



# Digital in-line vaporizer plus anesthetic shield: maximum control and maximum efficiency of anesthetic delivery

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## Background

### Circle circuit + 'out of circuit' vaporizer:

- Vaporizer output → huge buffer that must be washed out before change in [Anes] in blood: **imprecise targeting, slow, wasteful.**
- Low FGF: ↑ efficiency / longer time to change [Anes]

### Solution: in-line vaporizer

- works with **any** anesthetic or ventilator circuit
- Rapid changes in [Anes] at **any** FGF

## Hypothesis

In-line vaporizer + anesthetic reflector → ideal efficiency of anesthetic delivery: lose only what is absorbed by patient

## Methods

### Key components:

- Inline digital target controlled vaporizer (MADM™, TRI, Toronto, Canada)
- Anesthetic reflector (AnaConDa™)
- Anesthetic circuit; secondary circuit

### Protocol:

- 2 trials on a single pig:
  - Target isoflurane 2%
  - FGF 1 or 4 L/min with or without reflector

### Measurements:

- anesthetic consumption from weight of vaporizer averaged over 20 min
- tidal PCO<sub>2</sub>, PO<sub>2</sub>, SaO<sub>2</sub>, NIBP

### References

1. Eger II EI. Anesthetic uptake and action. Baltimore, London: Williams & Wilkins; 1974.
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3. Stureson LW, Malmkvist G, Bodelsson M, Niklasson L, Jonson B. Carbon dioxide rebreathing with the anaesthetic conserving device, AnaConDa®. Br J Anaesth. 2012 Aug;109(2):279-83.
4. Stureson LW, Bodelsson M, Johansson A, Jonson B, Malmkvist G. Apparent dead space with the anaesthetic conserving device, AnaConDa®: a clinical and laboratory investigation. Anesth Analg. 2013 Dec;117(6):1319-24.

Figure 1: Schematic of experimental set-up showing MADM™ on scale, breathing circuit. And position of reflector.

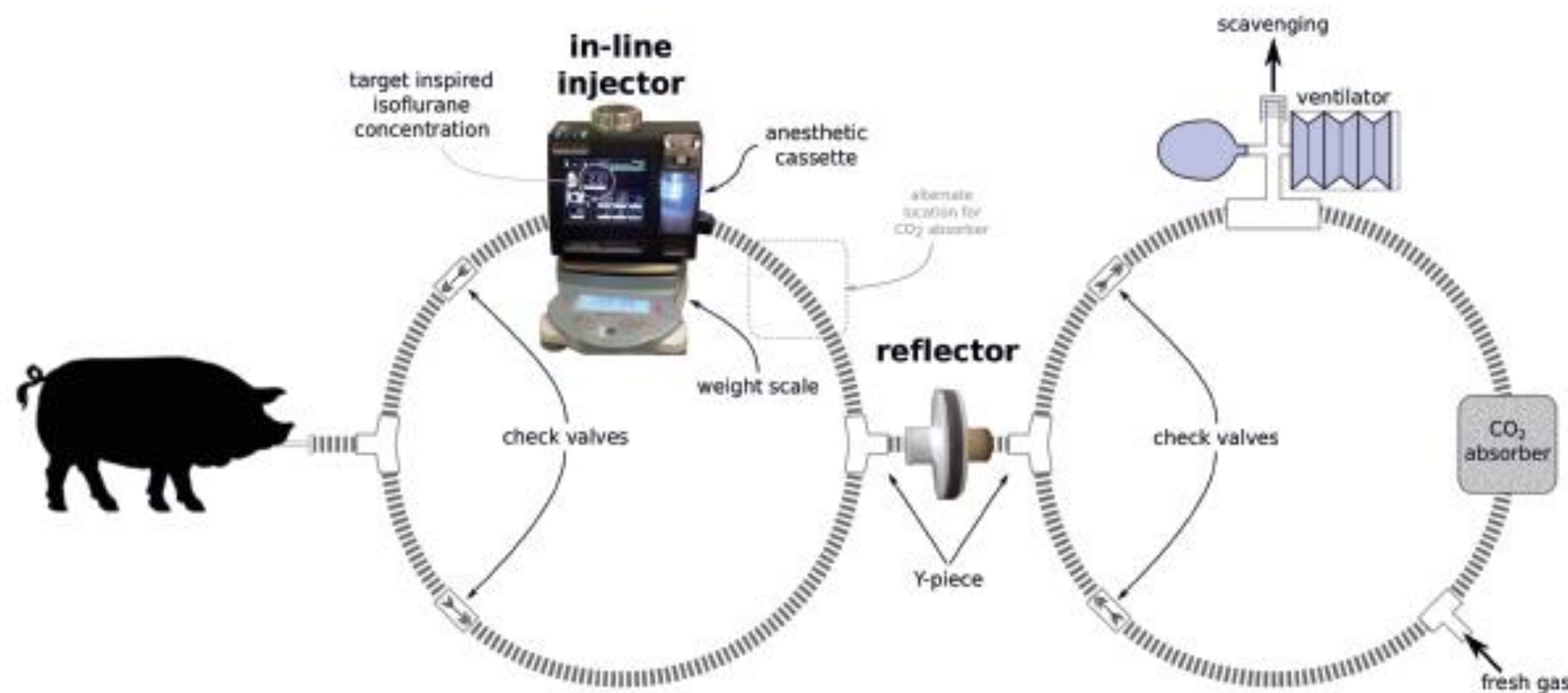
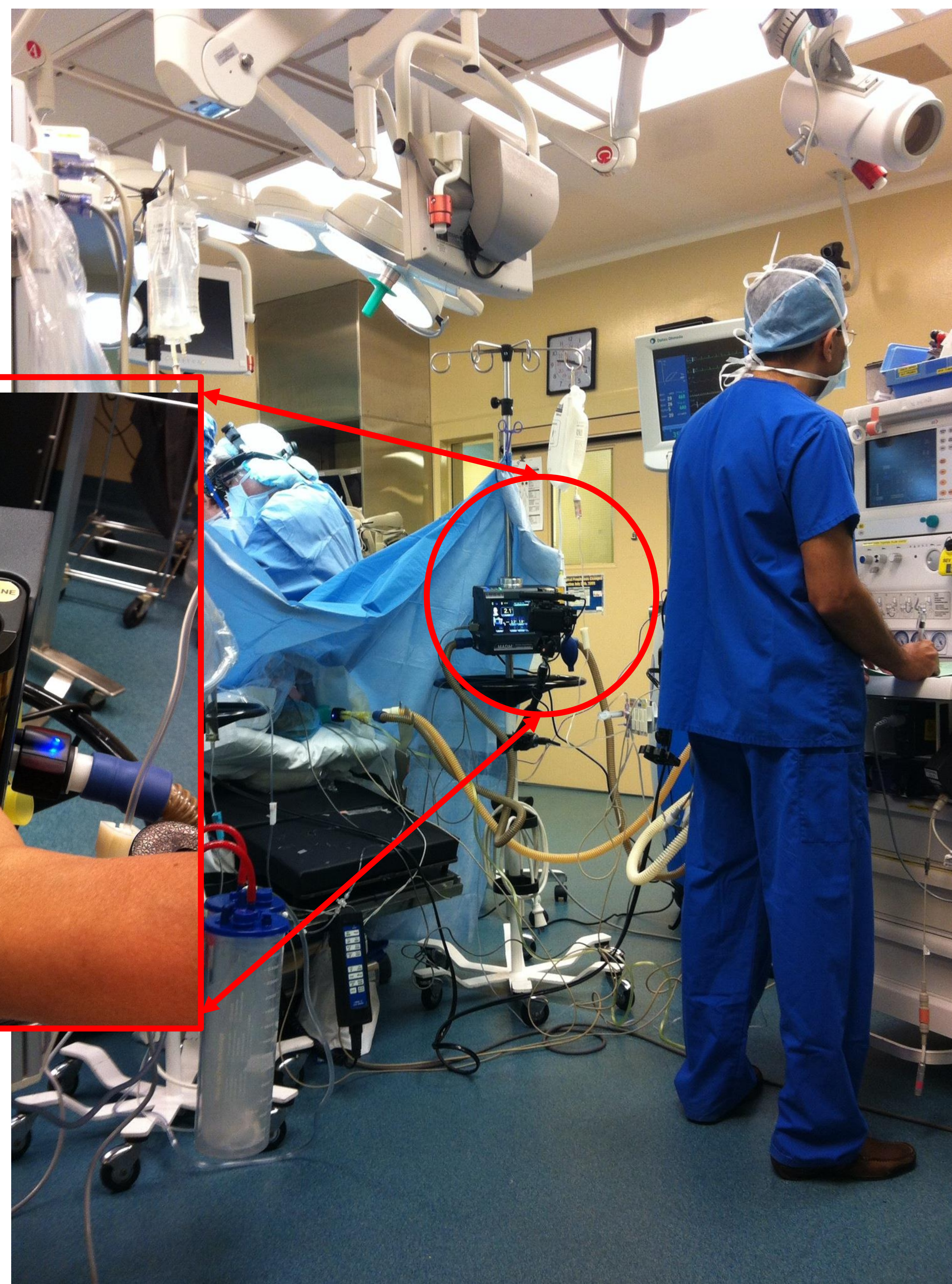
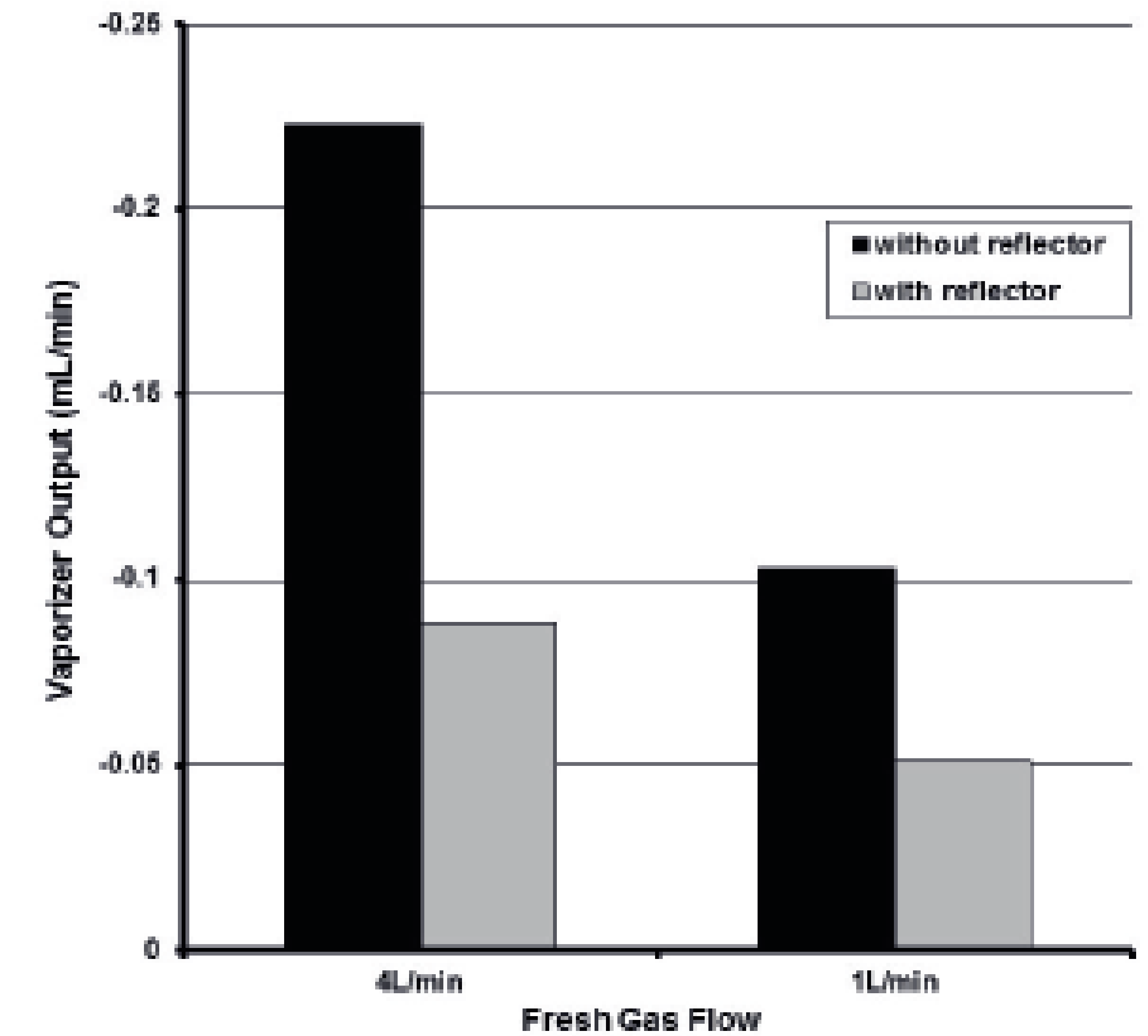


Figure 2: clinical use of MADM™ at University Health Network, Toronto, Canada.



## Results



- CO<sub>2</sub> rebreathing in all 4 trials
- PICO<sub>2</sub> was 3-4 mmHg without reflector; 12-15 mmHg with reflector

## Discussion & Conclusions

### In-line vs. out of circuit vaporizer:

- **Efficient:** direct control of inspired [Anes] independent of FGF
- **Simple:** what you dial is what you get
- **Compatibility:** Works with any breathing circuit: circle, flow through, self-inflating bag
- **Versatile:** small footprint; 5 Kg; use **anywhere**, with **anything**

### Adding reflector:

- Greatest possible efficiency of anesthesia

### Limitations:

- CO<sub>2</sub> rebreathing with reflector: 100 ml deadspace
- May not be as big a problem with humans (pigs have high VCO<sub>2</sub>)
- May need second CO<sub>2</sub> scrubber on inspiratory limb.