A Potential Source of Ozone with Concomitant Health Effects in the Hospital Environment

Kevin A. Vrablik MD, MPH, FACOEM  
Lehigh Valley Health Network, kevin.vrablik@lvhn.org

Philip G. Lewis MD, MPH, FACOEM

Judith Green-McKenzie MD, MPH, FACOEM

Published In/Presented At  
A Potential Source of Ozone with Concomitant Health Effects in the Hospital Environment

Kevin A. Vrablik, MD, PH Certificate, FACOEM
Philip G. Lewis, MD, MPH, FACOEM
Judith Green-McKenzie, MD, MPH, FACOEM

Case
A hospital employee with reactive airway disease reported developing shortness of breath and wheezing when in the vicinity where an ultraviolet sterilizing device was deployed

Introduction
• Mobile ultraviolet devices are increasingly being used to sterilize hospital facilities
• Ozone can be produced from atmospheric oxygen in the presence of intense ultraviolet light
• Ozone has a short half-life and can be a respiratory tract irritant
• The odor threshold is variable (1-50 ppb)
• OSHA Permissible Exposure Limit is 100 ppb TWA

Objective
To determine if mobile high-intensity ultraviolet C devices used to sterilize hospital patient rooms produce significant amounts of ozone that might induce symptoms in employees

Materials
• Two mobile ultraviolet room sterilization units
• 2B Technologies 202B direct reading ozone meter
• Ozone monitoring forms for written data collection
• Unoccupied hospital patient rooms already terminally cleaned

Methods
• Deploy mobile ultraviolet sterilization unit(s) in typical hospital patient rooms after terminal cleaning has been completed
• Test single and double unit deployment (this strategy is used to reduce area treatment time)
• Measure proximate ozone levels before, during and after deployment

Results
• Baseline ozone measurements were ≤ 0.3 ppb
• Single unit peak ozone level, after 25 minutes of deployment, was 6 ppb
• Double unit peak ozone level, after 37 minutes of deployment, was 3.7 ppb

Results (Continued)

Ozone Levels

Discussion
• The OSHA PEL is 100 ppb TWA
• This level does not guarantee zero risk
• A Quantitative Risk Analysis was performed
• Assumed 98% worker protection
• Maximum ozone level measured inside the patient room
• This was 6 ppb which is 17X lower than OSHA PEL
• If one assumes a 2% ill effect, then ~12 in 10,000 may have symptoms at this level
• Those with underlying respiratory diagnoses may be more susceptible

Limitations
• Only two trials were performed due to time and logistics constraints
• The two patient rooms had different cubic volumes
• Study did not control for air exchange rates
• Ozone extinction levels could have been measured for longer period
• Ozone levels were not measured outside patient rooms, but were noted to be above the odor threshold by the investigator

Conclusions
• Mobile ultraviolet room sterilization devices, when used either alone, or in tandem, do not produce significant amounts of ozone
• The ozone levels did exceed odor thresholds, but were magnitudes under the OSHA PEL inside the treatment area
• However, this does not mean that ALL individuals are protected from ill effects of ozone
• Individuals with underlying pulmonary disease may be more sensitive
• Utilizing engineering and administrative controls such as signage, negative pressure room settings, taping door jams and limiting foot traffic in the area MAY be mitigating measures

The author would like to acknowledge and thank Mr. Timothy Docherty, MBA, CH, Director of Occupational Safety Management at LVHN for his assistance with this project. This research was supported in part by training grants from the National Institute of Occupational Safety and Health - grant number: S-TO1-1H008628, and the Health Resources and Services Administration - grant number: D33HP25770-01-00.