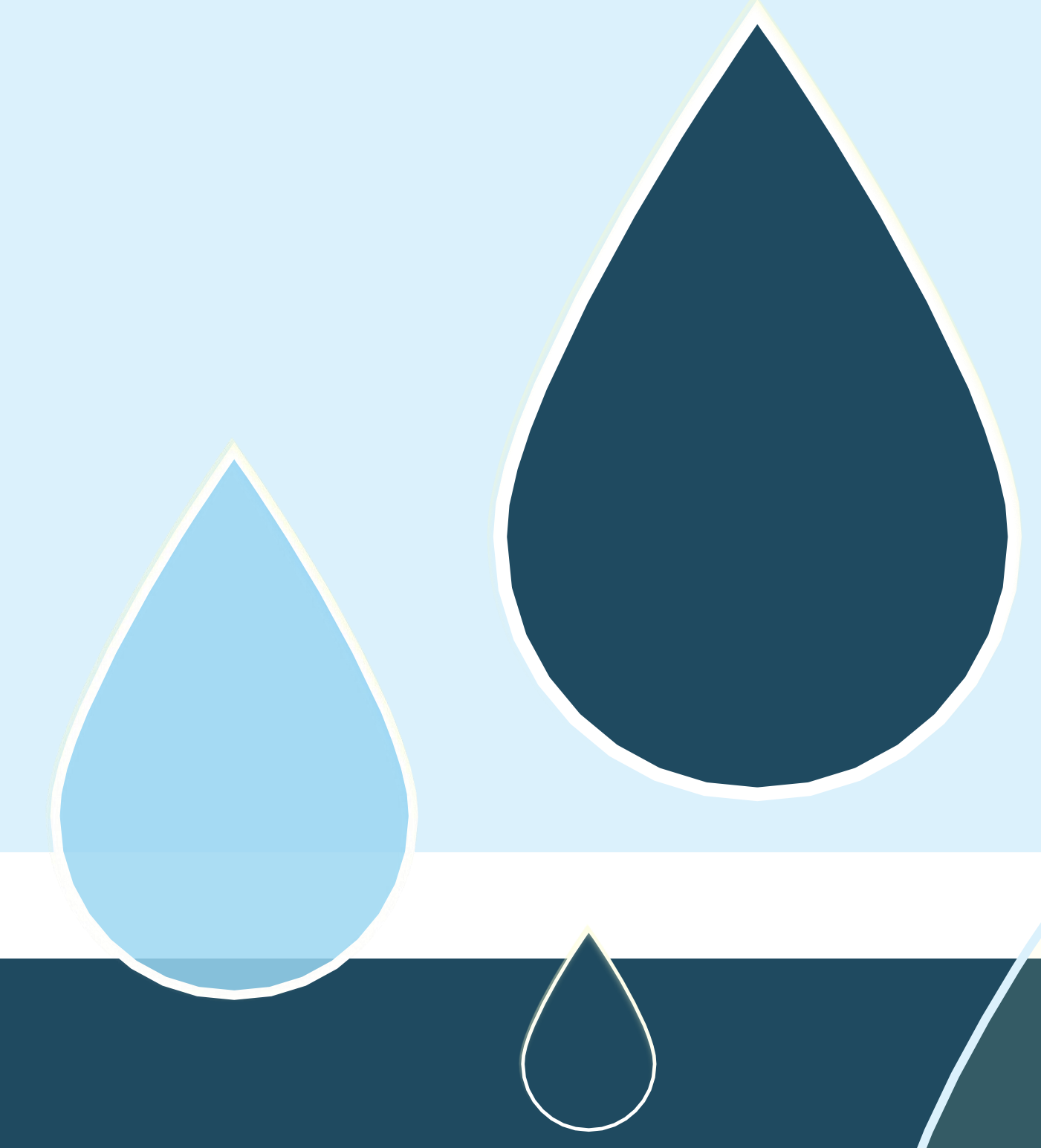Herlev og Gentofte Hospital

Accuracy of the calculated serum osmolarity to screen for hyperosmolar dehydration in older hospitalized medical patients

REGION

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Rationale

Older medical patients are at risk of hyperosmolar dehydration (HD). HD increases the risk of morbidity and mortality. Directly measured s-osmolality (mOsm/kg) is the reference standard to determine HD. However, this test is expensive and not used as routine assessment. The current method to determine HD is based on a clinical subjective assessment. A equation based on standard blood samples is recommended by ESPEN-guidelines[1]. Therefore, we aimed to validate the agreement between measured (mOsm/kg) and calculated s-osmolarity (mOsm/L).

Methods

Patients aged > 65 years were included from the emergency-medical-department at Herlev Hospital. Exclusion criteria; eGFR< 30 mmol/l, severe heart failure, decompensated cirrhosis, influenced by alcohol, and initiated rehydration.
We obtained data for measured mOsm/kg as well as calculated mOsm/L, using the by ESPEN recommended equation $[1.86*(Na^+ + K^+)+1.15*glucose+urea+14]$. In accordance with ESPEN-guidelines, we used a cut of value of > 300 mOsm/kg for measured values and a cut of value of > 295 mOsm/L for calculated values to determine HD.

Table 1 Characteristics	All n=90	≤300 n=80	>300 n=10
Age, years	78 (72-86)	78 (73-86)	76 (68-85)
Sex, female, n(%)	48 (53%)	47 (59%)	1 (10%)**
Weight, kg	67 (56-81)	66 (55-81)	77 (63-83)
BMI, weight/height²	24 (21-28)	24 (21-27)	26 (19-33)

Median (IQR) or n (%). Wilcoxon's-test or Chi² or fishers-test for patients at-risk vs. not at-risk *p<0.05, **p<0.01

Results

We included 90 patients (F: 53%), age median 78 years (IQR: 72-86). According to the measured mOsm/kg impending HD was evident in 32%, of these 11% had current HD.
There was a significant correlation between calculated mOsm/L and measured mOsm/kg (r²=0.7513, p<.0001). Bland-Altman analyses showed that the calculated mOsm/L overestimated with a mean bias of 3.19 (±6.95).
Comparing the methods according to ESPEN recommendations, we found a sensitivity of 90% (95% CL: 56-100%), a specificity of 68% (95% CL: 56-78%), a Positive Predictive Value of 26% (95% CL: 12-43%), and a Negative Predictive Value of 98% (95% CL: 90-100%). Notably, only 20% of the patients who had current HD (<300 mOsm/kg) were described with dehydration in the patient journal.

Table 2 Blood samples at baseline, and follow-up data	All n=90	≤300 mOsm/kg n=80	>300 mOsm/kg n=10
eGFR, mmol/l	66 (46-83)	67 (47-83.5)	58.5 (42.0-81.0)
s-Sodium, mmol/l (137-144)	138 (135-140)	137 (135-140)	140 (138-141)*
s-Potassium, mmol/l (3.5-4.4)	4.0 (±0.46)	3.98 (±0.47)	3.84 (±0.32)
s-Urea, mmol/l (F:3.1-7.9, M:3.5-8.1)	6.7 (5.8-9.6)	6.5 (5.7-8.6)	10.2 (9.2-11.3)**
b-Glucose, mmol/l (<11.1 mmol/l)	6.3 (5.8-7.3)	6.3 (5.7-7.1)	7.7 (6.3-8.4)
s-Albumin, mmol/l (36-45)	40 (37-43)	40 (37-43)	40 (37-40)
s-CRP, mmol/l (<10)	13 (3-57)	15 (3-58)	10 (3-19)
LOS (Length of stay), days	2 (0-5)	2 (0-5)	4 (0-6)
Readmitted within 30 days of discharge, n (%)	31 (34%)	27 (34%)	4 (40%)
Dead within 30 days after admission, n (%)	6 (7%)	3 (4%)	3 (30%)*

Median (IQR) or n (%). Wilcoxon's-test or Chi² or fishers-test for patients at-risk vs. not at-risk *p<0.05, **p<0.01

Figure 1: A Bland-Altman plot describing the agreement between measured and calculated values. The red solid horizontal line illustrates the average difference between measured and calculated values. The yellow dashed lines illustrate limits of agreement (bias ± 2 SD). A regression line has been fitted to identify the presence of differential bias with increased osmolality.
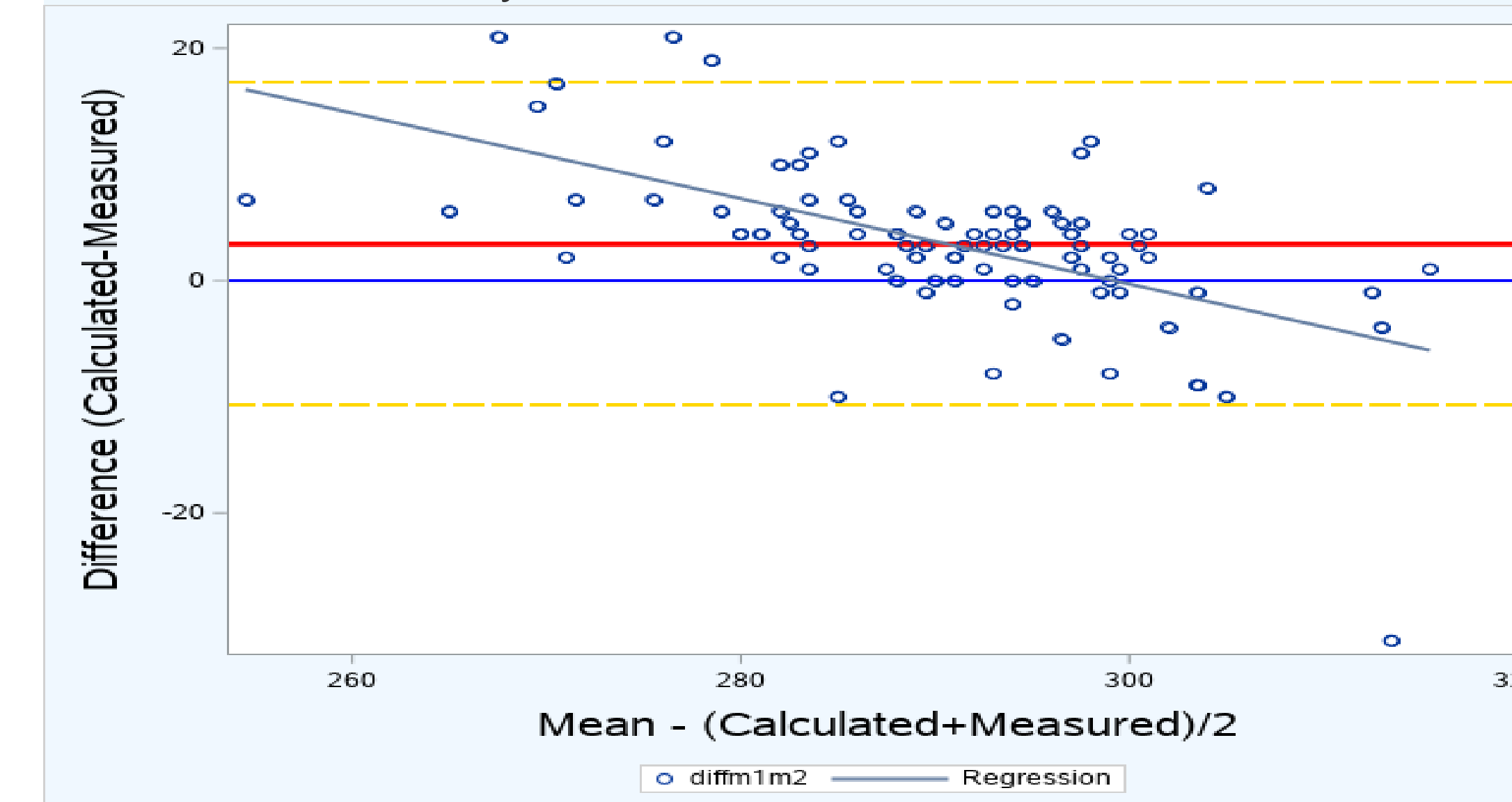
Conclusions

The equation recommended by ESPEN to calculate osmolarity was found to be an accurate objective diagnostic tool to assess hyperosmolar dehydration in older hospitalized medical patients.
The method is markedly superior to the current clinical practice.
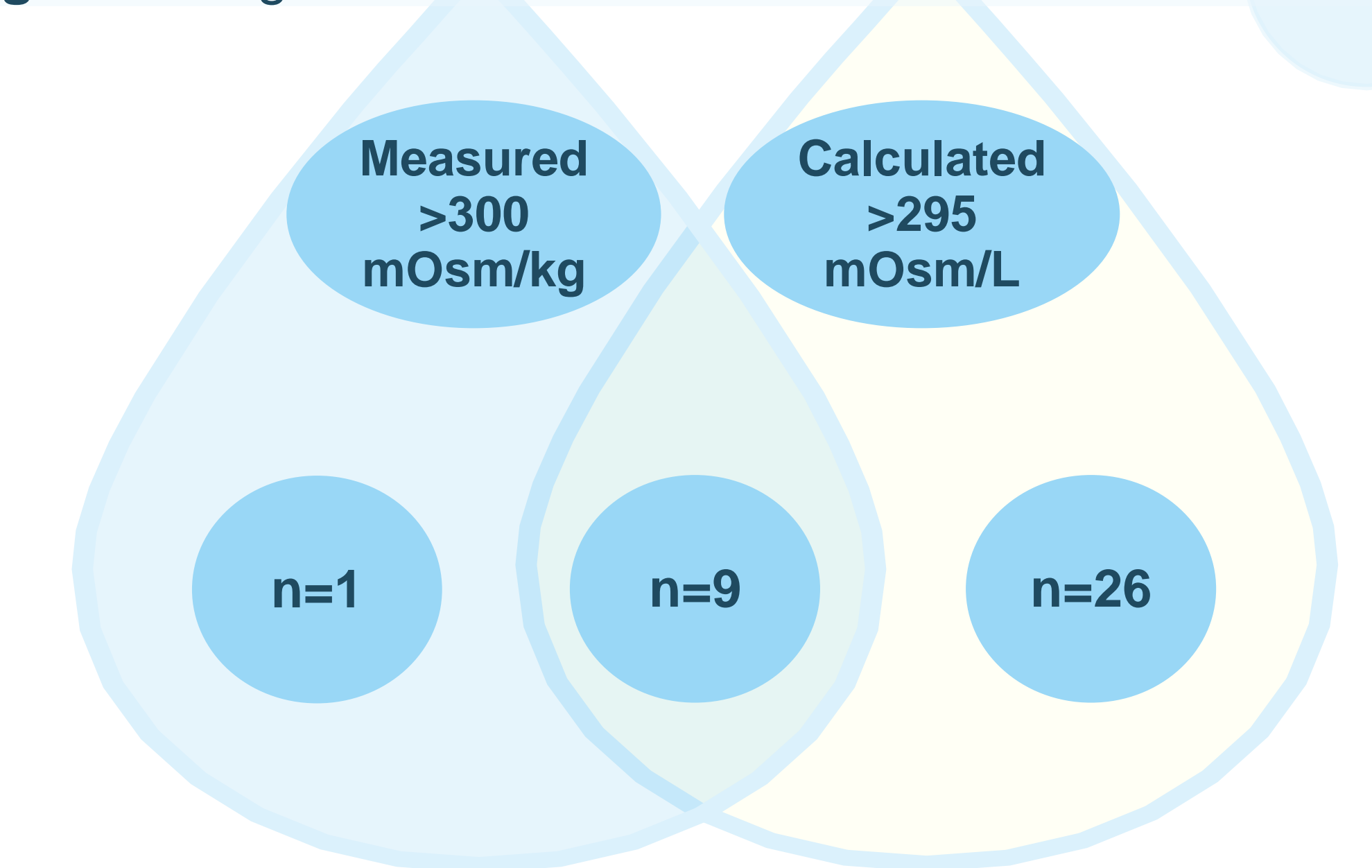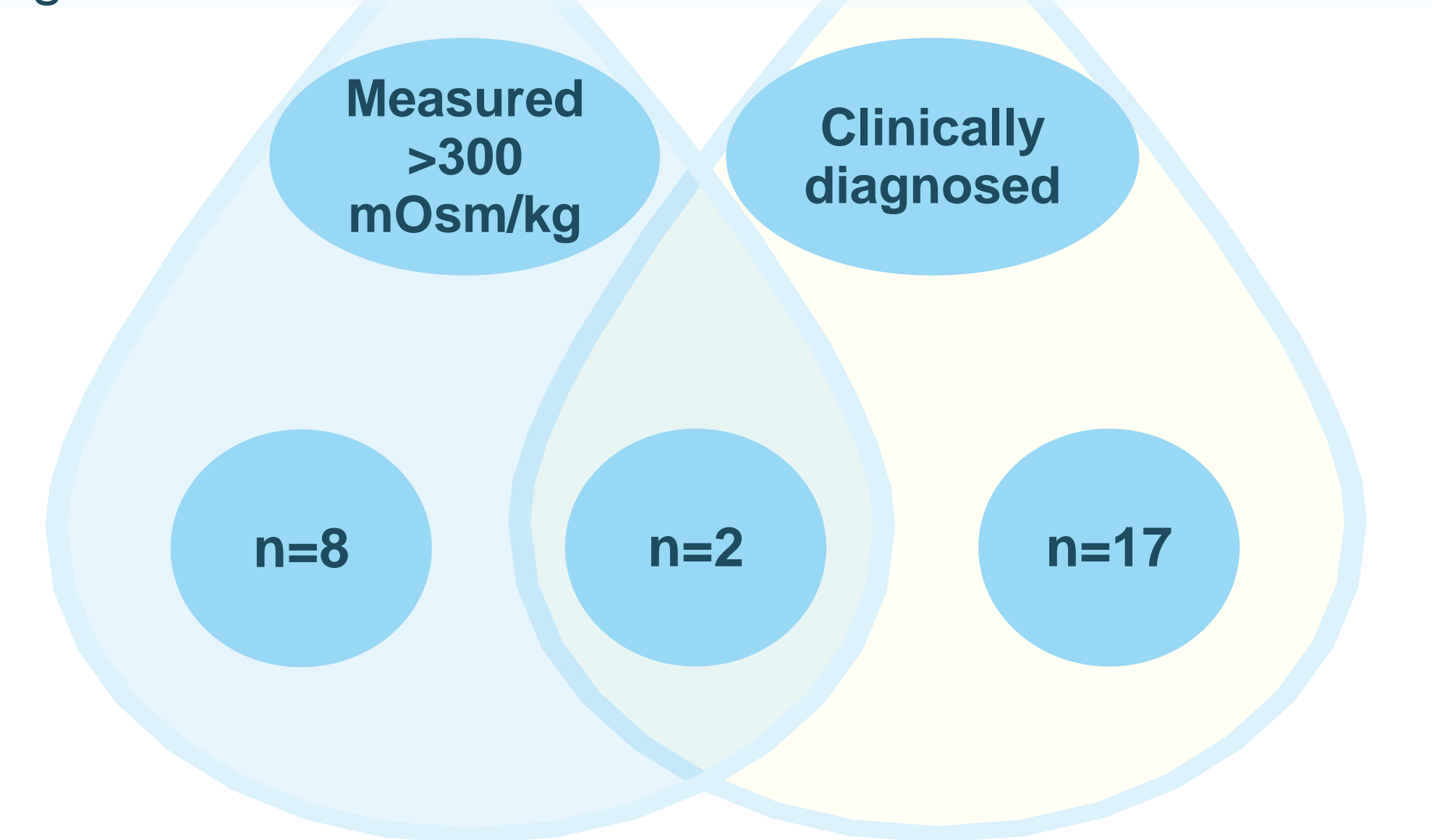
Figure 2: Agreement between measured and calculated HD

Measured >300 mOsm/kg   Calculated >295 mOsm/L

n=1   n=9   n=26

Figure 3: Agreement between measured and clinically diagnosed HD

Measured >300 mOsm/kg   Clinically diagnosed

n=8   n=2   n=17

[1] Volkert, D. et al. (2019) 'ESPEN guideline on clinical nutrition and hydration in geriatrics', Clinical Nutrition. Elsevier Ltd, 38(1), pp. 10–47. doi: 10.1016/j.clnu.2018.05.024.

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