Continuous Glucose Monitoring assessing the Clinical Impact of an Algorithm Driven Basal-Bolus Insulin Regimen in non-critically ill inpatients with T2DM

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Disclosure

X	No, nothing to disclose
	Yes, please specify:

Company Name	*Honoraria/ Expenses*	*Consulting/ Advisory Board*	*Funded Research*	*Royalties/ Patent*	*Stock Options*	*Ownership/ Equity Position*	*Employee*	*Other (please specify)*

Background
Inpatient glycemic management

- Improvement in glycemic control results in lower rates of hospital complications (Umpierrez et al. 2012, Murad et al. 2012)
- Guideline recommendations (ADA 2014)
  - Standardized insulin order set
  - Scheduled insulin
  - Pre-meal BG values <140 mg/dl
  - Four capillary BG measurements
- Four point BG profile provides only a sequence of snapshots (Joseph et al. 2009, Thabit 2014)

Background
Inpatient glycemic management

- CGM is used
  - …to detect patterns of responsiveness to therapeutic efforts (Gomez 2014)
  - …as a tool to assess the outcome of clinical trials (Beck 2012)

Objective

- To
  - …assess the clinical impact of an algorithm driven basal-bolus-insulin regimen
  - …compare CGM to routine blood glucose measurements in the hospital

Trial setting

BG POCT (Roche, Accu Chek)

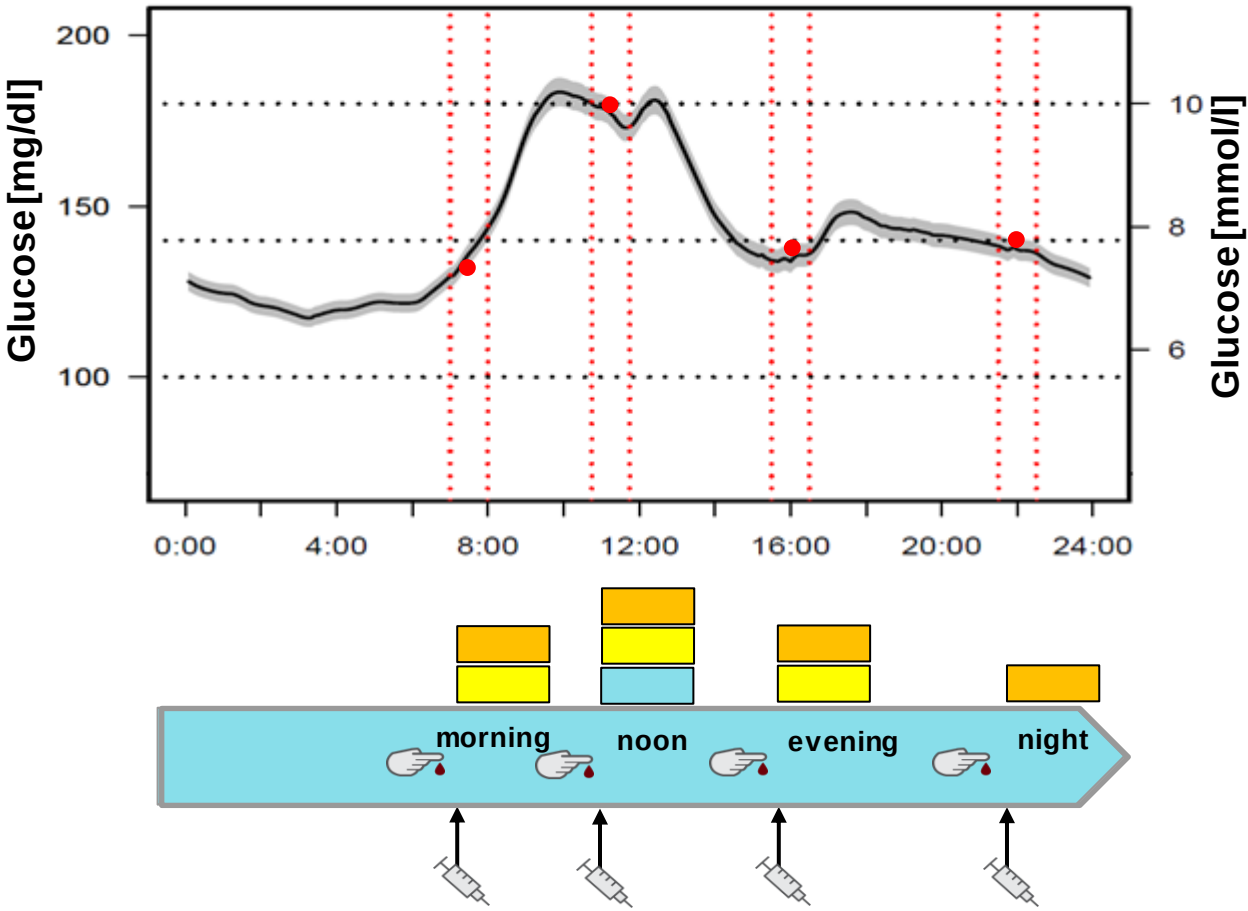
CGM (Medtronic, iPro2)

Insulin injection

Bolus insulin (meal)

Bolus insulin (supplement)

Basal insulin



Patient population

- **General ward.** Division for Endocrinology and Metabolism (Department of Internal Medicine, Medical University Graz, Austria)
- **Main inclusion criteria**
  - T2DM
  - Age between 18 and 90 years
  - Any antihyperglycemic therapy
- **Main exclusion criteria**
  - T1DM
  - Pregnancy
  - Terminal illness

Characteristics	
n	84
Gender, f/m	32/52
Age (years)	68.5 ± 10.3
BMI (kg/m²)	31.0 ± 6.6
Serum creatinine (mg/dl)	1.5 ± 1.0
HbA1c (mmol/mol)	72.8 ± 28.2
Diabetes duration (years)	15.1 ±11.1
Admission diagnosis (%)	
Cardiovascular diseases	31.3
Endocrine disorder	25.0
Infectious diseases	30.2
Gastrointestinal disease	1.0
Other	12.5

Comparison between CGM & BG

Glucose Profile	Overall		First Day		Last Day		Test
	CGM	BG	CGM	BG	CGM	BG	p-Value
Glucose values (n)	140,424	2,066	23,686	351	23,301	323	
Mean glucose (mg/dl)	**145.9**	**149.6**	**156.8**	**160.4**	**142.3**	**145.9**	**<0.02**
SD (mg/dl)	55.9	57.7	63.1	64.9	52.3	54.1	
Coefficient of variation CV (%)	**37.7**	**38.6**	**39.6**	**40.6**	**36.9**	**36.8**	**<0.03/ 0.05**
<50 mg/dl (%)	0.3	0.2	0.5	0.0	0.4	0.0	
<70 mg/dl (%)	2.4	2.7	2.6	1.7	2.8	1.2	**>0.2**
70-180 mg/dl (%)	**75.8**	**73.2**	**67.7**	**67.2**	**77.5**	**78.6**	**<0.04**
>180 mg/dl (%)	21.9	24.1	29.7	31.1	19.7	20.1	**<0.04**
>350 mg/dl (%)	0.5	0.6	0.9	1.1	0.4	0.6	

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70-180 mg/dl (%)	**75.8**	**73.2**	**67.7**	**67.2**	**77.5**	**78.6**	**<0.04**
>180 mg/dl (%)	5.6	5.9	8.6	10.0	3.7	3.4	
>350 mg/dl (%)	0.5	0.6	0.9	1.1	0.4	0.6	

Significant reduction of the CV

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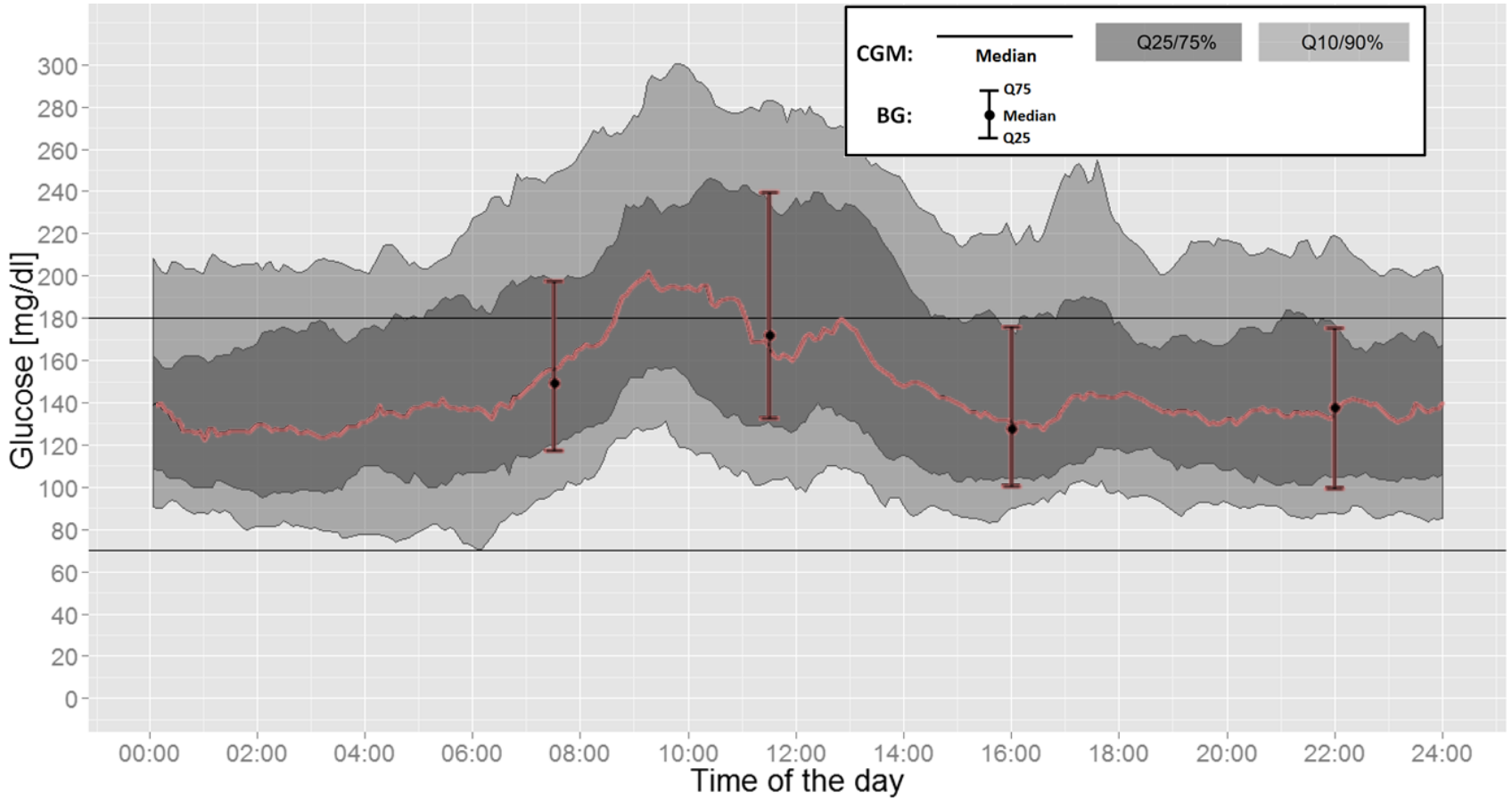
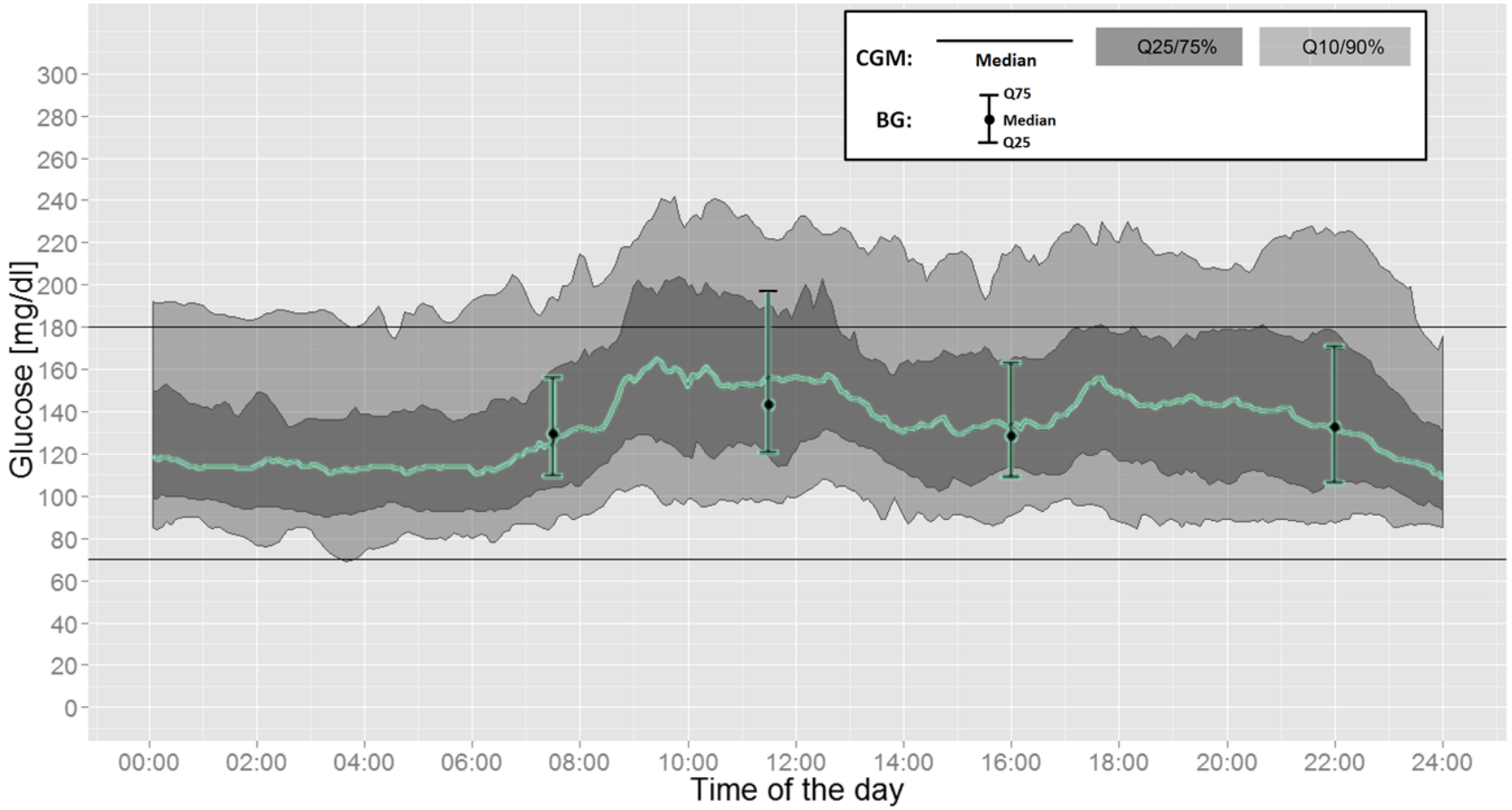
Significant increase in the range 70-180 mg/dl

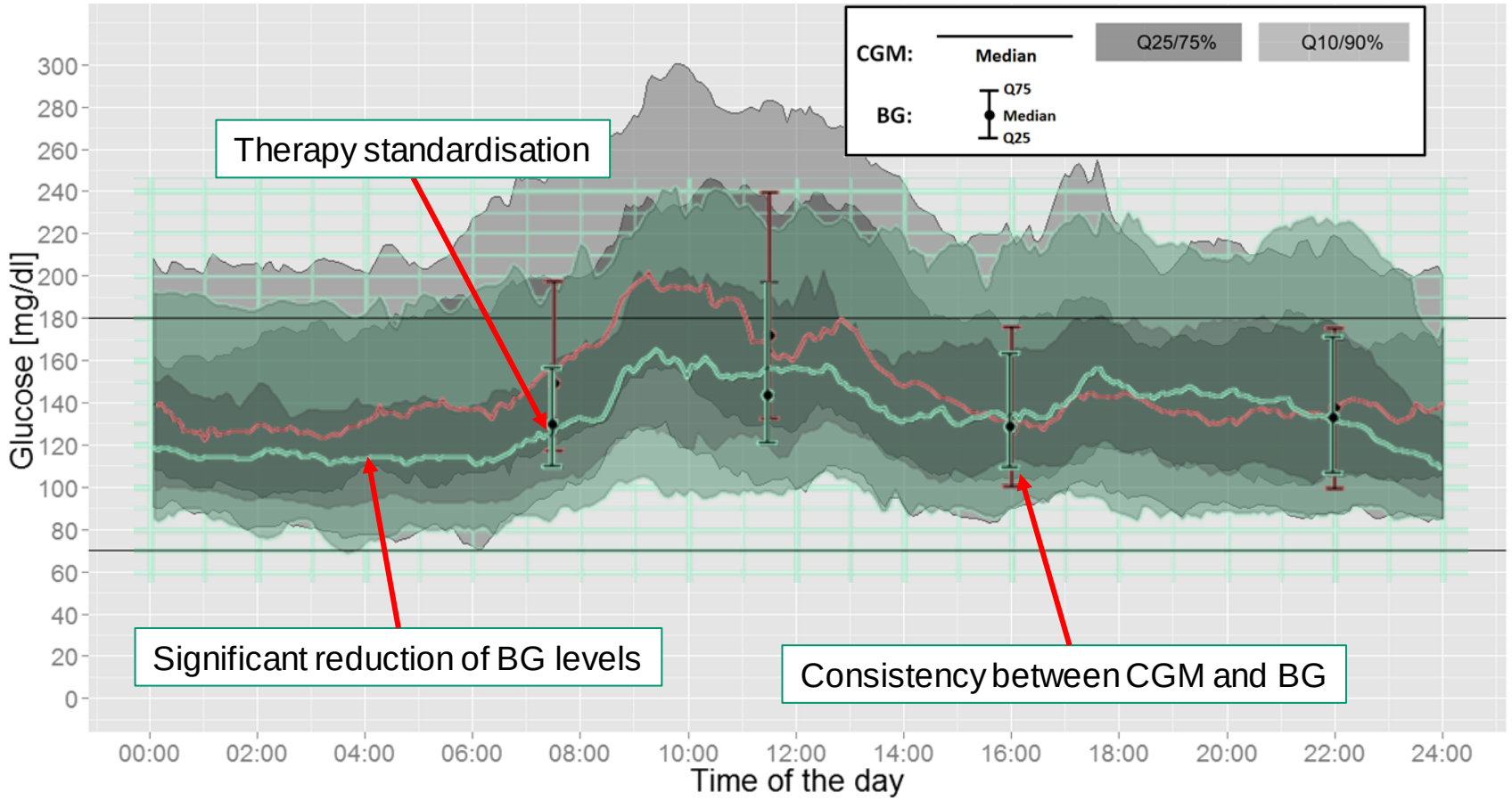
Glucose profile
First full day with CGM



Glucose profile
Last full day with CGM



Clinical impact
First vs. last full day with CGM



Conclusion

- High consistency between CGM and BG measurements
- CGM describes the overall daily routine in more detail
- Assessing the Basal-Bolus Therapy:
  - Lower glucose variations at the end of the hospital stay
  - Therapy yielded a higher percentage of BG values in the range 70-180 mg/dl
- A trend towards detecting more low-glycemic events with CGM

Thank you for your attention

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Dosing algorithm

A

initial TDD	TDD: **48 IU**	yesterday lunch (IU)	yesterday dinner (IU)	yesterday bedtime (IU)	today breakfast (IU)
	basal insulin (TDD/2)	**24**			
	bolus insulin (TDD/2/3)	**8**	**8**		**8**
	BG (mmol/l)	9.2	7.7	7.9	10.6

		breakfast: 10.6 mmol/l			
dinner:**7.7** (mmol/l)	BG range (mmol/l)	3.9 – <5.6	5.6 - 7.8	>7.8 – 10.0	>10.0
	3.9 – <5.6	-10 %	± 0 %	± 0 %	± 0 %
	5.6 – 7.8	± 0 %	± 0 %	± 0 %	+ 10 %
	>7.8 – 10.0	± 0 %	± 0 %	+ 10 %	+ 10 %
	>10.0	± 0 %	+ 10%	+ 10 %	+ 20 %
	if BG ≤ 3.9 mmol/l reduce next 24 h TDD by 20%				

new TDD	next 24 h TDD: **52 IU**	today lunch (IU)	today dinner (IU)	today bedtime (IU)	tomorrow breakfast (IU)
	basal insulin (TDD/2)	**26**			
	bolus insulin (TDD/2/3)	**9 (8+1)**	**8**		**9 (8+1)**

Dosing algorithm

insulin sensitivity mmol/l	O sensitive	O normal	O resistant
< 3.9	no bolus insulin		
3.9 – <5.6	reduce suggested bolus insulin dose by 50%		
5.6 – 7.8	0	0	0
>7.8 – 10.0	2	4	6
>10.0 – 12.2	4	6	8
>12.2 – 14.4	6	8	10
>14.4 – 16.7	8	10	12
>16.7 – 19.4	10	12	14
>19.4 – 22.2	12	14	16
> 22.2	14	16	18