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

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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

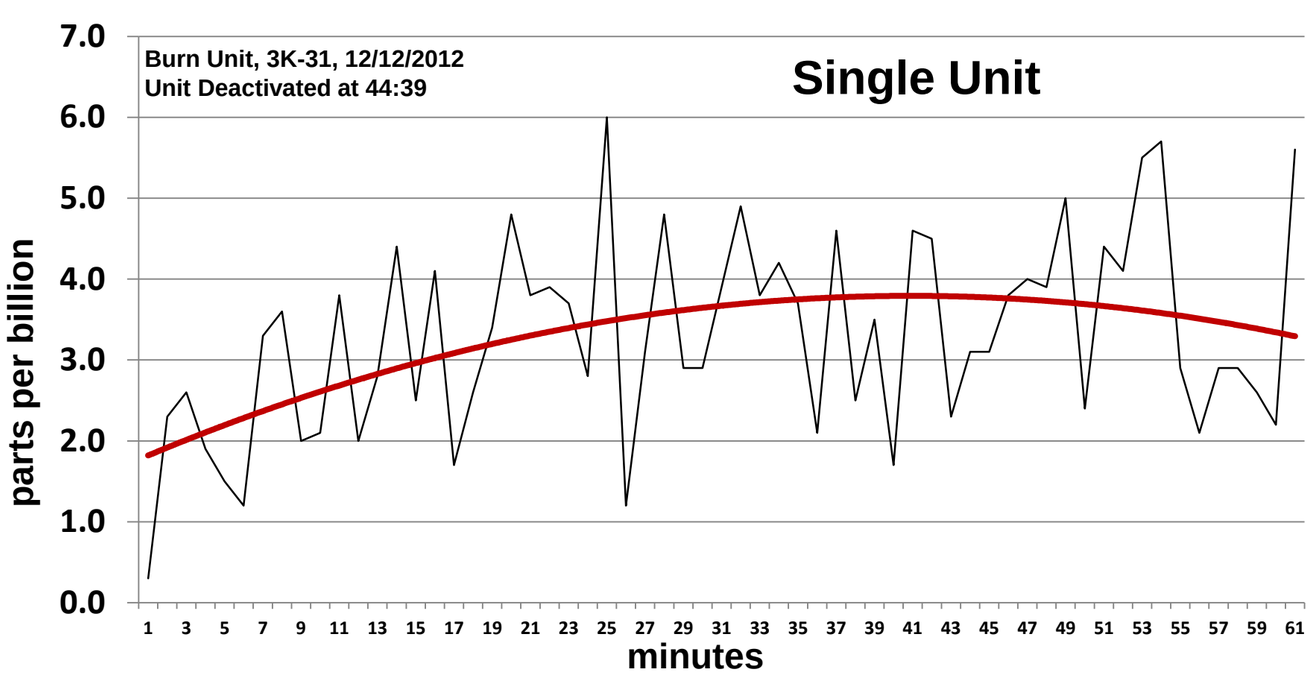
- Deploy mobile ultraviolet sterilization unit(s) in typical hospital patient rooms after terminal cleaning has been completed
- Test single and double unit deployment (this strategy is used to reduce area treatment time)
- Measure proximate ozone levels before, during and after deployment

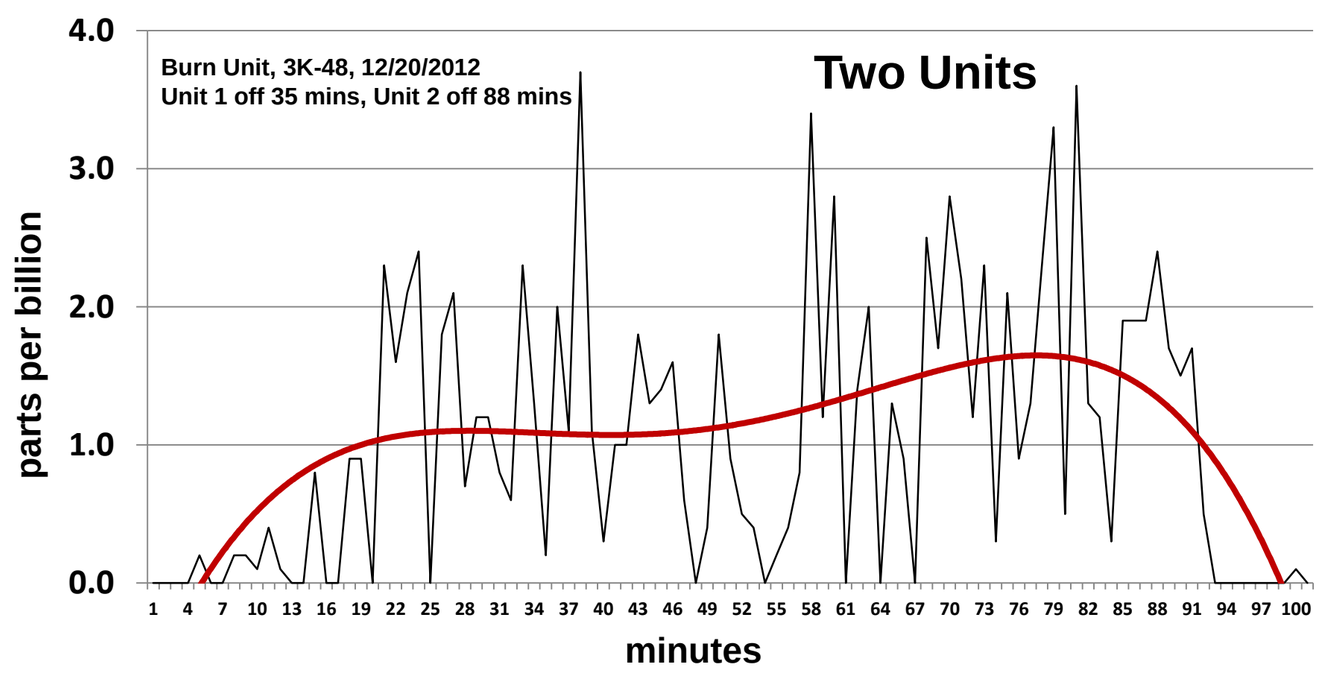
Results

- 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 jambs and limiting foot traffic in the area MAY be mitigating measures

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