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INTEGRATED OCCUPATIONAL, ENVIRONMENTAL AND PUBLIC HEALTH SOLUTIONS

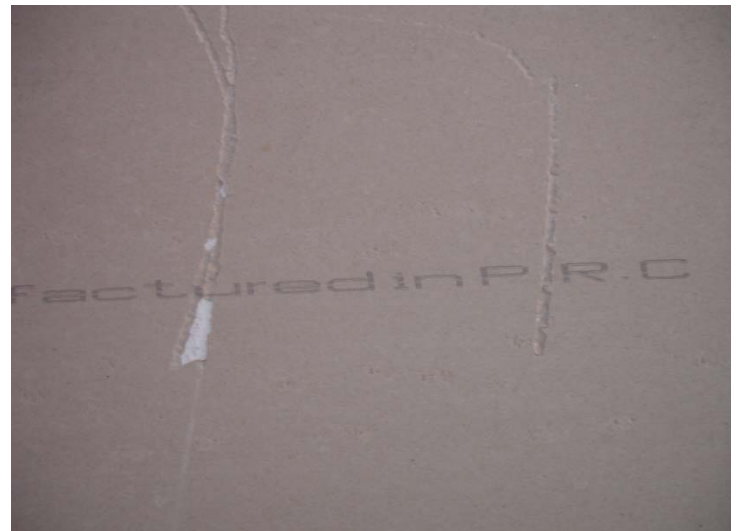
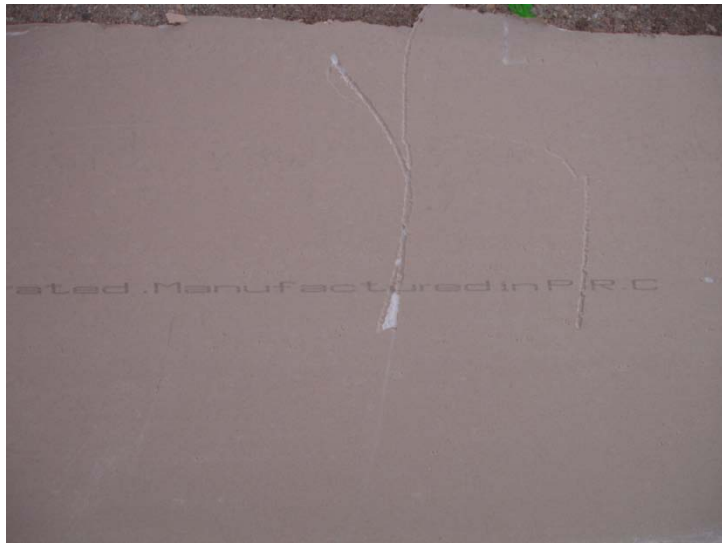
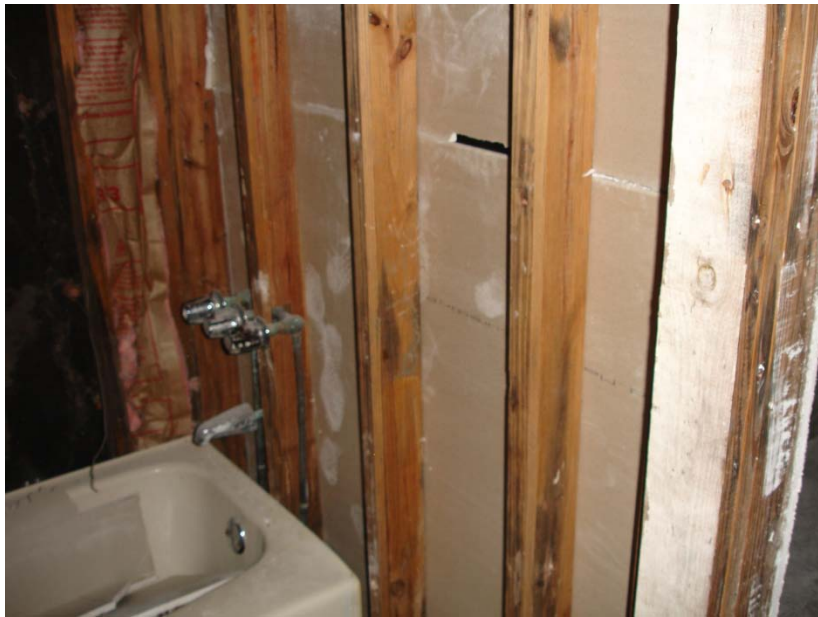
Corrosive Imported Dry Wall Health & Toxicology

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Case Example

- ▶ An emotional call comes in from a home owner:
- ▶ This CDW is killing us!
- ▶ It caused my wife's cancer!
- ▶ We are sick.
- ▶ Should we evacuate the house?
- ▶ What household items should be discarded and how should other items be cleaned?
- ▶ Will I have permanent injuries or illness?
- ▶ How would you handle this?



CDW & Health

- ▶ Have high Index of Suspicion. Additionally:
 - *It's important to recognize that [odors] are noticeable. They may be more commonly reported as causing symptoms*
(Fisher, B; EHP 1998)
- ▶ Start from the beginning:
 - Rule out non-environmental conditions/ triggers
 - If IAQ related:
 - Determine mechanism (e.g., allergic or irritation)
 - Assess Non-CDW environmental factors & 4 P's
 - Understand concepts of odor, irritation, dose & Health
 - Special consideration that must be teased apart
 - Team effort with health focus



Case Example

▶ Investigation:

- Husband and wife are “sick” and advises you that the HVAC contractor told them neighbors were sick (from CDW).
- Family moved into home 3.5 years ago.
- 2 dogs. Municipal water and sewage system.
- Corrosion noted in air conditioning unit which was replaced.
- Told by HVAC contractor that corrosion was due to CDW.



Case Example

- ▶ Husband – 45 year old account executive with history of asthma who reports frequent coughs, choking sensation at night & frequent asthma attacks since moving into the home. Travels for work and smokes an occasional cigar. Social alcohol usage.



Case Example

- ▶ Wife – 42 year old female with diagnosis of lung cancer 9 months after moving into house. Tumor was treated successfully. Also reports frequent migraine headaches. Has history of headaches that can be triggered by odors. Social alcohol usage and past h/o ETS exposure and brief h/o cig smoking.
- ▶ Environmental inspector also found traces of formaldehyde in home. He advised them to get out and remediate home with O3.



ATSDR

- ▶ CDW reported Symptoms:
 - irritated and itchy eyes and skin,
 - difficulty breathing,
 - persistent cough,
 - bloody noses,
 - runny noses,
 - recurrent headaches,
 - sinus infection, and
 - asthma attacks.



Differential diagnosis

- ▶ Conditions with coughs include:
 - Viral URI/ Influenza
 - Hayfever
 - Sinus congestion/ infection/ PND
 - Reaction to medications (e.g., BP meds)
 - Vocal cord mass/ polyp/ tumor
 - Asthma/ Bronchitis
 - Lung inflammation
 - Lung infections
 - Rheumatologic
 - GERD



Scenario I

- ▶ No odor reported by the home owners or HVAC contractor
- ▶ Why is this important clinically?
- ▶ What is “margin of safety?”



Volatile Chemicals

▶ Levels of Effects:

- Odor
- Annoyance – usually 4 to 5 times the odor threshold
- Irritation – Trigeminal nerve mediated physiologic response
 - This typically occurs with exposure to certain odorant classes such as sulfur-containing compounds with odor thresholds that are 3 – 4 orders of magnitude below the levels that cause classical tox or irritant symptoms (ppb or ppt vs. 10 – 20 ppm).

(Schiffman et al: J Agromed 2000)



Asthma Exacerbation Agents

- Alternative Triggers include:
 - Viral infections
 - Older references – 25% of asthma flares
 - 2006 – 60% to 93% of reported episode of cough, wheezing and reduced peak flow (PCR)
 - Bacterial infections or allergic conditions, esp. sinuses are associated with deterioration of underlying asthma
 - Inflammatory cells into respiratory tract
 - Common causative agent into airway
 - Manifestation of systemic reactions
 - GERD
 - Stress



Husband

- ▶ Evaluation/ History revealed:
 - Binge alcohol usage, spicy foods consumption.
 - Nighttime coughing and choking sensations even while on business trips
 - Reports stress from wife's condition

- ▶ Dx: ?



Wife

- ▶ Cancer – Not associated with CDW
 - Latency not appropriate for solid tumors
 - Levels were very low or ND
- ▶ Headaches – After thorough evaluation and metastasis ruled out. Thought to be due to stress from questioning own mortality and “waiting for the other shoe to drop.”
- ▶ Dx:?



Stress induced Symptoms include:

- ▶ Headache
- ▶ Back pain
- ▶ Chest pain
- ▶ Heart disease
- ▶ Heart palpitations
- ▶ High blood pressure
- ▶ Overeating
- ▶ Anxiety
- ▶ Restlessness
- ▶ Worrying
- ▶ Irritability
- ▶ Depression
- ▶ Sadness
- ▶ Anger
- ▶ Feeling insecure
- ▶ Undereating

Formaldehyde & Mix VOC Case

- ▶ CPA firm moves into 40 year old building. Audit and Consulting services took up space in opposite sides of a hallway and shared common HVAC unit.
 - Mechanical room serves as common return/ mixing chamber from both locations
- ▶ Extensive renovation with imported paneling and new furniture.
 - Auditing had more construction work and new furniture than Consulting



Formaldehyde & Mix VOC Case

- ▶ Employees with allergies at consulting division developed mucous membrane irritation symptoms
- ▶ More outside air added without relief
- ▶ Thought Consulting employees were stressed from the workload and,
 - Possibly, auditing manager had particular personality and is less approachable
- ▶ How would you tackle this?
 - Mitigating steps?



Environmental Health Investigation

Exposure, Dose and Health Outcomes



Exposure, Dose & Outcome

- ▶ Pollutant(s) or Agent(s)
- ▶ 4 P's
- ▶ Patient susceptibility
- ▶ Absorption
- ▶ Physiologic condition
- ▶ Metabolism/ excretion
- ▶ Biological available dose
- ▶ Early physiologic changes
- ▶ Health outcome



Potential Indoor Environmental Pollutants or Agents

Cause or Contribution ruled out?



Indoor Environmental Agents

- ▶ Combustion gases
- ▶ Chemicals and VOC's
- ▶ Biological/ Microbes
- ▶ House dust
- ▶ Outdoor pollutants



Indoor Environmental Agents

- ▶ Oil and gas – fired furnaces, water heaters, ovens, wood stoves, charcoal grills, and fireplaces all produce combustion gases. These gases may include:
 - Particulates, carbon monoxide (CO), carbon dioxide, nitrogen dioxide, nitric oxide, sulfur dioxide, water vapor,
 - hydrogen cyanide, formaldehyde, PAH and various hydrocarbons.



Indoor Environmental Agents

- ▶ Dozens of different VOCs have been measured in indoor air from a variety of sources and their emissions including:
 - Construction products,
 - Cleaning agents,
 - Paints and finishes,
 - Fragrances and hair sprays,
 - Household furniture,
 - Office equipment e.g., copiers/printers,
 - Occupant activities, e.g., hobbies, car maintenance
 - and infiltration of outdoor air.



Indoor Environmental Agents

- ▶ Biological pollutants are found to some degree in every home, school, and workplace.
- ▶ They come from:
 - Outdoor air in the form of pollen and other allergens,
 - From human occupants who expel viruses and bacteria,
 - From pets that shed dander and act as carrier of dust, dirt, soil and microbes,
 - From insect pests, and
 - From moist surfaces that allow mold and bacteria to grow.



Indoor Environmental Agents

- ▶ House dust contains all manner of particles from such activities as:
 - Cooking, other household processes, and smoking.
- ▶ It may also contain pollutants brought in from outdoors such as:
 - Pollen, pesticides, and heavy metals (e.g., lead, Arsenic), microbes, etc.
- ▶ Outdoor pollutants are tracked:
 - Shoes, clothing, the fur of pets. In fact, conc's of pesticides and other outdoor organic pollutants (10–100 x's > yard soil).



Non-infectious Mechanism

Respiratory Allergy vs. Irritation?

Why is this important?



Allergy vs. Irritation

▶ Allergy

- ▶ Requires prior exposure (sensitization period)
- ▶ Specific
- ▶ Minority of individuals
- ▶ Low-level exposures produce symptoms
- ▶ Avoidance

▶ Irritation

- ▶ No prior exposure required (sensitization not involved)
- ▶ Nonspecific
- ▶ Majority of individuals may be affected
- ▶ High level exposure usually involved
- ▶ Reduction of exposure

Respiratory Irritation



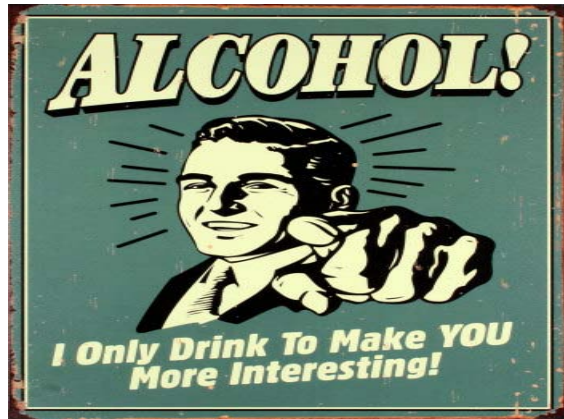
Dose makes the poison



- ▶ “What is there that is not poison? All things are poison and nothing without poison. Solely, the dose determines that a thing is not a poison”

Paracelsus (1493–1541)

A Little can be Benign or Good



What is Involved in Airway Irritation?

Airway & Function

- ▶ Upper airway – Glottis upward
 - Filters & conditions air
 - Odor – CN I
 - Irritation – CN V & IX
 - (Animal model – Sulfur-containing malodorant enhance responsiveness [flow reduction at expiration] to sensory irritant)
- ▶ Lower airway – Glottis downward
 - Gas distribution
 - Gas exchange



Odor & Irritation Senses

- ▶ Sensations of odor and upper airway irritation are often experienced as a unitary phenomenon
 - Airborne chemicals have the potential to activate multiple separate, yet interrelated, sensory pathways in the upper respiratory airways:
 - The olfactory nerve (CN I), which gives rise to sensations of odor, and
 - The trigeminal (CN V), glossopharyngeal (CN IX) nerves which give rise to temporary burning, stinging, tingling or painful sensations in the eyes and upper airways



Sensory Irritation CN. V

- ▶ Neuroanatomy:
 - CN. V (with its 3 branches: ophthalmic, maxillary, and mandibular) supplies the mucous membranes of the eyes, nose, oral cavity, and nasopharynx
- ▶ Neurobiology:
 - Sensory irritation – constellation of eye, nose, and throat irritation from non-olfactory, non-taste chemical stimulation of CN. V



Spectrum of Inhalation injuries

▶ Irritation

- ▶ Rhinitis/ Pharyngitis/ Conjunctivitis
- ▶ Laryngitis/ VCD
- ▶ Tracheobronchitis
- ▶ Irritant-induced asthma
- ▶ Bronchiolitis obliterans
- ▶ Chemical pneumonitis



What Can Cause Irritation?

- ▶ Indoor Pollutants include:
 - Tobacco smoke, ammonia, perfume or cologne, bathroom tile cleaners, bleach, fresh paint, magic marker, nail polish remover, bathroom cleaners, pesticide treatment, mothballs, solvents (e.g., turpentine), hair spray, potpourri, animal odors, restroom deodorizer, nail polish, adhesives, bed linens washed with odorous detergents, dry-cleaned clothes, scented candles, gas stove and oven, mold, formaldehyde (from particle board, tobacco smoke), new carpeting, building materials, detergents, beauty products, yard & gardening supplies, swimming pool, auto work, Paints & finishes, etc.



Odor & Health

Odor & Health

- ▶ Every-day experience tells us that strong and unpleasant odors may be accompanied by marked visceral responses.
- ▶ Breathing pattern:
 - Shallow and irregular breathing patterns were induced by exposure to unpleasant odors (swine odors, rotten fish, SULFIDES)
 - Deeper stable breathing patterns were characteristic of exposure to pleasant odors (chocolate chip cookies, orange cake).
 - These differences in breathing patterns (whether genetic or learned) may influence health symptoms.



Odor Cueing

- ▶ Many IAQ chemicals have odor thresholds orders of magnitude lower than their irritant thresholds
- ▶ Some individuals respond with symptoms at odorant (but subirritant) concentrations of these same chemicals.
- ▶ VOCs (volatile organic compounds) have both odorant and irritant qualities.
 - Because of this fact, *odor cueing* must be teased out in any assessment or threshold test of nasal irritation.



Odor Cueing & Irritation

- ▶ Comparison of 2 psychophysical techniques to assess intranasal irritation thresholds:
 - (A) – Responses of subjects who focused on intranasal CN. V mediated sensations
 - (B) – Method A with odor cueing neutralized
 - Result:
 - False positive?? – Method A (odor cueing) revealed thresholds that were approximately 32 times lower than when odor is teased out (however, it has great warning properties).
 - With method A, women were found to have lower thresholds than men.



Hazardous Waste sites

▶ Odor – Worry Interaction

- Significant positive relationships were observed between the prevalence of several symptoms (headache, nausea, eye and throat irritation) and both frequency of odor perception and degree of worry.
- In neighborhoods with no nearby waste sites, environmental worry has been found to be associated with symptom occurrence as well.



Special IAQ Considerations

- Ventilation inadequacies
- Factors that alter an individual's sensitivity: genetics, age, gender, disease or exposure history, e.g., Allergic individuals may be more susceptible to irritant effects
- Mixtures and irritancy
- Exposure concentration vs. exposure duration



Atopy & Irritation

- ▶ Upper respiratory tract symptoms, including mucous membrane (eye, nose and throat) irritation, subjective nasal congestion (sensation of airflow limitation) and rhinorrhea.
 - Irritant-induced nasal airflow limitation study:
 - Eight SAR and 8 NR subjects were exposed to 1.0 ppm chlorine and filtered air in random order
 - Cl₂ provocation significantly increased nasal airway resistance in SAR but not NR



Mixtures & Irritancy

- ▶ Threshold responses of odor, nasal pungency (irritation), and eye irritation were measured for single chemicals and mixtures of them.
 - Stimulus agonism (additive effects) were observed when testing mixtures.
 - The number of components and the lipophilicity of the chemicals were associated with increased degree of agonism.
 - For IAQ, Formaldehyde was the most irritating IAQ compound, with an irritant threshold estimated seven times lower than that of the next most irritating VOC, 2-phenoxyethanol (FIOH, 2009)



VOC's as irritants

- ▶ Careful history & coordination with field investigations –The dynamic nature of indoor VOC pollution, c/b VOC concentrations and complaints may be obscured if the measurements of both are not performed simultaneously.



Relocation

- ▶ No Medically based Public Health pronouncements
- ▶ Individual health based decisions – after comprehensive review and analysis
 - Team effort
 - Scenario/ preliminary potential causes
 - Duration of symptoms, e.g., years or new
 - Changes in pattern or severity?
 - Manageable with mitigation steps (irritants)?
 - Reversibility of symptoms or condition
 - Potential associated morbidity/ mortality
 - Preliminary (often precautionary) vs. final recommendations (Medical Causation-based)



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