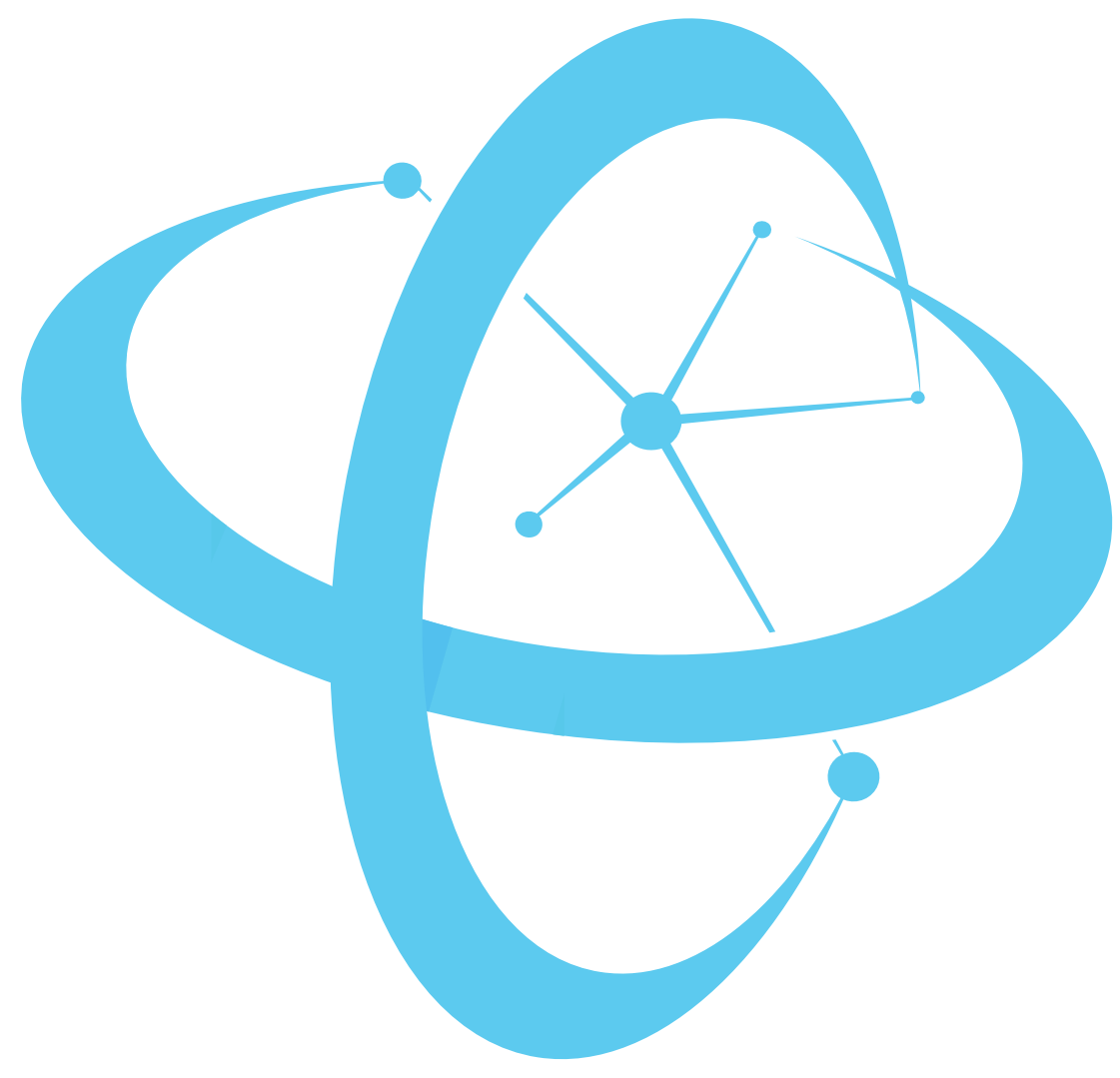




Consistency of Bolus Curves Produced by Radiowater Generators

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Introduction

- Radiowater, the mixture of radioactive water [¹⁵O]H₂O and saline, is routinely used for myocardial perfusion imaging at Turku PET Centre
- Radiowater is injected into the bloodstream over a short time as a bolus, and the shape of the bolus curve might cause uncertainty in quantitative myocardial blood flow values
- The uncertainty of bolus curves has not been previously researched in detail

Methods

- Repeated measurements were performed on four radiowater generators (Hidex Oy, Turku, Finland) at Turku PET Centre, with the set up in Figure 1.
- The measurement uncertainty was estimated as an expanded uncertainty for five parameters from the bolus curves, and for three parameters from the generator control unit
 - Area-under-the-curve (AUC), full-width-at-half-maximum (FWHM), time-to-peak, height, rise time
 - Production level, activity, infusion time
- Repeatability and reproducibility were included in the expanded uncertainty

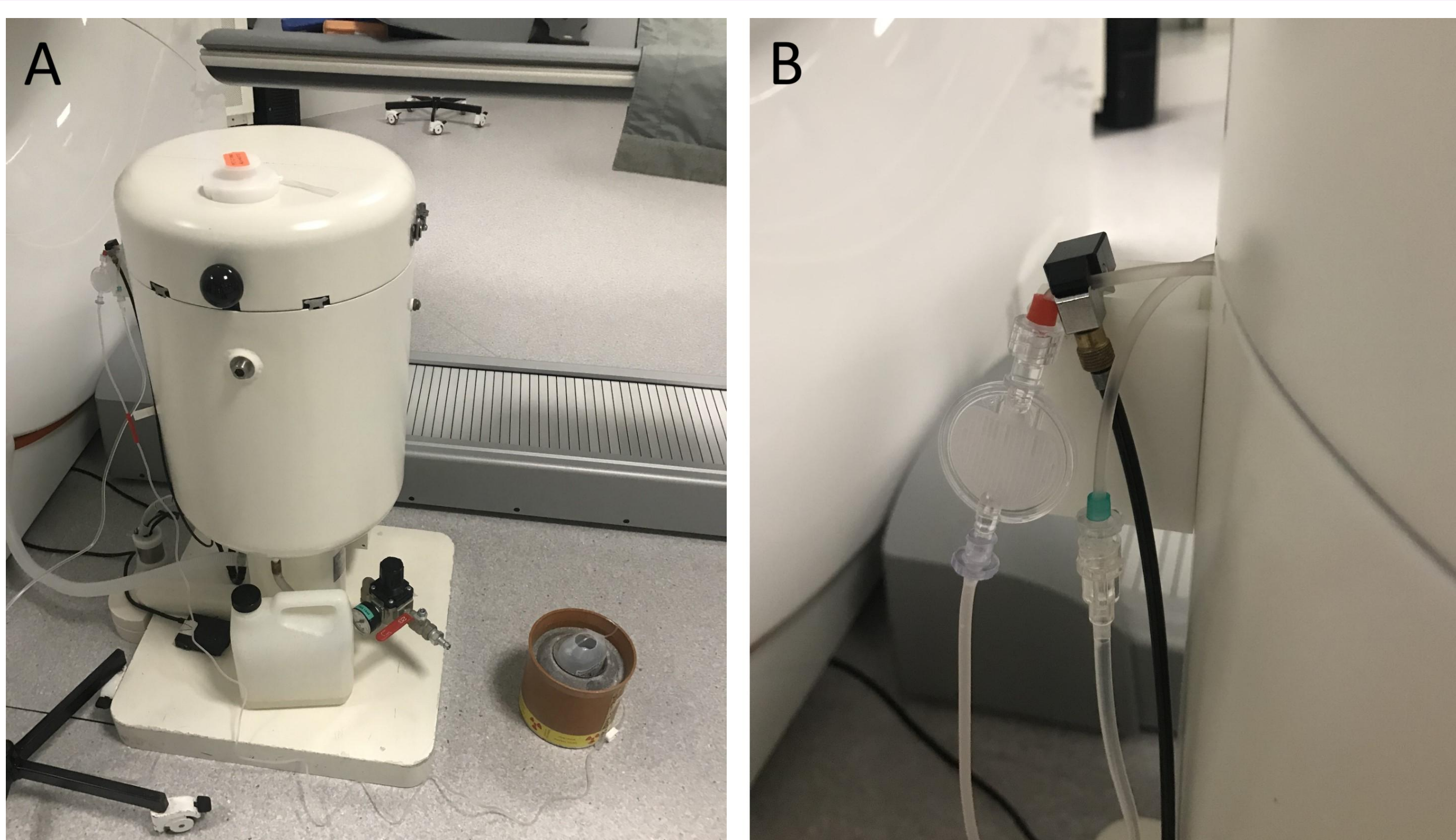


Figure 1: Example pictures of the measurement set up for Vision's radiowater generator. The radiowater was flowing freely into the bottle (A). The detector was placed as shown in picture B.

Results

- Figure 2 shows the average curve across all measurements

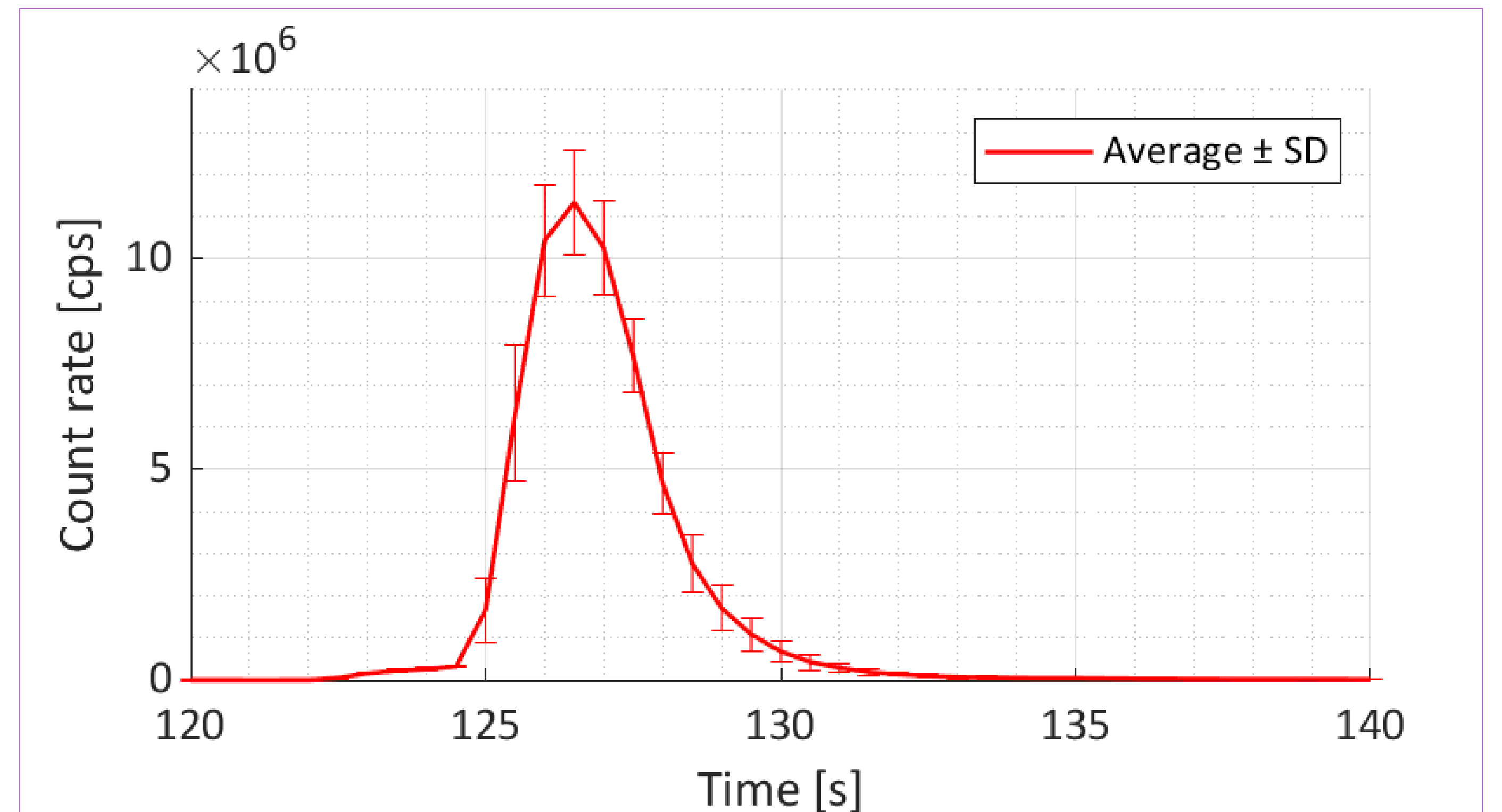


Figure 2: Average bolus curve across all measurements with error bars at each time point.

- For expanded uncertainty at 95 % confidence, coverage factor $k=2.20$ was used, according to Student's t-distribution
- The results for the three parameters with the highest uncertainties are shown in Table 1
- All parameters and generators considered the uncertainty varied from 0.31 % to 26.1 %

Table 1: Expanded uncertainty at 95 % confidence with $k = 2.20$.

	Average ± expanded uncertainty			
	Aino	Vision	Quadra	Signa
FWHM	4.93 ± 20.6 %	4.45 ± 19.9 %	5.23 ± 17.5 %	4.55 ± 20.3 %
Height (Mcps)	10.20 ± 26.1 %	11.66 ± 22.2 %	10.99 ± 23.0 %	13.07 ± 19.6 %
Rise time (s)	3.88 ± 18.7	4.17 ± 20.2 %	3.89 ± 13.6 %	3.89 ± 13.8 %

Conclusions

- The contribution of repeatability and reproducibility on measurement uncertainty was studied with eight parameters, of which three with the highest uncertainties are shown in Table 1
- According to the parameters considered, uncertainty in the curves mainly rises from the variation in the descending part of the curves, inter-generator variation of the bolus height, and the activity detected before the bolus
- Apart from the three parameters shown in Table 1, the measurement uncertainty is generally low
- This study provides a baseline for the bolus uncertainty for future research, where additional factors might be considered

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