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## SCIENTIFIC ARTICLE

# Comparison of waste anesthetic gases in operating rooms with or without an scavenging system in a Brazilian University Hospital

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### KEYWORDS

Inhaled anesthetics;  
Operating rooms;  
Indoor air pollution;  
Occupational exposure

### Abstract

**Background and objectives:** Occupational exposure to waste anesthetic gases in operating room without active scavenging system has been associated with adverse health effects. Thus, this study aimed to compare the trace concentrations of the inhalational anesthetics isoflurane and sevoflurane in operating room with and without central scavenging system.

**Method:** Waste concentrations of isoflurane and sevoflurane were measured by infrared analyzer at different locations (near the respiratory area of the assistant nurse and anesthesiologist and near the anesthesia station) and at two times (30 and 120 min after the start of surgery) in both operating room types.

**Results:** All isoflurane and sevoflurane concentrations in unscavenged operating room were higher than the US recommended limit (2 parts per million), regardless of the location and time evaluated. In scavenged operating room, the average concentrations of isoflurane were within the limit of exposure, except for the measurements near the anesthesia station, regardless of the measurement times. For sevoflurane, concentrations exceeded the limit value at all measurement locations and at both times.

**Conclusions:** The exposure to both anesthetics exceeded the international limit in unscavenged operating room. In scavenged operating room, the concentrations of sevoflurane, and to a lesser extent those of isoflurane, exceeded the recommended limit value. Thus, the operating room scavenging system analyzed in the present study decreased the anesthetic concentrations, although not to the internationally recommended values.

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## PALAVRAS-CHAVE

Anestésicos  
inalatatórios;  
Salas cirúrgicas;  
Poluição do ar em  
ambientes fechados;  
Exposição  
ocupacional

## Comparação de resíduos de gases anestésicos em salas de operação com ou sem sistema de exaustão em hospital universitário brasileiro

### Resumo

**Justificativa e objetivos:** A exposição ocupacional aos resíduos de gases anestésicos em salas de operação (SO) sem sistema ativo de exaustão tem sido associada a efeitos adversos à saúde. Assim, o objetivo do estudo foi comparar os resíduos dos anestésicos inalatórios isoflurano e sevoflurano em SO com e sem sistema de exaustão.

**Método:** Concentrações residuais de isoflurano e sevoflurano foram mensuradas por analisador infravermelho em diferentes locais (próximo à área respiratória do auxiliar de enfermagem e do anestesiológista e próximo à estação de anestesia) e em dois momentos (30 e 120 min após o início da cirurgia) em ambos os tipos de SO.

**Resultados:** Todas as concentrações de isoflurano e sevoflurano nas SO sem sistema de exaustão foram mais elevadas em relação ao valor limite recomendado pelos EUA (2 partes por milhão), independentemente do local e momento avaliados. Nas SO com sistema de exaustão, as concentrações médias de isoflurano ficaram dentro do limite de exposição, exceto para as mensurações próximas à estação de anestesia, independentemente dos momentos avaliados. Para o sevoflurano, as concentrações excederam o valor limite em todos locais de medição e nos dois momentos.

**Conclusões:** A exposição a ambos os anestésicos excedeu o limite internacional nas SO sem sistema de exaustão. Nas SO com sistema de exaustão, as concentrações de sevoflurano, e em menor extensão as de isoflurano, excederam o valor limite recomendado. Dessa forma, o sistema de exaustão das SO analisado no presente estudo diminuiu as concentrações dos anestésicos, embora não tenha reduzido a valores internacionalmente recomendados.

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## Introduction

Occupational exposure to residual concentrations of inhaled (volatile) anesthetics in operating rooms (ORs) without scavenging system has been associated with adverse health effects, such as headache, irritability, neurobehavioral changes, and DNA damage.<sup>1</sup>

Although the cause-and-effect relationship has not yet been established, agencies in several developed countries recommend limit values for exposure to anesthetic gases to minimize health risks. The US National Institute of Occupational Safety and Health (NIOSH)<sup>2</sup> recommends the value of 2 parts per million (ppm) as occupational exposure limit to halogenated inhalational anesthetics.

Halogenated anesthetics are the most widely used agents in inhalational anesthesia worldwide. An anesthetic power measure refers to the minimum alveolar concentration (MAC). In adult patients, the halogenated sevoflurane has a MAC of about 2%, which is higher than that of isoflurane (1.2%).<sup>3</sup>

The use of inhalational anesthetics requires a scavenging system to reduce both the OR environmental contamination and occupationally exposed professionals. However, adequate OR scavenging systems are uncommon in most hospitals in developing countries. Even with the presence of an OR scavenging system in these countries, there are still large differences in efficiency between systems in developed and developing countries.<sup>4</sup>

Due to the subject relevance and the absence of national data, this unpublished work aimed to compare the residual concentrations of isoflurane and sevoflurane in ORs with and without an anesthetic gas scavenging system in a public university hospital.

## Method

This study was approved by the local Research Ethics Committee (4440-2012) and performed in a hospital with a theater setting of 13 ORs, seven of which without a scavenging system, with only one air conditioner, and six with a (partial) scavenging system with only 25% of clean external air (thus, with 75% air recirculation), with seven air changes per hour. Regarding the anesthesia stations, there was no scavenging system exclusive to inhalational anesthetics.

The study was performed in the ORs, always with the measurement of anesthetic residues during the first general anesthesia of the day, under anesthesia maintenance with isoflurane or sevoflurane, in 24 patients with tracheal intubation with cuffed tube, which was filled with minimum seal pressure to avoid leakage during artificial ventilation.

Both isoflurane and sevoflurane concentrations were used around 1 MAC, according to patient's need, with fresh gas flow (FGF) of 2 L min<sup>-1</sup> in circular breathing circuit with CO<sub>2</sub> absorber, according to the standard procedures of our hospital. The anesthesia workstation Dräger Fabius GS Premium (Germany) was used in all ORs.

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