CONTINUOUS GLUCOSE MONITORING IN ELDERLY PATIENTS WITH DIABETES MELLITUS

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Objective

- Upon completion of this activity, participants will be able identify the benefits of continuous glucose monitoring in elderly patients with diabetes mellitus

Let's start with a case

- 78 year old male with type 2 diabetes mellitus since 1982
- Currently on glargine 11 units at night and lispro with a carbohydrate ratio of 1 unit for every 10 grams of carbohydrate and correction scale of 1 unit for every 50 in BG over 150
- His hemoglobin A1c has ranged from 6.8-8.1% over the last 2 years
- He has hypoglycemia awareness and has hypoglycemia 1-2 times/week on average
- He checks his fingerstick BG 4-6 times daily
- In the last several years he has had 3 episodes of nocturnal hypoglycemia that required EMS to be called

Doctor:		Glucose Average:	167
Result Type:	mg/dL / Plasma	Glucose High:	504
Standard Deviation:	98	Glucose Low:	38
Before Meal Target:	70 - 130	# of Readings:	159
After Meal Target:	70 - 180	% Within Target:	35.8%
Overall Target:	70 - 130	% Above Target:	50.9%
Hypoglycemic Level:	69	% Below Target:	13.2%

Blood Tests

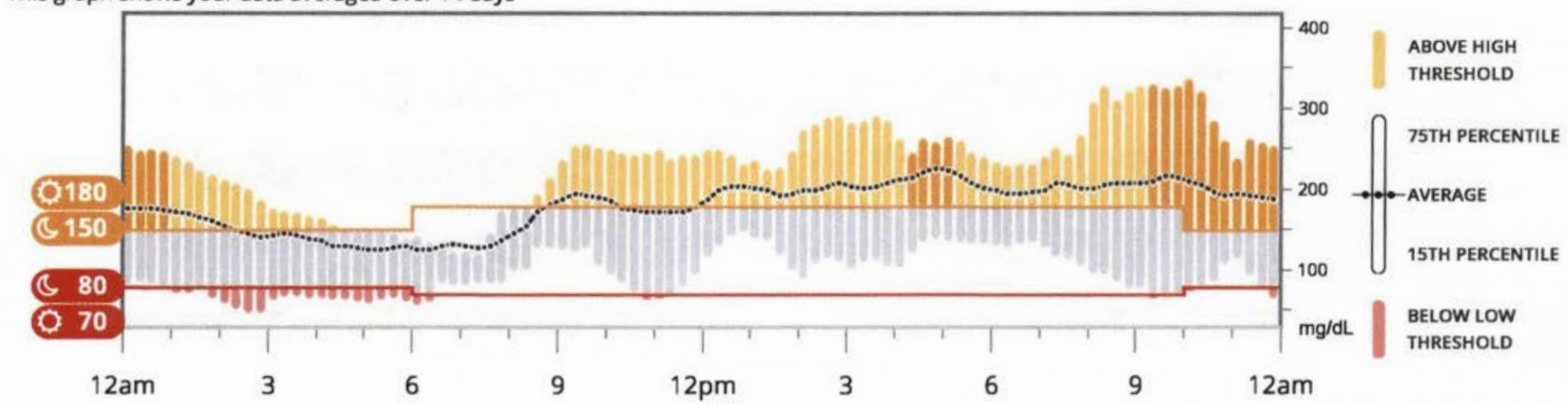
Date/Time	Result	Event Marker
1/18/2017 8:28:00 AM	102	
1/18/2017 10:54:00 AM	257	
1/18/2017 2:29:00 PM	504	
1/18/2017 5:47:00 PM	48	
1/18/2017 9:15:00 PM	128	
1/19/2017 8:10:00 AM	80	
1/19/2017 11:10:00 AM	88	
1/19/2017 2:04:00 PM	92	
1/19/2017 5:15:00 PM	66	
1/19/2017 9:11:00 PM	353	
1/20/2017 8:35:00 AM	125	
1/20/2017 11:30:00 AM	121	
1/20/2017 4:04:00 PM	198	
1/20/2017 9:16:00 PM	191	
1/21/2017 7:50:00 AM	64	
1/21/2017 10:59:00 AM	99	
1/21/2017 2:16:00 PM	155	
1/21/2017 5:14:00 PM	103	
1/21/2017 9:04:00 PM	154	
1/22/2017 8:03:00 AM	232	
1/22/2017 10:46:00 AM	60	
1/22/2017 2:14:00 PM	147	
1/22/2017 5:41:00 PM	292	
1/22/2017 9:14:00 PM	414	

178	86	HIGH / MODERATE / **LOW** / MINIMAL	45% / 7% / 3%	CGM data 13 / 14
mg/dL	mg/dL			Avg. calibrations per day 1.4
Average glucose (CGM)	Standard deviation (CGM)	Hypoglycemia risk	Time in range	Sensor usage

Top Patterns

1. **Patient had a pattern of nighttime highs**
   Patient had a pattern of significant highs between 9:25 PM and 12:50 AM.
2. **Patient had a pattern of daytime highs**
   Patient had a pattern of significant highs between 4:25 PM and 5:10 PM.
3. **Patient's best glucose day was March 9, 2019**
   Patient's glucose data was in the target range about 79% of the day.

This graph shows your data averaged over 14 days



Review of available CGM's

Freestyle Libre

Medtronic Guardian 3

DexCom G6

Summary of CGM systems available

	Freestyle Libre	DexCom G6	Medtronic Guardian 3
Indicated wear life	14 days	10 days	7 days
Calibration with FSBG required	No	No	Yes
Immediate access to glucose values	Only when scanned by device	Yes	Yes
Alters/alarms	No	Yes	Yes
Trend arrows	Yes	Yes	Yes
Integration with insulin pump	No	Yes, Tandem t:slim X2	Yes, Medtronic MiniMed 670G or 630G
Integration with smart phone	Yes	Yes	Yes
Share CGM data with others	No	Yes	No

Adapted from Adolfsson, Eur Endocrinol. 2018

Cost of CGM

- Patients who are covered by Medicare can expect to cover 20% of the costs, although this additional amount may be covered by secondary insurance. Medicare will cover the remaining 80%.
- DexCom G6
  - Box of sensors (3 sensors that last 10 days/sensor): $349 (same as G5, though you get three sensors lasting 10 days, vs. four sensors lasting 7+ each)
  - Two transmitters: $475 per bundle (compared to $599 per bundle for G5)
  - Touchscreen receiver: $365
- Freestyle Libre
  - 10-day Libre sensor - $35.99 (about $108 per month)
  - Reader (one time purchase) - $69.99

Blood glucose test strips can cost between $0.50-$1/strip

Medicare requirements to obtain CGM

The beneficiary has to meet all requirements:

1. Testing BG 4 or more times daily
2. Treated with 3 or more daily injections or using an insulin pump
3. Insulin regimen requires frequent adjustments
4. Had a visit to assess diabetes within 6 months of initiating CGM
5. Must have a visit every 6 months to assess diabetes

medicare.gov

How can CGM help older patients with diabetes

- Prevention of hypoglycemia
- Reduction in hyperglycemia
- Quality of Life

Hypoglycemia is common in older patients

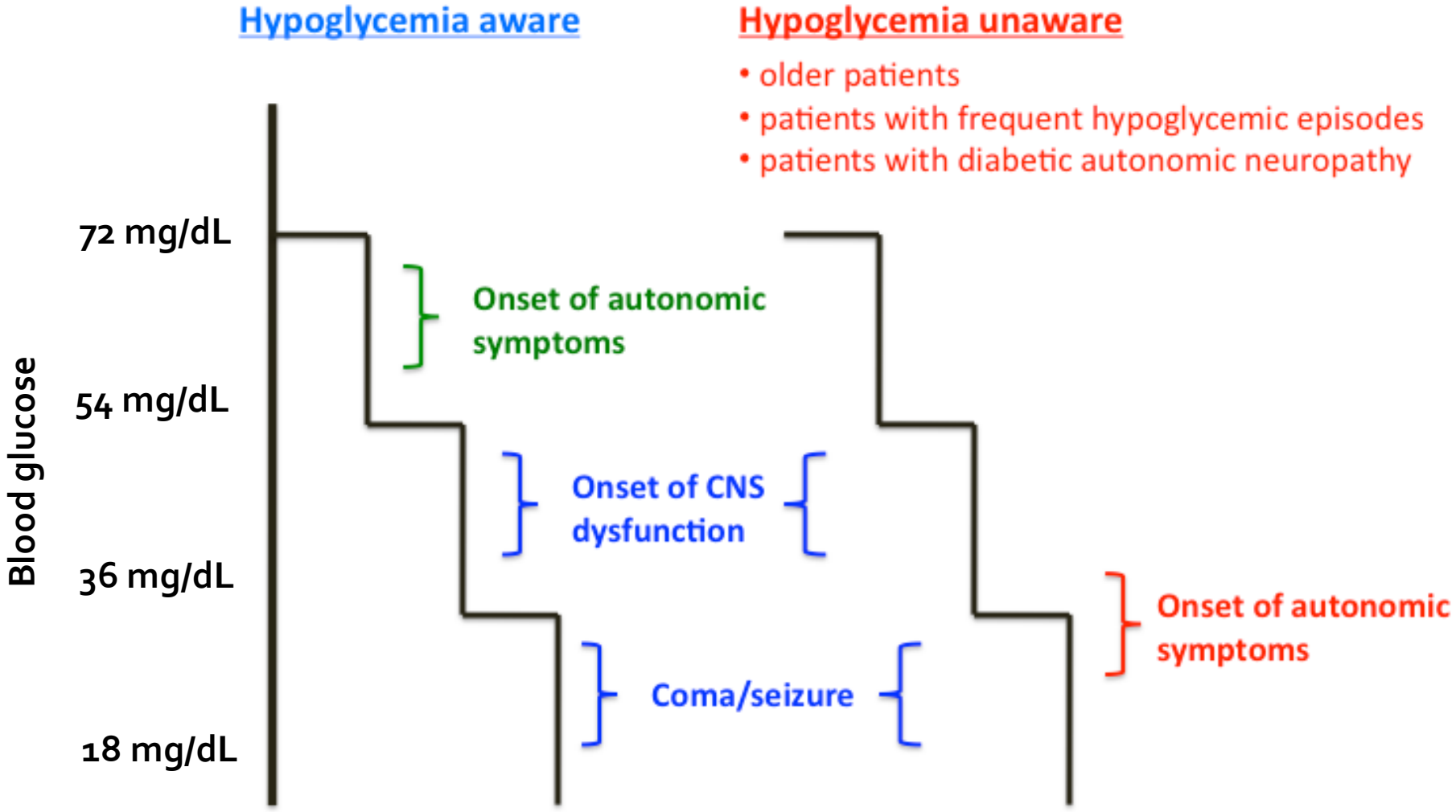
- Insulin is the 2nd most frequent medication associated with ED visits in people over 65 in the US
- Hospital admissions for hypoglycemia are more common than hospital admissions for hyperglycemia in Medicare beneficiaries
- Hypoglycemia rates have been reported to be as high as 41.9% in long-term care facilities

Budnitz, Ann Intern Med. 2007

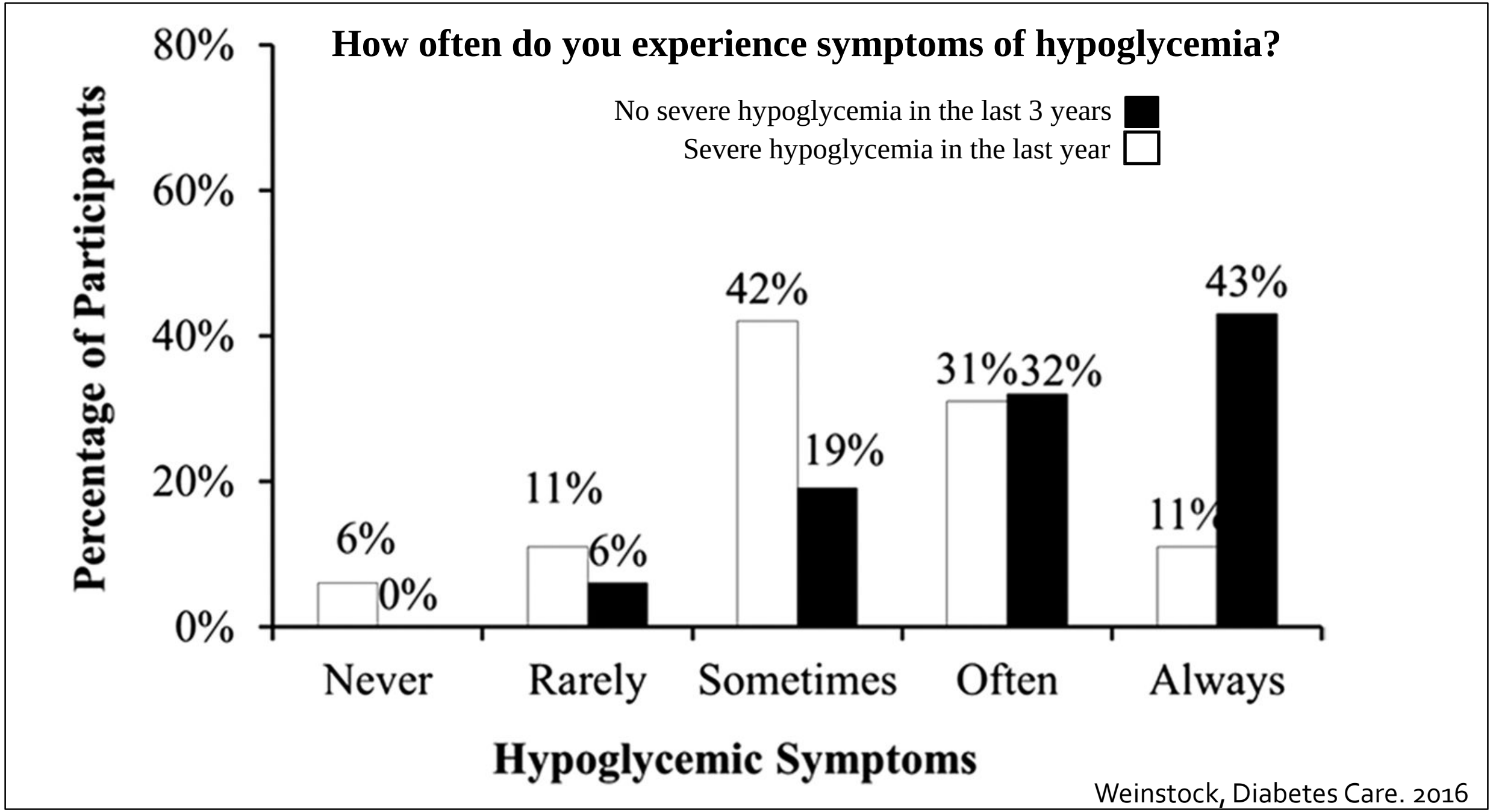
Lipska, JAMA Intern Med. 2014

Chen, J Am Geriatr Soc. 2008

Older patients may not react to hypoglycemia

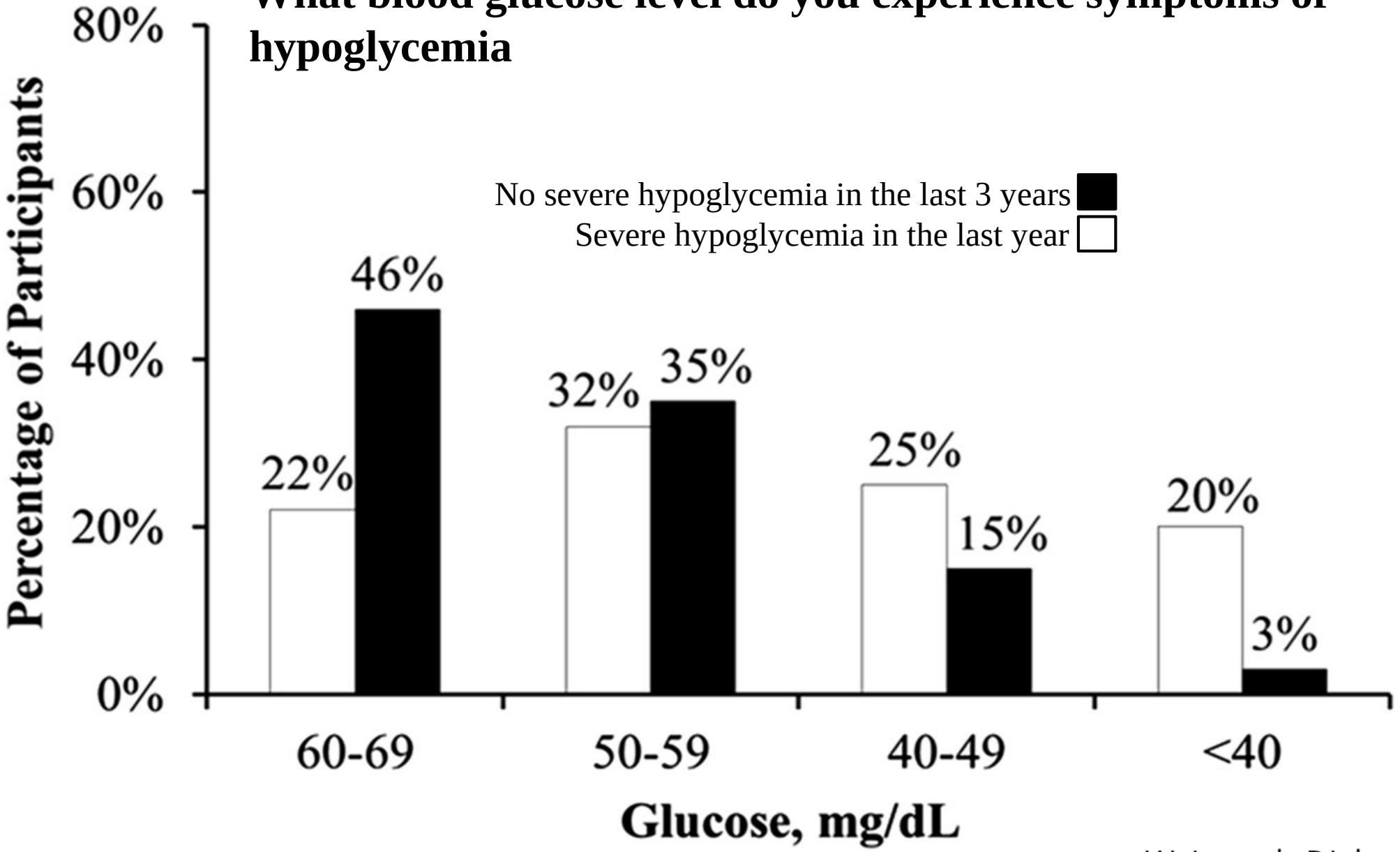


Holt, Essential Endo and Diabetes. 2007



Weinstock, Diabetes Care. 2016

What blood glucose level do you experience symptoms of hypoglycemia

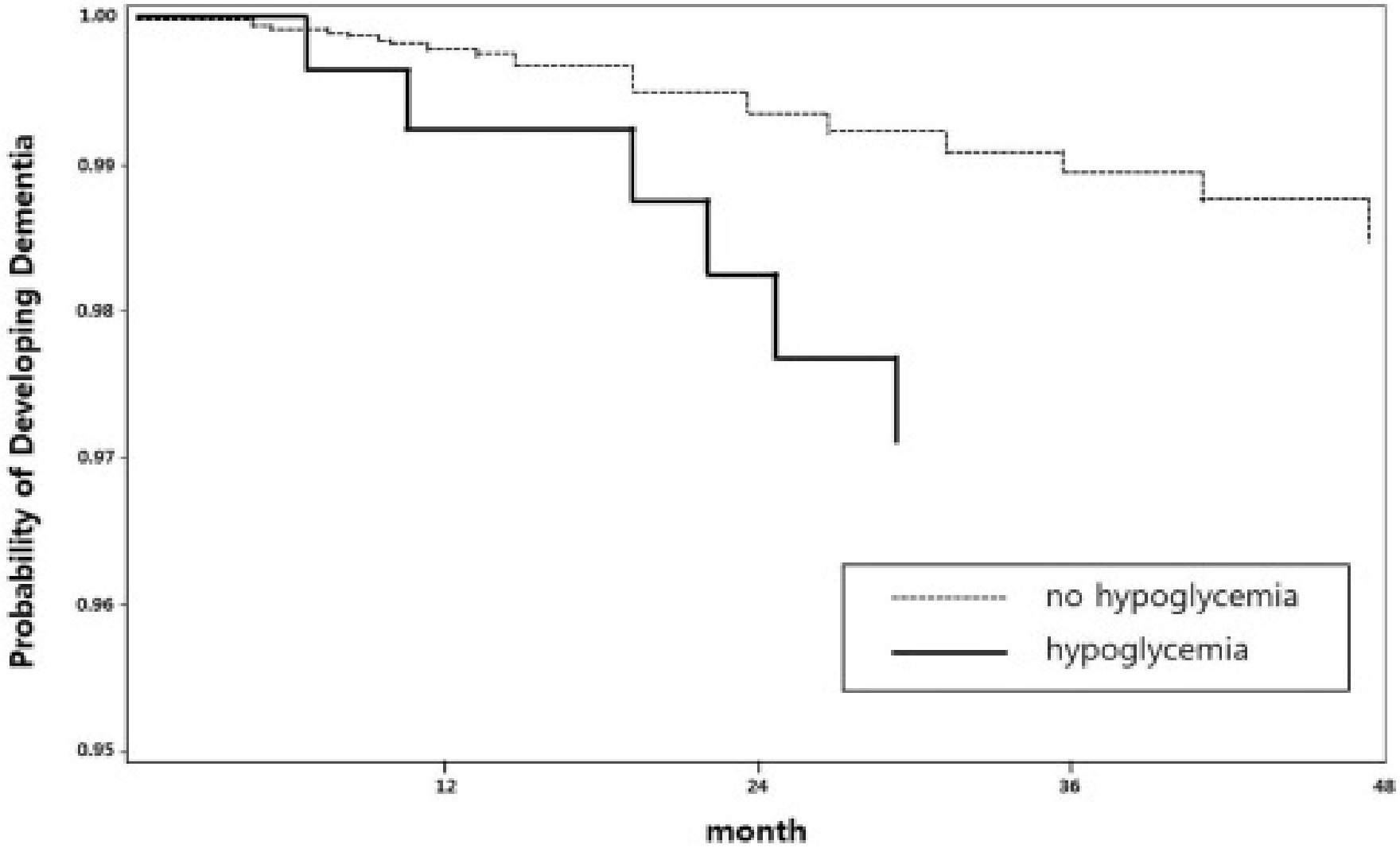


Weinstock, Diabetes Care. 2016

The effects of hypoglycemia in older adults

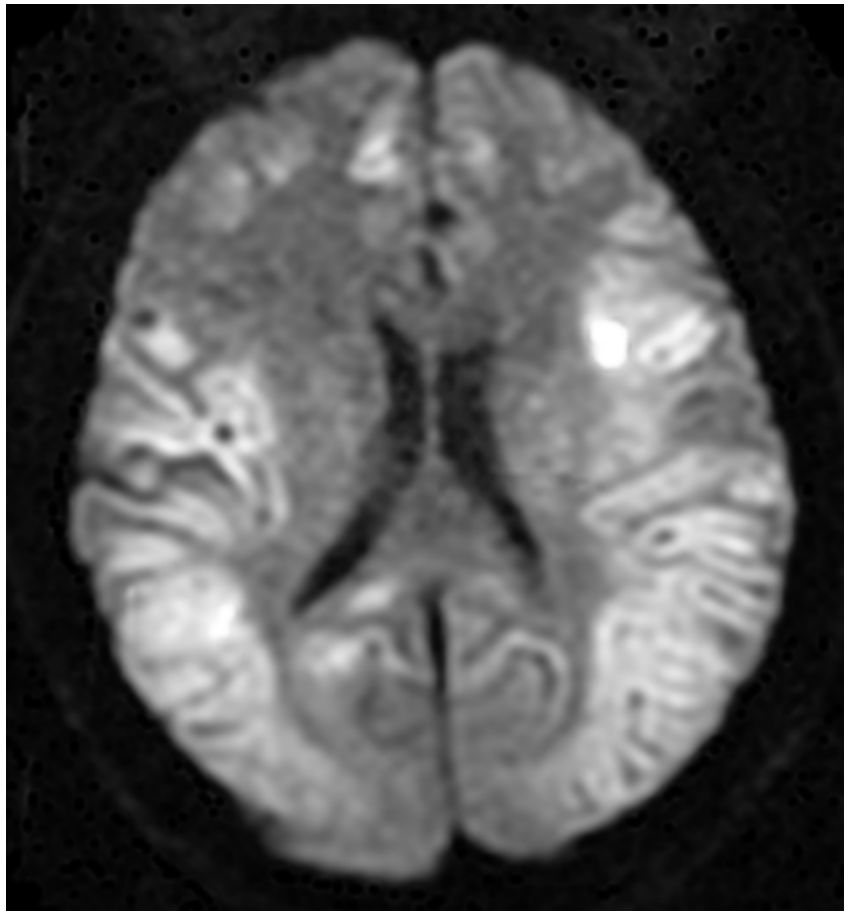
- Cardiovascular events
- Cognitive dysfunction/dementia
- Falls
- Fractures
- Hospitalizations
- Increased mortality

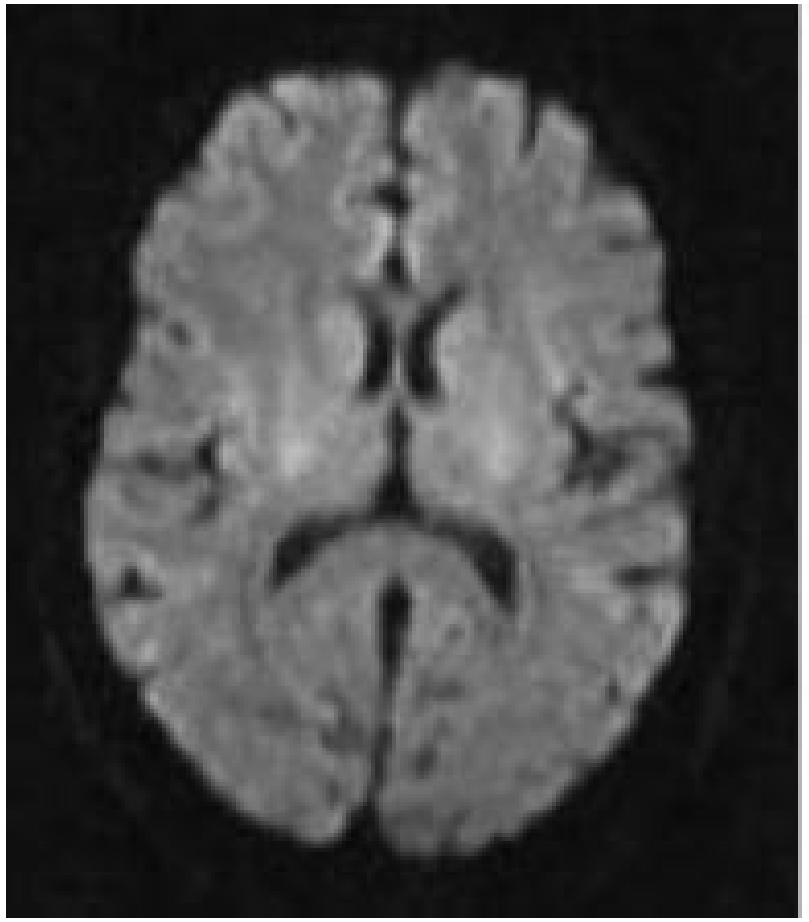
Hypoglycemia: A risk factor for dementia



Chin, Diabetes Res Clin Prac. 2016

CNS manifestations of hypoglycemia





Radiopaedia

CGM decreases hypoglycemia

- Reduced nocturnal hypoglycemia (<70 mg/dL) in T1DM on MDI by 48%
- Reduced nocturnal hypoglycemia (<54 mg/dL) in T1DM on MDI by 65%
- Reduced daytime hypoglycemia (<54 mg/dL) in T1DM on MDI by 54%

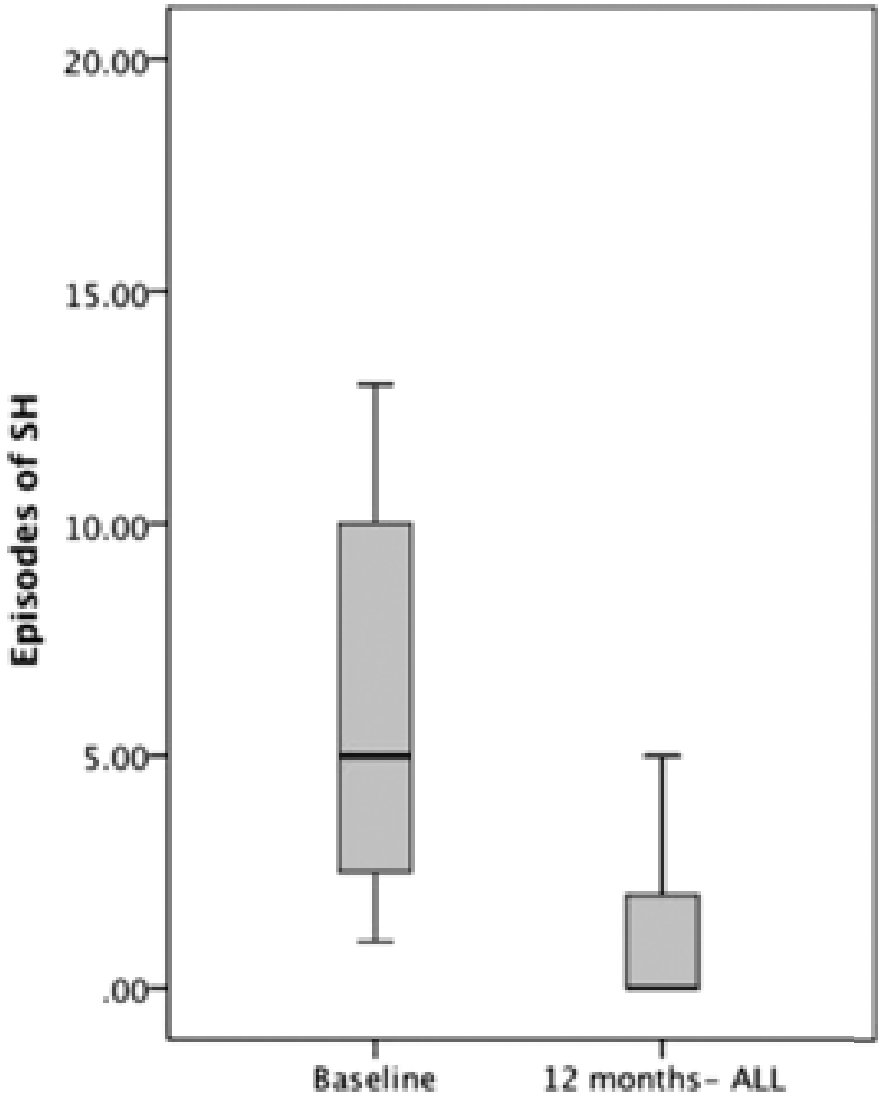
Olaffsdottir, Diabetes Technol Ther. 2018

CGM reduces hypoglycemia in older adults

- Wireless innovation for Seniors with Diabetes Mellitus (WISDM) Study
  - Patients with T1DM wore a DexCom CGM for 6 months
  - Less time with BG less than 70 mg/dL
  - Decreased episodes of severe hypoglycemia
  - 2 more hours per day in range (70-180 mg/dl) by the end of the six months vs. fingersticks
  - Benefits were noted in both insulin pump and in patients on multiple daily injections

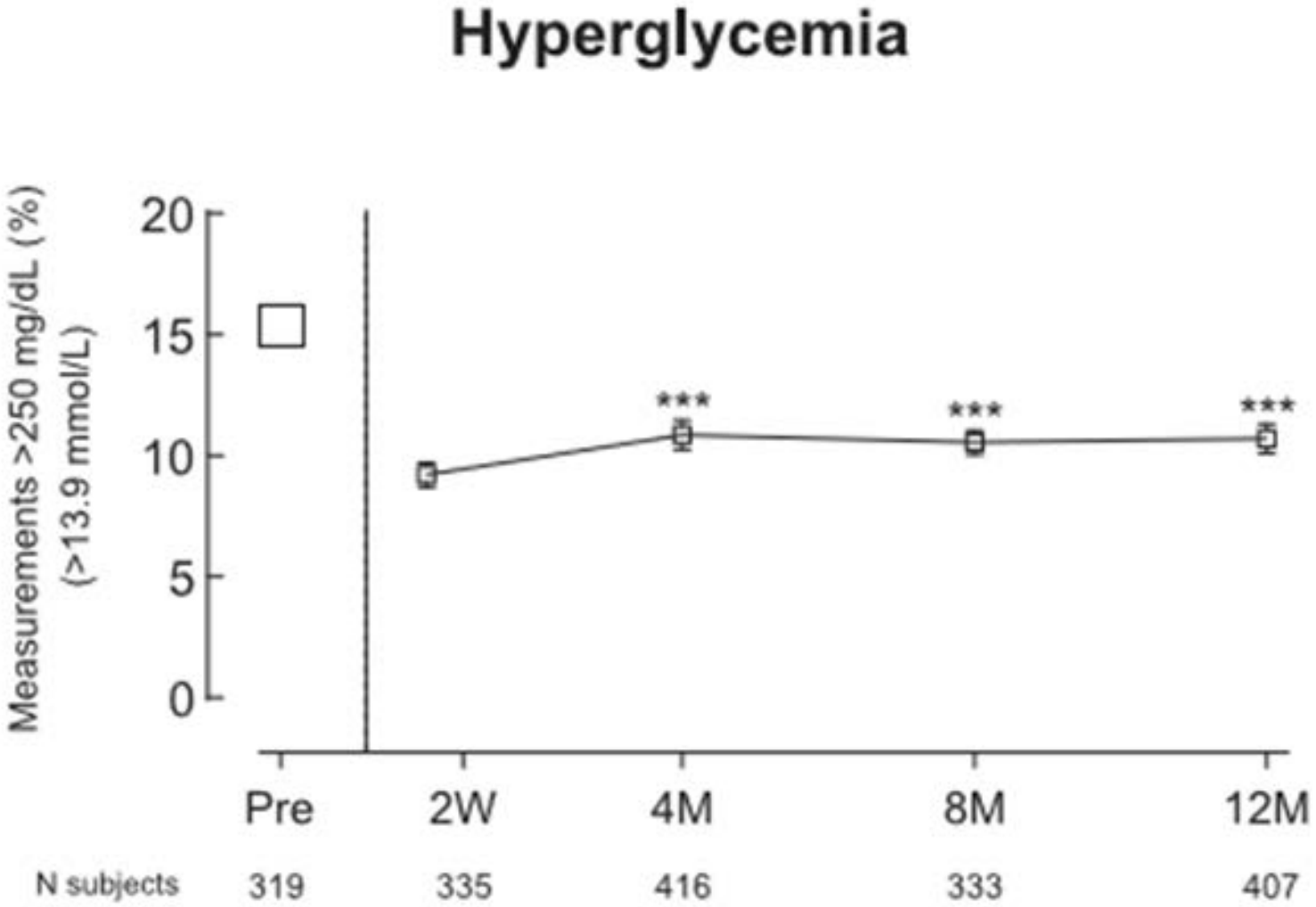
ADA Scientific Sessions, 2019

CGM in patients with hypoglycemia unawareness



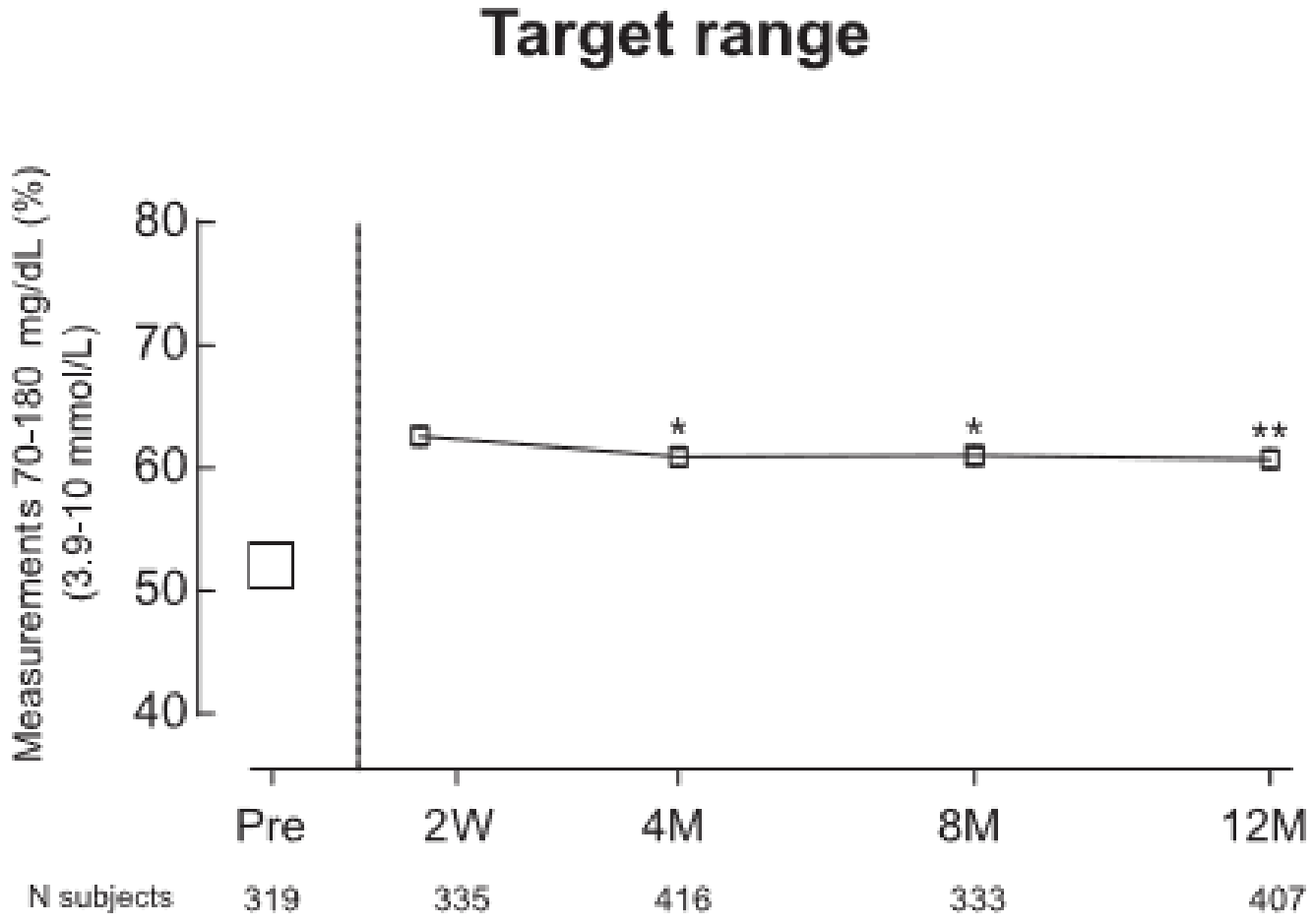
Choudhary, Diabetes Care. 2013

CGM can also decrease hyperglycemia



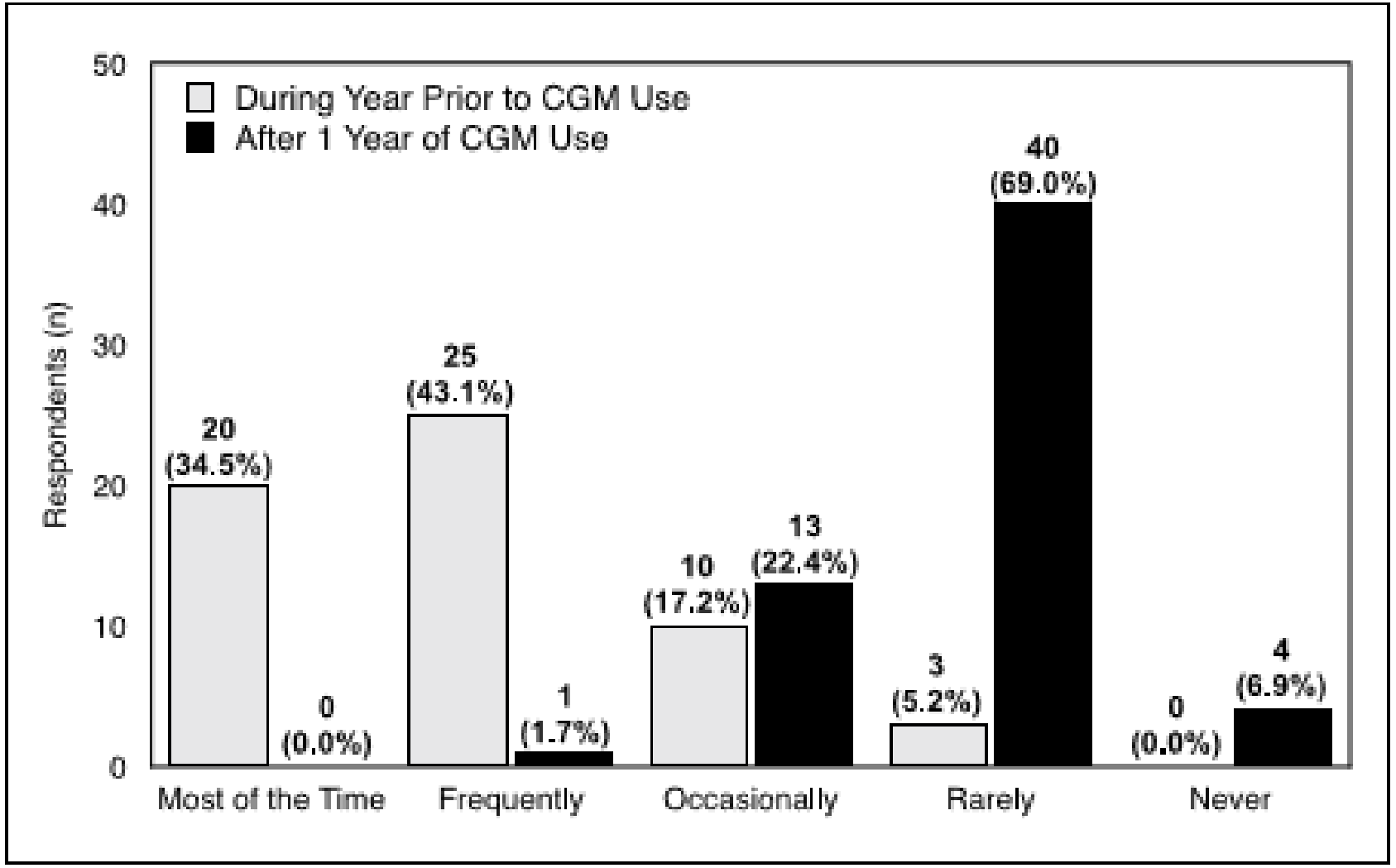
Charler, JCEM. 2018

CGM can also decrease hyperglycemia



Charler, JCEM 2018

CGM and fear of hypoglycemia



Chamberlain, J Diabetes Sci Technol 2016

Quality of life with CGM

	Before Reimbursement (n = 448)	12 Months of Reimbursement (n = 362)	*P* Value	Effect Size[a]
SF-36				
Physical functioning	79.4 (21.1)	82.7 (21.2)	<0.0005	0.16
Role-physical	62.5 (27.1)	68.0 (26.8)	<0.0005	0.20
Bodily pain	71.8 (26.2)	74.4 (27.0)	0.033	0.10
General health	49.5 (21.5)	54.1 (22.5)	<0.0005	0.21
Vitality	54.5 (19.3)	57.4 (19.5)	0.003	0.15
Social functioning	70.0 (26.1)	76.3 (24.9)	<0.0005	0.24
Role-emotional	70.8 (28.1)	76.4 (26.7)	<0.0005	0.20
Mental health	65.2 (17.8)	68.8 (18.1)	<0.0005	0.20

Charler, JCEM. 2018

What patients should CGM be used in?

- Patients who are on multiple daily injections or insulin pumps
- Patients who have a good understanding of how to adjust insulin doses/activity/food intake based on CGM data
- Patients with hypoglycemia unawareness or recurrent especially severe hypoglycemia
- Patients who meet insurance carriers requirements to receive CGM
- Patients with cognitive dysfunction, visual or hearing impairments, or dexterity problems may not benefit as much from CGM