

Health Hazards Associated with Indoor Marijuana Grow Operations

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National Jewish Health



#1 Respiratory Hospital in the U.S.
- U.S. News & World Report

- Medical center focused on respiratory disease
- Division focused on occupational and environmental health issues
- Unique combination of exposure and medical professionals
- Previous work on exposures in meth labs
- Nationally recognized experts in indoor air quality and bioaerosol exposures

Multi-Agency Cooperation

- U.S. Department of Justice
 - Grant #10DJ06491
- Colorado Drug Investigators Association
- North Metro Drug Task Force
 - Cdr. Jerry Peters
 - Sgt. Jim Gerhardt
- National Jewish Health
 - John Martyny, PhD, CIH: Project Lead
 - Mike Van Dyke, PhD, CIH
 - Kate Serrano, MPH
 - Josh Schaeffer, MS
- Many others: Aurora, Thornton, Broomfield, Commerce City, Adams County, Longmont



Colorado Marijuana Demand

- 7.8% of Colorado residents reported “abusing” marijuana in the last year (2000)
- 123,890 Colorado residents possess valid Medical Marijuana Registry ID Cards (3/2011)
 - Nearly 2.5% of the population
 - 69% male, Average age of 40
- Awaiting licensing as of Summer of 2010
 - 818 dispensaries
 - 318 manufacturers
 - 1,218 grow operations
- Number of illegal grow operations estimated at several times the number of “legal” grow ops

Growing Marijuana 101



- High temperature
 - 71° to 88° F
 - Optimum as high as 95° F
 - Excess heat vented outside
- High relative humidity
 - 50%-70%
- High intensity lighting
 - 2,000 lumens/ft²
 - Controlled photoperiod
- Elevated carbon dioxide
 - 700 to 1500 ppm
- Frequent fertilization
- Pest control (mites & fungi)
- Use of solvents for hashish production or THC extraction

Potential Health Hazards of Marijuana Grow Operations



- Outdoors: Low Hazard
 - Pesticide and fertilizer application
 - Harvesting/seizing operations
- Greenhouse grow ops
 - Hazards similar to outdoor operations
 - Moisture resistant structure
 - Adequate ventilation
 - Professional electrical installation

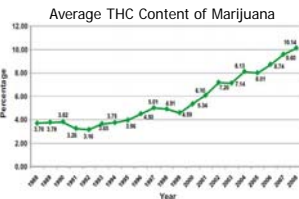
Potential Health Hazards of Indoor Marijuana Grow Operations



- Concealed operation
- Inadequate ventilation
- Excessive moisture
- Makeshift carbon dioxide concentrator
- Improper electrical installation
- Limited knowledge of safe pesticide and fertilizer handling
- Growers and family live in house

Indoor MGO Advantages

- Controlled growing conditions
 - Plants grow and mature faster
 - THC content can be doubled
- More difficult for law enforcement to detect
- Continuous crop rotations
- Inexpensive real estate



Exposure Concerns

- High humidity and warm temperatures
 - Mold/Fungi
 - Endotoxin
- Elevated combustion pollutants
 - Carbon dioxide
 - Carbon monoxide
 - Oxides of nitrogen (NO_x)
- Pesticides
- Irritant chemicals
 - Volatile Organic Compounds (VOCs)
- High levels of solvents (extraction processes)
- Airborne and surface THC
- Electrical hazards

Mold/Fungi



- Mold is ubiquitous
- Excess Moisture + Organic Material =Mold Growth
- Molds reproduce by releasing spores into the air
- Growing molds produce odorous chemicals (Volatile Organic Compounds)
- Previous MGO studies found elevated mold levels

Health Effects of Mold/Fungi

- Allergic Reactions
 - Allergic rhinitis
 - Asthma
 - Hypersensitivity pneumonitis
- Infections
 - Immune compromised
 - Open wounds
- Respiratory irritation
 - Volatile organic compounds



Combustion Pollutants



- Use of gas or propane appliances to increase carbon dioxide in MGOs
- Combustion produces
 - Carbon dioxide
 - Carbon monoxide
 - Nitrogen oxides

Health Effects of Combustion Pollutants

- Carbon Dioxide (CO₂)
 - Toxic reactions are only at very high exposure levels
 - Oxygen Displacement
- Carbon Monoxide (CO)
 - Interferes with oxygen delivery to tissues
 - At high concentrations can have rapid loss of consciousness
 - Binds to hemoglobin 200 times stronger than oxygen
 - One of the most common causes of accidental death
 - Colorless, odorless, and tasteless
- Oxides of Nitrogen (NO_x)
 - Present even if CO is absent or low
 - Respiratory irritant at very low concentrations
 - Exacerbates asthma symptoms

Pesticides

- Insecticides
 - Pyrethrins
 - Pyrethroids
- Fungicides
 - Sulfur
 - Potassium Bicarbonate
 - Neem Oil
 - Other organics
 - Almond Oil
 - Rosemary
 - Peppermint
 - Sesame Oil



Pesticide Health Effects

- Pyrethrin
 - Non-persistent
 - Low volatility
 - Human toxicity is usually as a dermal and respiratory irritant
 - High doses can have central nervous system effects (tremors, convulsions)
- Pyrethroids
 - Some neurotoxicity
 - Possible reproductive effects
- Organic fungicides
 - Upper respiratory irritation



Other Chemicals



- Volatile chemicals produced by plants
 - Terpenes
- Solvents used for THC extraction and hashish production
 - Chloroform
 - Butane gas
 - Fine petroleum distillates
 - Alcohols
 - Hexane

Health Effects from Other Chemicals

- Terpenes
 - Skin, eye, and mucous membrane irritant
 - May be associated with development of contact dermatitis (allergic or non-allergic)
 - Can react with UV light to form ozone
- Solvents used for extraction
 - Typically central nervous system effects
 - Sometimes cause Liver and kidney damage

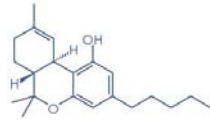
THC



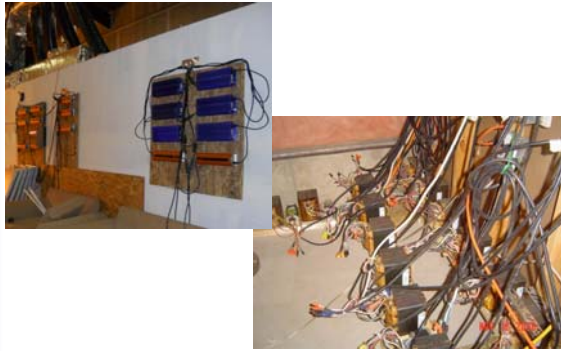
- THC found mostly in buds and resin on plants
- Can be absorbed through skin
- Concerns about THC on surfaces
- THC on airborne particles??

THC Exposures

- Primary effects
 - Central Nervous System
- Other affected systems:
 - Immune suppression
 - Cardiovascular/Respiratory?
 - Liver?, Kidney?
 - Reproductive effects
- Acute effects:
 - Euphoria, anxiety, panic, impaired attention, memory, psychomotor performance, perceptual alterations
- Long-term effects:
 - Cancer?



Electrical Hazards



Reports of Health Complaints

- Denver Area Law Enforcement
 - Reports of rashes, difficulty breathing, increased asthma symptoms.
- Other Law Enforcement Complaints
 - Upper respiratory irritation, runny nose, cough, rash, eye irritation.

Study Goals

- Determine the exposures associated with the investigation of marijuana grow operations
- Determine the potential adverse health effects to first responders and children
- Suggest appropriate PPE for first responders
- Examine approximately 15 to 20 marijuana grow operations



Samples We Collected

- Mold/Fungi
 - Culturable
 - Spore Trap
 - Temperature/Humidity
 - Dust Sample (MSQPCR)
 - Air Sample (MSQPCR)
- Combustion Pollutants
 - CO₂
 - CO
 - NO_x
- Pesticides
- Irritant VOCs
- THC
 - Wipes (surface samples)
 - Air Samples

Acceptable Mold Spore Levels

- There are no specific levels for mold over-exposure.
- It is generally accepted that mold exposures that exceed **10x** the outside level are potentially injurious
 - especially to children and sensitive individuals.
- Species such as *Aspergillus* sp and *Penicillium* sp are considered to be more of a problem for some individuals.
- If the inside mold levels are composed of different species than the outside air that is also of concern
 - looking again for a 10X increase

Mold/Fungi Exposures



- High moisture levels
 - Average 48%
 - Mostly 35-60% RH
- Temperature levels
 - Average 70°F
 - Mostly 65-75°F
- Elevated mold levels
 - Cladosporium
 - Penicillium
- Higher during seizure activities

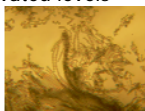
Mold Levels (All Species)

- Total viable mold spore levels were increased more than 10X in 6 of the 30 MGO's
 - Outside levels ranged from 90 – 756.
 - Grow room levels ranged from 144 – 11,286.
- Total spore count levels were increased more than 10X in 5 of the 30 MGO's.
 - Outside levels ranged from 95 – 787
 - Inside levels ranged from 245 – 134,000



Penicillium Levels

- Large shift in species between outside and inside air levels
 - Outside mold levels composed of Cladosporium sp.
 - Inside mold levels composed of Penicillium sp.
- Viable mold samples indicated elevated levels (greater than 10X) in 17 of the 30 MGO's
 - Outdoor levels ranged from 14 – 972
 - Indoor levels ranged from 0 - >5400
- Spore count mold samples indicated elevated levels in 16 of the MGO's
 - Outdoor levels ranged from 42 – 570
 - Indoor levels ranged from 63 – 132,000



Penicillium Levels During Tear-Out

- Viable mold samples indicated elevated levels
 - Indoor levels ranged from 0 – >5400
 - Tear-out levels ranged from 18 - >5400
 - Levels averaged 10X greater on tear-out
- Spore count mold samples indicated elevated levels
 - Indoor levels ranged from 63 – 132,000
 - Tear-out levels ranged from 1010 – 534,000
 - Levels averaged 77X greater on tear-out



Mold/Fungi Exposures



- In 21/30 (70%) MGOs, mold at levels classified as "IAQ problem"
 - Typically with > 50 plants
- During tear-out 6/10 (60%) MGOs mold increased compared to initial samples

Mold levels sufficient to cause respiratory irritation, possible allergic symptoms, and exacerbate asthma symptoms. Respirators will limit these symptoms.

Combustion Exposures



- Carbon dioxide
 - Normal outdoor level: 350-450 ppm
 - OEL: 5,000 ppm
 - Highest we have seen: 1400 ppm
- Carbon monoxide
 - Average in homes with gas stoves: 0.5-5 ppm
 - EPA Limit: 9 ppm
 - Highest we have seen: 0.8 ppm
- NOx:
 - Non-detect in MGOs

Most significant acute exposure risk. Air monitoring upon entry recommended.

Pesticide Exposures



Protective measures should be based on inventory of chemicals at MGO.

- Little evidence of significant pesticide use
- Limited use of pyrethrin based insecticides
 - All air samples we collected were non-detect
- Some of the pesticides were listed for outside use only. ("Not for residential use")

Other Chemical Exposures



Respirators and gloves can be used to limit irritation symptoms.

- Low level exposure to terpenes
 - ppb level
 - Below levels associated with chronic health effects
 - May cause irritation symptoms
 - Very strong odors
- No extraction operations observed

Other Chemical Exposures

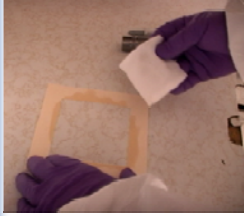


- Chemicals in unmarked containers
- Chemicals not properly stored



These could pose a concern when children are living in the grow facility.

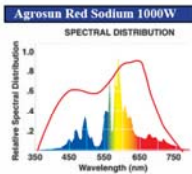
THC Exposures



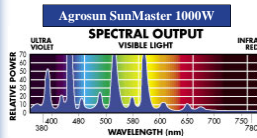
- Most surfaces in IMGO's were contaminated with measurable levels of THC
- Handling plants resulted in as much as 2900 µg/wipe on hands
- No measurable airborne THC

Gloves should be used to limit skin exposures to THC.

Ocular (Eye) Exposures



- Grow bulbs can be:
 - High Pressure Sodium
 - Metal Halide
- Some bulbs may present ocular hazards



Due to the variety of bulbs used in grows, it is important to turn off any grow lights upon entry to protect your eyes.

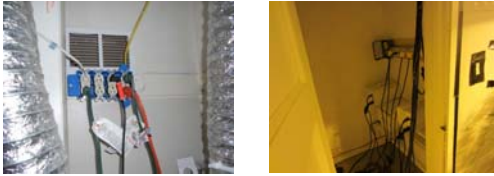
Additional Hazards from Grow Bulbs



- Some bulbs may contain mercury, lead, elemental sodium or other heavy metals
 - Caution should be observed when handling the bulbs
 - Broken bulbs could result in exposure to metals

It is important to handle bulbs carefully. If broken, ensure adequate ventilation, use gloves, goggles, and properly dispose of bulb waste.

Electrical Hazards



- Significant electrical concerns at all MGOs

Building inspector critical in clearing the MGO for seizure activities.

Conclusions

- Significant mold exposure hazard at most MGOs
 - Allergic symptoms, asthma exacerbation, special considerations for immunosuppressed individuals
- Combustion pollutants were not a significant issue in Colorado MGOs
- Pesticide use in Colorado MGOs was very limited
- Significant potential for irritation symptoms from volatile organic compounds
- Most surfaces in an MGO are contaminated with significant levels of THC
- Use of respiratory protection and gloves remains an important practice for investigators

Questions?



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Photo by National Jewish Health
