Assessing Volatile Organic Compounds in a Hospital Burn Center

Friday, November 9, 2018
2:15 – 2:30 pm

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Objective:	Upon completion of the lecture, attendees should be better prepared to: ▪ Discuss potential VOCs in a burn Center ▪ Recognize the potential harm VOCs may produce over long-term exposure

Abstract:

Introduction: While outdoor pollution has long been recognized as a contributor to adverse health outcomes, indoor air quality (IAQ) has recently been gaining attention and generating research interests as humans are now spending the majority (over 90%) of their time indoors. Unlike most homes and a fair amount of work places, health care facilities, especially hospitals, are among the most demanding indoor environments with regards to indoor air quality. These facilities often contain chemicals like waste medical gases (e.g. anesthetic gases), disinfecting and sterilizing substances, microbial contaminants and also other particles such as skin cells, lint, and aerosols. However, in addition to dealing with multiple sources of air pollutants, health facilities must have some of the cleanest air due to the nature of certain treatment processes and operating procedures. Therefore, understanding the nature of contaminants present is crucial for understanding how best to treat these contaminants and ensure better air quality for patients and healthcare workers alike. Herein, the research team assessed the VOCs in a hospital burn center.

Method: The non-selective real time measurement of total volatile organic compounds (TVOC) utilized a photoionization detector (PID) to quantify total VOC concentrations (ppb). The PID utilized is a ppbRAE plus (RAE Systems, Inc.), with detection limits in the parts per billion range, was calibrated to isobutylene. The hospital air temperature was controlled at 71° F. Eight burn center locations were identified for VOC concentration measurements. Six measurements were taken in each of the 8 specified burn unit locations, analyzed for various VOCs and quantified.

Results: The following tables and graphs provide an overview of the data collected during the burn unit VOC air quality study. The first set of data is provided for the EPA TO-15 quantification and characterization methods. In general, the VOCs are detailed with respect to the location. Please see Tables and Figures attached.

Conclusion: Our study is the first of its kind assessing air quality in a major burn center. From the results identified, most of the compounds detected are solvents, refrigerants, preservative or anesthetics. While the relative quantity of the VOCs are small, the most extreme adverse health effects of the compounds detected range from central nervous system depression, irritation of eyes and throat, impairment of liver and kidneys' functioning and cancer from chronic exposure. The low ppbv levels

of the VOCs should not be ignored, as hospital workers may have negative health effects due to long term exposure to these compounds. Additionally, individuals with sensitivities, such as, young children, pregnant women, older patients, and recovering individuals may be susceptible to these ambient concentrations on a short term basis. More work should be done to assess the threshold at which the most sensitive populations demonstrate a response, which could be linked to patient outcomes.

References and Resources:

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Disclosure:

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Silhan Liu – No Relevant Financial Relationships to Disclose
John Fox – No Relevant Financial Relationships to Disclose

Table 1. Average concentration of EPA TO-15 detected compounds (in ppbv), ranked from highest to lowest average concentration level. Number of locations (out of 8) with positive detection.

Average			No. of Times Appeared (8 rooms in total)		
Rank	Chemical	Average	Day 1	Day 2	Day 3
1	Isopropyl Alcohol	126.33	8	8	8
2	Ethanol	48.46	8	8	8
3	Sevoflurane	41.33	4	1	1
4	Acetone	16.79	8	8	8
5	Acetonitrile	11.55	2	0	0
6	Isoflurane	11.33	8	1	7
7	Unknown Compound	5.3	0	0	1
8	Toluene	3.86	5	4	3
9	Methyl Ethyl Ketone	2.91	8	8	8
10	Methylene Chloride	2.2	1	0	0
10	m & p-xylene	2.2	1	0	0
12	Ethyl Acetate	2.01	8	6	6
13	Chloromethane	1.15	1	1	2
14	Heptane	1.2	1	0	0
15	Freon-12	1.1	1	0	1
15	Freon-11	1.1	1	0	1

Table 2. Maximum concentrations (in ppbv) of EPA TO-15 detected compounds out of all samples collected

Maximum				
Rank	Chemical	Average	Which Day	Which Room
1	Isopropyl Alcohol	390	Day 2	OR
2	Sevoflurane	110	Day 1	SR
3	Ethanol	92	Day 1	PR
4	Isoflurane	27	Day 3	ICU
5	Acetone	26	Day 2	SR/ICU
6	Toluene	19	Day 1	NS
7	Acetonitrile	18	Day 1	HW
8	Methyl Ethyl Ketone	13	Day 1	HW
9	Ethyl Acetate	5.7	Day 1	HW
10	Unknown Compound	5.3	Day 3	PR
11	m & p-xylene	2.2	Day 1	NS
11	Methylene Chloride	2.2	Day 1	HW
13	Chloromethane	1.2	Day 1/2	SR/OR
13	Heptane	1.2	Day 1	NS
13	Freon-11	1.2	Day 1	SR
16	Freon-12	1.1	Day 1/3	SR

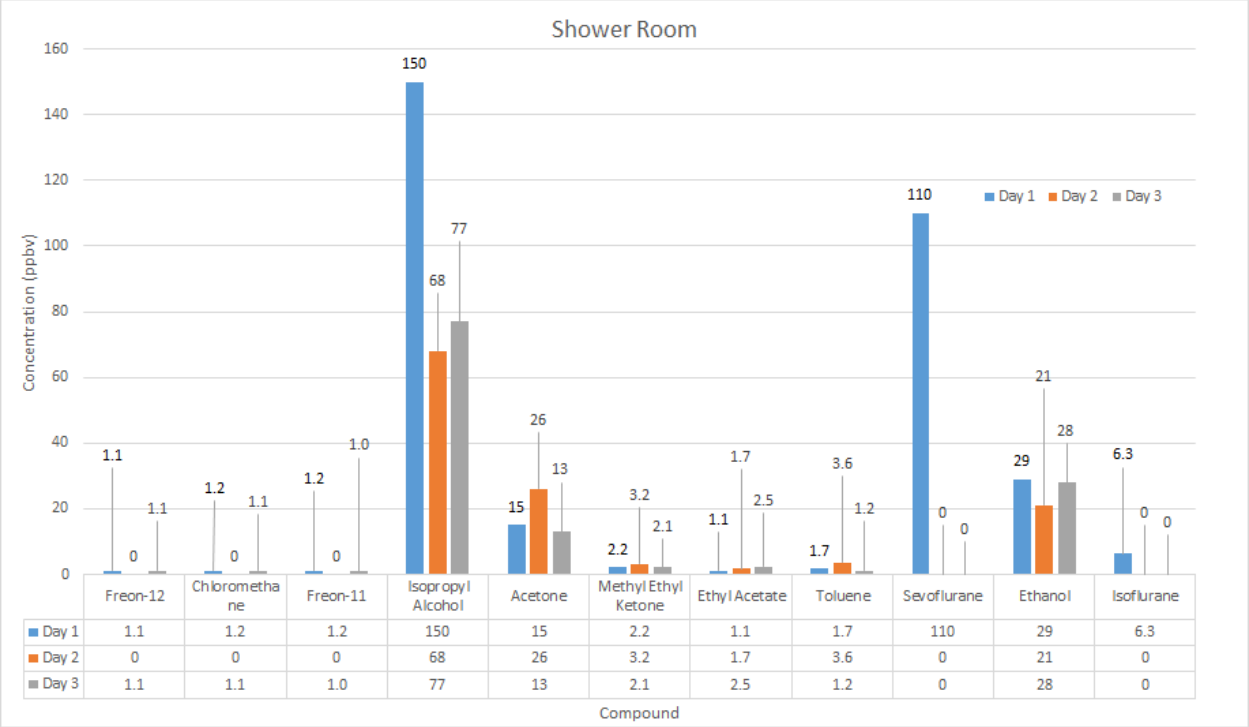

Figure 1. Shower Room Compound Concentration Chart

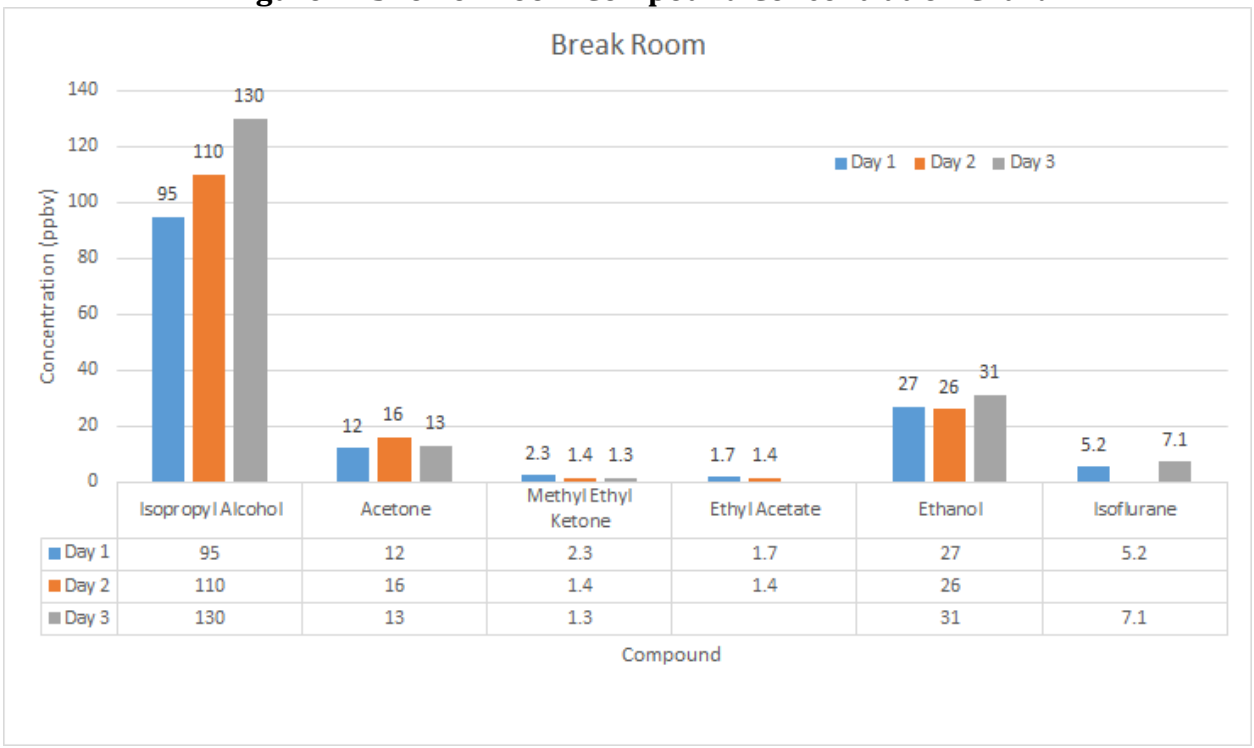

Figure 2. Break Room Compound Concentration Chart

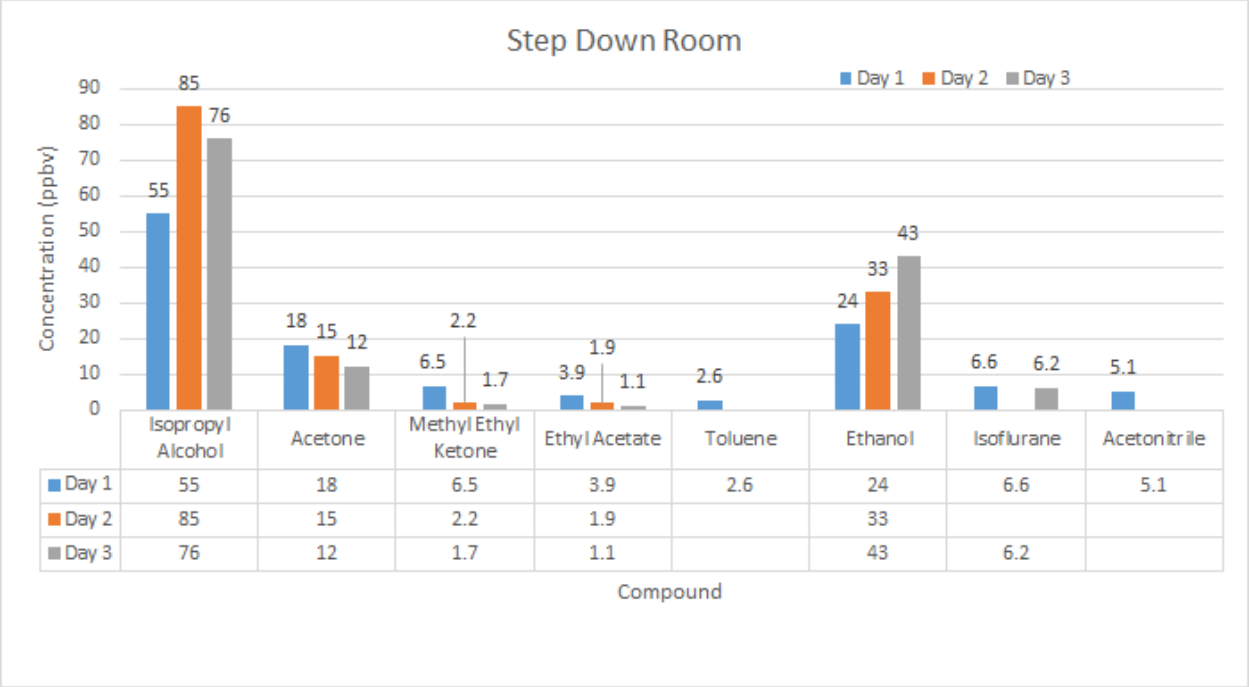

Figure 3. Step Down Room Compound Concentration Chart

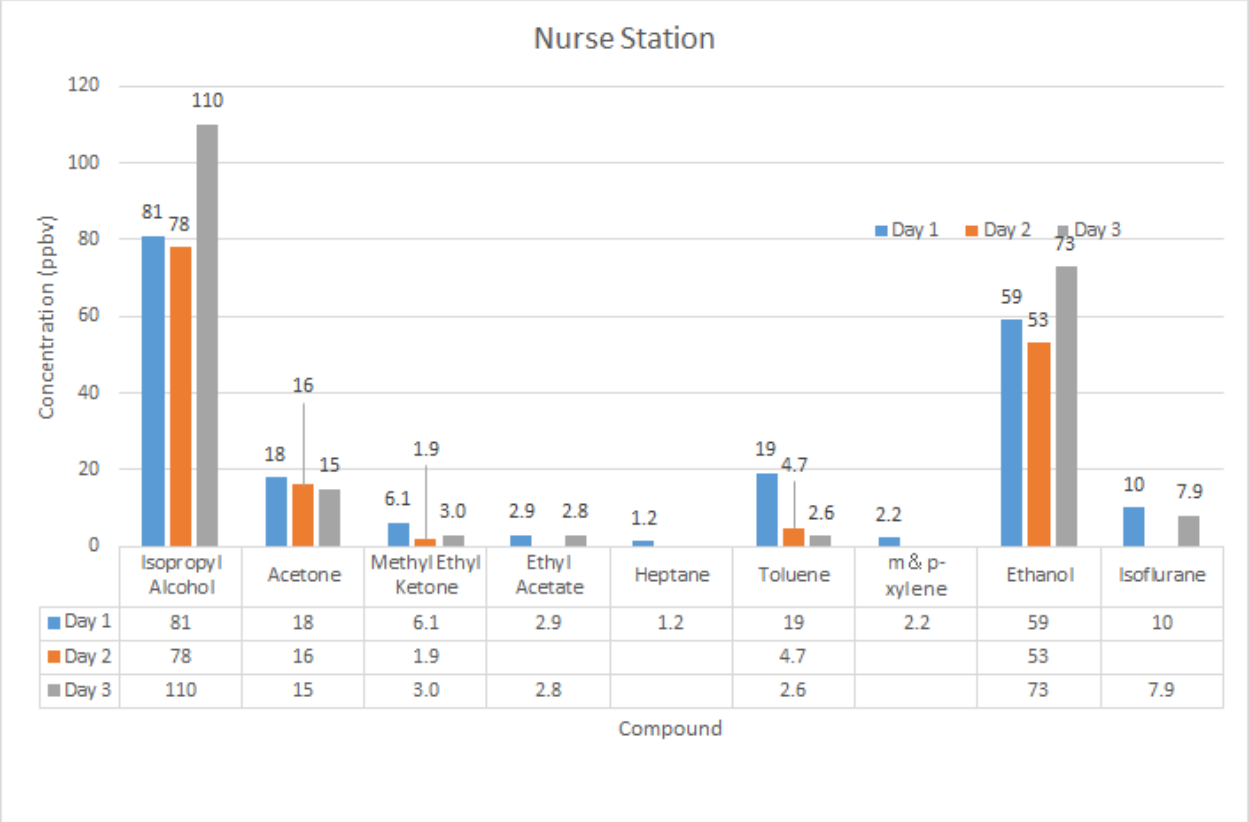

Figure 4. Nurse Station Compound Concentration Compound Chart

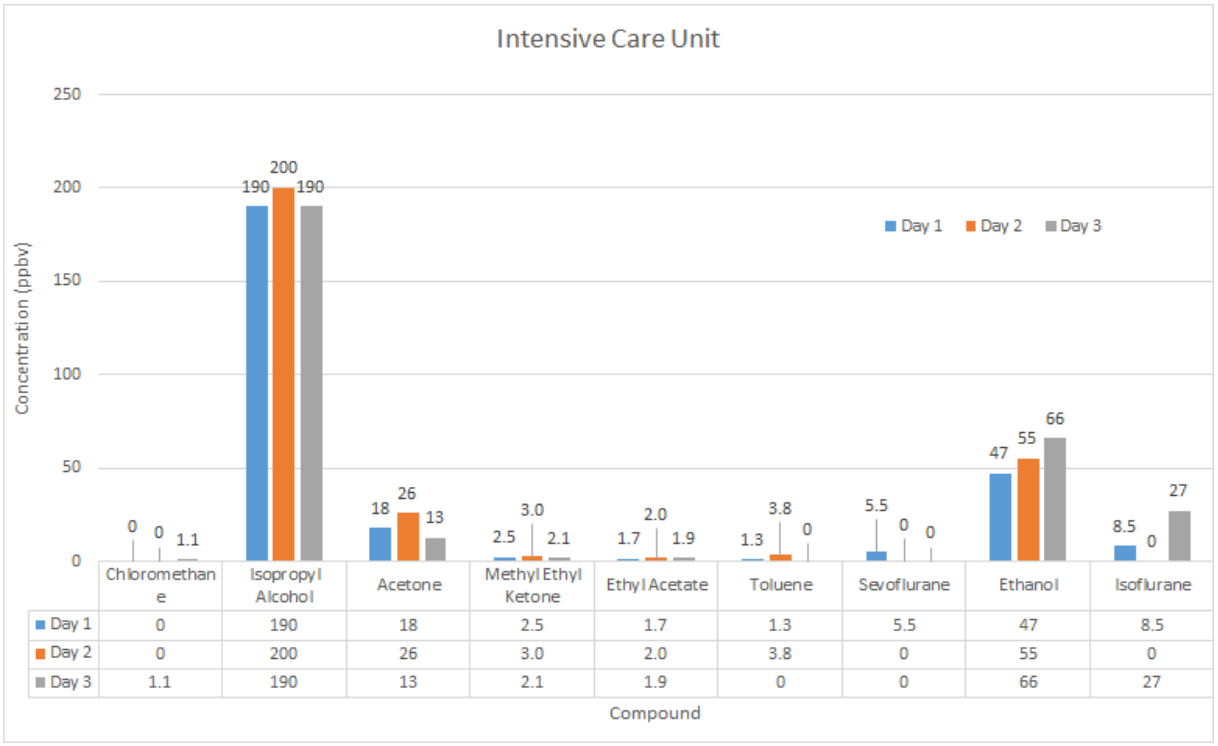

Figure 5. Intensive Care Unit Compound Concentration Chart

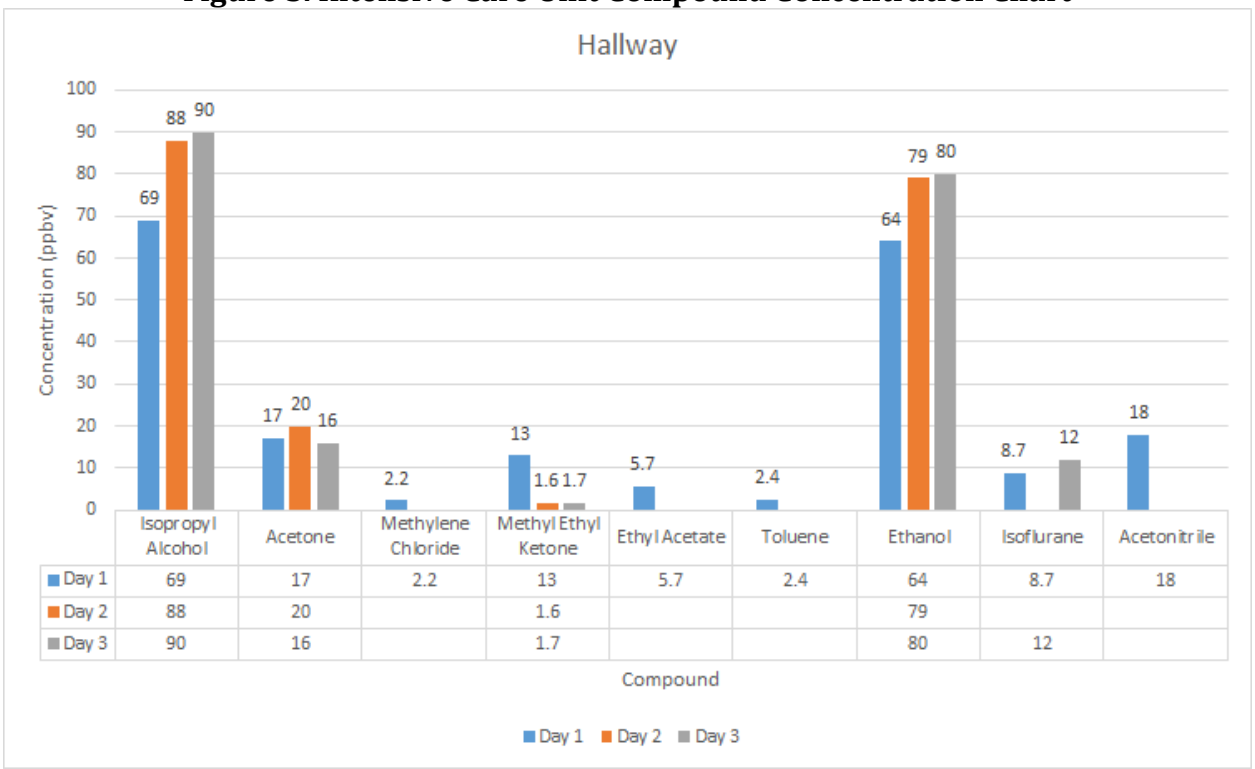

Figure 6. Hallway Compound Concentration Chart

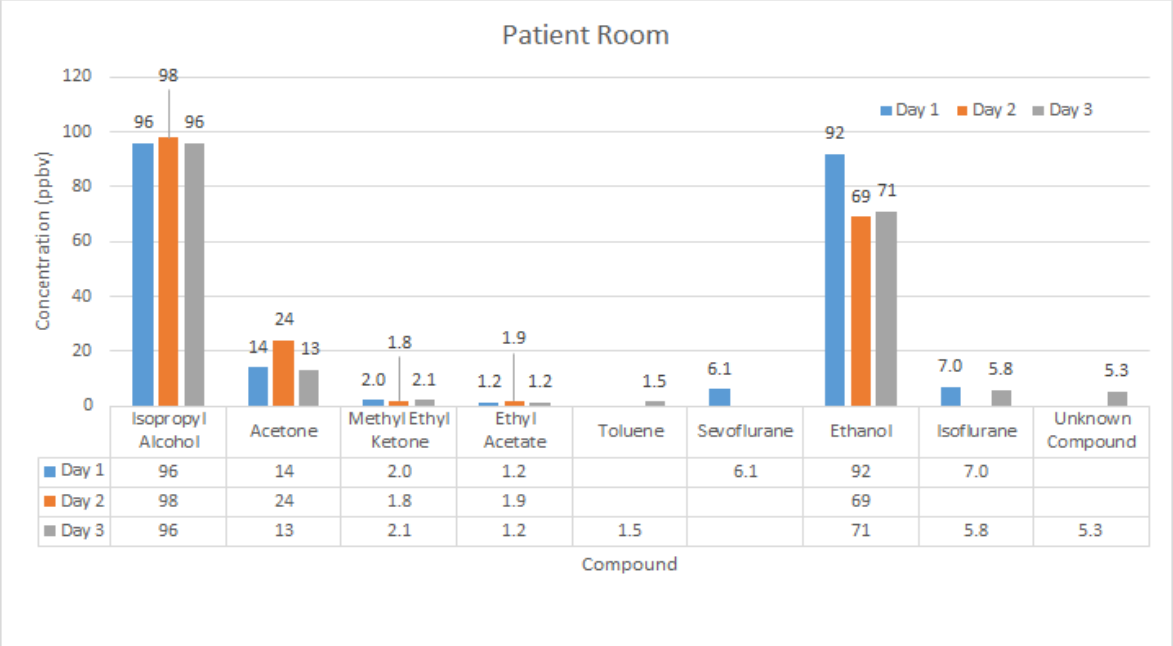

Figure 7. Patient Room Compound Concentration Chart

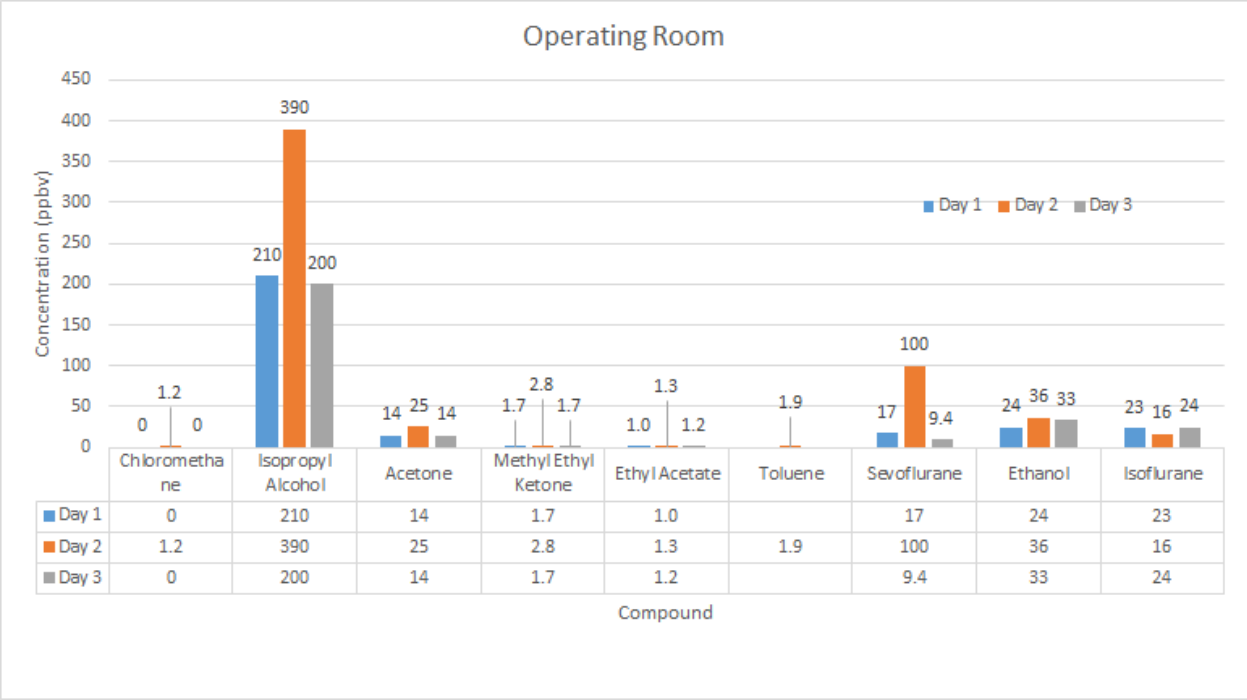

Figure 8. Operating Room Compound Concentration Chart

The real time total VOC concentrations are provided in Table 3. These real time results are comparable to the average sum of the EPA TO-15 results provided in Table 4.

Table 3. Average total VOC concentrations measured by PID in the 8 sample locations.

PID Total VOC measurement	
Room Code	Average of 6 trials (ppb)

SR	172.6
BR	132.2
SDR	121.2
NS	211.8
ICU	372.6
HW	152.75
PR	135.4
OR	188

Total* VOC Gas Chromatography Average	
Room Code	Average of 3 days (ppb)
SR	189.8
BR	160.1
SDR	132.9
NS	189.1
ICU	288.5
HW	196.1
PR	203
OR	382.7