FACULTY OF PHARMACEUTICAL SCIENCES

DEPARTMENT OF BIOANALYSIS
LABORATORY OF TOXICOLOGY



Near-infrared-based hematocrit prediction using volumetric absorptive microsampling devices: an in-depth evaluation

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Research Foundation Flanders
Opening new horizons

Dried blood spots and the hematocrit effect

Dried blood spots: multiple benefits

However… **The hematocrit effect**

- Physiological aspect
- Analytical aspect
  - Area bias
  - Recovery bias
  - Matrix bias

Different approaches to cope with this

- Alternative (volumetric) devices → VAMS



- Methodologies to determine the Hct

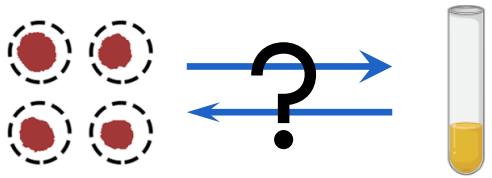
VAMS and the hematocrit effect

Volumetric devices (VAMS) → Hct-dependent area bias

However…

1. possible Hct-dependent recovery and matrix bias

2. physiological aspect



Methodologies to determine the Hct of volumetric devices

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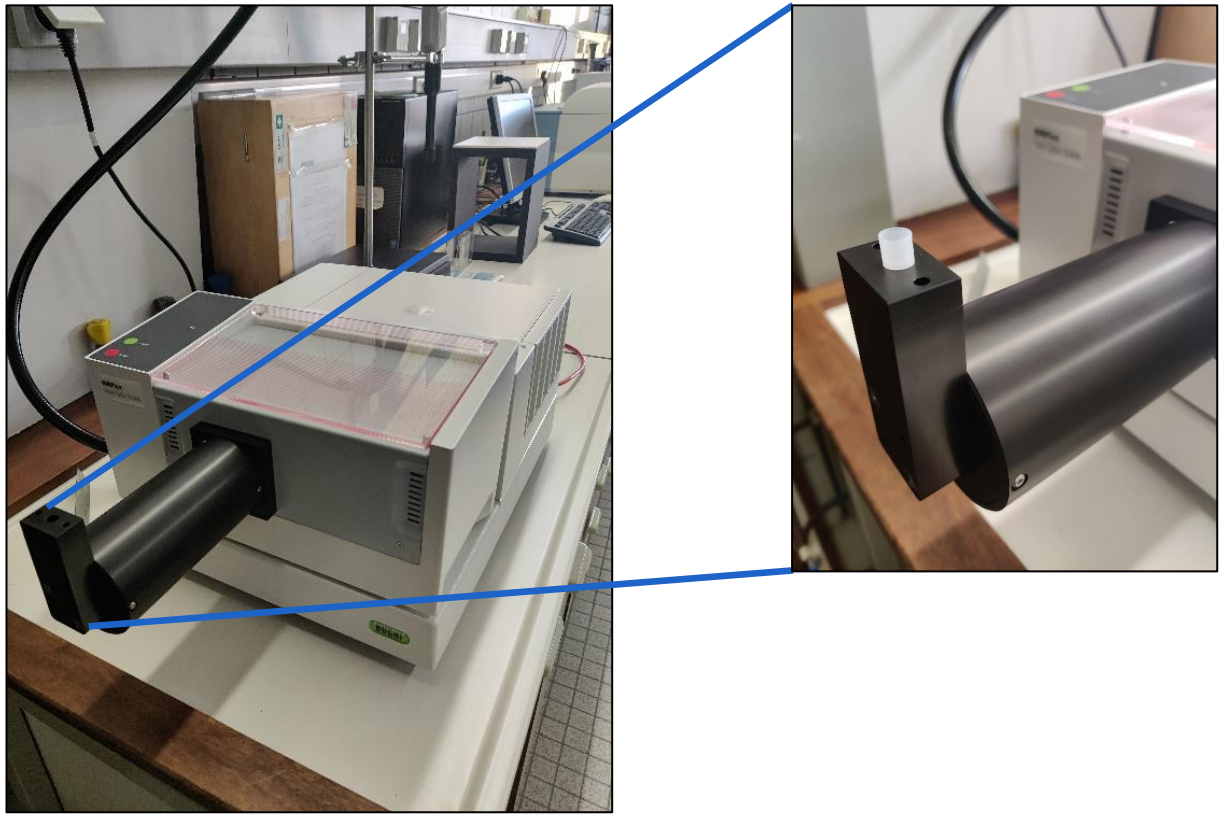
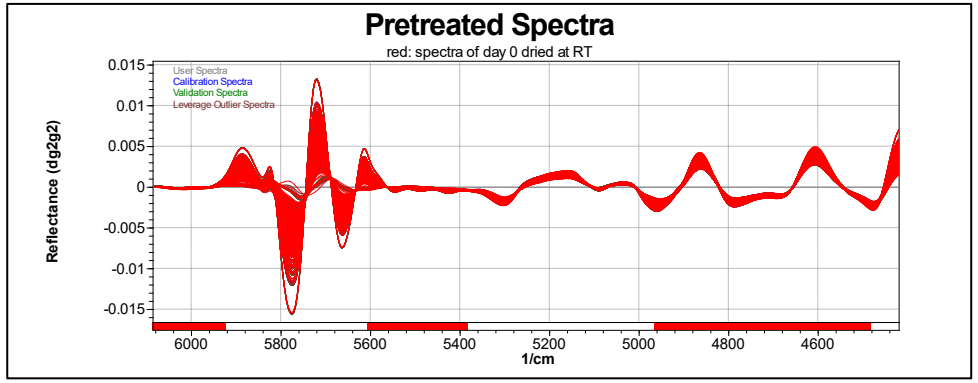
Non-contact NIR-based Hct prediction of VAMS





Hct value (L/L)

- Spectroscopic technique based on molecular overtone and combination vibrations of covalent bonds
- Fast, robust, non-destructive

Study objectives

In-depth evaluation of NIR-based Hct prediction of VAMS samples

- Optimization calibration model
- Evaluation of measurement conditions
- Method validation and method comparison
- VAMS-related variables

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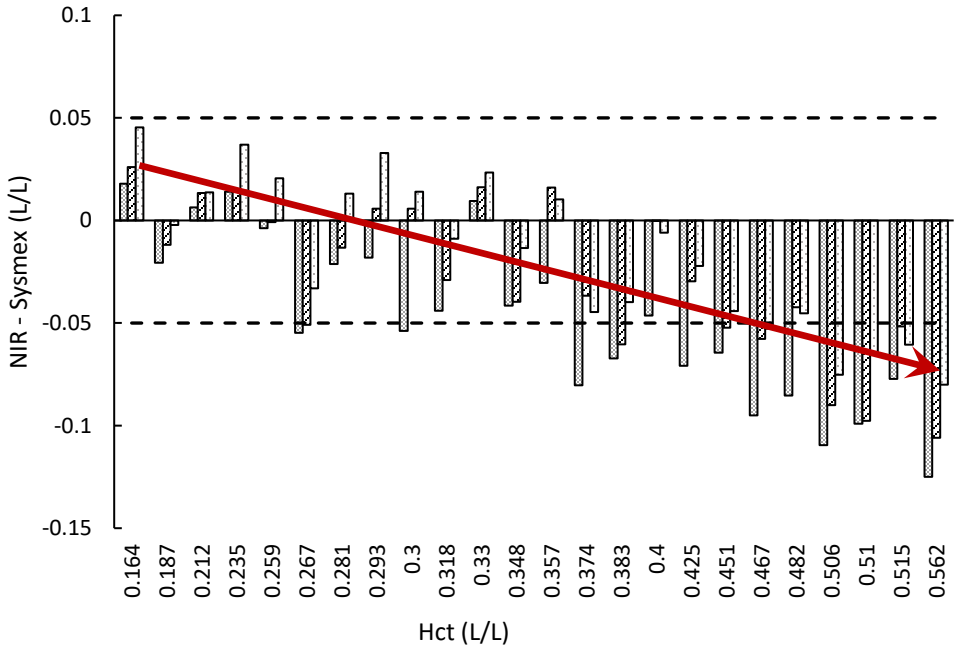
Results



Evaluation of an initial calibration model (n = 90) based on **10 µL VAMS samples**

1. Hct-dependent bias, with an unacceptable negative bias @high Hct values

2. A time-dependent bias

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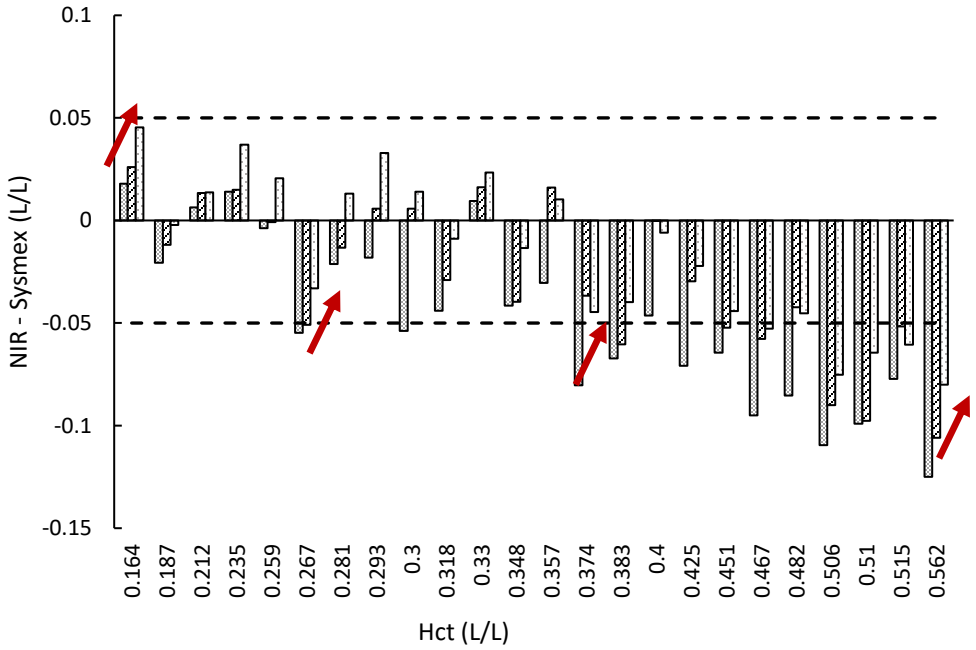
Results



Evaluation of an initial calibration model (n = 90) based on **10 µL VAMS samples**

1. Hct-dependent bias, with an unacceptable negative bias @high Hct values

2. A time-dependent bias

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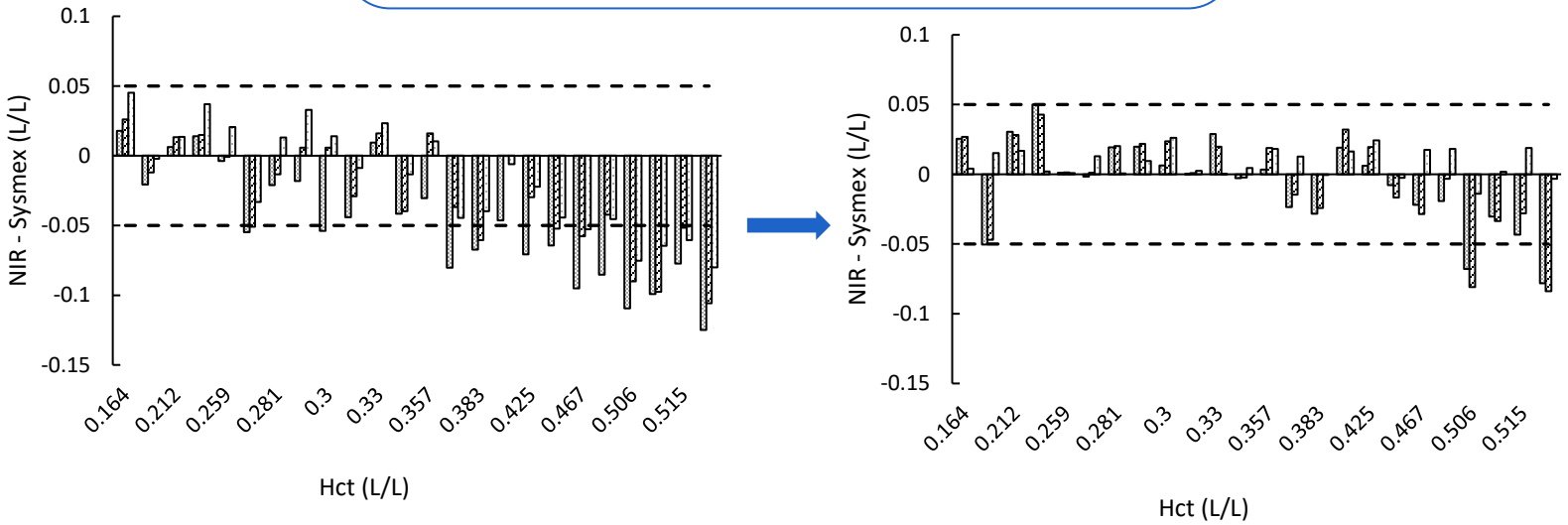
Results

Inclusion of spectra obtained from 5 additional samples < 0.20 L/L and > 0.50 L/L + spectral changes



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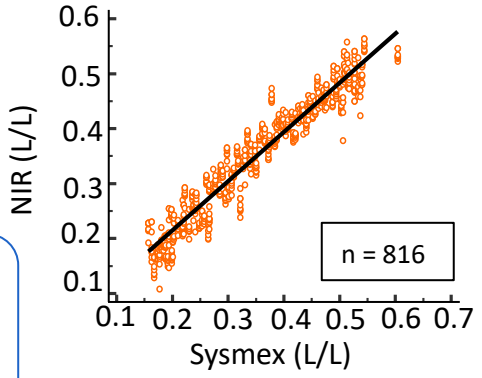
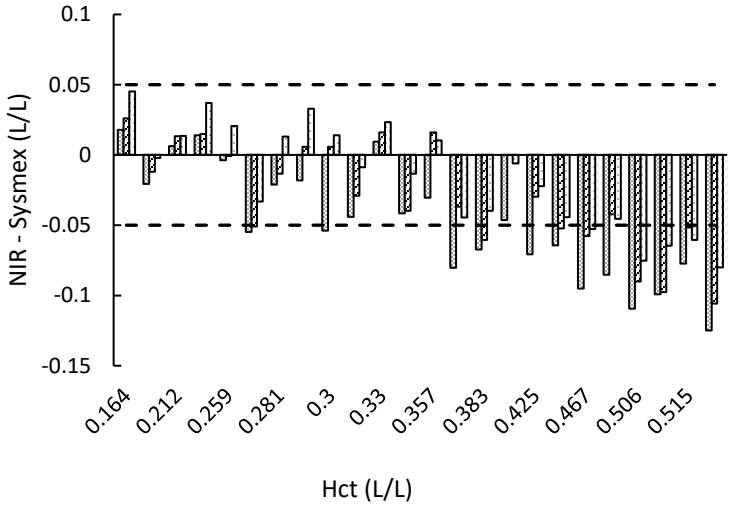
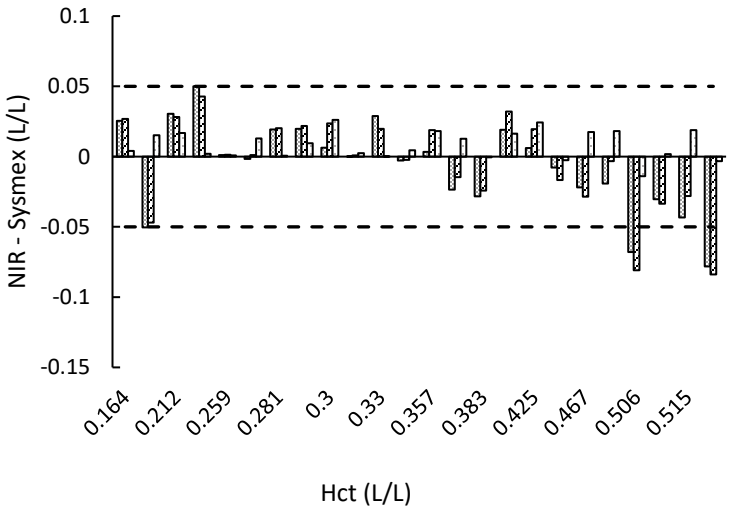
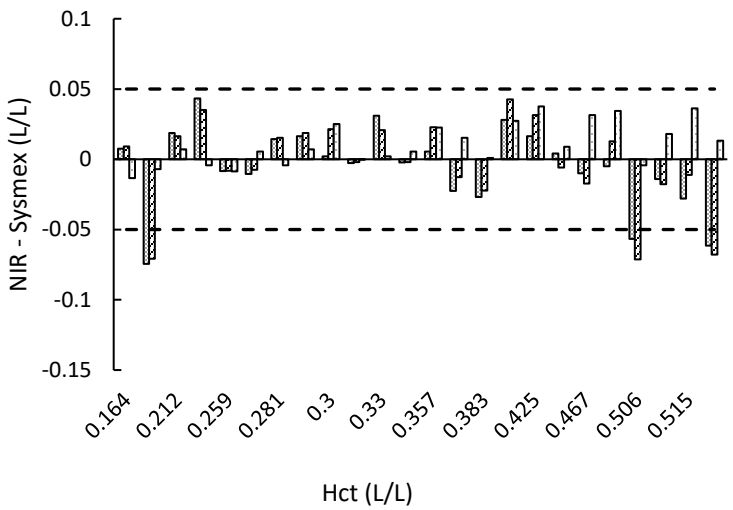
Results



Application of a correction factor based on linear regression







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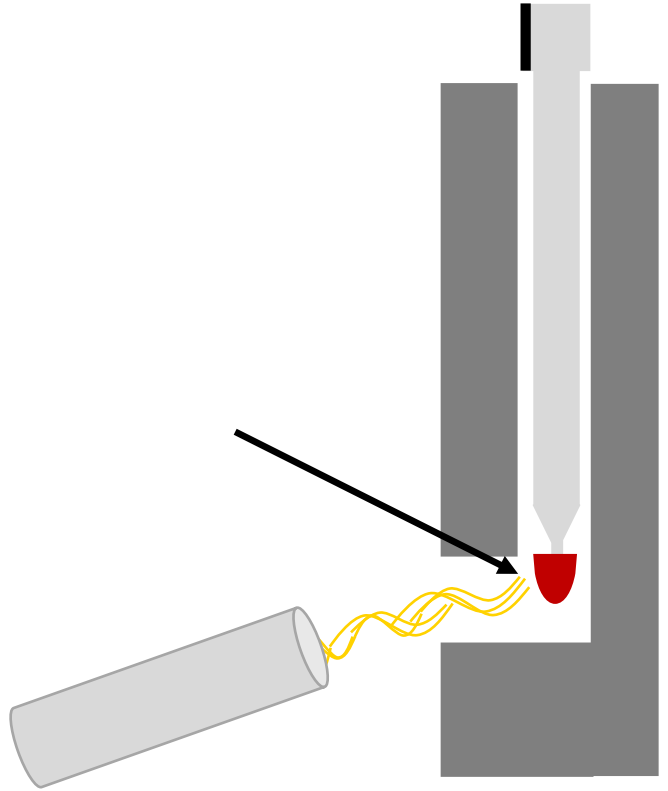
Results

A Hct value (L/L) = mean of 3 sub-measurements

- 3 x same segment of VAMS tip?
- 3 x different segment of VAMS tip (= ‘turning’)?



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Results

A Hct value (L/L) = mean of 3 sub-measurements

- 3 x same segment of VAMS tip?
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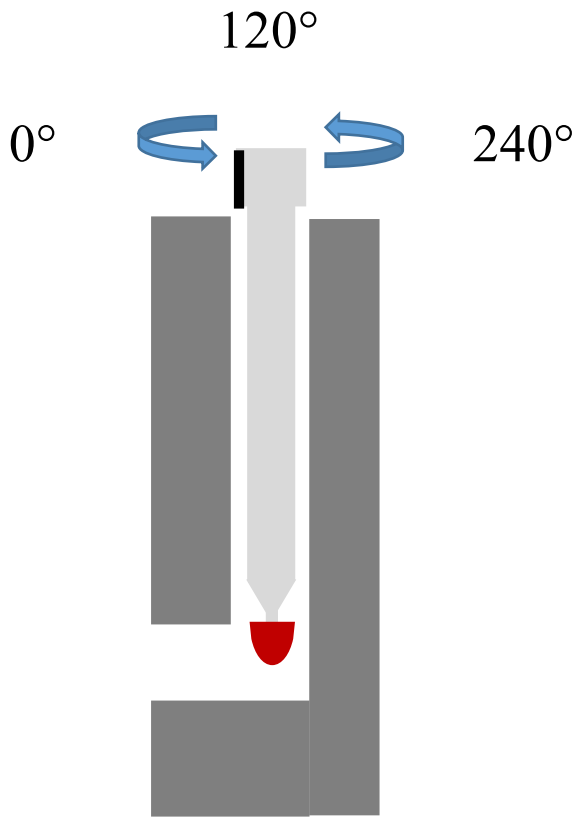
Robustness ↑



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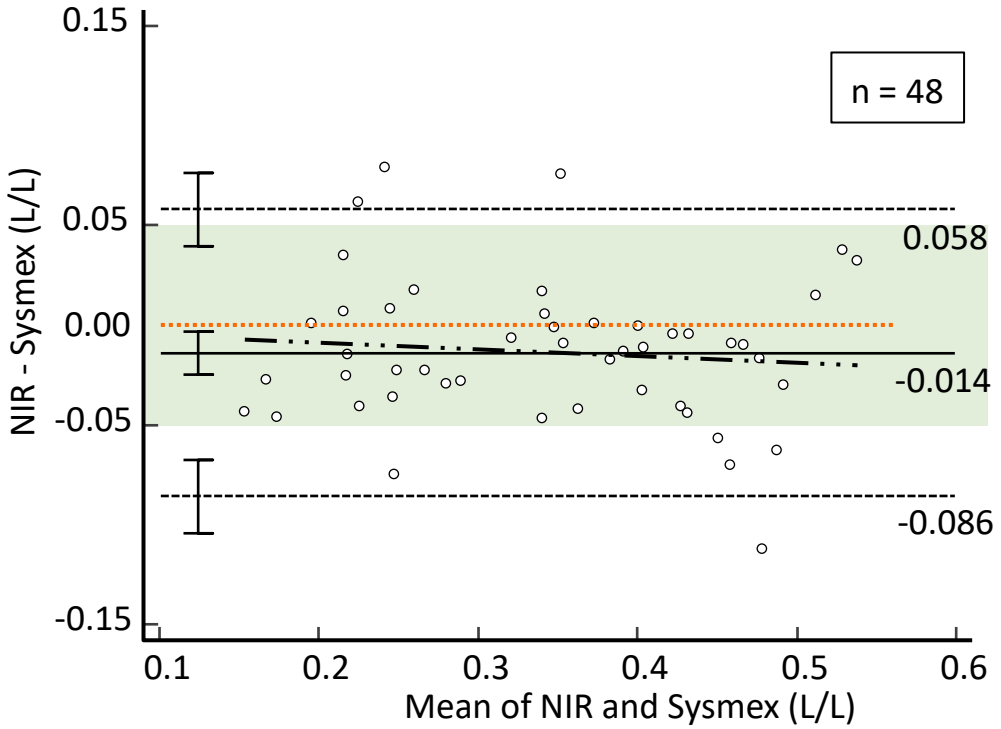
Results

Method validation

- Accuracy: maximum bias of - 0.022 L/L ✓
- Precision: maximum total imprecision of 10.6 % ✓
- Stability ✓

Method comparison



Conventional Hct measurement (via a hematology analyzer) *vs.* NIR-based Hct prediction

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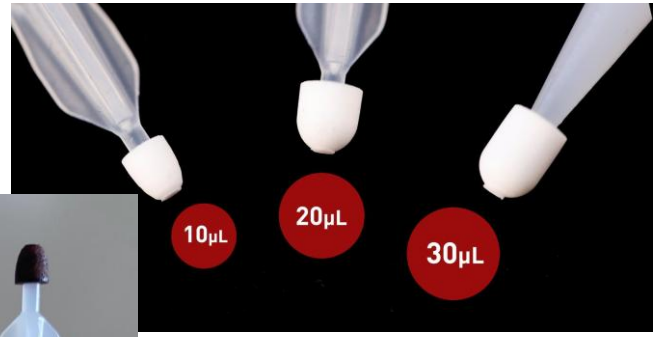
Results

VAMS-related variables





- ✗ Not suitable for Hct prediction of **20 µL** and **30 µL VAMS samples**
- ✗ Hct prediction is off for **over- and underfilled** samples
- ✓ No impact of **new lot** of VAMS devices
- ✓ Results independent on the **operator**

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Conclusion

- We extensively and successfully validated a custom-made NIR set-up, allowing non-contact Hct prediction of VAMS samples
- Hct can still be predicted after 1 month of storage of the VAMS samples at RT
- NIR-based Hct prediction is robust for 10 µL VAMS samples

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