Dr Cameron Jones

Inhaling Danger: Mould Exposure and its Effects on Health

“We spend 90% of our time indoors, which makes indoor air quality an important factor in our overall health and well-being.”

U.S. Environmental Protection Agency. 1989. Report to Congress on indoor air quality: Volume 2. EPA/400/1-89/001C. Washington, DC.

EPA United States Environmental Protection Agency

Dr Cameron Jones

Introduction

This presentation will provide a brief overview of the different types of mould and its impact on health, the evaluation tools available, and strategies for clinical management. We will explore how mould affects both adults and children, with a focus on early intervention and prevention.

Biological ® Health Services

NIIM NATIONAL INSTITUTE OF INTEGRATIVE MEDICINE

mould.net.au

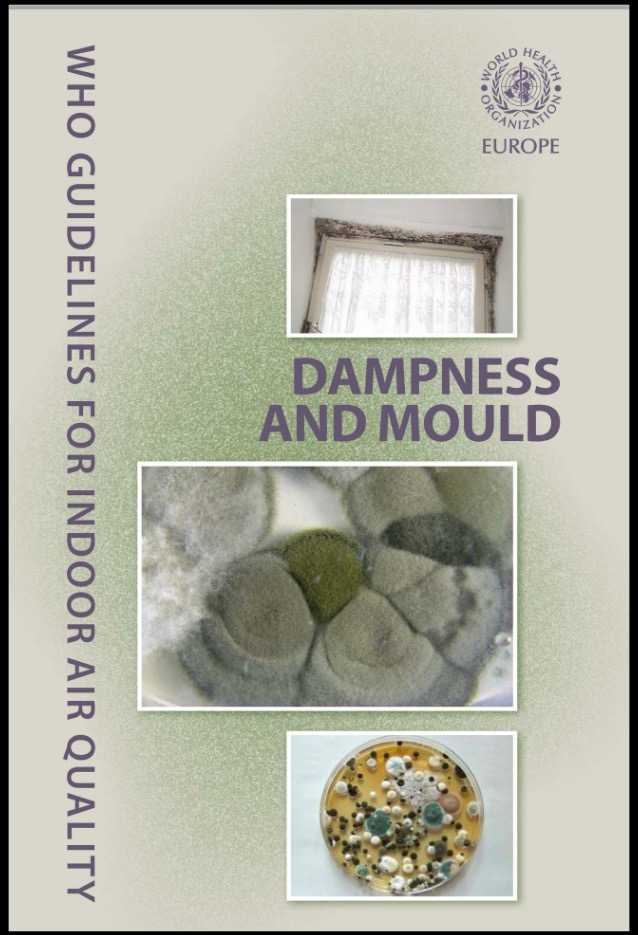
What is mould and what are the different types

- Mould is a type of fungus that thrives in moist, warm environments. *Alternaria*, *Aspergillus*, *Cladosporium*, and *Penicillium* are the most common allergenic moulds, whereas some like *Candida albicans*, *Cryptococcus neoformans* and *Aspergillus fumigatus* are extremely pathogenic causing serious disease.

- The most common types of mould found in the home are black and green varieties which appear after water damage. Moulds are multicellular, can reporoduce sexually and asexually and commonly liberate spores which are dispersed long distances and these spores are often thermotolerant.

Risk to Health

- For healthy people, the risk of infection from indoor mould is low. Only moulds capable of producing toxins can cause mycotoxicosis.
- Mould exposure can cause a variety of health problems, including allergic reactions such as watery eyes, runny nose, sneezing, itching, coughing, wheezing, and difficulty breathing. In some cases, it can also cause or worsen asthma and impact on immunity.
- Everyone can be affected by odour effects and/or a reduction in well-being when there is indoor moisture/mold damage. Genetic and hormonal influences, imprinting, context, and adaptation effects can all be predisposing factors for odour effects. Environmental concerns, anxieties, conditioning and attributions, as well as a variety of diseases, are all risk factors for wellbeing impairment. Patients with immunosuppression and mucoviscidosis (cystic fibrosis) must be protected from infections, and individuals with asthma must be protected from allergies.



When did things start getting serious about indoor air quality?

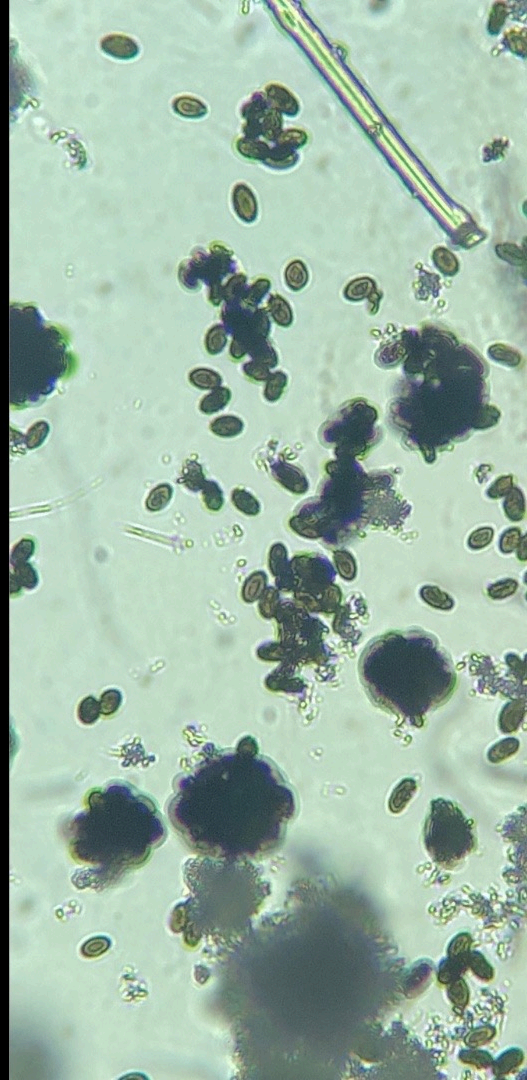
- The World Health Organization (WHO) has issued indoor air quality guidelines, which include dampness and mould.
- These 2009 recommendations are based on a thorough review of scientific evidence on health issues related to building moisture and biological agents.
- Certain groups, such as atopic and allergic people, are especially vulnerable to the effects of dampness and mould. Building dampness has been linked to negative health effects such as allergies, according to research.

CIRS

- Chronic Inflammatory Response Syndrome (CIRS) is a condition that can occur when an individual is exposed to biotoxins (mycotoxins), which are toxic substances produced by certain species of fungi. The term was first coined by Dr. Ritchie Shoemaker, a physician who has extensively studied the health effects of mould exposure.

- When a person is exposed to biotoxins, their immune system may mount an inflammatory response to try to remove the toxins from the body. However, in some cases, the immune system may become overwhelmed and chronic inflammation can result, leading to a wide range of symptoms that may affect multiple organ systems in the body.

- Common symptoms of CIRS can include fatigue, cognitive impairment, joint pain, respiratory problems, and gastrointestinal symptoms.



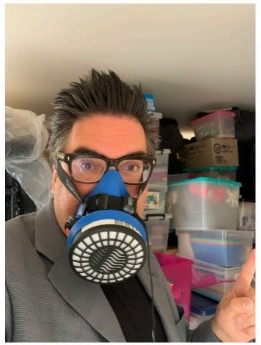
Why it's important to consider and to test/not test for mould

- In its “Guidelines for Indoor Air Quality: Dampness and Mould,” the World Health Organization (WHO) stated, “Persistent dampness and microbial growth on interior surfaces and in building structures should be avoided or minimised, as they may lead to adverse health effects.”
- It is critical to consider testing for mould when it cannot be seen but can be smelled. Surface sampling may be useful in determining whether an area has been adequately cleaned or remediated. However, air testing alone is usually insufficient to detect the presence of mould behind walls or in ceiling spaces and performing mould testing properly is often costly. Because mould spores can travel long distances, especially inside roof cavities or migrate via balcony waterproofing defects into the inside of cladding or wall linings, any building-related matters may in turn have health consequences and the building should be carefully inspected and sampled.
- If you already have visible mould and know the cause, you usually don't need a mould professional or additional testing unless you are suffering new onset adverse health or are involved in a legal dispute

Evaluation Tools

There are several evaluation tools that are used to test for mould in the home or workplace

The visual walk through



Mould Testing Standards

Designation: D7338 – 14

Standard Guide for Assessment Of Fungal Growth in Buildings[1]

This standard is issued under the fixed designation D7338; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide provides a compendium of information and a menu of options for assessment of fungal growth in buildings, but does not recommend a specific course of action. Due to the wide variety of fungal problems affecting buildings and their occupants, and the wide variety of buildings, it is not possible to describe a set of uniform steps that will always be performed during an assessment (that is, a standard practice); therefore the user of this guide must decide which steps are appropriate for a given situation or building.

1.2 This guide is specific to fungal growth, which is only one potential problem in a building environment. It may be part of, but is not intended to take the place of, a comprehensive indoor air quality investigation.

1.3 This guide describes minimum steps and procedures for collecting background information on a building in question, procedures for evaluating the potential for moisture infiltration or collection, procedures for inspection for suspect fungal growth, and procedures beyond the scope of a basic survey that may be useful for specific problems.

1.4 Assessments for fungal growth may be useful wherever fungal growth is suspected, excess moisture has been present or when there are concerns regarding potential fungal growth.

1.5 Periodic fungal assessment in buildings may be a component of preventative maintenance programs.

1.6 This guide is applicable to buildings including residential (for example, single or multi-family), institutional (for example, schools, hospitals), government, public assembly, commercial (for example, office, retail), and industrial facilities.

1.7 Recommendations for developing a sampling strategy or methods for the collection and analysis of fungal samples are beyond the scope of this guide. For recommendations for developing a sampling strategy, see Ref (1)[2], Chapter 10.

1.8 Recommendations for remediation of fungal growth are beyond the scope of this guide.

1.9 This guide is not intended to supersede any government regulations governing the assessment of fungal growth in buildings.

1.10 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

C755 Practice for Selection of Water Vapor Retarders for Thermal Insulation
C1699 Test Method for Moisture Retention Curves of Porous Building Materials Using Pressure Plates
D653 Terminology Relating to Soil, Rock, and Contained Fluids
D4442 Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials
E331 Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
E547 Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference
E631 Terminology of Building Constructions
E1105 Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference
E1186 Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
E1356 Test Method for Assignment of the Glass Transition Temperatures by Differential Scanning Calorimetry
E2128 Guide for Evaluating Water Leakage of Building Walls

[1] This guide is under the jurisdiction of ASTM Committee D22 on Air Quality and is the direct responsibility of Subcommittee D22.08 on Sampling and Analysis of Mold.

Current edition approved June 1, 2014. Published July 2014. Originally approved in 2010. Last previous edition approved in 2010 as D7338 – 10. DOI:10.1520/D7338-14.

[2] The boldface numbers in parentheses refer to a list of references at the end of this standard.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

Designation: D7391 – 20

Standard Test Method for Categorization and Quantification of Airborne Fungal Structures in an Inertial Impaction Sample by Optical Microscopy[1]

This standard is issued under the fixed designation D7391; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method is a procedure that uses direct microscopy to analyze the deposit on an inertial impaction sample.

1.2 This test method describes procedures for categorizing and enumerating fungal structures by morphological type. Typically, categories may be as small as genus (for example, *Cladosporium*) or as large as phylum (for example, basidiospores).

1.3 This test method contains two procedures for enumerating fungal structures: one for slit impaction samples and one for circular impaction samples. This test method is applicable for impaction air samples, for which a known volume of air (at a rate as recommended by the manufacturer) has been drawn, and is also applicable for blank impaction samples.

1.4 Enumeration results are presented in fungal structures/sample (fs/sample) and fungal structures/m^3 (fs/m^3).

1.5 The range of enumeration results that can be determined with this test method depends on the size of the spores on the sample trace, the amount of particulate matter on the sample trace, the percentage of the sample trace counted, and the volume of air sampled.

1.6 This test method addresses only the analysis of samples. The sampling process and interpretation of results is outside the scope of this test method.

1.7 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.9 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1193 Specification for Reagent Water
E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *ASTM Definitions (see the ASTM Online Dictionary of Engineering Science and Technology*[3]*):*

3.1.1 *numerical aperture.*

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *circular impaction sample, n*—a sample of airborne particulate matter collected by means of a device that draws air through a round aperture at a specified rate, impacting the particles suspended in the air onto an adhesive medium, resulting in a circular area of deposition. A circular impaction sample may be collected by means of a cassette manufactured for that purpose, or by means of a sampling device that requires slides to be pre-coated with impaction medium.

3.2.2 *debris rating, n*—a distinct value assigned to an impactor sample based on the percentage of the sample area potentially obscured by particulate matter, and ranging from 0 to 5.

3.2.3 *field blank, n*—a sample slide or cassette carried to the sampling site, exposed to sampling conditions (for example,

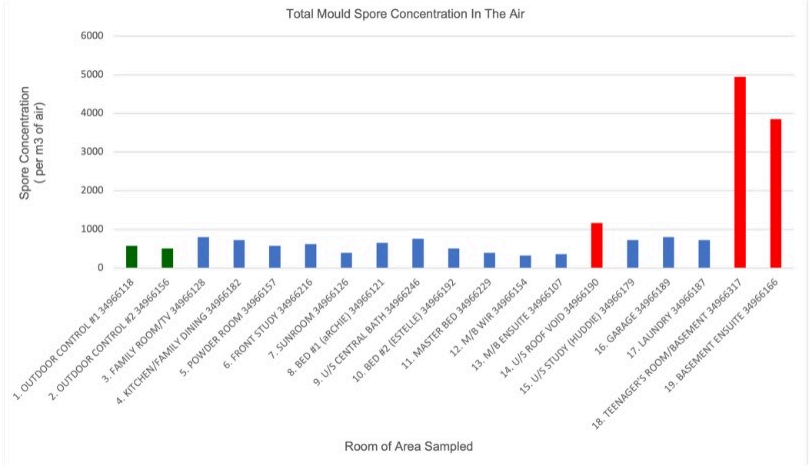
[1] This test method is under the jurisdiction of ASTM Committee D22 on Air Quality and is the direct responsibility of Subcommittee D22.08 on Assessment, Sampling, and Analysis of Microorganisms.

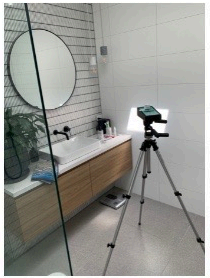
Current edition approved March 15, 2020. Published April 2020. Originally approved in 2009. Last previous edition approved in 2017 as D7391 – 17[ε1]. DOI: 10.1520/D7391-20.

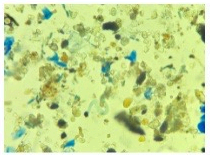
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

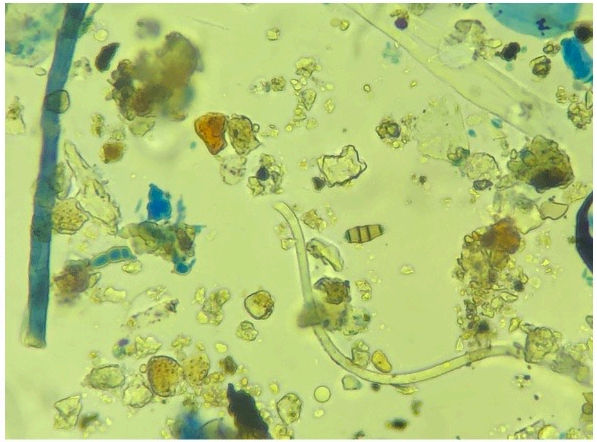
[3] *ASTM Online Dictionary of Engineering Science and Technology* (Stock #: DEFONLINE) is available on the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org.

Spore Trap Testing

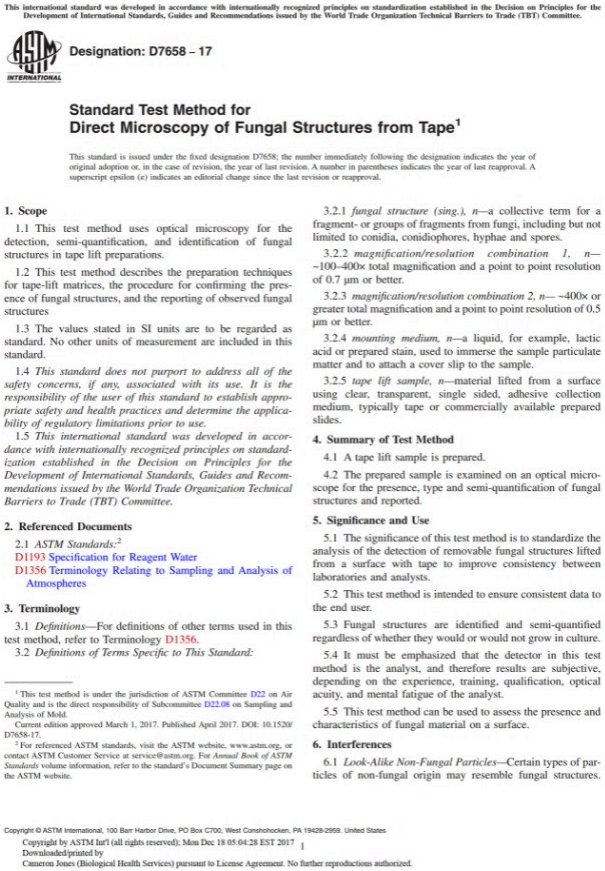








Mould Testing Standards...



This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: D7658 – 17

Standard Test Method for Direct Microscopy of Fungal Structures from Tape[1]

This standard is issued under the fixed designation D7658; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method uses optical microscopy for the detection, semi-quantification, and identification of fungal structures in tape lift preparations.

1.2 This test method describes the preparation techniques for tape-lift matrices, the procedure for confirming the presence of fungal structures, and the reporting of observed fungal structures

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1193 Specification for Reagent Water

D1356 Terminology Relating to Sampling and Analysis of Atmospheres

3. Terminology

3.1 *Definitions*—For definitions of other terms used in this test method, refer to Terminology D1356.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *fungal structure (sing.), n*—a collective term for a fragment- or groups of fragments from fungi, including but not limited to conidia, conidiophores, hyphae and spores.

3.2.2 *magnification/resolution combination 1, n*—~100–400× total magnification and a point to point resolution of 0.7 µm or better.

3.2.3 *magnification/resolution combination 2, n*— ~400× or greater total magnification and a point to point resolution of 0.5 µm or better.

3.2.4 *mounting medium, n*—a liquid, for example, lactic acid or prepared stain, used to immerse the sample particulate matter and to attach a cover slip to the sample.

3.2.5 *tape lift sample, n*—material lifted from a surface using clear, transparent, single sided, adhesive collection medium, typically tape or commercially available prepared slides.

4. Summary of Test Method

4.1 A tape lift sample is prepared.

4.2 The prepared sample is examined on an optical microscope for the presence, type and semi-quantification of fungal structures and reported.

5. Significance and Use

5.1 The significance of this test method is to standardize the analysis of the detection of removable fungal structures lifted from a surface with tape to improve consistency between laboratories and analysts.

5.2 This test method is intended to ensure consistent data to the end user.

5.3 Fungal structures are identified and semi-quantified regardless of whether they would or would not grow in culture.

5.4 It must be emphasized that the detector in this test method is the analyst, and therefore results are subjective, depending on the experience, training, qualification, optical acuity, and mental fatigue of the analyst.

5.5 This test method can be used to assess the presence and characteristics of fungal material on a surface.

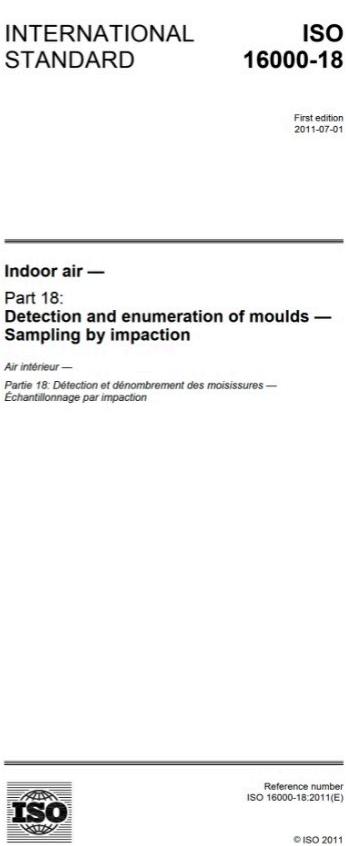
6. Interferences

6.1 *Look-Alike Non-Fungal Particles*—Certain types of particles of non-fungal origin may resemble fungal structures.

[1] This test method is under the jurisdiction of ASTM Committee D22 on Air Quality and is the direct responsibility of Subcommittee D22.08 on Sampling and Analysis of Mold.

Current edition approved March 1, 2017. Published April 2017. DOI: 10.1520/D7658-17.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.



INTERNATIONAL STANDARD **ISO 16000-18**

First edition
2011-07-01

Indoor air —

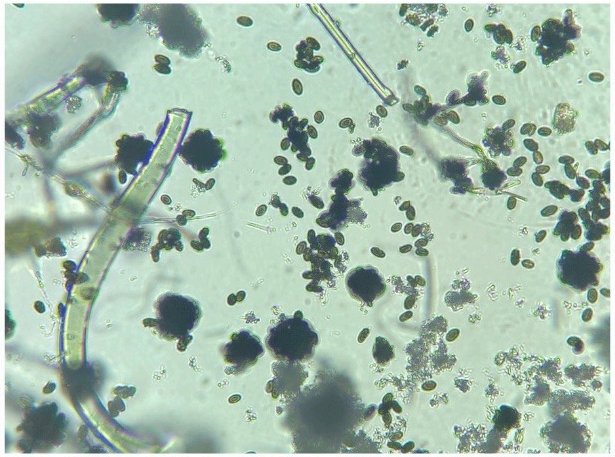
Part 18:
Detection and enumeration of moulds — Sampling by impaction

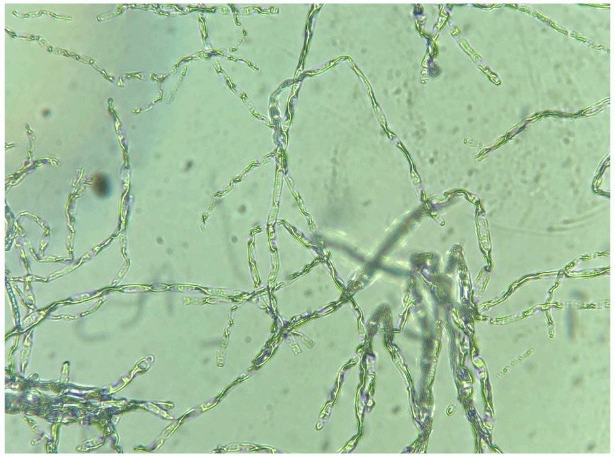
Air intérieur —

Partie 18: Détection et dénombrement des moisissures — Échantillonnage par impaction

Reference number
ISO 16000-18:2011(E)

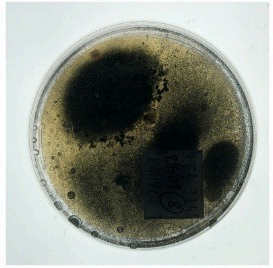
Tape Lift Surface Testing

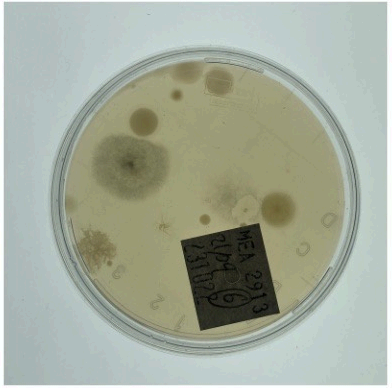


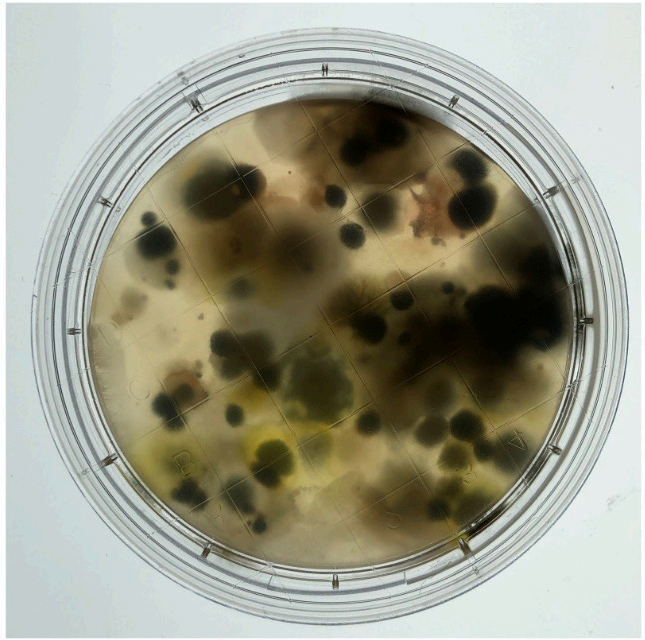


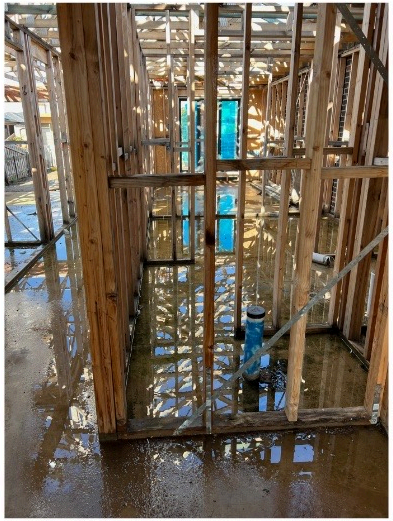
Viable Petri Plate Culture

- RODAC contact plates
- Swab streaking
- Settle plates

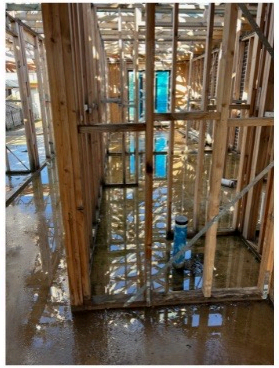


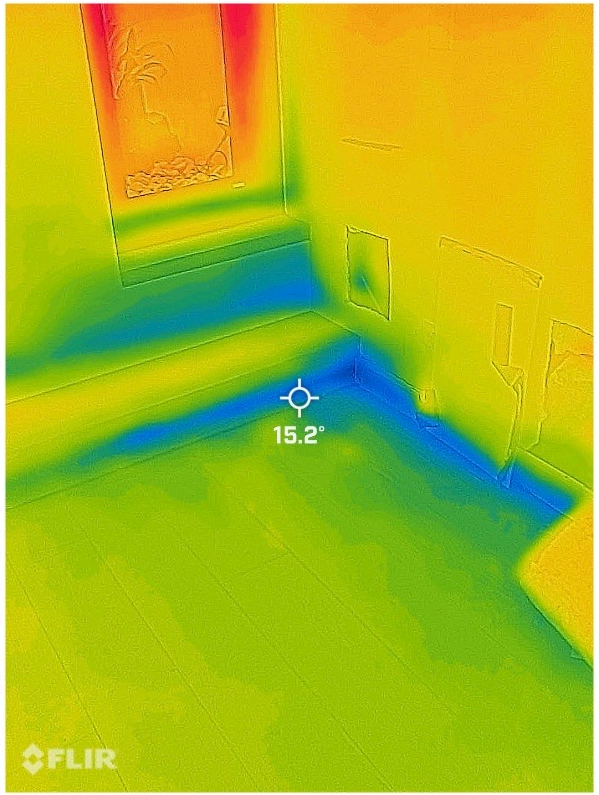






Moisture mapping





Management & Remediation

It is critical to permanently correct the water or moisture problem in order to manage and treat moisture-related illnesses. Homeowners and renters should clean up mould problems in their homes and prevent future growth. It is best to remove the mould and work to prevent future growth. If condensation is observed on cold surfaces or relative humidity levels exceed 50%, portable dehumidifiers and HEPA air scrubbers should be used.

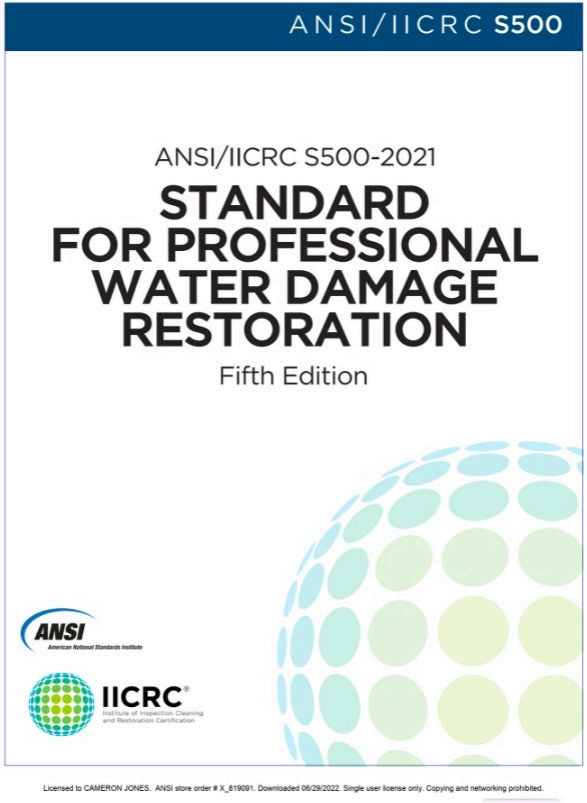
Because all moulds should be treated the same way, regardless of type an occupational hygienist may not be required.

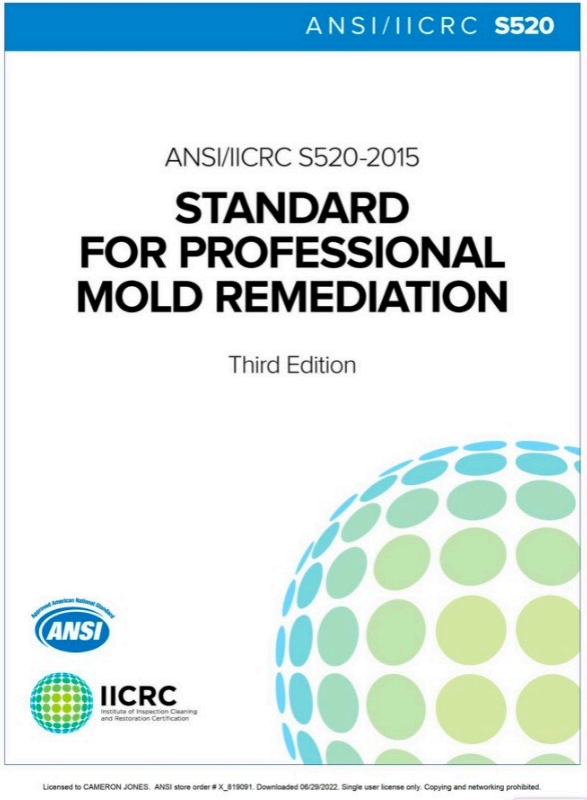
Environmental intervention and assessment

- Environmental assessment: identifying potential sources of moisture, evaluating indoor air quality, testing for mould

- The role of an occupational hygienist, Indoor Environmental Professional, building biologist, microbiologist/mycologist in environmental intervention and assessment: They all have expertise in identifying and managing environmental hazards, conducting thorough assessments, implementing effective remediation strategies & writing reports based on the evidence collected and as necessary will explore or define Scope of Works/Recommendations for remediation

Mould Remediation Standards



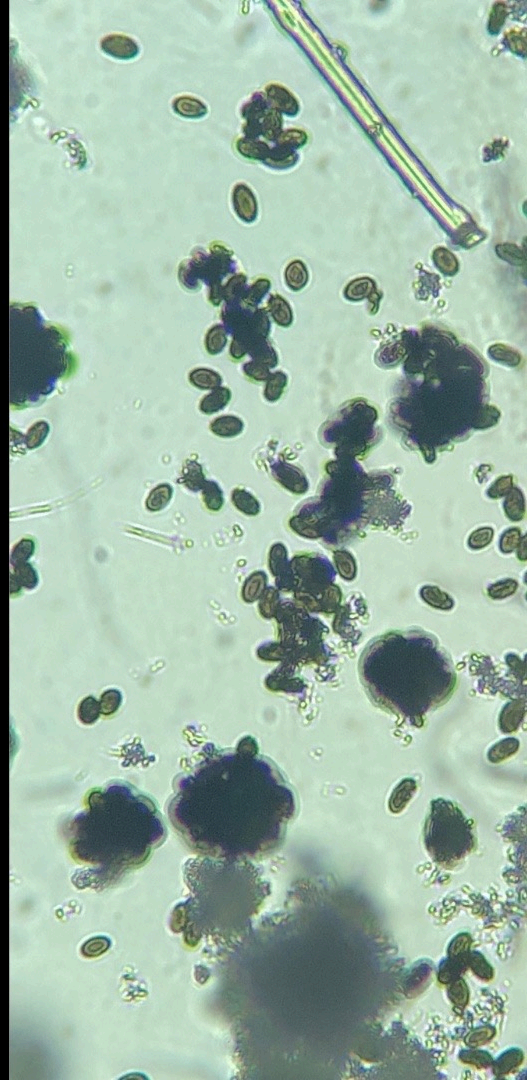


The role of clinicians in the identification of mould-related environmental disease

Clinicians play a critical role in the diagnosis of mould-related environmental disease. They can help with diagnosis and make suggestions for clinical and environmental testing. Healthcare professionals should be aware of what to do if a fungal disease outbreak is suspected, as well as the relationship between the indoor environment, mould exposure, and moisture.

Current understanding of the relationship between mould exposure and illness

According to current research, exposure to a large number of mould spores can result in allergic reactions such as watery eyes, runny nose, sneezing, itching, coughing, wheezing, difficulty breathing, and skin rashes. Furthermore, microbial growth may increase the number of spores, cell fragments, allergens, mycotoxins, endotoxins, B-glucans, and volatile organic compounds in indoor environments, exacerbating health problems. Several studies have found evidence to support a link between damp spaces, indoor mould, and respiratory illnesses.



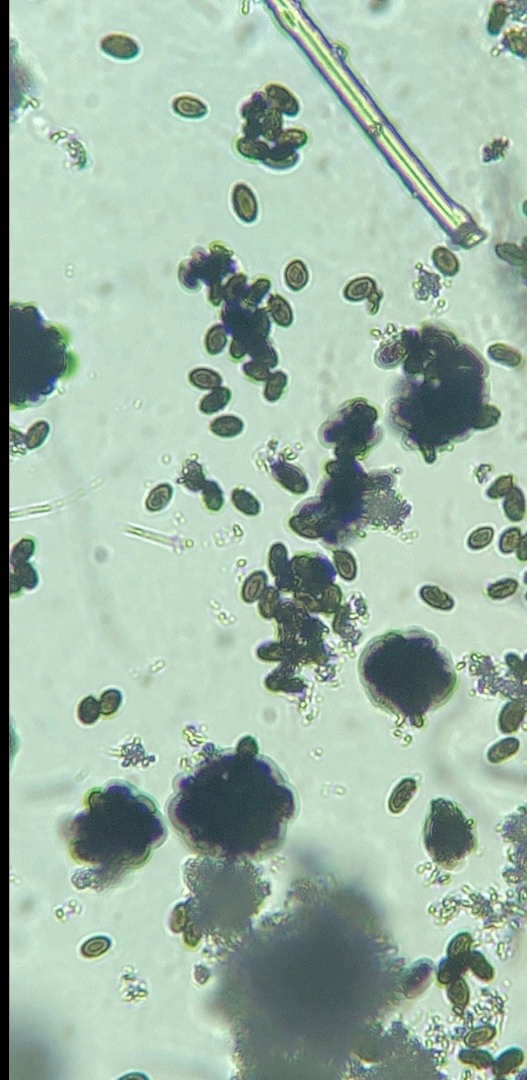
Current understanding of the relationship between mould exposure and illness

- How exposure to mould affects health: respiratory problems, allergic reactions, infections, mycotoxins (biotoxins)

- Factors affecting severity of symptoms: mould type, amount of exposure, individual sensitivity, building age/condition, history of water damage, history of water damage insurable events, potentil that insurance-driven mould remediation may not have been successful

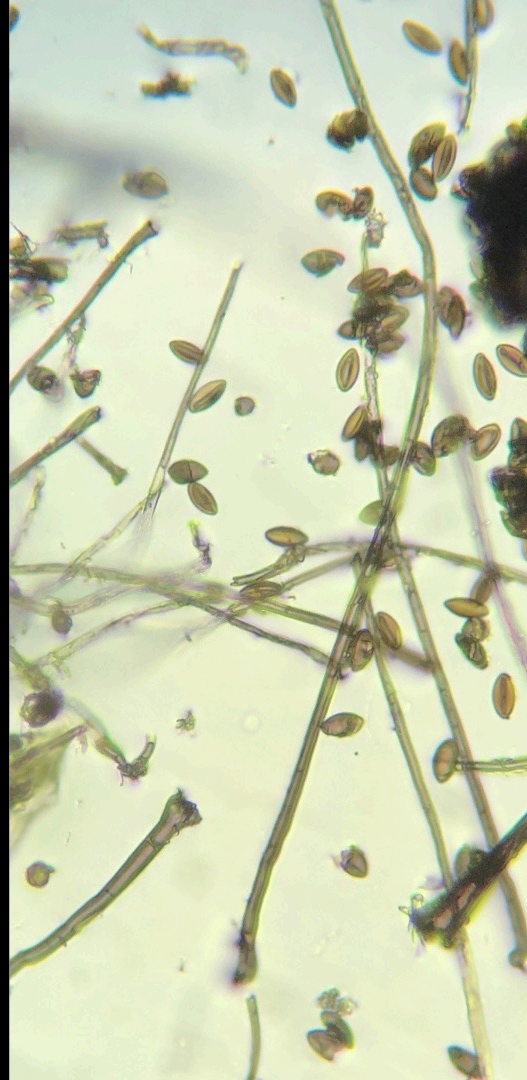
- Current understanding of the relationship between mould exposure and illness: exposure to mould can cause symptoms, severity of symptoms varies based on factors mentioned above = CIRS

  Chronic Inflammatory Response Syndrome



Approaches to diagnosis in children and adults

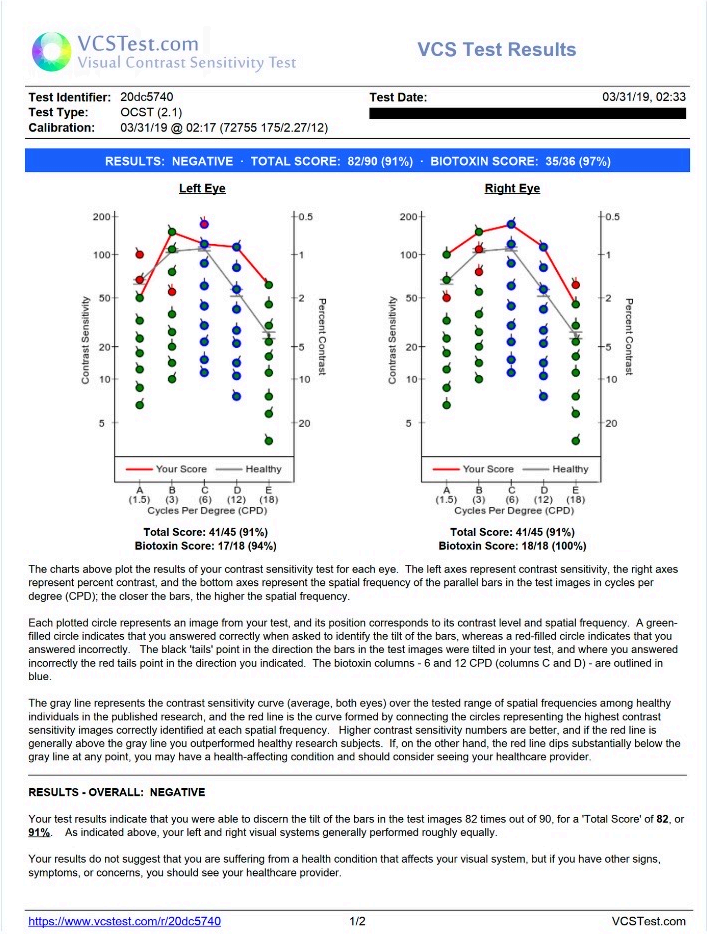
- Steps in diagnosis: medical evaluation, environmental evaluation, considering symptoms and exposure history
- Approaches to diagnosis in children: considering age-specific symptoms and the potential for early-life exposure to high levels of contaminated particulate matter
- Ask about any water damage in the home or workplace or in the car?
- Do symptoms appear or lessen when away from the home?



Visual Contrast Sensitivity

VCS measures a person's ability to distinguish grayscale, brightness and contrast. VCS testing is a non-invasive examination done in a doctor's office or clinic to evaluate a patient's visual function. Mould exposure may cause health issues, including eye problems. VCS testing may help doctors diagnose and monitor mould sickness.

Visual Contrast Sensitivity in Chronic Toxic Encephalopathy. Kilburn KH, Warshaw RH, Thornton JC. Archives of Environmental Health, 1989



VCSTest.com
Visual Contrast Sensitivity Test

VCS Test Results

Test Identifier: 20dc5740
Test Type: OCST (2.1)
Calibration: 03/31/19 @ 02:17 (72755 175/2.27/12)

Test Date: 03/31/19, 02:33

RESULTS: NEGATIVE · TOTAL SCORE: 82/90 (91%) · BIOTOXIN SCORE: 35/36 (97%)

Left Eye

Total Score: 41/45 (91%)
Biotoxin Score: 17/18 (94%)

Right Eye

Total Score: 41/45 (91%)
Biotoxin Score: 18/18 (100%)

The charts above plot the results of your contrast sensitivity test for each eye. The left axes represent contrast sensitivity, the right axes represent percent contrast, and the bottom axes represent the spatial frequency of the parallel bars in the test images in cycles per degree (CPD); the closer the bars, the higher the spatial frequency.

Each plotted circle represents an image from your test, and its position corresponds to its contrast level and spatial frequency. A green-filled circle indicates that you answered correctly when asked to identify the tilt of the bars, whereas a red-filled circle indicates that you answered incorrectly. The black 'tails' point in the direction the bars in the test images were tilted in your test, and where you answered incorrectly the red tails point in the direction you indicated. The biotoxin columns - 6 and 12 CPD (columns C and D) - are outlined in blue.

The gray line represents the contrast sensitivity curve (average, both eyes) over the tested range of spatial frequencies among healthy individuals in the published research, and the red line is the curve formed by connecting the circles representing the highest contrast sensitivity images correctly identified at each spatial frequency. Higher contrast sensitivity numbers are better, and if the red line is generally above the gray line you outperformed healthy research subjects. If, on the other hand, the red line dips substantially below the gray line at any point, you may have a health-affecting condition and should consider seeing your healthcare provider.

RESULTS - OVERALL: NEGATIVE

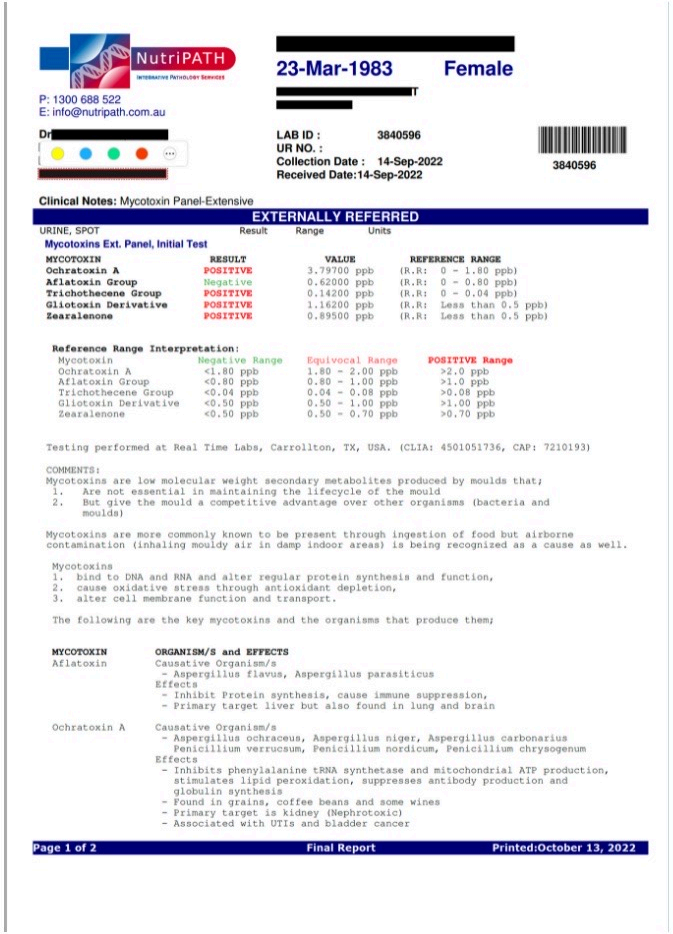
Your test results indicate that you were able to discern the tilt of the bars in the test images 82 times out of 90, for a 'Total Score' of **82**, or **91%**. As indicated above, your left and right visual systems generally performed roughly equally.

Your results do not suggest that you are suffering from a health condition that affects your visual system, but if you have other signs, symptoms, or concerns, you should see your healthcare provider.

Mycotox Testing

Great Plains Laboratory's MycoTOX Profile tests urine for mold-produced mycotoxins. Some doctors think the MycoTOX Profile can diagnose and track mould sickness. The MycoTOX Profile analyses 11 urine mycotoxins, including aflatoxin, ochratoxin, trichothecenes, and others. Mycotoxin exposure is assessed by comparing a first-morning urine sample to a reference range.

Urinary Mycotoxin Markers for Exposure Assessment in the National Health and Nutrition Examination Survey. Vesper SJ, Magnuson ML, Dearwent SM, et al. Journal of Environmental and Public Health, 2013



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INTEGRATIVE PATHOLOGY SERVICES

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23-Mar-1983 Female
[redacted]

Dr [redacted]

LAB ID : 3840596
UR NO. :
Collection Date : 14-Sep-2022
Received Date:14-Sep-2022

3840596

Clinical Notes: Mycotoxin Panel-Extensive

EXTERNALLY REFERRED

URINE, SPOT — Result — Range — Units

Mycotoxins Ext. Panel, Initial Test

MYCOTOXIN	RESULT	VALUE	REFERENCE RANGE
Ochratoxin A	POSITIVE	3.79700 ppb	(R.R: 0 - 1.80 ppb)
Aflatoxin Group	Negative	0.62000 ppb	(R.R: 0 - 0.80 ppb)
Trichothecene Group	POSITIVE	0.14200 ppb	(R.R: 0 - 0.04 ppb)
Gliotoxin Derivative	POSITIVE	1.16200 ppb	(R.R: Less than 0.5 ppb)
Zearalenone	POSITIVE	0.89500 ppb	(R.R: Less than 0.5 ppb)

Reference Range Interpretation:

Mycotoxin	Negative Range	Equivocal Range	POSITIVE Range
Ochratoxin A	<1.80 ppb	1.80 - 2.00 ppb	>2.0 ppb
Aflatoxin Group	<0.80 ppb	0.80 - 1.00 ppb	>1.0 ppb
Trichothecene Group	<0.04 ppb	0.04 - 0.08 ppb	>0.08 ppb
Gliotoxin Derivative	<0.50 ppb	0.50 - 1.00 ppb	>1.00 ppb
Zearalenone	<0.50 ppb	0.50 - 0.70 ppb	>0.70 ppb

Testing performed at Real Time Labs, Carrollton, TX, USA. (CLIA: 4501051736, CAP: 7210193)

COMMENTS:
Mycotoxins are low molecular weight secondary metabolites produced by moulds that;
1. Are not essential in maintaining the lifecycle of the mould
2. But give the mould a competitive advantage over other organisms (bacteria and moulds)

Mycotoxins are more commonly known to be present through ingestion of food but airborne contamination (inhaling mouldy air in damp indoor areas) is being recognized as a cause as well.

Mycotoxins
1. bind to DNA and RNA and alter regular protein synthesis and function,
2. cause oxidative stress through antioxidant depletion,
3. alter cell membrane function and transport.

The following are the key mycotoxins and the organisms that produce them;

MYCOTOXIN	ORGANISM/S and EFFECTS
Aflatoxin	Causative Organism/s - Aspergillus flavus, Aspergillus parasiticus Effects - Inhibit Protein synthesis, cause immune suppression, - Primary target liver but also found in lung and brain
Ochratoxin A	Causative Organism/s - Aspergillus ochraceus, Aspergillus niger, Aspergillus carbonarius Penicillium verrucsum, Penicillium nordicum, Penicillium chrysogenum Effects - Inhibits phenylalanine tRNA synthetase and mitochondrial ATP production, stimulates lipid peroxidation, suppresses antibody production and globulin synthesis - Found in grains, coffee beans and some wines - Primary target is kidney (Nephrotoxic) - Associated with UTIs and bladder cancer

Page 1 of 2 — Final Report — Printed:October 13, 2022

NeuroQuant

NeuroQuant programme measures brain areas such the hippocampus, amygdala, and thalamus using MRI. The software can diagnose Alzheimer's, multiple sclerosis, and traumatic brain injury. NeuroQuant for mould sickness measurement is not well-documented. Toxic mould exposure can cause mould disease, also known as CIRS. Mold sickness causes weariness, cognitive impairment, joint discomfort, and respiratory issues. No single test can diagnose the disease.

NeuroQuant in Detection of Hippocampal Atrophy in Mold-Related Illness. Shoemaker RC, House DE. Journal of Environmental and Public Health, 2018

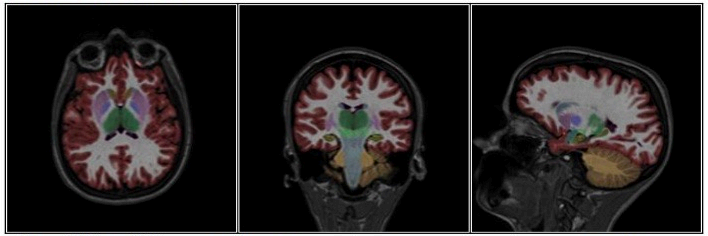
NeuroQuant®
Triage Brain Atrophy Report

I-Med Radiology
Address line 1
Address line 2
Preferred contact info

PATIENT INFORMATION **Version 2.3.0**

Patient ID: [redacted]	Patient Name: [redacted]	Sex: F	Age: 24
Accession Number: [redacted]3	Referring Physician: [redacted]	Exam Date: 2021-02-02	

MORPHOMETRY RESULTS



Intracranial Volume (ICV) (cm³)	ICV Percentile
1724.30	89

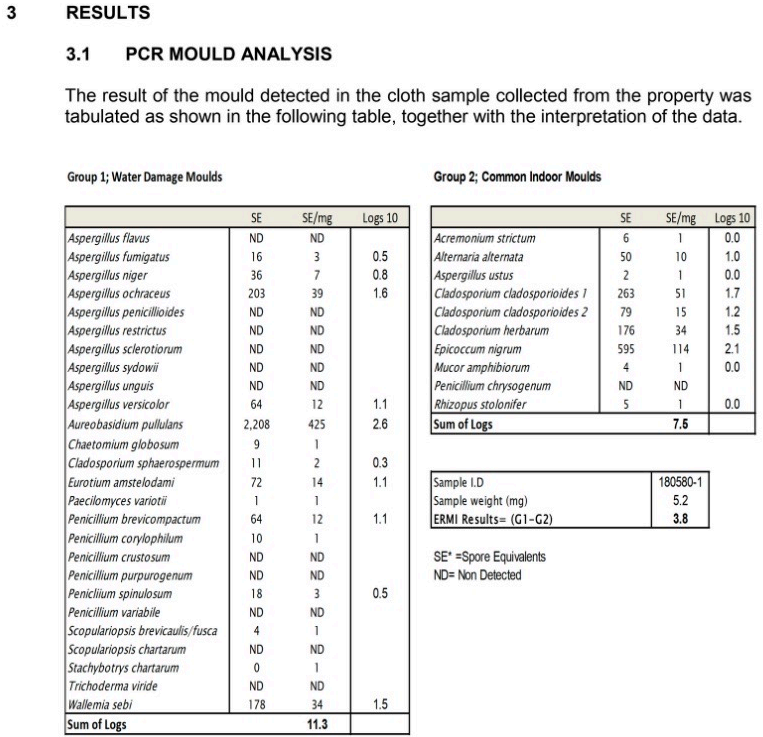
Total Volumes	Percentiles		
	Left	Right	Total
Cerebral White Matter	32	31	31
Cortical Gray Matter	61	64	62
Ventricles	40	44	41
Subcortical Structures			
Cerebellar White Matter	83	87	86
Cerebellar Gray Matter	72	71	72
Brainstem	-	-	35
Thalamus	70	57	64
Ventral Diencephalon	32	52	42
Basal Ganglia			
Putamen	74	61	68
Caudate	20	21	19
Nucleus Accumbens	99	79	95
Pallidum	4	11	6
Cingulate	73	97	93
Anterior Cingulate	92	99	99
Posterior Cingulate	52	84	71
Isthmus Cingulate	47	57	51

Cortical Brain Regions	Percentiles		
	Left	Right	Total
Frontal Lobes	74	73	74
Superior Frontal	45	40	43
Middle Frontal	99	92	97
Inferior Frontal	83	64	77
Lateral Orbitofrontal	59	68	64
Medial Orbitofrontal	61	48	52
Paracentral	9	26	15
Primary Motor	36	80	59
Parietal Lobes	73	68	71
Primary Sensory	57	60	58
Medial Parietal	49	24	36
Superior Parietal	75	26	50
Inferior Parietal	66	95	89
Supramarginal	88	77	85
Occipital Lobes	24	55	35
Medial Occipital	42	56	49
Lateral Occipital	21	57	33
Temporal Lobes	45	28	37
Transverse Temporal + Superior Temporal	84	67	78
Posterior Superior Temporal Sulcus	1	59	37
Middle Temporal	43	24	31
Inferior Temporal	7	22	10
Fusiform	92	64	81
Parahippocampal	66	11	33
Entorhinal Cortex	20	7	8
Temporal Pole	6	35	13
Amygdala	79	31	60
Hippocampus	35	20	26

ERMI

The EPA's Environmental Relative Moldiness Index (ERMI) measures mould levels in buildings and environments. The DNA of mould species in building dust samples is analysed and compared to a database of indoor mould species to determine ERMI. High ERMI scores indicate mould contamination. The index detects indoor air quality-related moulds that can cause mould sickness but samples settled material rather than the airspace.

Relationship Between Environmental Relative Moldiness Index and Occupational, Environmental, and Health-Related Symptoms: A Study of University Administrative Staff. Thrasher JD, Gray MR, Crago R, et al. Journal: Journal of Occupational and Environmental Medicine, 2018



3 RESULTS

3.1 PCR MOULD ANALYSIS

The result of the mould detected in the cloth sample collected from the property was tabulated as shown in the following table, together with the interpretation of the data.

Group 1; Water Damage Moulds

	SE	SE/mg	Logs 10
Aspergillus flavus	ND	ND	
Aspergillus fumigatus	16	3	0.5
Aspergillus niger	36	7	0.8
Aspergillus ochraceus	203	39	1.6
Aspergillus penicillioides	ND	ND	
Aspergillus restrictus	ND	ND	
Aspergillus sclerotiorum	ND	ND	
Aspergillus sydowii	ND	ND	
Aspergillus unguis	ND	ND	
Aspergillus versicolor	64	12	1.1
Aureobasidium pullulans	2,208	425	2.6
Chaetomium globosum	9	1	
Cladosporium sphaerospermum	11	2	0.3
Eurotium amstelodami	72	14	1.1
Paecilomyces variotii	1	1	
Penicillium brevicompactum	64	12	1.1
Penicillium corylophilum	10	1	
Penicillium crustosum	ND	ND	
Penicillium purpurogenum	ND	ND	
Peniclium spinulosum	18	3	0.5
Penicillium variabile	ND	ND	
Scopulariopsis brevicaulis/fusca	4	1	
Scopulariopsis chartarum	ND	ND	
Stachybotrys chartarum	0	1	
Trichoderma viride	ND	ND	
Wallemia sebi	178	34	1.5
Sum of Logs		**11.3**	

Group 2; Common Indoor Moulds

	SE	SE/mg	Logs 10
Acremonium strictum	6	1	0.0
Alternaria alternata	50	10	1.0
Aspergillus ustus	2	1	0.0
Cladosporium cladosporioides 1	263	51	1.7
Cladosporium cladosporioides 2	79	15	1.2
Cladosporium herbarum	176	34	1.5
Epicoccum nigrum	595	114	2.1
Mucor amphibiorum	4	1	0.0
Penicillium chrysogenum	ND	ND	
Rhizopus stolonifer	5	1	0.0
Sum of Logs		**7.5**	

Sample I.D	180580-1
Sample weight (mg)	5.2
ERMI Results= (G1-G2)	**3.8**

SE* =Spore Equivalents
ND= Non Detected

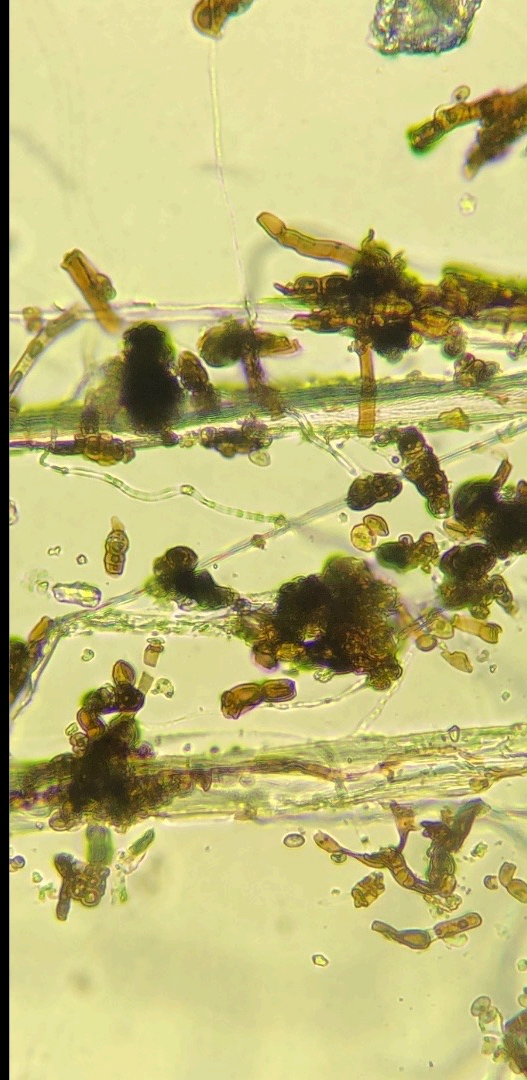
Clinical Management

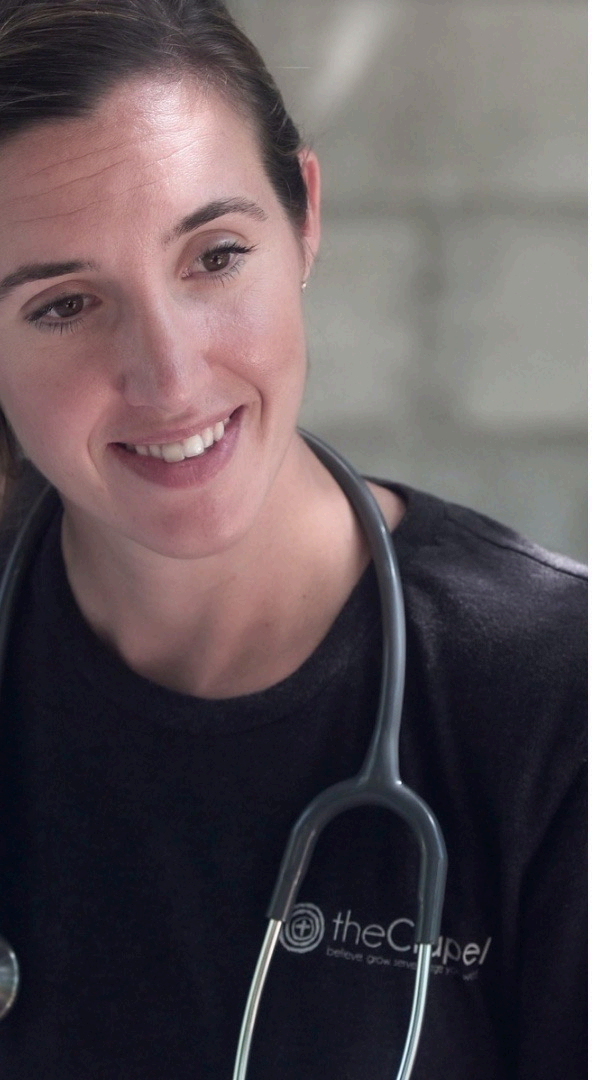
Clinical management strategies should focus on early intervention and prevention. Treatment should include alerting patients to potential sources of exposure such as dampness or water intrusion in their homes. Other strategies such as lifestyle changes or medications may also be necessary.

Early intervention and prevention are key when it comes to clinical management.

Strategies for clinical management and preventive intervention

Identifying and eliminating mould exposure, using a variety of treatment approaches such as detoxification, immune modulation, and lifestyle modifications, testing for mould toxins with urine tests, differentiating between the general population, allergy, or genetically susceptible individuals, and avoiding areas where mould contamination is present are all clinical management and preventive intervention strategies for mould and biotoxin illness.



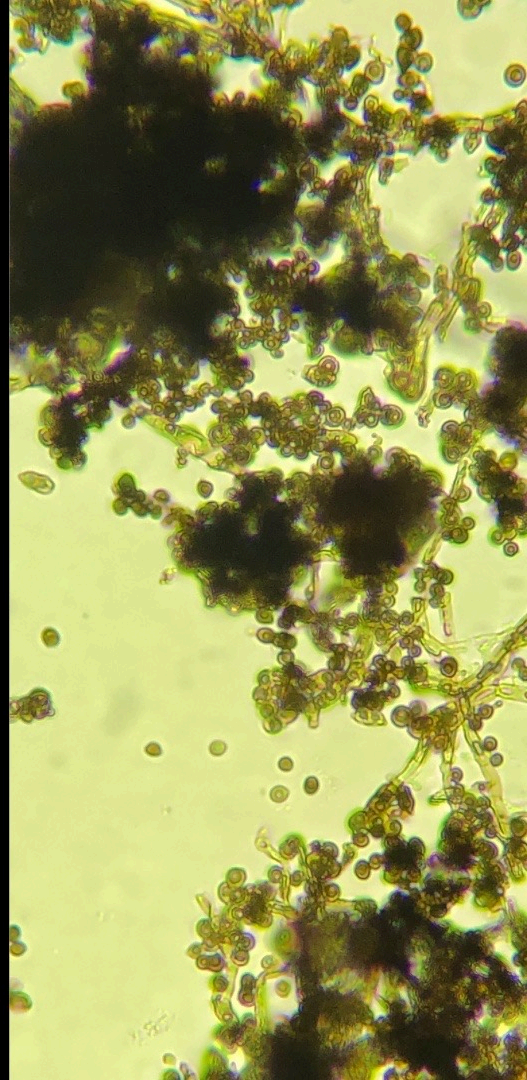


Top Questions You Should Consider Asking Your Patients Who Present With Possible Mould Exposure

1. Have you experienced any exposure to water-damaged buildings or materials?
2. What symptoms are you experiencing, and how long have you had them?
3. Have you had any testing or evaluation for mould exposure or CIRS?
4. Do you live or work in an environment with visible mould growth or a musty odor?
5. Have you undergone any remediation or removal of mould from your living or working environment?

Strategies for clinical management and preventive intervention

- Education of patients and families about mould exposure and health effects
- Encouragement of regular home inspections
- Identification and reporting of water damage and mold growth
- Management of symptoms through medication and lifestyle changes
- Regular monitoring of affected individuals
- Development of a plan for preventive intervention and environmental management.



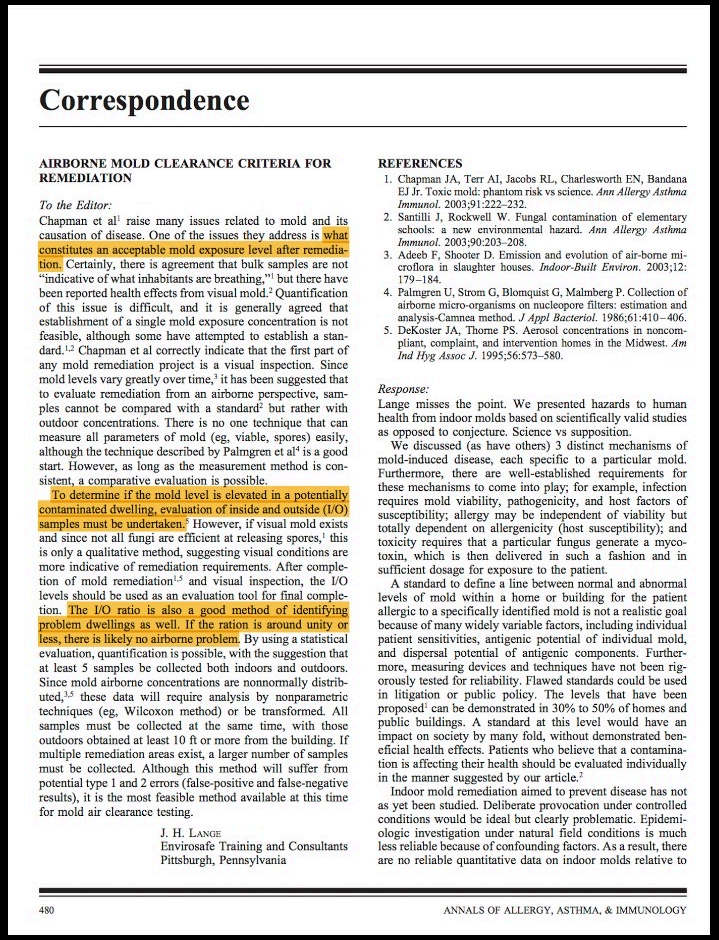
The importance of good data

- Bad environmental inspections cause huge problems!
- Need scientifically valid sets of data. If 'before' and 'after' testing is done, it should be 'like for like'
- The remediator should not do the testing
- Beware of free inspections!
- Some labs work mainly for the Insurer or remediator, so in many cases there is no testing done at the end or poor sampling at the outset
- Always look for evidence-based inspection reports

Biological Health Services

Contents

Post Remediation Verification



Correspondence

AIRBORNE MOLD CLEARANCE CRITERIA FOR REMEDIATION

To the Editor:

Chapman et al[1] raise many issues related to mold and its causation of disease. One of the issues they address is what constitutes an acceptable mold exposure level after remediation. Certainly, there is agreement that bulk samples are not "indicative of what inhabitants are breathing,"[1] but there have been reported health effects from visual mold.[2] Quantification of this issue is difficult, and it is generally agreed that establishment of a single mold exposure concentration is not feasible, although some have attempted to establish a standard.[1,2] Chapman et al correctly indicate that the first part of any mold remediation project is a visual inspection. Since mold levels vary greatly over time,[3] it has been suggested that to evaluate remediation from an airborne perspective, samples cannot be compared with a standard[2] but rather with outdoor concentrations. There is no one technique that can measure all parameters of mold (eg, viable, spores) easily, although the technique described by Palmgren et al[4] is a good start. However, as long as the measurement method is consistent, a comparative evaluation is possible.

To determine if the mold level is elevated in a potentially contaminated dwelling, evaluation of inside and outside (I/O) samples must be undertaken.[5] However, if visual mold exists and since not all fungi are efficient at releasing spores,[1] this is only a qualitative method, suggesting visual conditions are more indicative of remediation requirements. After completion of mold remediation[1,5] and visual inspection, the I/O levels should be used as an evaluation tool for final completion. The I/O ratio is also a good method of identifying problem dwellings as well. If the ration is around unity or less, there is likely no airborne problem. By using a statistical evaluation, quantification is possible, with the suggestion that at least 5 samples be collected both indoors and outdoors. Since mold airborne concentrations are nonnormally distributed,[3,5] these data will require analysis by nonparametric techniques (eg, Wilcoxon method) or be transformed. All samples must be collected at the same time, with those outdoors obtained at least 10 ft or more from the building. If multiple remediation areas exist, a larger number of samples must be collected. Although this method will suffer from potential type 1 and 2 errors (false-positive and false-negative results), it is the most feasible method available at this time for mold air clearance testing.

J. H. Lange
Envirosafe Training and Consultants
Pittsburgh, Pennsylvania

REFERENCES

1. Chapman JA, Terr AI, Jacobs RL, Charlesworth EN, Bandana EJ Jr. Toxic mold: phantom risk vs science. *Ann Allergy Asthma Immunol.* 2003;91:222–232.
2. Santilli J, Rockwell W. Fungal contamination of elementary schools: a new environmental hazard. *Ann Allergy Asthma Immunol.* 2003;90:203–208.
3. Adeeb F, Shooter D. Emission and evolution of air-borne microflora in slaughter houses. *Indoor-Built Environ.* 2003;12: 179–184.
4. Palmgren U, Strom G, Blomquist G, Malmberg P. Collection of airborne micro-organisms on nucleopore filters: estimation and analysis-Camnea method. *J Appl Bacteriol.* 1986;61:410–406.
5. DeKoster JA, Thorne PS. Aerosol concentrations in noncompliant, complaint, and intervention homes in the Midwest. *Am Ind Hyg Assoc J.* 1995;56:573–580.

Response:

Lange misses the point. We presented hazards to human health from indoor molds based on scientifically valid studies as opposed to conjecture. Science vs supposition.

We discussed (as have others) 3 distinct mechanisms of mold-induced disease, each specific to a particular mold. Furthermore, there are well-established requirements for these mechanisms to come into play; for example, infection requires mold viability, pathogenicity, and host factors of susceptibility; allergy may be independent of viability but totally dependent on allergenicity (host susceptibility); and toxicity requires that a particular fungus generate a mycotoxin, which is then delivered in such a fashion and in sufficient dosage for exposure to the patient.

A standard to define a line between normal and abnormal levels of mold within a home or building for the patient allergic to a specifically identified mold is not a realistic goal because of many widely variable factors, including individual patient sensitivities, antigenic potential of individual mold, and dispersal potential of antigenic components. Furthermore, measuring devices and techniques have not been rigorously tested for reliability. Flawed standards could be used in litigation or public policy. The levels that have been proposed[1] can be demonstrated in 30% to 50% of homes and public buildings. A standard at this level would have an impact on society by many fold, without demonstrated beneficial health effects. Patients who believe that a contamination is affecting their health should be evaluated individually in the manner suggested by our article.[2]

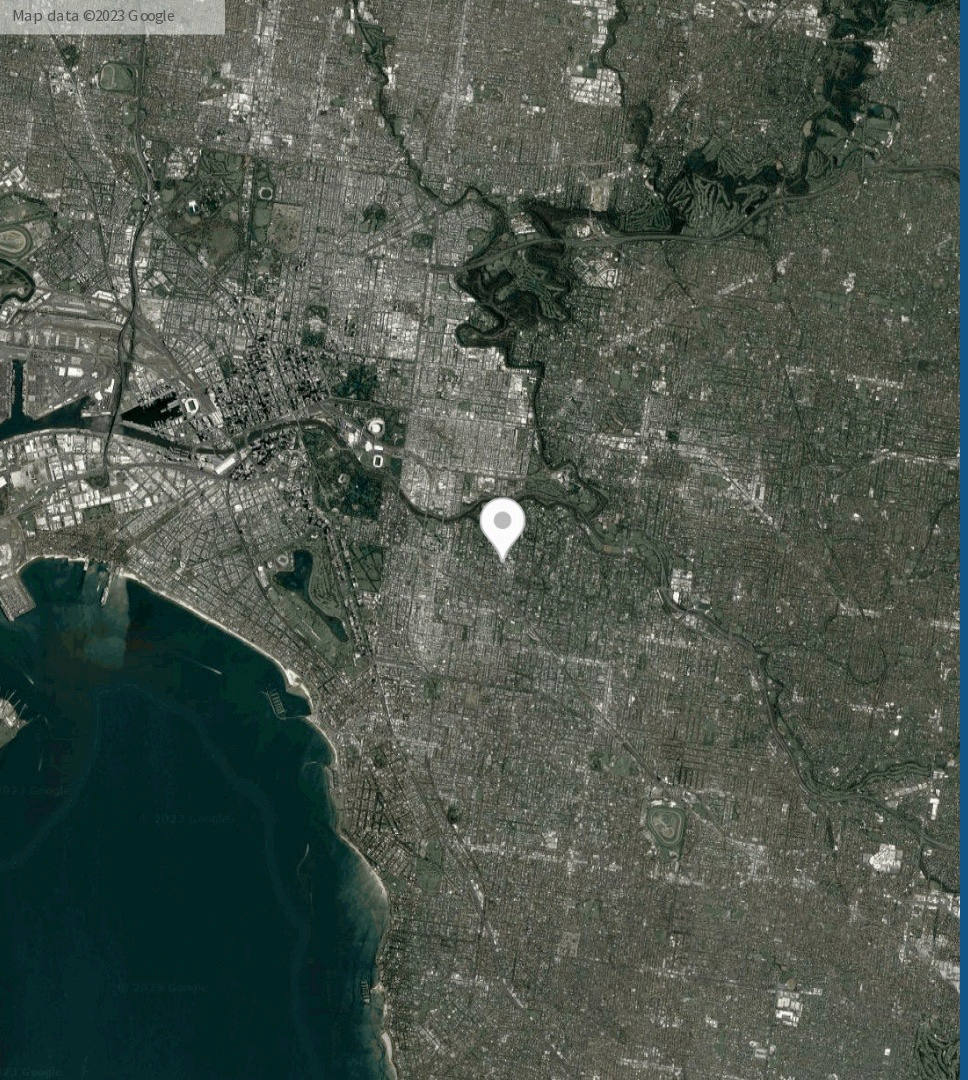
Indoor mold remediation aimed to prevent disease has not as yet been studied. Deliberate provocation under controlled conditions would be ideal but clearly problematic. Epidemiologic investigation under natural field conditions is much less reliable because of confounding factors. As a result, there are no reliable quantitative data on indoor molds relative to

- To determine if the mold level is elevated in a potentially contaminated dwelling, evaluation of inside and outside (I/O)samples must be undertaken.
- The I/O ratio is also a good method of identifying problem dwellings as well. If the ratio is around unity or less, there is likely no airborne problem.
- At least 5 samples should be collected indoors including at least 1 outdoor control.

LANGE JH. AIRBORNE MOLD CLEARANCE CRITERIA FOR REMEDIATION. ANN ALLERGY ASTHMA IMMUNOL. 2004 APR;92(4):480; AUTHOR REPLY 480-1. DOI: 10.1016/S1081-1206(10)61789-9. PMID: 15104203.

“Breathing clean air is just as important as eating healthy food and drinking clean water.”

According to Prince William, breathing clean air is just as important as eating healthy food and drinking clean water. This sentiment has been echoed by International Space Station astronaut Ron Garan, the World Health Organization, the United Nations, and a UN expert on human rights and a healthy planet.



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