# The AnaConDa® and Sevoflurane in the ICU:
## *data on ambient pollution and staff exposure*

**A.T. Bos MD, Anesthesiologist-Intensivist**
**Dept. of Intensive Care, VieCuri Medical Center Venlo, the Netherlands**
**alexbos@viecuri.nl**

### Introduction
The AnaConDa® (Sedana Medical, Uppsala, Sweden) is a reflection filter that can be used to administer volatile anesthetics to intubated patients on a conventional ventilator outside the OR. We have recently implemented sevoflurane as a sedative in our ICU and found that little data are available on staff exposure and ambient pollution when using the AnaConDa® (Fig. 1). A risk analyses was performed, as requested by our occupational health service. We have measured ambient pollution, staff exposure and peak values of sevoflurane on all connection points of the AnaConDa® system and FlurAbsorb scavenger in a Critical Care setting (Fig. 2) . Aim of this study was to quantify ambient pollution and staff exposure to sevoflurane while using the AnaConDa® and relate it to current safety standards.

Fig. 1 Reflection filter and syringe

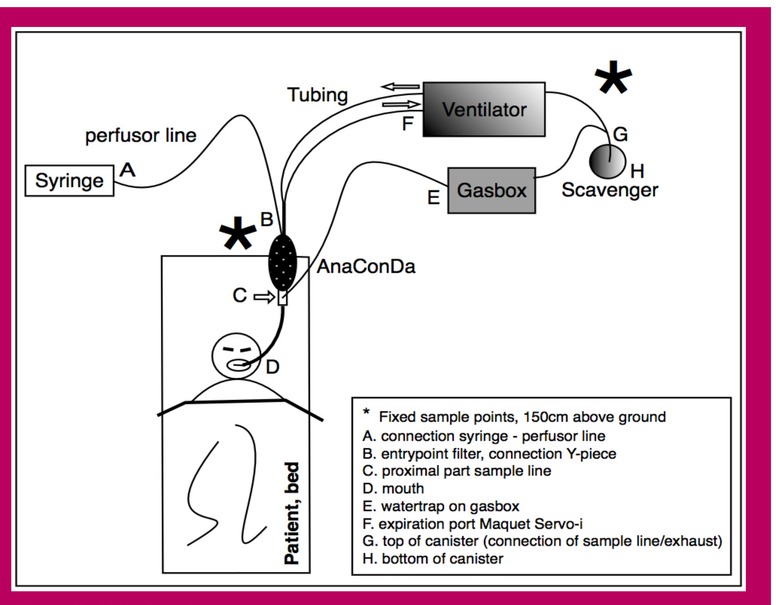

Fig. 2 Clinical setting

### Methods
Since pollution data are patient independent and relate to the integrity of the breathing circuit, only one intubated subject was used to perform sampling. Air sampling was performed by an independent institute (RPS). A Miran SapphIRe portal ambient analyzer was used for realtime measurements on eight different connecting points of the breathing circuit and AnaConDa® system, including the FlurAbsorb scavenger. Charcoal sorbent tubes (SKC226-01) were used for stationary and personal measurements and were analyzed in a laboratory (OSHA 103 method). Stationary 8 hour measurements were performed on two different locations in an ICU room (fig 2). These measurements were repeated with new sampling tubes.

**Sevoflurane sample data in a standard single patient ICU room, VieCuri Medical Centre.**
**Physical data of the ICU room: 52m³, air refreshing rate minimum 6/hr.**

| Position | Description | Sample time (min) | % exposure limit | Total sample volume (L) | TWA 8hrs (mg/m³) | Conc (ppm) |
|---|---|---|---|---|---|---|
| **Nurse 1 shift 1** [a] | personal air sampling | 484 | 0,10 | 23,9 | 0,0418 | |
| **Nurse 2 shift 2** [a] | personal air sampling | 493 | 0,10 | 24,7 | 0,0404 | |
| **Stationary 1 shift 1** [b] | stationary, above patients head | 465 | 0,24 | 23,6 | 0,0998 | |
| **Stationary 1 shift 2** [b] | stationary, above patients head | 496 | 0,60 | 25,9 | 0,251 | |
| **Stationary 2 shift 1** [b] | stationary, near scavenger | 465 | 0,26 | 24,1 | 0,111 | |
| **Stationary 2 shift 2** [b] | stationary, near scavenger | 500 | 0,19 | 25,4 | 0,0792 | |
| **Position A** [c] | **syringe – infusion line** | realtime | | | | 0,23 |
| **Position B** [c] | **AnaConDa® filter – Y-piece** | realtime | | | | 0,19 |
| **Position C** [c] | **AnaConDa® filter - sample line** | realtime | | | | 1,12 |
| **Position D** [c] | **patients mouth** | realtime | | | | 0,25 |
| **Position E** [c] | **sample line – gasbox (watertrap)** | realtime | | | | 0,23 |
| **Position F** [c] | **ventilator exp. port - exhaust** | realtime | | | | 0,22 |
| **Position G** [c] | **top of scavenger canister (confluent of sample line & exhaust)** | realtime | | | | 0,36 |
| **Position H** [c] | **bottom scavenger canister** | realtime | | | | 0,31 |

**a)** personal air sampling, (SKC 226-01 charcoal tube)
**b)** stationary sampling approx. 150cm above ground, (SKC 226-01 charcoal tube)
**c)** Realtime measurements, (Miran SapphIRe infrared ambient air analyzer)
Reference: Arbejdstilsynet; grænseværdiliste Bekendtgørelse; **42mg/m³** (5ppm), time weighted average over 8 hrs; ***(1 ppm = 8,33 mg/m³)***
**NEN 689 model:**
- Exceedance can be ruled out if concentration is <10% of exposure limit
- Possible exceedance if concentration is 10-100% of exposure limit
- **Exceedance; concentration is >100%**

Table 1. Sample data

### Results
Our results are summarized in table 1. Time weighted measurements are expressed as a percentage of exposure limits (NEN 689 model). An exceeding can be ruled out if concentrations are <10% of exposure limits. We clearly show that peak concentrations and TWA are far below the allowed occupational exposure limits.

### Discussion
The exposure to volatile anesthetics should be reduced to ‘a level as low as reasonably achievable’ (ALARA). Local differences in ICU’s necessitate quantification of exposure prior to routine use, in order to guarantee a safe work environment. Furthermore, protocols should be used to ensure a standard way of care when using volatile anesthetics.

### Conclusion
We concluded that sedation with sevoflurane and the AnaConDa® system with the FlurAbsorb scavenger is safe in an ICU setting. Occupational exposure is negligible and meets international standards. These data highly contributed to staff safety perception and awareness. Our data may be helpful to those who want to implement volatile anesthetics in their ICU.

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Contact: alexbos@viecuri.nl / +31-77 320 5259