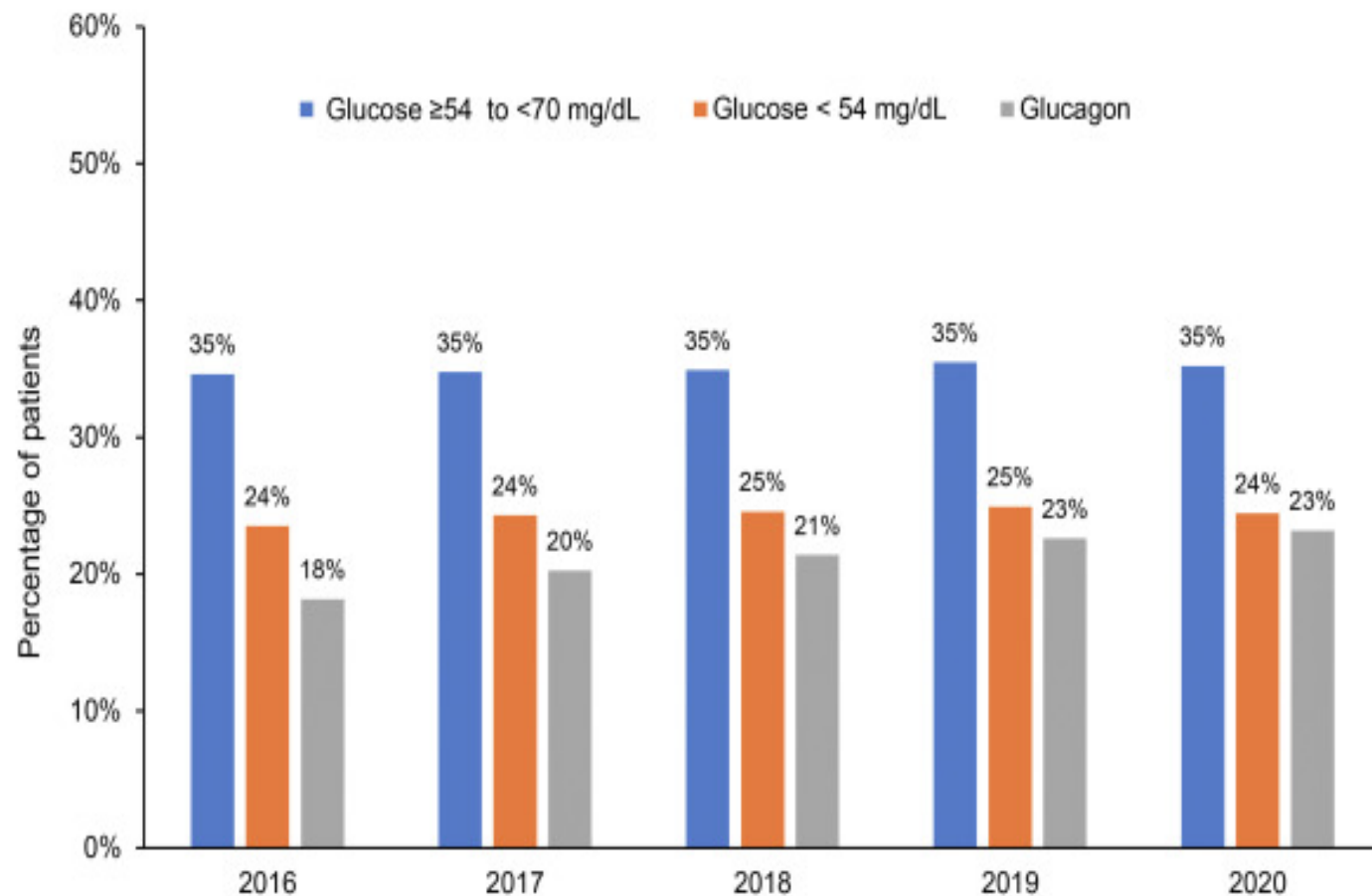
Table. Characteristics Before and After Simplification at 5 and 8 Months

Characteristic	Baseline, Mean (SD)	5 Month, Mean (SD)	P Value	8 Month, Mean (SD)	P Value
Duration of hypoglycemia (<70 mg /dL glucose), min/5-d CGM	277 (252)	111 (184)	<.001	97 (163)	<.001
(Range)	(5-1060)	(0-900)		(0-455)	
HbA _{1c} (%)	7.7 (1.2)	7.5(0.9)	.13	7.7 (1.0)	.23
Duration of hyperglycemia (>250 mg/dL glucose), min/5-d CGM	830 (817)	930 (859)	.42	1083 (1033)	.12
(Range)	(0-4810)	(0-4260)		(0-3555)	
Insulin dose, unit/kg	0.76 (0.41)	0.43 (0.3)	<.001	0.43 (0.2)	<.001
Daily insulin injections, No.	3.7 (1.3)	1.0 (0.3)	<.001	1.0 (0.3)	<.001
Patients taking noninsulin agents, %					
Metformin	38	58		58	
Sulfonylurea	17	32		32	
DPP4 Inhibitor	0	20		20	
GLP-1 RA	8	23		23	
PAID ⁶	26.5 (15.9)	17 (14.5)	<.001	17.3 (15.2)	.003
SCI-2	66.2 (9.2)	68.2 (8.1)	.08	66.7 (10.2)	.80
IADL	13.9 (3.2)	13.8 (3.3)	.90	14.1 (2.8)	.70
ADL	11.5 (1.1)	11.6 (0.8)	.70	11.7 (0.5)	.60
6-min walk test	331.3 (121)	346 (118.9)	.60	353 (115.9)	.80
GDS	3.1 (3.2)	2.6 (2.5)	.40	2.5 (2.8)	.30
CIB test	6.1 (1.8)	6.3 (1.6)	.70	6.2 (1.8)	.80

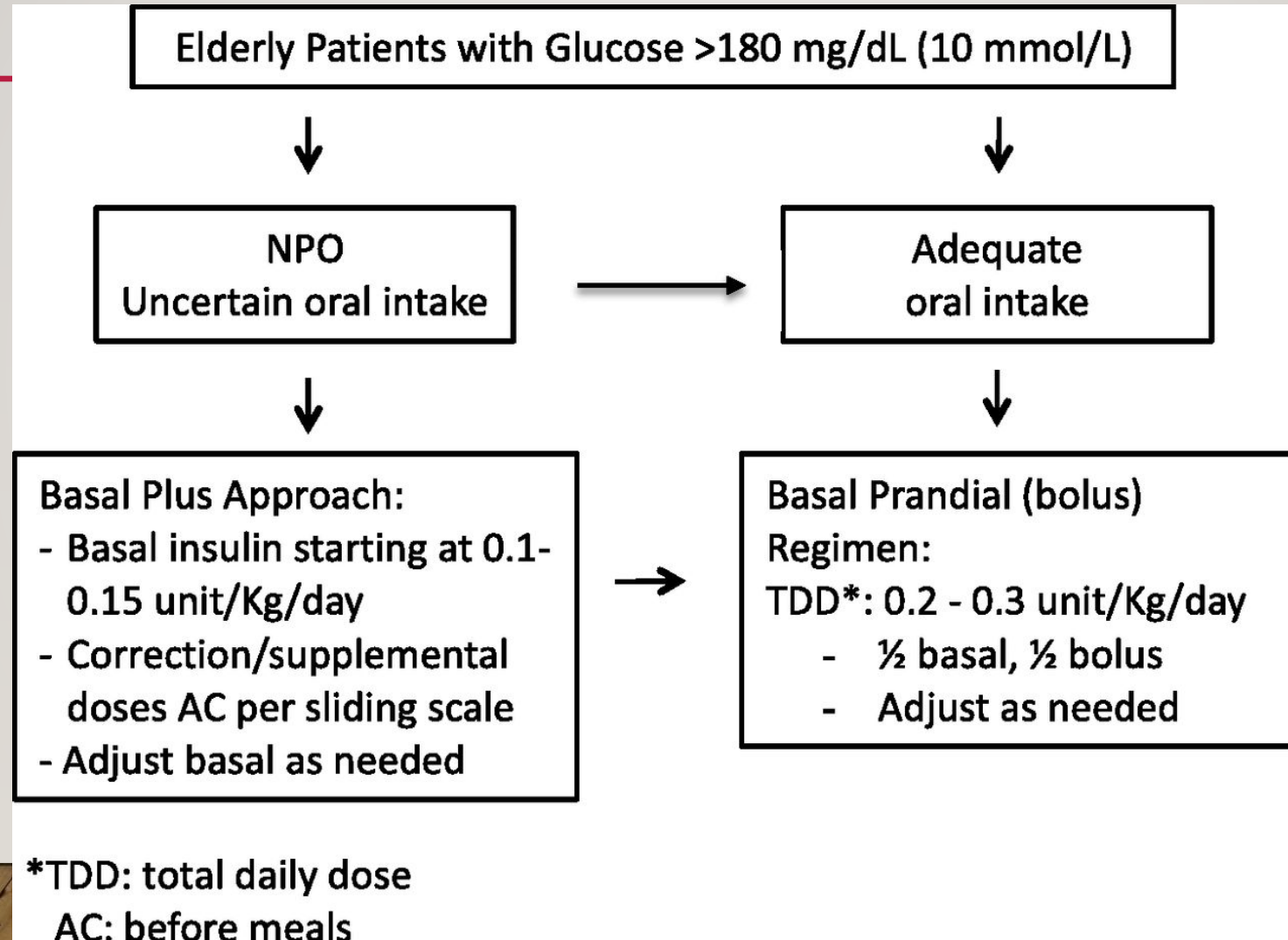


HYPOGLYCEMIA IN LTCF

Percentage of all patients prescribed glucose-lowering medications who experienced hypoglycemia each year, by study-defined hypoglycemia



INSULIN MANAGEMENT IN THE HOSPITAL



METFORMIN

- Metformin has a low risk of hypoglycemia and is weight neutral
- Contraindications: eGFR <30 ml/min/1.73 m², acute heart failure or active decompensated liver disease

Older adults considerations:

- cause gastrointestinal adverse events such as nausea, and diarrhea → higher risk of dehydration
- (rarely) increased risk of lactic acidosis if used in patients with impaired kidney function

INSULIN SECRETAGOGUES

- **Sulfonylureas (SU)**

- **hypoglycemia**, (irregular caloric intake, decreased renal function, and polypharmacy)
- lead to poor outcome and increase 7% to 10% mortality rate if induced hypoglycemia
- higher all-cause mortality compared to metformin
- increased risk of fractures

- **Metiglinides**

- lower rates of severe hypoglycemia with metiglinides when compared to SU in RCTs involving older adults (ambulatory settings)

THIAZOLIDINEDIONES (TZD)

- **Older adults' considerations:**

- fluid retention
- peripheral edema
- weight gain
- macular edema
- heart failure (HF)
- increase risk of CHF exacerbation
- older adults have more prevalence of osteoporosis or osteopenia and TZD has been associated with a higher rate of fractures, particularly in postmenopausal women

DIPEPTIDYL PEPTIDASE-IV(DPP4) INHIBITORS:

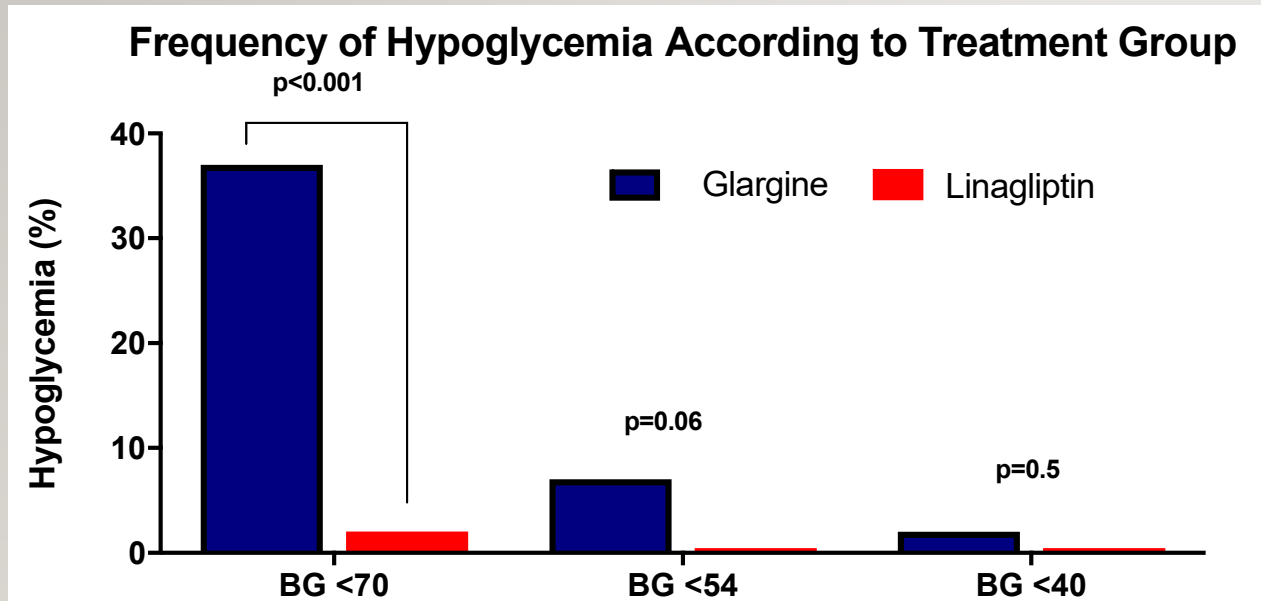
- Improves postprandial glucose levels

Older adults' considerations:

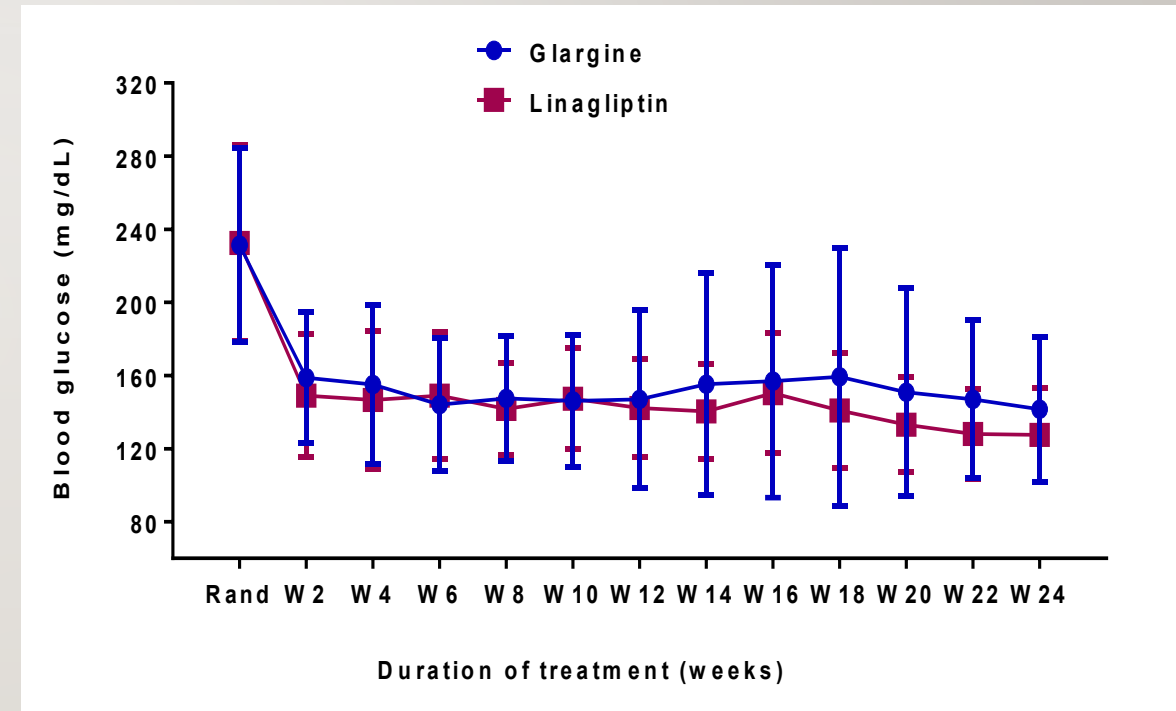
- can be use in the setting of renal dysfunction (after adjustment)
- have limited side effects
- low rate of hypoglycemia

DPP-4I IN LTCF

Glargine at a starting dose of 0.1 U/kg/d



fewer mild hypoglycemic events <70 mg/dl (3% vs 37%)



	Basal	Linagliptin	p
Mean daily BG, mg/dL	157±36	146±34	0.06

GLUCAGON-LIKE PEPTIDE-1 (GLP-1) RA

- + cardiovascular benefits among patients with established atherosclerotic cardiovascular disease
- Renal protection of GLP1-RA (FLOW trial) and possible positive effects on cognitive and memory functions

Older adults' considerations:

- most of GLP1-RA are injectable once daily or weekly
- require visual, motor, and cognitive skills for administration
- gastrointestinal side effects such as nausea and diarrhea (10-28%)
- screen for malnutrition status
- ?effects on bone and lean body mass



SODIUM-GLUCOSE TRANSPORT 2 (SGLT2) INHIBITORS

- Reduced hospitalization for heart failure by 23% in patients with diabetes and reduced the progression of renal disease by 45%

Older adults' considerations:

- + urinary tract infections (UTI) and yeasts infections
- increased risk of euglycemic diabetic ketoacidosis
- osmotic diuresis effects → ++ risk of dehydration (not recommended in hospital settings)
- worsening urinary incontinence (common in older adults)



GLPI-RA & SGLT-2i

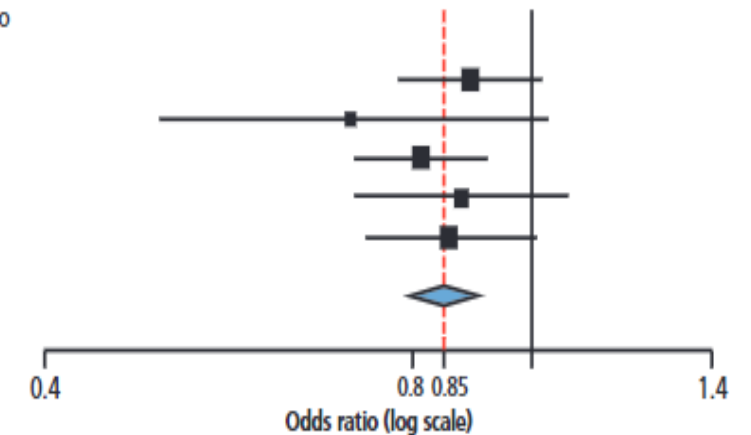
Systematic review for older adults who were eligible for inclusion in these large randomized controlled trials

Yet, frailty levels are unknown

Figure 2. Major adverse cardiovascular events (MACE) in placebo-controlled trials comparing (A) glucagon-like peptide-1 receptor agonists (GLP-1RA) and (B) sodium-glucose co-transporter-2 inhibitors (SGLT-2i) in addition to standard of care in older adults (>65 years).

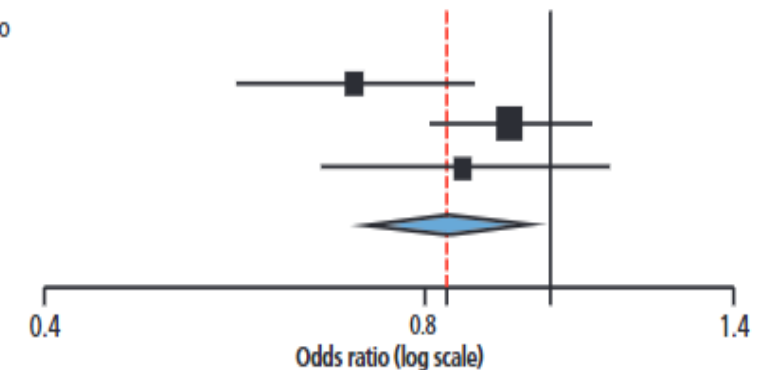
(A)

Studies	Estimate (95% CI)	MACE/GLP-1RA	MACE/Placebo
LEADER >65 year old 2016	0.891 (0.779, 1.019)	468/3471	528/3548
SUSTAIN-6 >65 year old 2016	0.715 (0.498, 1.026)	55/793	76/805
EXSCEL >65 year old 2017	0.812 (0.717, 0.920)	546/3573	657/3616
HARMONEY >65 year old 2018	0.875 (0.718, 1.065)	204/2356	235/2403
REWIND >65 year old 2019	0.855 (0.728, 1.003)	331/2314	384/2350
Overall ($I^2=0\%$, $p=0.746$)	0.847 (0.788, 0.910)	1604/12507	1880/12722



(B)

Studies	Estimate (95% CI)	MACE/SGLT-2i	MACE/Placebo
Empa-Reg >65 year old 2015	0.701 (0.565, 0.870)	239/2091	161/1036
DECLARE >65 year old 2019	0.927 (0.801, 1.072)	390/3951	418/3956
CREDENCE >65 year old 2019	0.854 (0.659, 1.108)	120/1009	143/1048
Overall ($I^2=5478\%$, $p=0.110$)	0.831 (0.699, 0.989)	749/7051	722/6040



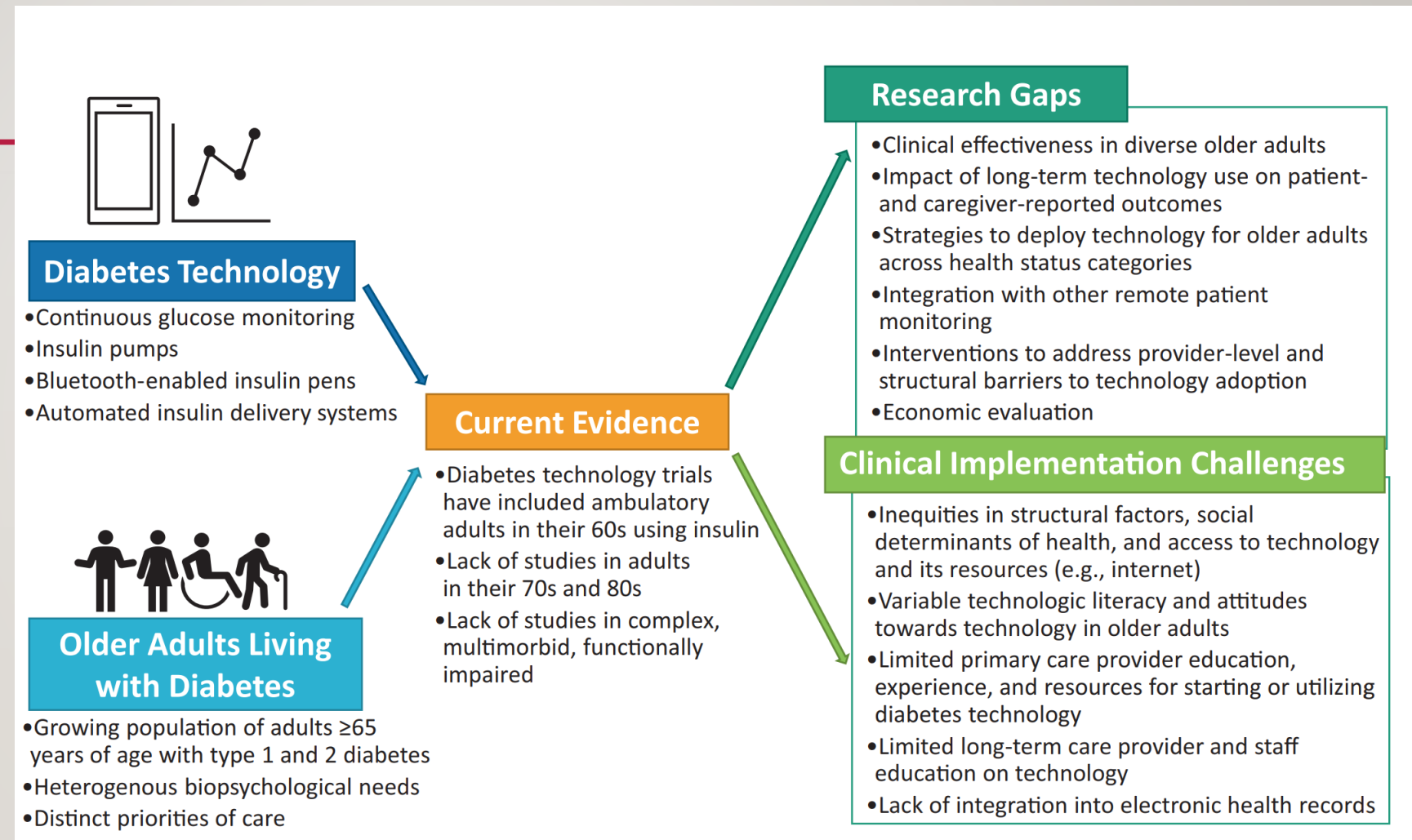


DM TECHNOLOGY

13.5 Recommend continuous glucose monitoring (CGM) for older adults with **type 1 diabetes** to improve glycemic outcomes, reduce hypoglycemia, and reduce treatment burden. **A**

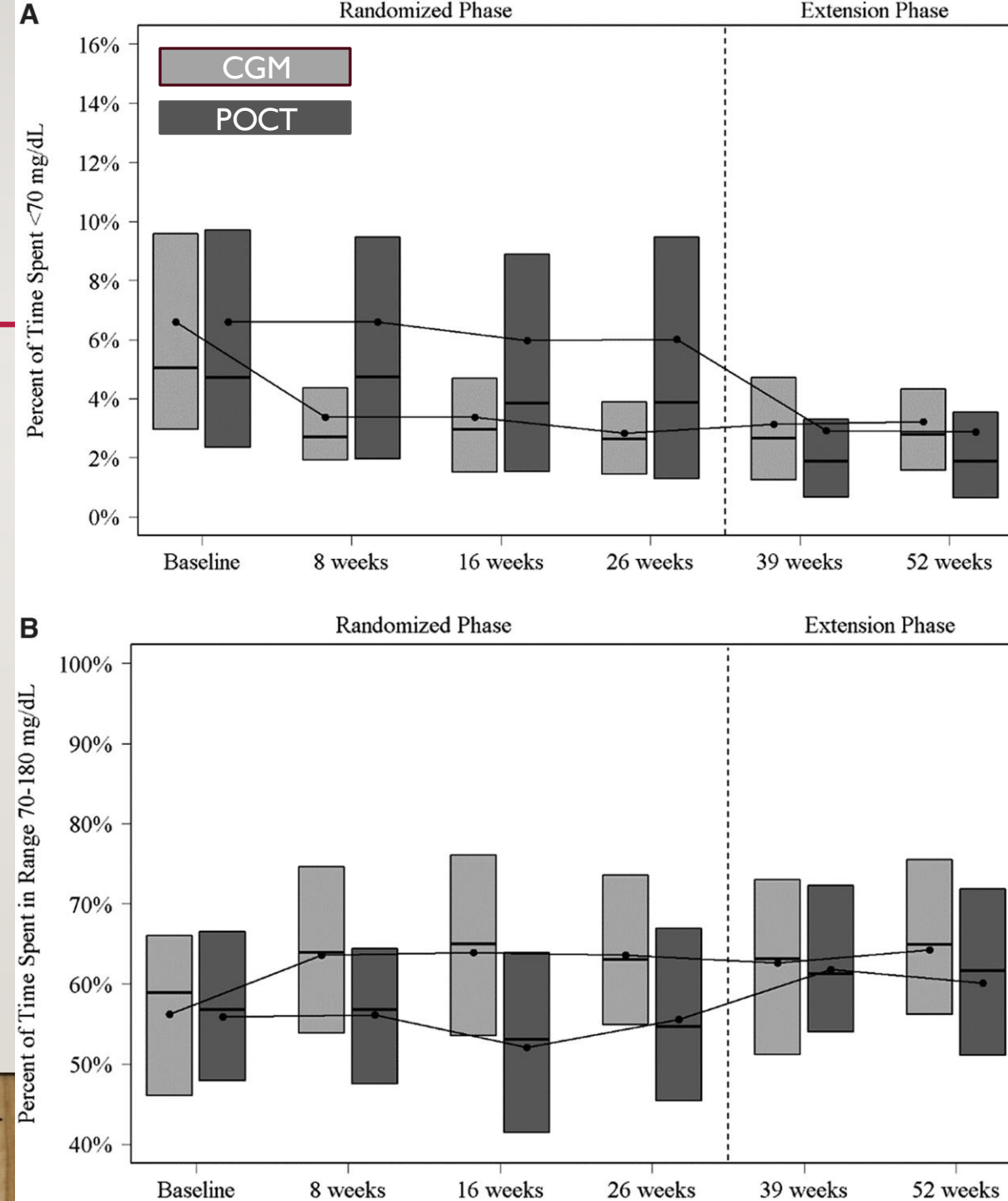
13.6 Offer CGM for older adults with **type 2 diabetes on insulin therapy** to improve glycemic outcomes and reduce hypoglycemia. **B**

13.7 Consider the use of automated **insulin delivery systems**, **A** mechanical insulin delivery systems, **E** and other advanced insulin delivery devices such as connected pens **E** to reduce risk of **hypoglycemia for older adults**, based on individual ability and support system.



The Wireless Innovation in Seniors with Diabetes Mellitus (WISDM) trial

- CGM vs No-CGM
- Statistically significant reduction in time spent with hypoglycemia (glucose level <70mg/dL)
- Glycemic variability was reduced with CGM → increase time spent in range (70-180 mg)/dL



WHY CGM FOR LTCF?

Patient QoL

- 3-4 POCT daily vs one click every 10-15 days

Staff burden

- POCT vs one click
- In 2021, 30% LTCF reported staff shortages

Exposure

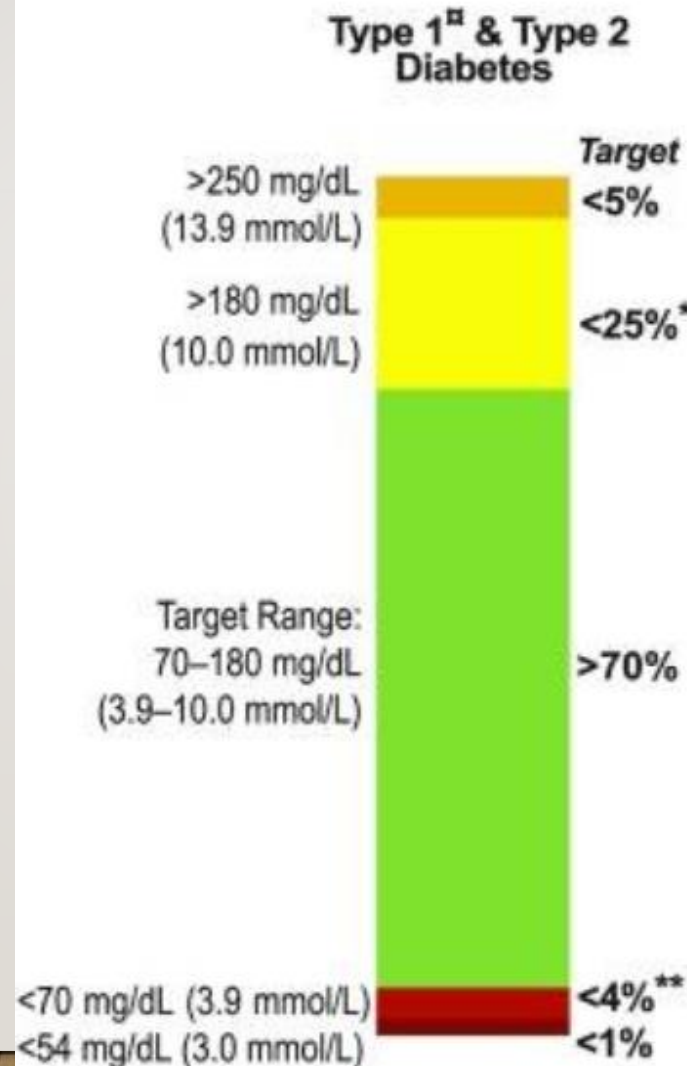
- In 2022, report of 149,000 residents and nearly 2,200 staff members death due to COVID-19 in LTCFs

Hypoglycemia in older adults

- Insulin and SU are responsible for most cases of hypoglycemia
 - *Decreased cognition
 - *Polypharmacy
 - *Renal dysfunction
 - *Unpredictable eating behavior



CGM METRICS TARGETS

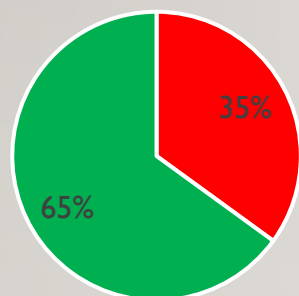


HYPOGLYCEMIA DETECTION IN LTCF



71,200 to 120,861 residents

■ Hypoglycemia

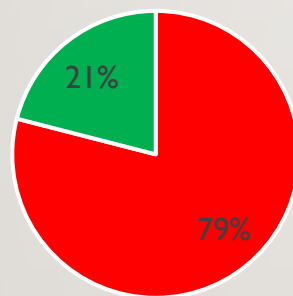


Real world database
USA 2016 to 2020

~ 40% had dementia

42 residents

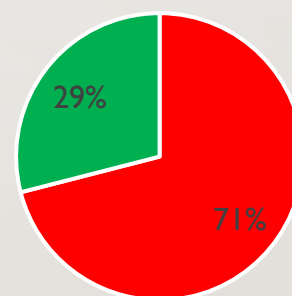
■ Hypoglycemia



Six geriatric centers
France 2019 – 2020

21 residents

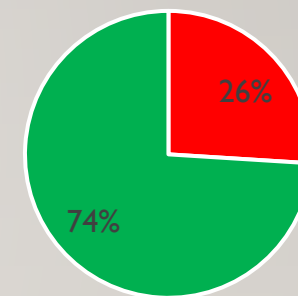
■ Hypoglycemia



One geriatric center

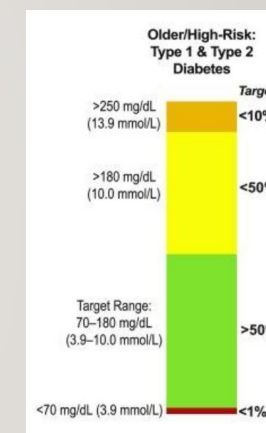
65 residents

■ TBR (<70) > 1%



Eight LTCF in Ohio and Michigan

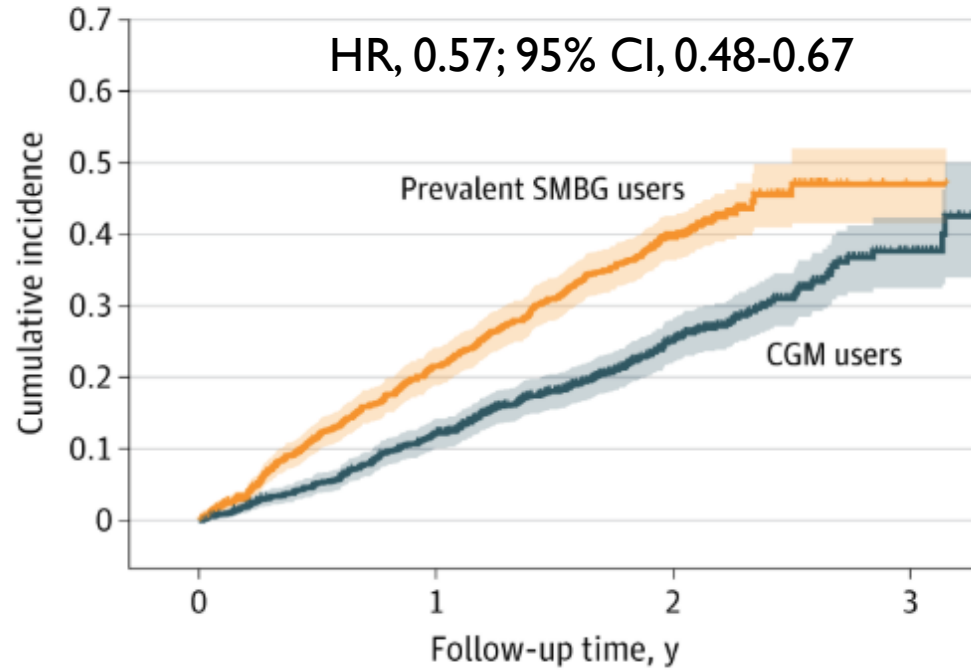
~ 27% had cognitive impairment



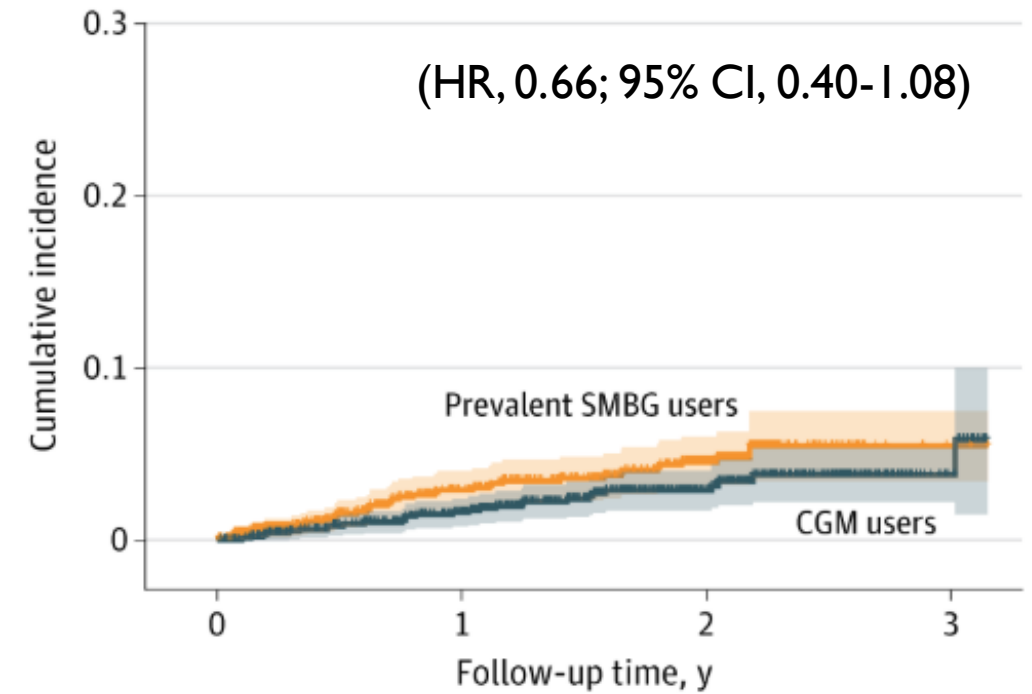
CGM And Alzheimer Disease And Related Dementias

- 1034 CGM users matched to SMBG users
- 15% random sample of Medicare claims data
- 2016 to December 2020

All-cause mortality



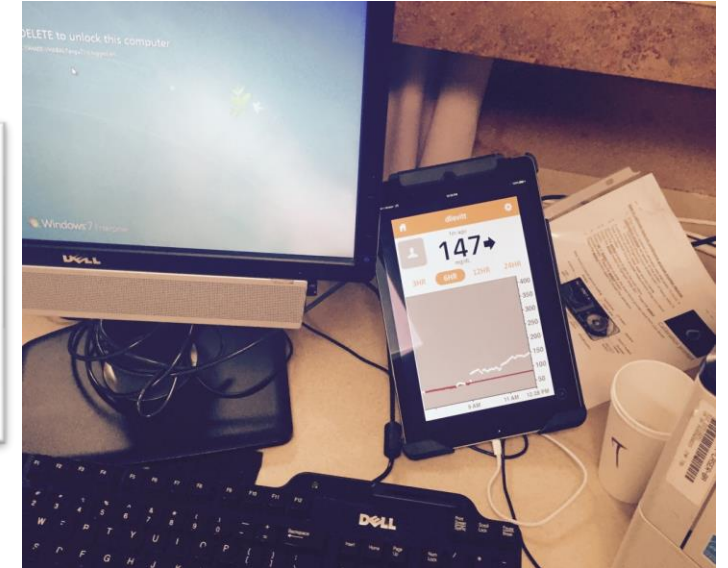
Hypoglycemia hospitalization





DM MANAGEMENT USING CGM IN LTCF

Glucose Telemetry System (GTS)



Real time CGM

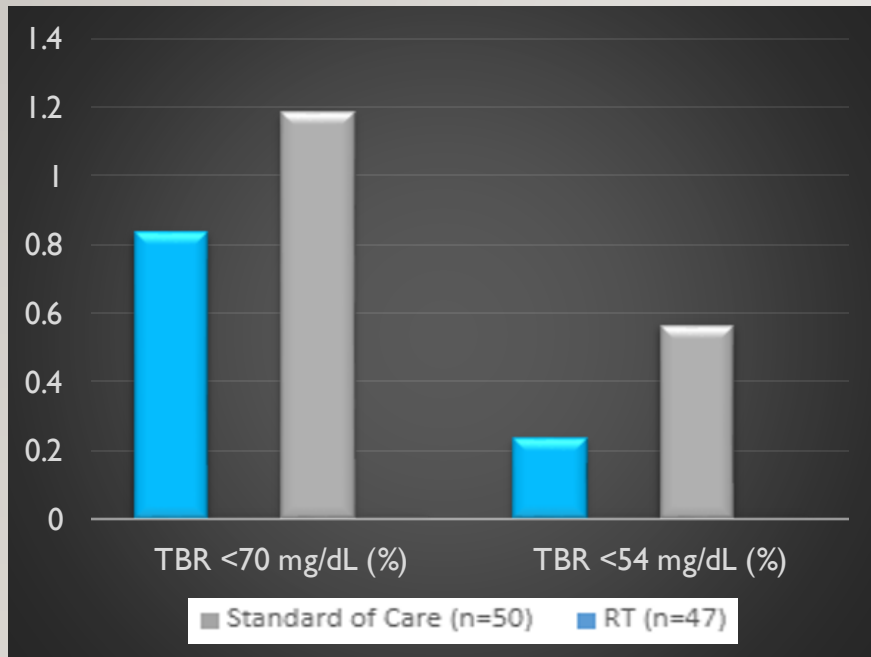


Cellphone

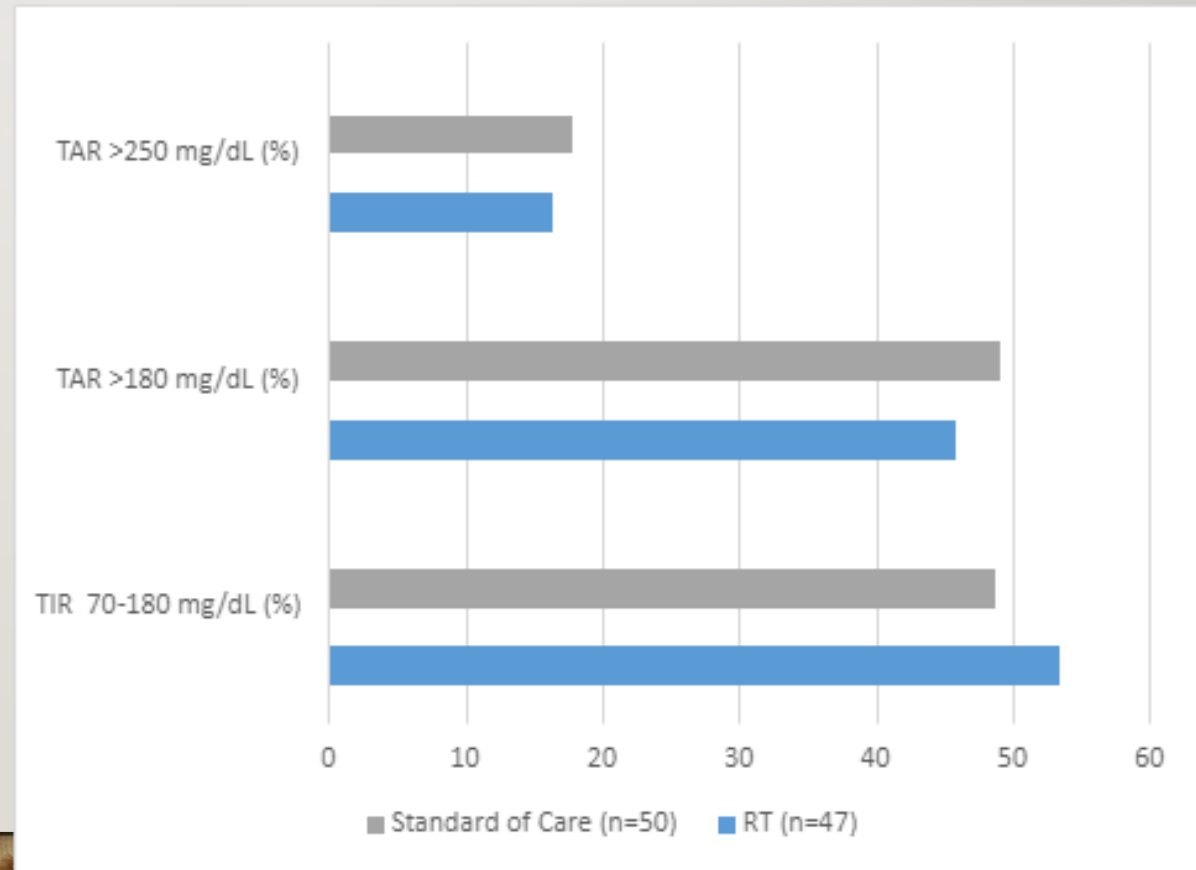


Tablet and remote monitoring
with alarms

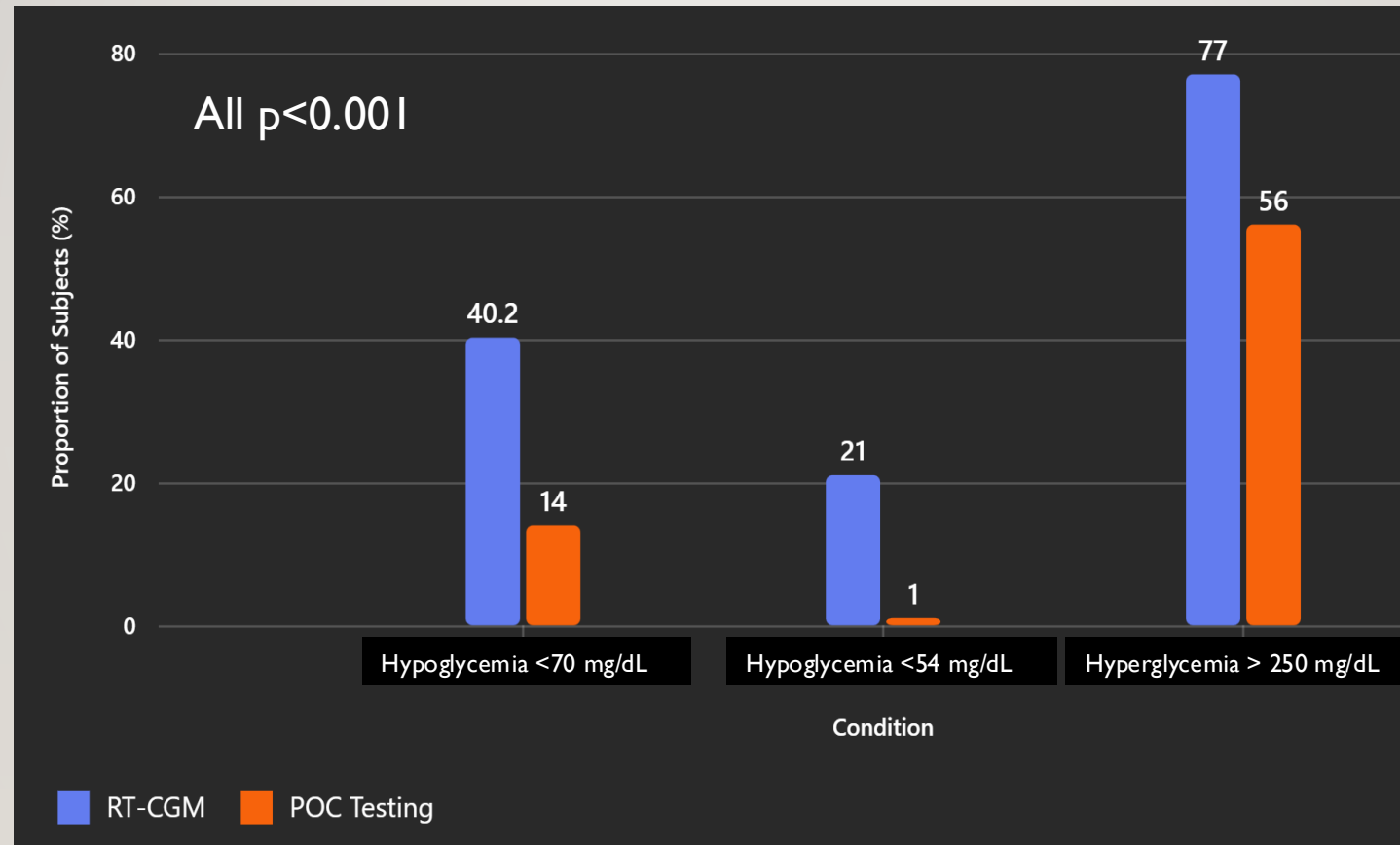
CGM-guided Insulin Adjustment In LTCF



Variable	RT (n=47)	Std of Care (n=50)	P-value
TBR <70 mg/dL (%)	0.83 ± 2	1 ± 3	0.51
TBR <54 mg/dL (%)	0.23 ± 0.85	0.56 ± 2	0.88



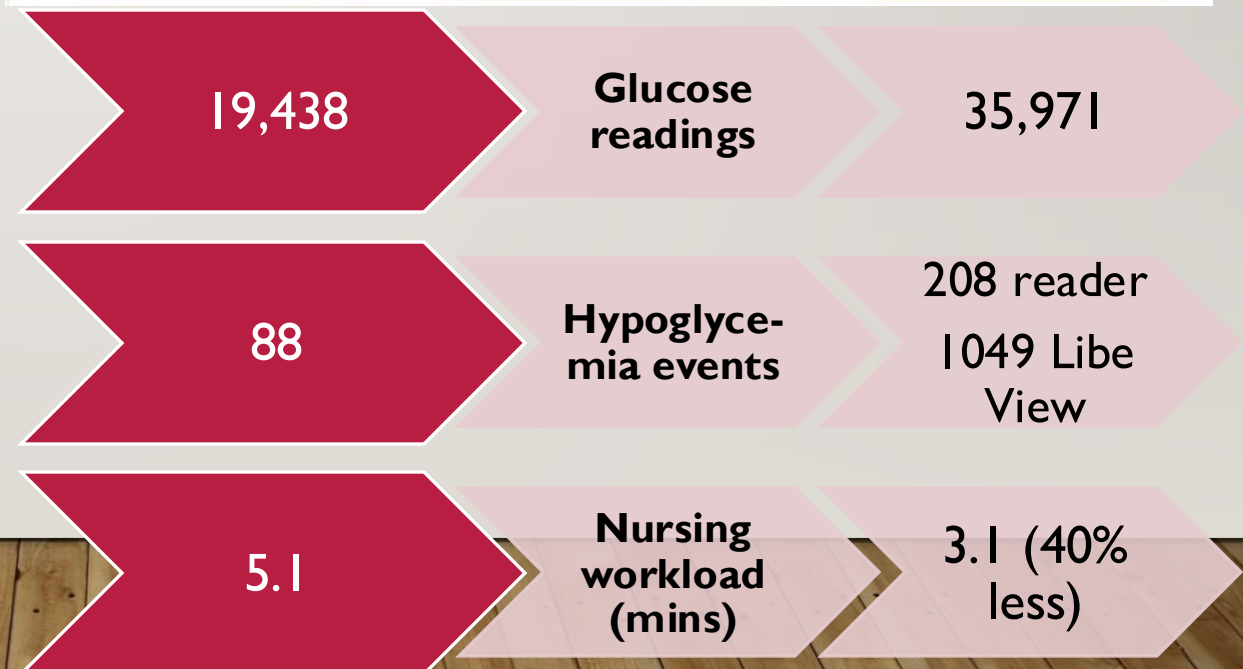
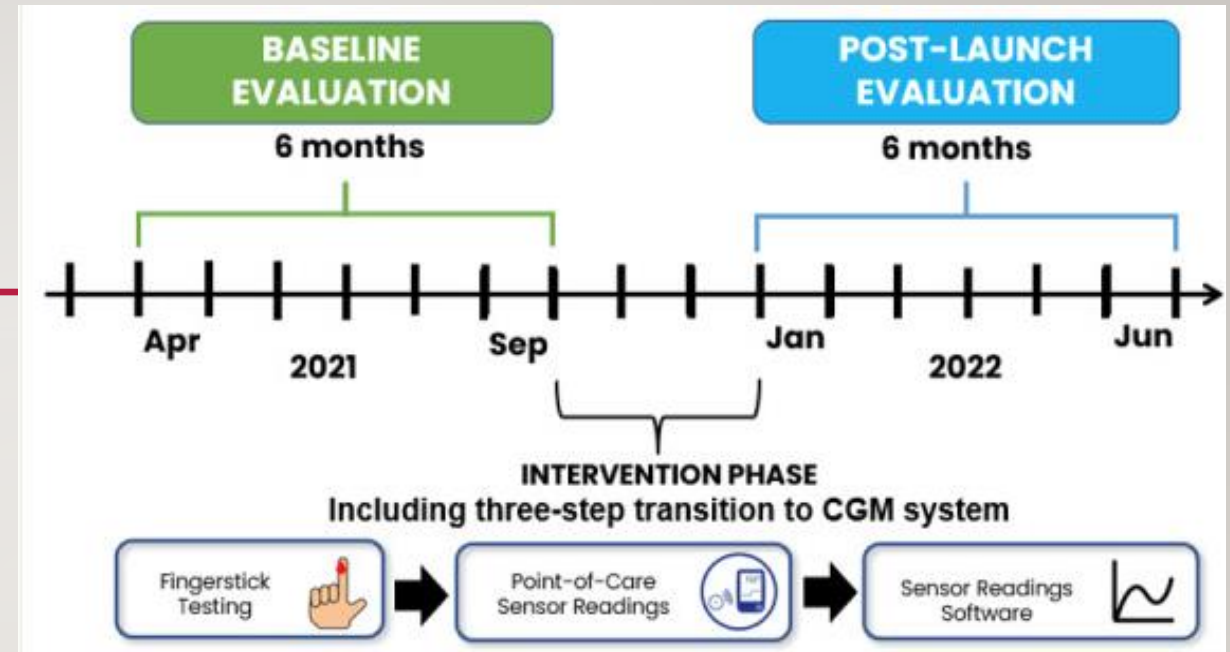
CGM-GUIDED INSULIN ADJUSTMENT IN LTCF



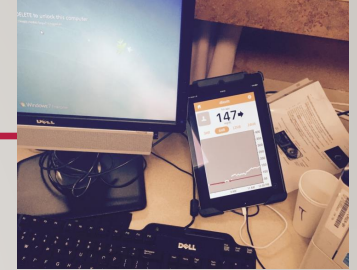
Pilot QI Using CGM In LTCF

- FreeStyle Libre 2
- Canada 2 LTCF

34 hours of nursing time could be saved per resident per year.



Practical Points

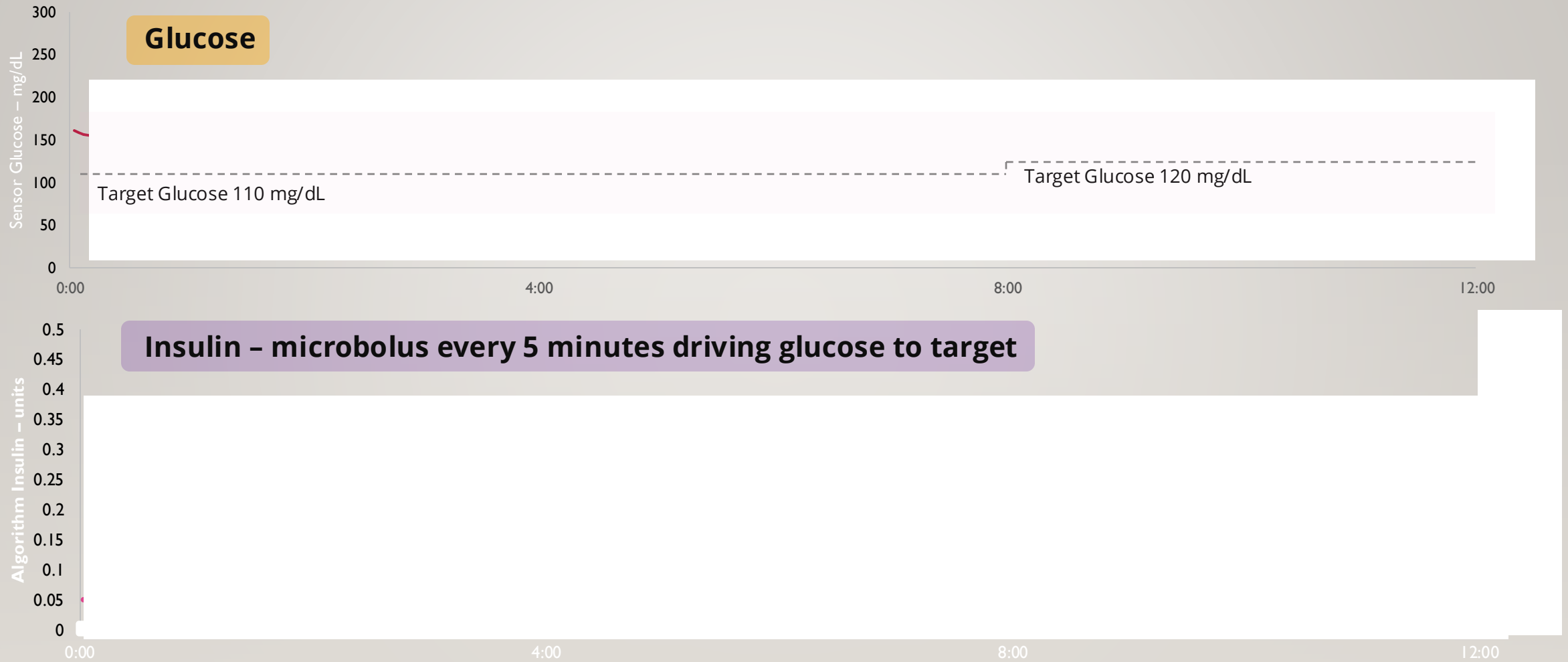


- Best candidate?
(? moderate to severe cognitive dysfunctions/ delirium)
- Family involvement/education
- Who applies the sensor? And create account so data can be shared

- WiFi vs LTE
(Connectivity issues and cost)
- What if resident left the room?
(PT)
- Tech champion

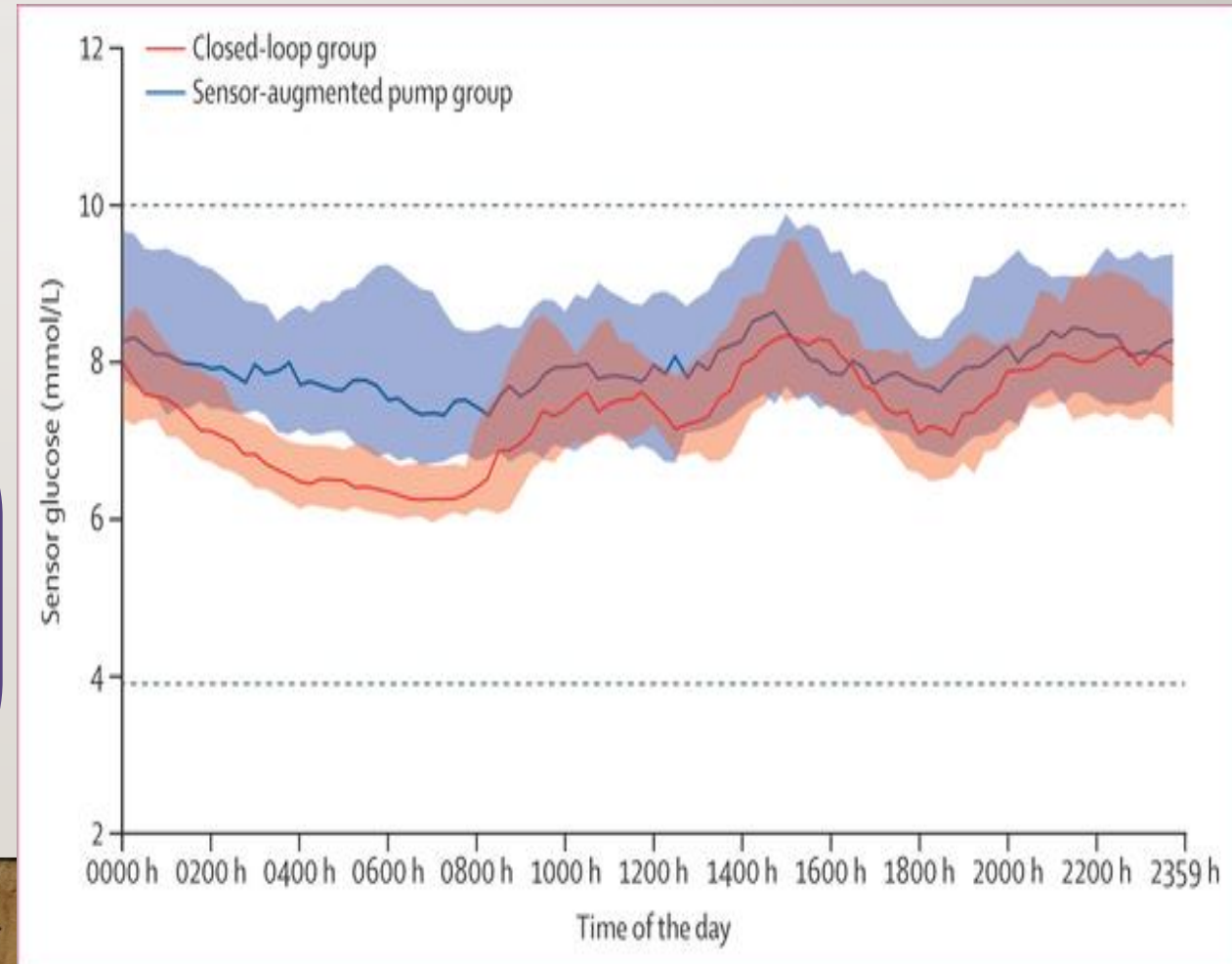
- Location of the tele monitoring
(ipad)
- Alarm cut offs and responsibility
- Who adjust DM management
(remote endo vs local providers)
- How frequently data should be
evaluated
- Training and education

Insulin Pump Algorithm



DM Technology- Insulin Pump

- T1DM > 60 years
 - T1DM 12 months or more
 - insulin pump therapy for 3 months or more
 - RCT, cross-over for 16 weeks
- increase in time in range by 8.6 percentage points and a reduction in HbA_{1c} of (0.2%) without increasing the time in hypoglycemia.
 - closed-loop usage in the present study was high, suggesting high acceptability of this therapy in this age group.



Closed-Loop Insulin Delivery Versus Sensor-Augmented Pump Therapy in Older Adults With Type 1 Diabetes

- To assess the efficacy and safety of closed-loop insulin delivery compared with sensor-augmented pump
- Age :+60
- 30 participants

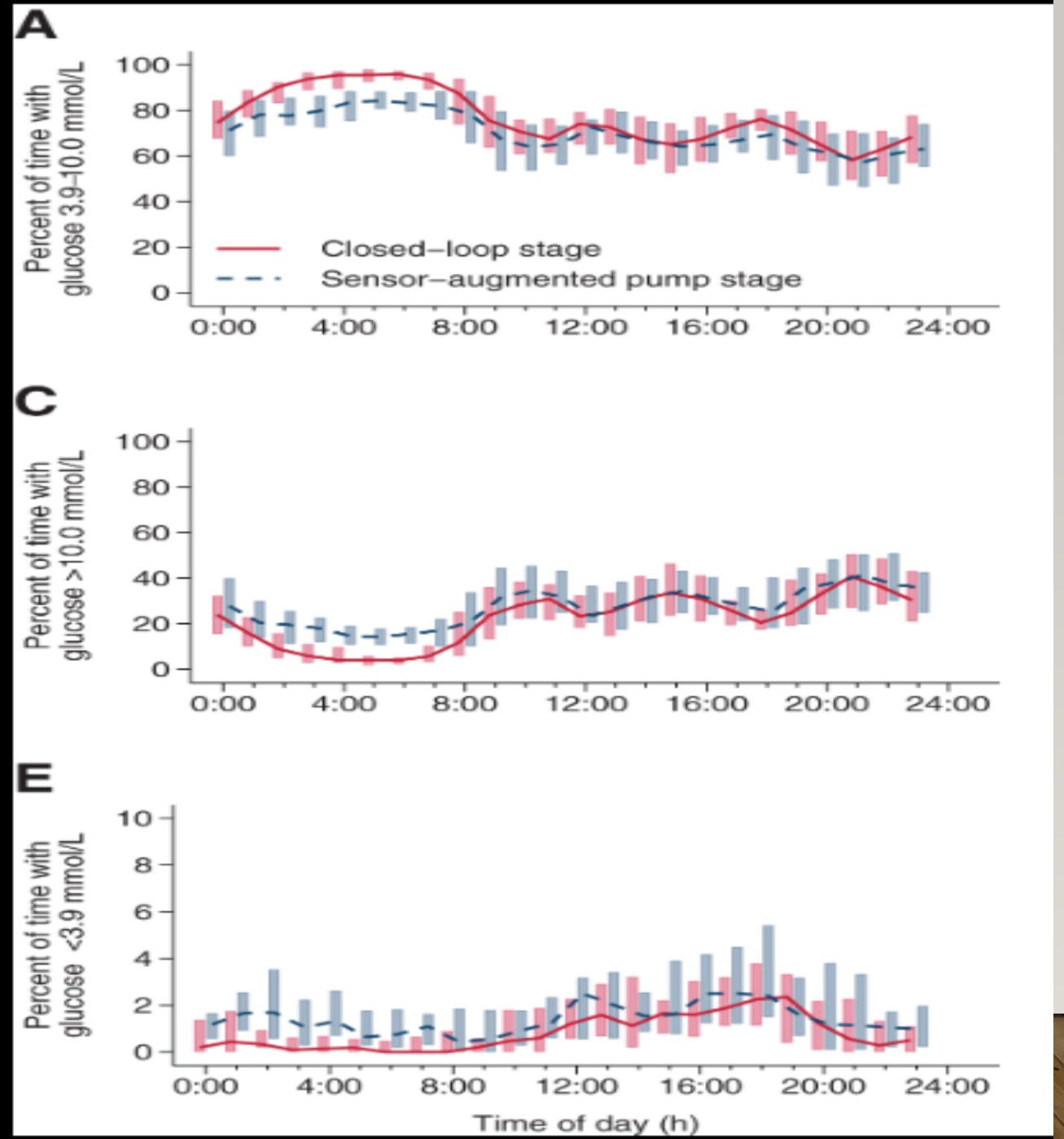
moderate or severe dementia were excluded

Older Adults'(ORACL) Study: RCT

Impaired awareness of hypoglycemia	
Gold score ≥ 4	10 (33)
Clarke score ≥ 4	9 (30)
Montreal Cognitive Assessment (MoCA)	
MoCA score	27 (26–28)
Normal cognitive function (MoCA score ≥ 26)	24 (80)
Mild cognitive impairment (MoCA score 18–25)	6 (20)
Mini Mental State Examination score	30 (29–30)
Verbal IQ	
National Adult Reading Test score	37 (32–44)
National Adult Reading Test ≥ 1.5 SD below normative data	0 (0)
Executive functioning	
Trail Making Task B, s	85.5 (60.6–110.3)
Trail Making Task B ≥ 1.5 SD below normative data	3 (10)
Psychomotor speed	
Symbol Digit Modalities Test (<i>n</i> correct)	41 (34–46)
Symbol Digit Modalities Test ≥ 1.5 SD below normative data	0 (0)
Trail Making Task A, s	29.5 (24.8–40.5)
Trail Making Task A ≥ 1.5 SD below normative data	2 (7)
Grooved pegboard (dominant), s	82 (75–100)
Pegboard (dominant) ≥ 1.5 SD below normative data	5 (17)
Grooved pegboard (nondominant), s	102 (80–117)
Pegboard (nondominant) ≥ 1.5 SD below normative data	3 (10)
FRAIL scale categories	
Nonfrail	24 (80)
Prefrail	6 (20)
Frail	0 (0)

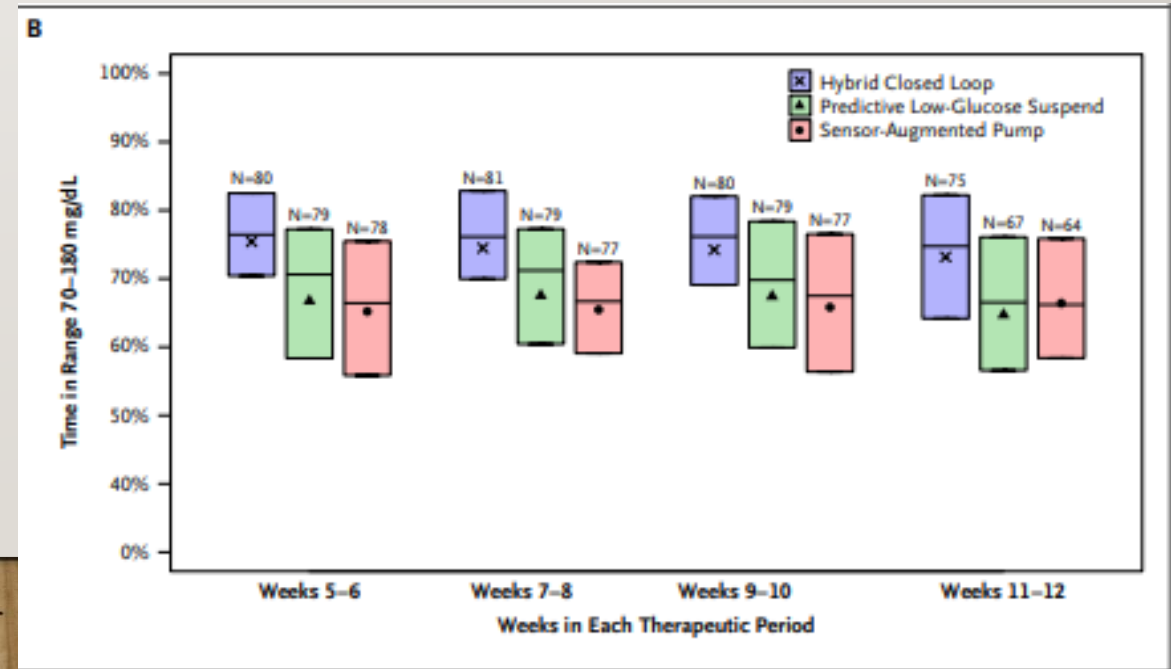
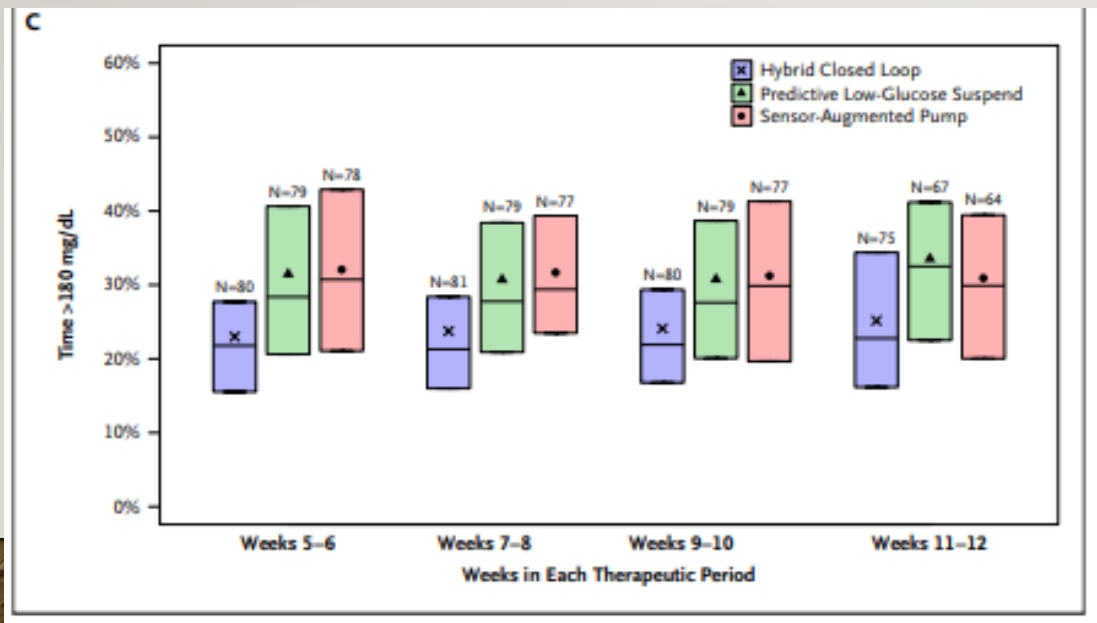
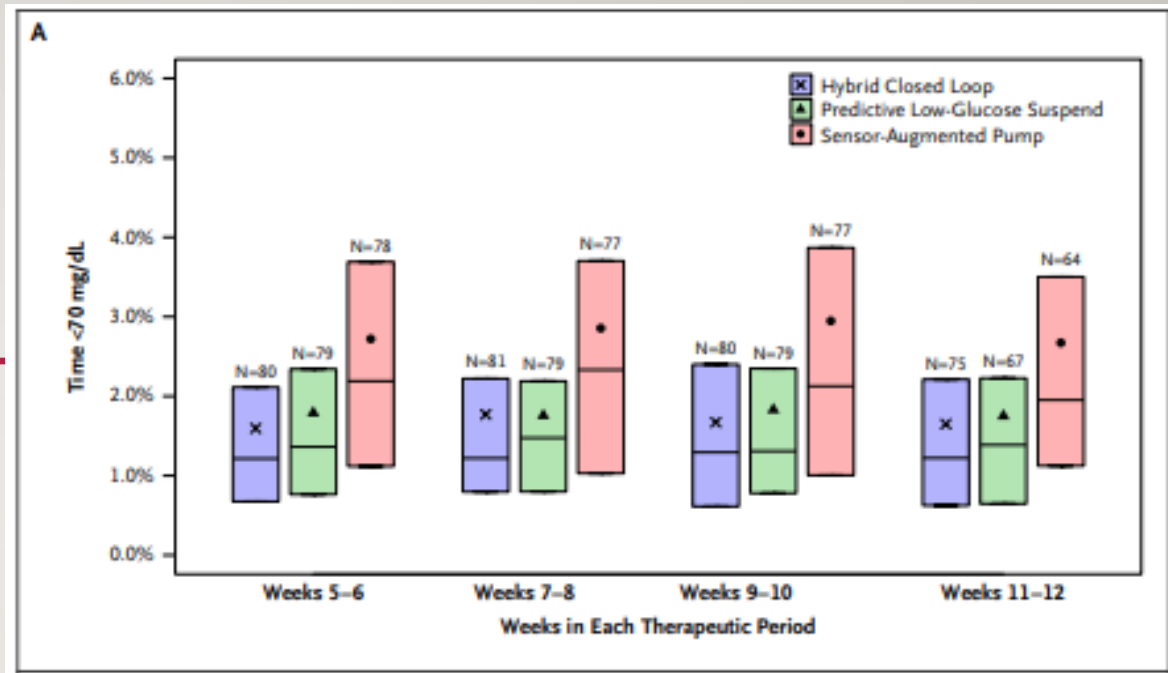
Older Adults' (ORACL) Study

Closed loop reduced the time spent in hypoglycemic range overnight



Older Adults' AID Study (2IQP Trial)

- randomized crossover trial
- > 65 years T1D
- 82 participants
- 27% mild cognitive impairment
- 12-week periods
- baseline mean A1c 7%



Older Adults' AID Study (2IQP Trial)



Efficacy, regardless of cognitive impairment status (mild)



System usability and technology acceptance



More technical support



Double the visits/calls/contacts

Thank you

Thayer Idrees, MD

Tidrees@emory.edu