CONSIDERATION OF OUTDOOR MOLD LEVELS ("ERMI") WHEN EVALUATING INDOOR ENVIRONMENTAL CONDITIONS

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INTRODUCTION-JOHN BANTA, CIH

- 35 Years Indoor Environmental Professional
- 25 Years Emphasis on Water Damaged Environments
- 10 Years Focus on Medically Important Investigations
- Certified Industrial Hygienist
- Senior Environmental Consultant for RestCon Environmental
- Co-Author *Prescriptions for a Healthy House: A Practical Guide for Architects, Builders and Homeowners.* 4th Edition, April 2022

INTRODUCTION-BONI PASSMORE, PHD

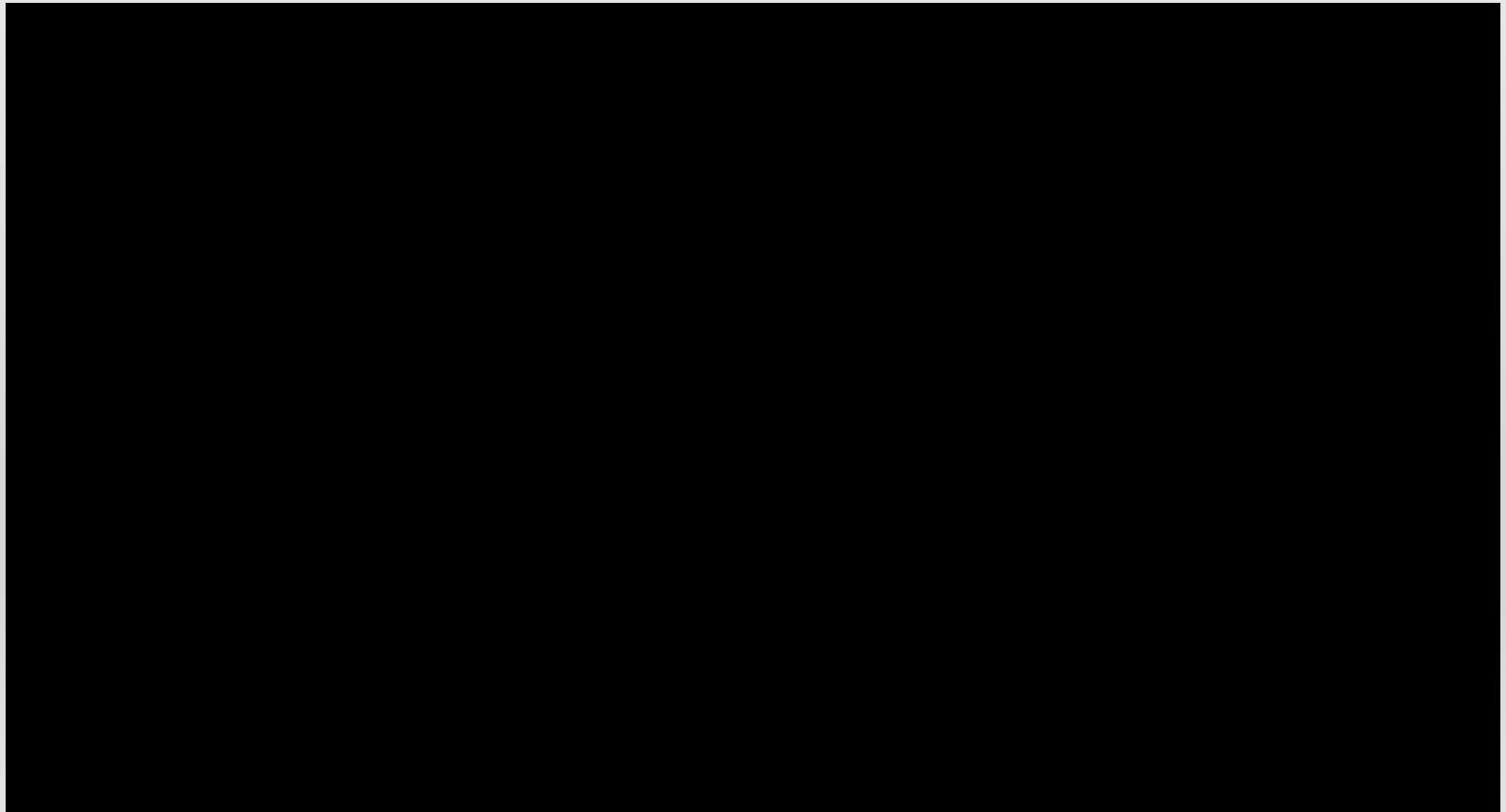
- Doctorate in Biochemistry/Biophysics from UC Davis
- 15 years Research Scientist in UC Davis Dept. of Plant Pathology, specializing in plant viruses
- Pioneered the use of PCR technology for scientific research
- 22 years Indoor Environmental Quality experience
- 20 years RCAnalytical Lab Director and Head Analyst

INTRODUCTION-MICHAEL SCHRANTZ, CIEC

- Owner & Operator of **Environmental Analytics LLC**
- ACAC Council-Certified Indoor Environmental Consultant
- ACAC Council-Certified Microbial Investigator
- 25 years of Indoor Environmental Quality experience
- Focus on serving those with Chronic Illness & Low-Dose Environmental Exposure concerns
- 2 publications involving MSQPCR & Microbial Remediation
- Host of IEPRadio.com
- Learn More: **https://environmentalanalytics.net/about-us/**

OVERVIEW

- Movement of particles within our atmosphere occurs all the time.
- A variety of strong surface winds, atmospheric conditions, and many other factors continually create the driving forces that are able to transport these aerosols to local and distant locations



IT'S NOT JUST FROM THE SAHARA!

Your nearby Ecosystem has a lot to offer!

Fungi

Bacteria

..and more, just for you!

Welcome to Earth!!

IT'S NOT JUST FROM THE SAHARA!

Wildfires can influence Indoor Environmental Quality by transporting large quantities of particulates/chemicals long distances. –Colorado, December 2021

IT'S NOT JUST FROM THE SAHARA!

Wildfires can influence Indoor Environmental Quality by transporting large quantities of particulates/chemicals long distances.-Bay Area August 2020

IT'S NOT JUST FROM THE SAHARA!

Nearby sources (manmade & agriculture)

YOUR BACKYARD!

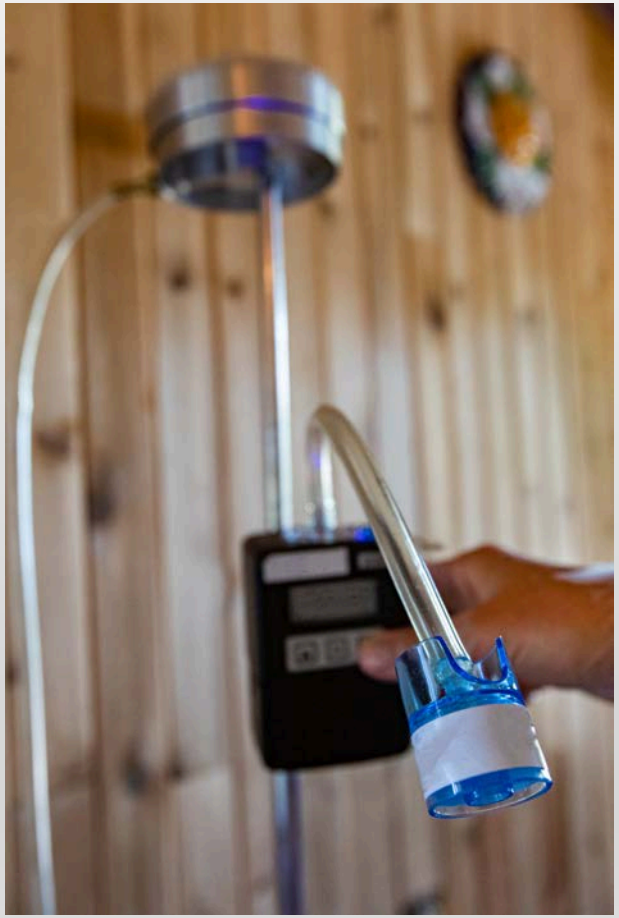
And certainly our immediate surroundings are sources of mold!

YOUR BACKYARD!

And certainly our immediate surroundings are sources of mold!

SAMPLING OF THE ENVIRONMENTS

- Air sampling for mold has been the common method of collection for decades.
- Traditionally, outdoor (control) samples are also collected to compare with indoor air samples.
- While air sampling is the method necessary to evaluate direct inhalation exposure, **surface dust collection** offers many data points. It can help determine cleaning effectiveness, the accumulation of settled mold structures, as well as providing indirect evidence of what may become airborne in the future as well as remnants of what was airborne in the past are a few examples.



MSQPCR SURFACE DUST SAMPLING

- In 2006, MSQPCR analysis became available for environmental inspections by a limited number of laboratories.
- This technology identifies and quantifies "mold DNA" to a species level in collected surface dust, swab, or air samples.
- This has the advantage of identifying biomass (vs "spore counts only"), helping to better quantify the total presence of targeted mold species and their potential bioburden.

MSQPCR SURFACE DUST SAMPLING

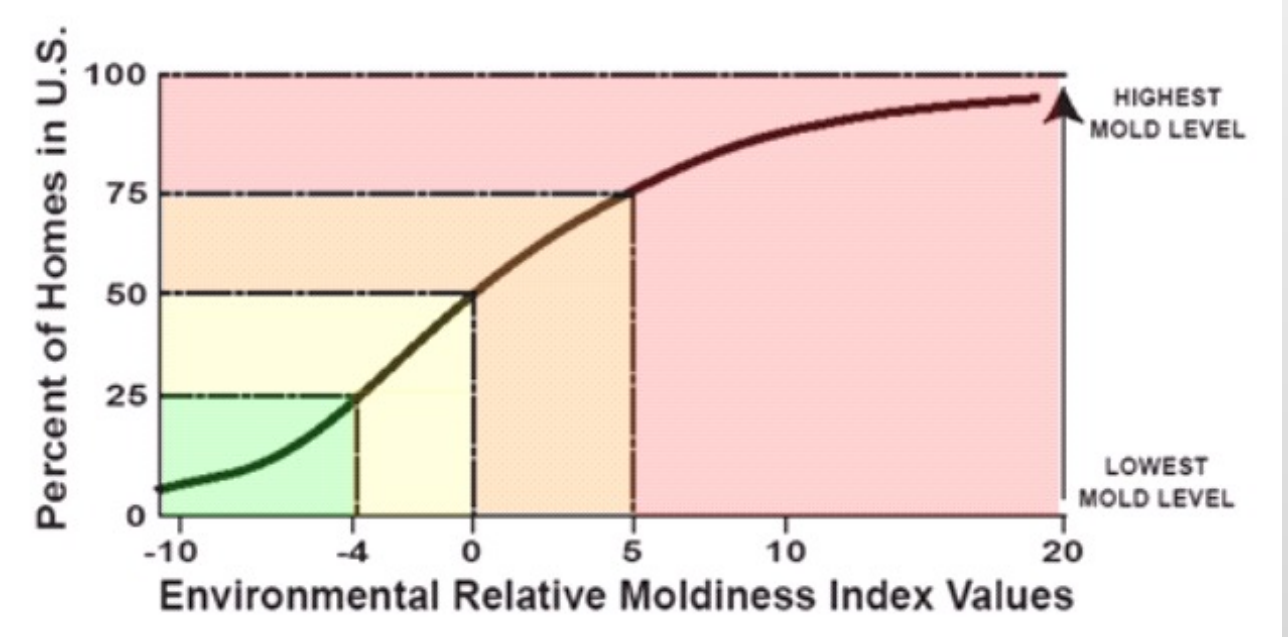
- MSQPCR has been involved in multiple published research studies over the last 20 years. For many years, this research has helped the industry better understand and appreciate the potential biomass that may be present by focusing on targeted mold species.
- As this newer method of sample analysis and the ability to interpret the data has evolved, there has been a rising need to better understand the outdoor influence on the molds being identified indoors.
- While some of the mold species commercially available for detection are considered to be somewhat reliable "indicator molds" of indoor elevated moisture and damp conditions, **some of these same mold species are commonly found outdoors.**

ERMI PANEL OF 36 MOLD SPECIES	
GROUP 1	GROUP 2
Fungal ID \ Sample ID	**Fungal ID \ Sample ID**
Aspergillus flavus/oryzae	Acremonium strictum
Aspergillus fumigatus	Alternaria alternata
Aspergillus niger	Aspergillus ustus
Aspergillus ochraceus	Cladosporium cladosporioides 1
Aspergillus penicillioides	Cladosporium cladosporioides 2
*Aspergillus restrictus**	Cladosporium herbarum
Aspergillus sclerotiorum	Epicoccum nigrum
Aspergillus sydowii	Mucor amphibiorum*
Aspergillus unguis	Penicillium chrysogenum
Aspergillus versicolor	Rhizopus stolonifer
Aureobasidium pullulans	
Chaetomium globosum	
Cladosporium sphaerospermum	
*Eurotium (Asp.) amstelodami**	
Paecilomyces variotii	
Penicillium brevicompactum	
Penicillium corylophilum	
*Penicillium crustosum**	
Penicillium purpurogenum	
*Penicillium spinulosum**	
Penicillium variabile	
Scopulariopsis brevicaulis/fusca	
Scopulariopsis chartarum	
Stachybotrys chartarum	
*Streptomyces griseus+**	
*Trichoderma viride**	
Wallemia sebi	

ERMI = SUM OF LOG10 GROUP I –(MINUS) SUM OF LOG10 GROUP II

MSQPCR SURFACE DUST SAMPLING

- This makes the interpretation of indoor-only sampling more complex.
- For decades, with the exception of a few mold professionals, this method of sample analysis has not been used to collect outdoor samples for baseline comparison.
- This presents challenges with data interpretation and incorrect conclusions; **the reader assuming that "Indicator molds" present on an indoor sample "must have come from the indoors."**



MSQPCR SURFACE DUST SAMPLING

- This study takes a deeper look into the impact of the outdoors, how it can affect ERMI results, and what to consider when collecting and interpreting an MSQPCR surface dust sample.

CASE STUDY #1-ENVIRONMENTAL ANALYTICS-PAIA, HAWAII

- Year Built: 2000/2009
- Square footage: 5000ft^2
- 2-level with walk-out basement
- Part-time occupant (grandson)-Chronic Illness diagnosed by a California-based clinician.
- VERY clean (dust & airborne particulates) home.
  (.3um 15% of outdoor levels)

CASE STUDY #1-ENVIRONMENTAL ANALYTICS-PAIA, HAWAII

Homeowner-Provided-History and visual evidence:

- Water staining at Basement Living Room (South wall)
- Water staining and suspect mold growth at Basement Guest Bathroom and vanity sink cabinet (bottom shelf cavity)
- Suspect moisture stains/minor damage to Basement Laundry Room sink cabinet bottom shelf
- Suspect water staining behind Main Level Prana's Bedroom Bathroom-East wall (behind toilet)
- Suspect water staining on Master Bathroom Lavatory ceiling

CASE STUDY #1-ENVIRONMENTAL ANALYTICS-PAIA, HAWAII

- The client (mother) had concerns about ongoing mold exposure based on her son's health.
- This home served as a temporary location for them while there primary home was being remediated due to multiple microbial issues in the home.

CASE STUDY #1-ENVIRONMENTAL ANALYTICS-PAIA, HAWAII

- **Interstitial cavity sampling identified mold sources throughout the basement (lower level)** *but none were identified on the main level.*

CASE STUDY #1-ENVIRONMENTAL ANALYTICS-PAIA, HAWAII

MSQPCR ("ERMI") samples collected from multiple "zones" on Main Level

Project ID	EA: 3128			
Mycometrics Report No.				
Location	Main Level (ML)-Prana Bedroom Surface dust	ML-Master Bedroom Surface dust	ML-Stephanie Bedroom Surface dust	ML-Living Rm area Surface dust
	Spore E./mg	Spore E./mg	Spore E./mg	Spore E./mg
Fungal ID \ Sample ID	**#10**	**#11**	**#12**	**#13**
Aspergillus flavus/oryzae	0	0	1	0
Aspergillus fumigatus	0	0	1	0
Aspergillus niger	11	4	5	10
Aspergillus ochraceus	0	4	0	0
Aspergillus penicillioides	11	32	37	20
*Aspergillus restrictus**	2	1	7	2
Aspergillus sclerotiorum	0	0	0	0
Aspergillus sydowii	0	0	0	1
Aspergillus unguis	0	0	0	0
Aspergillus versicolor	0	0	2	4
Aureobasidium pullulans	55	24	57	23
Chaetomium globosum	0	1	8	2
Cladosporium sphaerospermum	1	3	7	3
*Eurotium (Asp.) amstelodami**	81	35	62	120
Paecilomyces variotii	0	0	1	0
Penicillium brevicompactum	0	0	1	1
Penicillium corylophilum	0	0	0	0

Location	Main Level (ML)-Prana Bedroom Surface dust	ML-Master Bedroom Surface dust	ML-Stephanie Bedroom Surface dust	ML-Living Rm area Surface dust
*Penicillium crustosum**	0	3	3	1
Penicillium purpurogenum	0	0	0	0
*Penicillium spinulosum**	0	0	0	0
Penicillium variabile	3	0	0	2
Scopulariopsis brevicaulis/fusca	0	0	0	0
Scopulariopsis chartarum	1	0	2	0
Stachybotrys chartarum	0	0	2	0
*Trichoderma viride**	0	0	0	0
Wallemia sebi	3	15	21	6
Sum of the Logs (Group I):	**6.99**	**7.77**	**11.12**	**8.50**
Acremonium strictum	0	0	0	0
Alternaria alternata	5	1	2	1
Aspergillus ustus	6	24	3	4
Cladosporium cladosporioides 1	94	53	36	21
Cladosporium cladosporioides 2	12	3	5	3
Cladosporium herbarum	0	4	7	1
Epicoccum nigrum	0	7	28	9
*Mucor amphibiorum**	0	2	4	7
Penicillium chrysogenum	0	0	4	3
Rhizopus stolonifer	0	1	8	5
Sum of the Logs (Group II):	**4.53**	**5.33**	**7.44**	**5.38**
ERMI (Group I - Group II):	**2.46**	**2.44**	**3.68**	**3.12**
HERTSMI-2 Scores:	4	4	8	4

CASE STUDY #1-ENVIRONMENTAL ANALYTICS-PAIA, HAWAII

Client has continued exposure concerns—could this data indicate an indoor source?

Project ID	**EA: 3128**			
Mycometrics Report No.				
Location	**Main Level (ML)-Prana Bedroom Surface dust**	**ML-Master Bedroom Surface dust**	**ML-Stephanie Bedroom Surface dust**	**ML-Living Rm area Surface dust**
	Spore E./mg	**Spore E./mg**	**Spore E./mg**	**Spore E./mg**
Fungal ID \ Sample ID	**#10**	**#11**	**#12**	**#13**
Aspergillus penicillioides	11	32	37	20
Aureobasidium pullulans	55	24	57	23
*Eurotium (Asp.) amstelodami**	81	35	62	120
Wallemia sebi	3	15	21	6
Sum of the Logs (Group I):	**6.99**	**7.77**	**11.12**	**8.50**
Cladosporium cladosporioides 1	94	53	36	21
Cladosporium cladosporioides 2	12	3	5	3
Sum of the Logs (Group II):	**4.53**	**5.33**	**7.44**	**5.38**
ERMI (Group I - Group II):	**2.46**	**2.44**	**3.68**	**3.12**
HERTSMI-2 Scores:	4	4	8	4

CASE STUDY #1-ENVIRONMENTAL ANALYTICS-PAIA, HAWAII

Outdoor "control" sample included in interpretation of indoor samples.

Project ID	**EA: 3128**				
Mycometrics Report No.					
Location	**Outdoor Surface dust (control)**	**Main Level (ML)-Prana Bedroom Surface dust**	**ML-Master Bedroom Surface dust**	**ML-Stephanie Bedroom Surface dust**	**ML-Living Rm area Surface dust**
	Spore E./mg	**Spore E./mg**	**Spore E./mg**	**Spore E./mg**	**Spore E./mg**
Fungal ID \ Sample ID	#9	#10	#11	#12	#13
Aspergillus penicillioides	2200	11	32	37	20
Aureobasidium pullulans	5200	55	24	57	23
*Eurotium (Asp.) amstelodami**	63	81	35	62	120
Wallemia sebi	180	3	15	21	6
Sum of the Logs (Group I):	**25.27**	**6.99**	**7.77**	**11.12**	**8.50**
Cladosporium cladosporioides 1	1700	94	53	36	21
Cladosporium cladosporioides 2	7100	12	3	5	3
Sum of the Logs (Group II):	**12.04**	**4.53**	**5.33**	**7.44**	**5.38**
ERMI (Group I - Group II):	**13.23**	**2.46**	**2.44**	**3.68**	**3.12**
HERTSMI-2 Scores:	18	4	4	8	4

CASE STUDY #1-ENVIRONMENTAL ANALYTICS-PAIA, HAWAII

Conclusions:

- The outdoor control sample helped us narrow down the concerns in the home (basement) and help rule out main level issues.
- Molds can grow in a variety of indoor and outdoor conditions, but knowing the physiology of these mold species also helped us and the homeowners understand what is “normal” indoors.
- Homeowner made additional improvements to their whole-house air filtration and ventilation systems to further improve overall Indoor Environmental Quality.

CASE STUDY #2-RESTCON ENVIRONMENTAL-ROSEVILLE, CA

- Built 2017, original owners, watched it being built, no rain events during construction
- 3,500 ft^2, 2-story, concrete slab foundation, hard surface floors throughout
- Autistic child diagnosed with mold sensitivities
- MSQPCR done March 2020 indicated elevated level of *Stachybotrys* in the home

CASE STUDY #2-RESTCON ENVIRONMENTAL-ROSEVILLE, CA

- Small water intrusion in upstairs hall bathroom
- Significant water intrusion in Apartment kitchen
- Major fungal remediation done in Apartment
- Conducted destructive investigation in Main House; including removal of gypsum wallboard and sections of hardwood floors, no mold found
- MSQPCR following remediation showed Stachybotrys still present in Living Room only (adjacent to backyard)

CASE STUDY #2 RESTCON ENVIRONMENTAL-ROSEVILLE, CA

- Small backyard with artificial turf over 6 inches of carpet pad and poor drainage
- Sampling of backyard showed *Stachybotrys* present in settled dust and in the carpet pad
- Occupants removed carpet pad, fixed drainage and cleaned all backyard surfaces
- Occupants instituted Effective Cleaning practices

CASE STUDY #2-RESTCON ENVIRONMENTAL-ROSEVILLE, CA

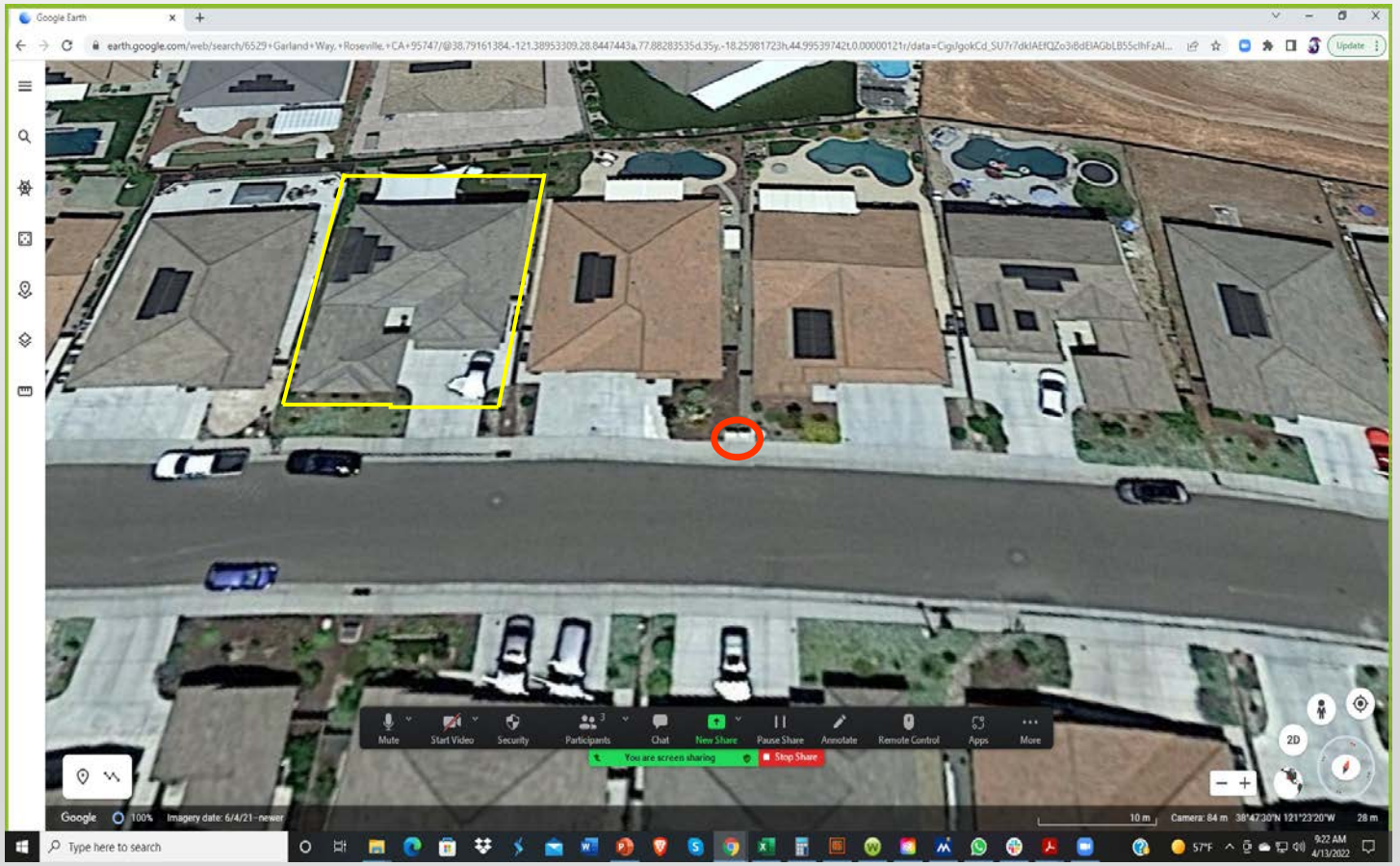
- Repeated the MSQPCR analysis of the home and backyard
- *Stachybotrys* level in the backyard is still very high – 110,000 sp eq/mg dust
- No *Stachybotrys* was found indoors
- Visual inspection of adjoining yards does not reveal an obvious potential source, most are hardscaped

CASE STUDY #2-RESTCON ENVIRONMENTAL-ROSEVILLE, CA

- While we still don't know what the source of the outdoor *Stachybotrys* is, the outdoor control sample has alleviated the occupant's concerns that there is still a mold source in the house.
- With two young children it's difficult to keep control of tracking in particulates from outdoors but, now that they know there is an outdoor source, they have instituted mitigation practices to keep it as minimal as possible.

CASE STUDY #2-RESTCON ENVIRONMENTAL-ROSEVILLE, CA

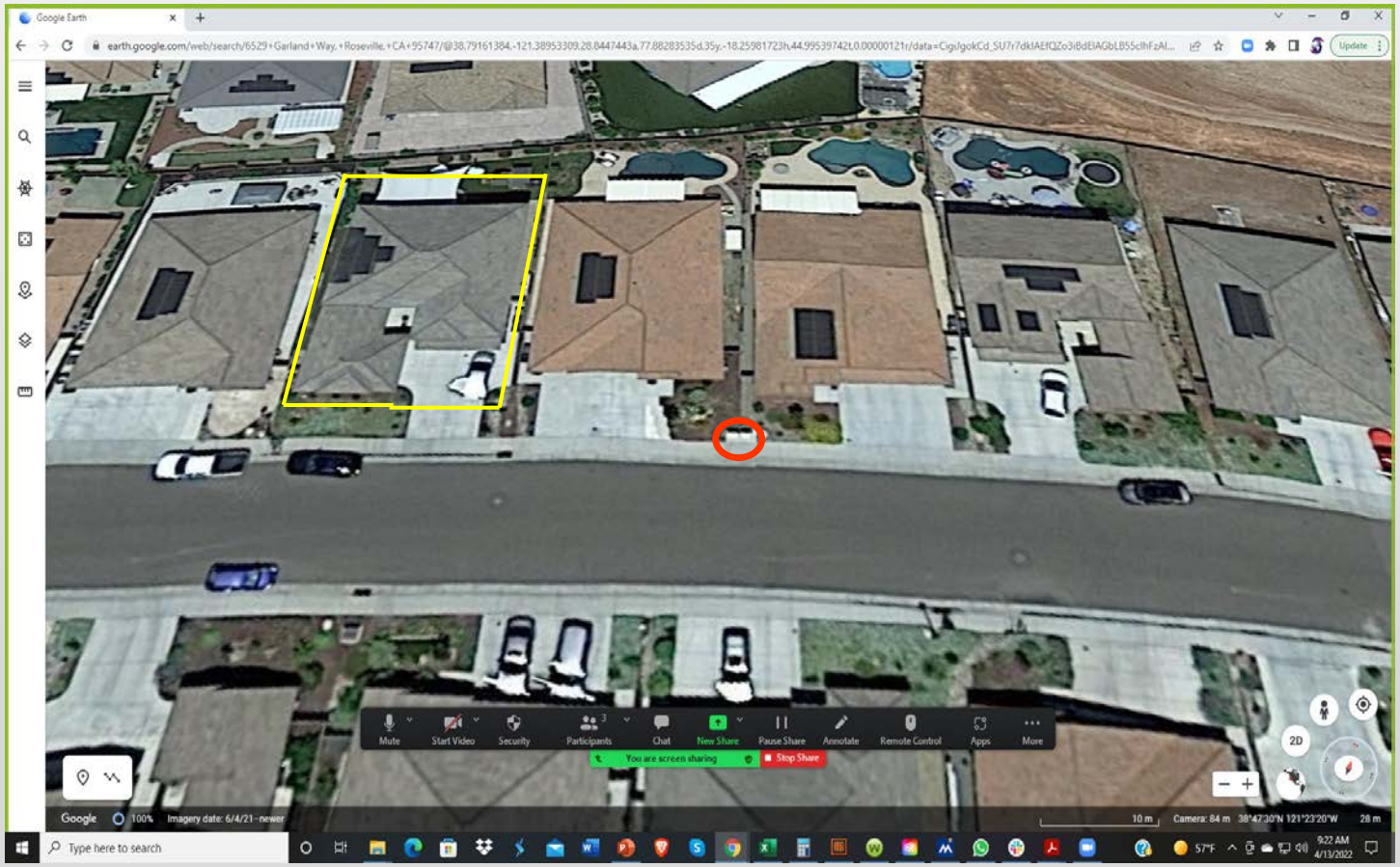
- Follow-up Outdoor control sample was collected on March 7th, 2022 from the top of the mailboxes (two homes away).
- The results identified 23,000 sp eq/mg dust of *Stachybotrys chartarum*



CASE STUDY #2-RESTCON ENVIRONMENTAL-ROSEVILLE, CA

- Possible explanations for outdoor findings:
  - New/existing source not yet identified (within or outside of client property)
  - Sampled outdoor surfaces reflect residual *Stachybotrys chartarum* from improvements in the client's backyard.

- Plans to perform follow-up sampling of the neighborhood to narrow down source/s.

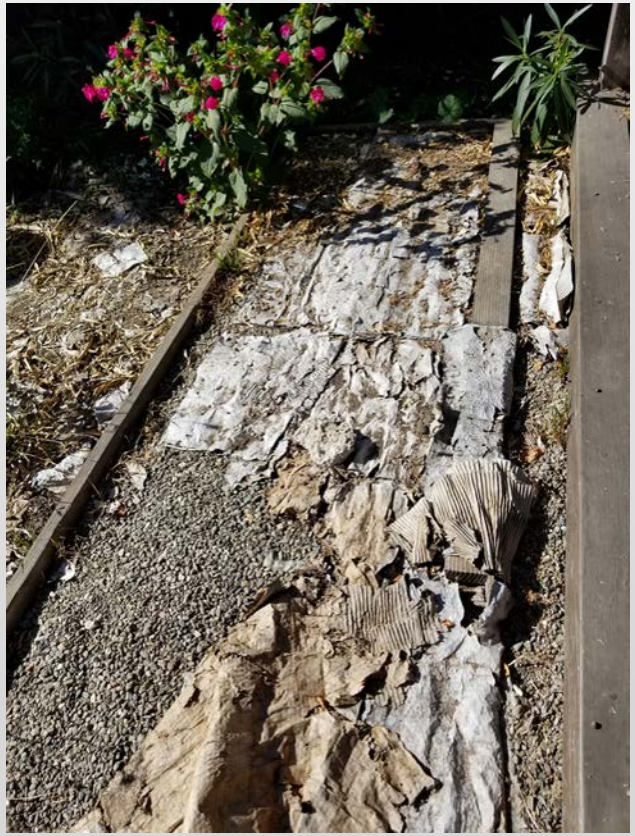


CASE STUDY #3-RESTCON ENVIRONMENTAL-SAN LEANDRO, CA

- Built 1940, 2 bedroom, 1 bath
- 1,128 ft^2, raised foundation
- Client has CIRS-WDB
- Inspection and MSQPCR sampling performed in October 2019

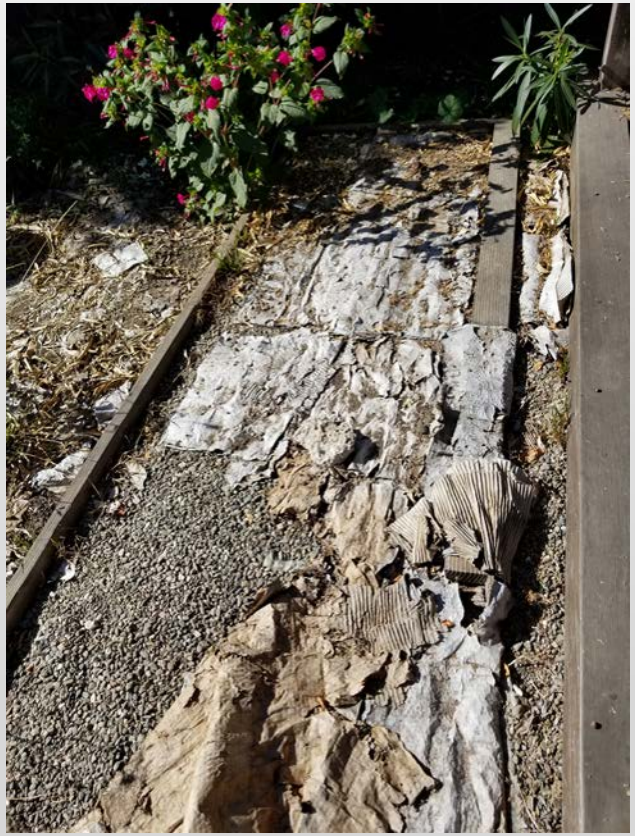
CASE STUDY #3-RESTCON ENVIRONMENTAL-SAN LEANDRO, CA

- During outdoor visual inspection, it was noted that cardboard had been used as a weed-stop.
- The owner indicated they had installed the cardboard several years earlier.
- Visible mold was observed on the cardboard.
- Exterior entry from backyard into Primary Bedroom



CASE STUDY #3-RESTCON ENVIRONMENTAL-SAN LEANDRO, CA

- Multiple MSQPCR samples were collected in various "zones" inside home.
- Primary Bedroom showed significantly elevated levels of the following:
  - 330 sp eq/mg dust of *Stachybotrys chartarum*
  - 650 sp eq/mg dust of *Penicillium brevicompactum*
  - 1,100 sp eq/mg dust of *Aureobasidium pullulans*



CASE STUDY #3-RESTCON ENVIRONMENTAL-SAN LEANDRO, CA

HERTSMI-2 scores for sampled Zones:

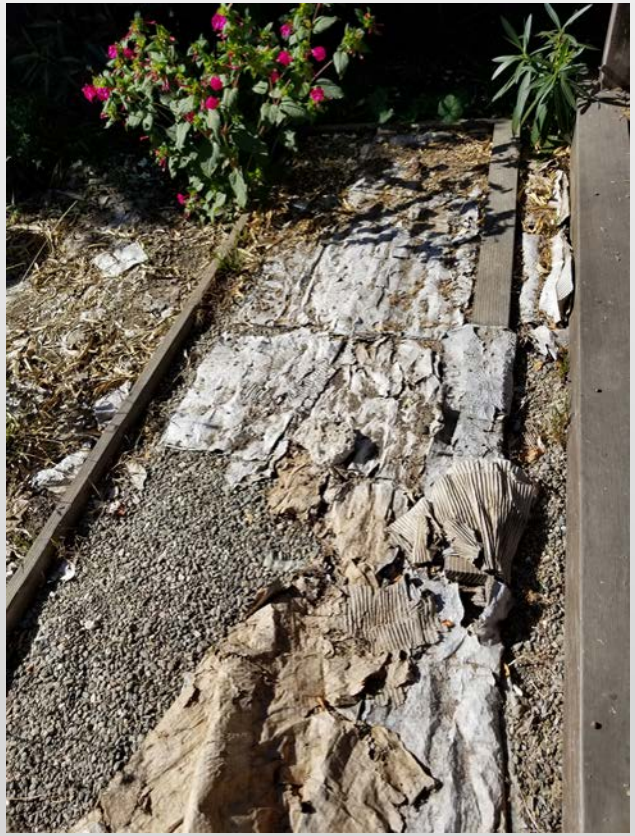
Primary Bedroom: 14

Son's Bedroom: 4

Living Room: 4

CASE STUDY #3-RESTCON ENVIRONMENTAL-SAN LEANDRO, CA

- Outdoor MSQPCR sampling performed identified the following:
  - 680 sp eq/mg dust of *Stachybotrys chartarum*
  - 750 sp eq/mg dust of *Penicillium brevicompactum*
  - 10,000 sp eq/mg dust of *Aureobasidium pullulans*
- *HERTSMI-2 Score 14 (just for fun)*



CASE STUDY #3-RESTCON ENVIRONMENTAL-SAN LEANDRO, CA

- Based on the outdoor levels of identified mold species, it was recommended to remove the cardboard from the backyard.
- Occupants also installed weed-cloth with decomposed granite or bark mulch.

CASE STUDY #3-RESTCON ENVIRONMENTAL-SAN LEANDRO, CA

- Follow-up Outdoor control sample was collected on March 24th, 2022 from various surfaces in the backyard.
- The results identified 4,400 sp eq/mg dust of *Stachybotrys chartarum*

CASE STUDY #3-RESTCON ENVIRONMENTAL-SAN LEANDRO, CA

- Possible explanations for outdoor findings:
  - New/existing source not yet identified (within or outside of client property)
  - Sampled outdoor surfaces reflect residual *Stachybotrys chartarum* from improvements in the client's backyard.
- Plans to continue monitoring outdoor levels and the effects of weather/rains in reduction of outdoor concentrations

MSQPCR SURFACE DUST SAMPLING *THE OUTDOOR ENVIRONMENT*

THE DATA.

Outdoor MSQPCR surface dust data has been well documented over the past 7 years.

Environmental Analytics & Restcon Environmental are the primary contributors of this data.

A total of 209 outdoor surface dust samples were collected throughout the United States:

- 104 AZ
- 82 CA
- 13 CO
- 10 other (CT, HI, ID, KY, MI, NY, TX)

MSQPCR SURFACE DUST SAMPLING *THE OUTDOOR ENVIRONMENT*

Outdoor Geometric Means

Group 1	GM Indoors AHHS I	GM Indoors AHHS II	GM Study Outdoors	Group 2	GM Indoors AHHS I	GM Indoors AHHS II	GM Study Outdoors
Aspergillus flavus	2	1	4	Acremonium strictum	4	7	3
Aspergillus fumigatus	3	2	10	Alternaria alternata	35	75	657
Aspergillus niger	4	18	90	Aspergillus ustus	2	2	3
Aspergillus ochraceus	2	3	4	Cladosporium cladosporiodes 1	331	892	3,635
Aspergillus penicilloides	91	140	5	Cladosporium cladosporiodes 2	4	13	173
Aspergillus restrictus	2	6	2	Cladosporium herbarum	31	180	1,367
Aspergillus sclerotiorum	2	2	1	Epicoccum nigrum	117	59	502
Aspergillus sydowii	3	6	1	Mucor racemosus	15	17	11
Aspergillus unguis	2	1	1	Penicillium chrysogenum	5	24	2
Aspergillus versicolor	2	14	3	Rhizopus stolonifer	1	2	6
Aureobasidium pullulans	263	335	5,955	n=	1096	694	209
Chaetomium globosum	2	3	1				
Cladosporium sphaerospermum	13	47	16				
Eurotium amstelodami	155	71	58				
Paecilomyces varioti	2	2	3				
Penicillium brevicompactum	5	6	12				
Penicillium corylophilum	2	4	3				
Penicillium crustosum	1	6	2				
Penicillium purpurogenum	1	1	2				
Penicillium spinulosum	1	1	3				
Penicillium variabile	3	6	2				
Scopulariopsis brevicaulis	2	2	2				
Scopulariopsis chartarum	2	3	4				
Stachybotrys chartarum	2	1	6				
Trichoderma viride	2	3	4				
Wallemia sebi	18	155	21				

MSQPCR SURFACE DUST SAMPLING *THE OUTDOOR ENVIRONMENT*

Outdoor Geometric Means by State

Group 1	STUDY GM Outdoors	STUDY GM AZ	STUDY GM CA	STUDY GM CO
Aspergillus flavus	4	5	3	1
Aspergillus fumigatus	10	3	56	5
Aspergillus niger	90	105	118	15
Aspergillus ochraceus	4	6	3	1
Aspergillus penicilloides	5	4	6	5
Aspergillus restrictus	2	1	2	1
Aspergillus sclerotiorum	1	1	1	1
Aspergillus sydowii	1	2	1	1
Aspergillus unguis	1	1	1	1
Aspergillus versicolor	3	2	6	4
Aureobasidium pullulans	5,955	3,435	11,615	3,333
Chaetomium globosum	1	1	2	1
Cladosporium sphaerospermum	16	2	175	2
Eurotium amstelodami	58	44	72	78
Paecilomyces varioti	3	1	6	2
Penicillium brevicompactum	12	2	110	6
Penicillium corylophilum	3	2	5	1
Penicillium crustosum	2	1	3	3
Penicillium purpurogenum	2	2	2	1
Penicillium spinulosum	3	1	10	1
Penicillium variabile	2	1	2	2
Scopulariopsis brevicaulis	2	2	3	2
Scopulariopsis chartarum	4	3	8	3
Stachybotrys chartarum	6	4	13	2
Trichoderma viride	4	1	21	2
Wallemia sebi	21	10	40	37

Group 2	STUDY GM Outdoors	STUDY GM AZ	STUDY GM CA	STUDY GM CO
Acremonium strictum	3	1	6	5
Alternaria alternata	657	1,105	313	635
Aspergillus ustus	3	4	2	1
Cladosporium cladosporiodes 1	3,635	823	21,934	1,717
Cladosporium cladosporiodes 2	173	11	6,273	18
Cladosporium herbarum	1,367	382	3,949	25,151
Epicoccum nigrum	502	69	3,854	1,532
Mucor racemosus	11	9	16	3
Penicillium chrysogenum	2	1	3	2
Rhizopus stolonifer	6	7	5	4
n=	209	104	82	13

MSQPCR SURFACE DUST SAMPLING *THE OUTDOOR ENVIRONMENT*

Outdoor Geometric Means by Season

Group 1	STUDY GM Outdoors	STUDY GM FALL	STUDY GM WINTER	STUDY GM SPRING	STUDY GM SUMMER
Aspergillus flavus	4	5	2	3	6
Aspergillus fumigatus	10	11	13	11	6
Aspergillus niger	90	105	81	77	101
Aspergillus ochraceus	4	4	3	5	4
Aspergillus penicilloides	5	10	7	3	4
Aspergillus restrictus	2	2	2	1	1
Aspergillus sclerotiorum	1	1	1	1	1
Aspergillus sydowii	1	2	1	1	2
Aspergillus unguis	1	1	1	1	1
Aspergillus versicolor	3	3	2	5	2
Aureobasidium pullulans	5,955	5,815	10,934	8,836	1,804
Chaetomium globosum	1	1	1	2	1
Cladosporium sphaerospermum	16	21	28	11	10
Eurotium amstelodami	58	69	93	42	41
Paecilomyces varioti	3	3	3	2	3
Penicillium brevicompactum	12	7	35	12	7
Penicillium corylophilum	3	2	5	4	2
Penicillium crustosum	2	2	3	2	1
Penicillium purpurogenum	2	2	2	1	1
Penicillium spinulosum	3	2	3	3	3
Penicillium variabile	2	2	2	2	1
Scopulariopsis brevicaulis	2	2	2	3	2
Scopulariopsis chartarum	4	4	4	7	3
Stachybotrys chartarum	6	6	6	13	3
Trichoderma viride	4	4	5	5	3
Wallemia sebi	21	33	23	21	11

Group 2	STUDY GM Outdoors	STUDY GM FALL	STUDY GM WINTER	STUDY GM SPRING	STUDY GM SUMMER
Acremonium strictum	3	6	3	2	2
Alternaria alternata	657	949	1,088	600	249
Aspergillus ustus	3	3	3	2	3
Cladosporium cladosporiodes 1	3,635	5,071	10,059	2,820	952
Cladosporium cladosporiodes 2	173	211	693	100	50
Cladosporium herbarum	1,367	1,497	2,277	2,158	371
Epicoccum nigrum	502	523	800	617	210
Mucor racemosus	11	12	10	9	13
Penicillium chrysogenum	2	2	3	2	1
Rhizopus stolonifer	6	8	5	4	4
n=	209	57	53	55	44

MSQPCR SURFACE DUST SAMPLING *THE OUTDOOR ENVIRONMENT*

Outdoor % Occurrence

Group 1	% Occur Indoors AHHS I	% Occur Indoors AHHS II	% Occur Outdoors Study	Group 2	% Occur Indoors AHHS I	% Occur Indoors AHHS II	% Occur Outdoors Study
Aspergillus flavus	35%	47%	49%	Acremonium strictum	57%	82%	34%
Aspergillus fumigatus	62%	70%	74%	Alternaria alternata	88%	100%	97%
Aspergillus niger	69%	97%	96%	Aspergillus ustus	40%	60%	45%
Aspergillus ochraceus	27%	74%	51%	Cladosporium cladosporiodes 1	99%	100%	100%
Aspergillus penicilloides	90%	99%	65%	Cladosporium cladosporiodes 2	70%	95%	95%
Aspergillus restrictus	12%	76%	21%	Cladosporium herbarum	84%	99%	100%
Aspergillus sclerotiorum	26%	54%	8%	Epicoccum nigrum	93%	98%	99%
Aspergillus sydowii	29%	6%	22%	Mucor racemosus	92%	97%	82%
Aspergillus unguis	20%	36%	8%	Penicillium chrysogenum	66%	95%	29%
Aspergillus versicolor	30%	70%	32%	Rhizopus stolonifer	29%	52%	66%
Aureobasidium pullulans	94%	100%	100%	n=	1096	694	209
Chaetomium globosum	51%	72%	11%				
Cladosporium sphaerospermum	82%	98%	68%				
Eurotium amstelodami	98%	100%	96%				
Paecilomyces varioti	46%	64%	33%				
Penicillium brevicompactum	52%	89%	64%				
Penicillium corylophilum	17%	68%	41%				
Penicillium crustosum	8%	63%	26%				
Penicillium purpurogenum	15%	25%	31%				
Penicillium spinulosum	20%	5%	15%				
Penicillium variabile	50%	87%	32%				
Scopulariopsis brevicaulis	53%	64%	37%				
Scopulariopsis chartarum	38%	75%	57%				
Stachybotrys chartarum	35%	38%	64%				
Trichoderma viride	27%	78%	42%				
Wallemia sebi	75%	100%	87%				

MSQPCR SURFACE DUST SAMPLING *THE OUTDOOR ENVIRONMENT*

Conclusions:

- Many Group 1 molds are well represented/present outdoors
  - Aspergillus niger (118 GM CA)
  - Aureobasidium pullulans (5,955 GM)
  - Eurotium amstelodami (78 GM in CO)
  - Wallemia sebi (40 GM in CA)

- And it's not just the "water-damage (Group 1)" molds we should be looking at!
  - Example: *Penicillium chrysogenum* (GM=2 in Outdoor Study). Despite being classified as a common outdoor mold (Group 2), it is a toxigenic mold commonly found growing in water damaged buildings

MSQPCR SURFACE DUST SAMPLING *THE OUTDOOR ENVIRONMENT*

Conclusions:

- Consider the following when interpreting indoor MSQPCR samples:
  - Regional differences will have an effect on indoor mycoflora present
  - Local sources (e.g., landscaping) can influence indoor results
  - Outdoor sampling can provide valuable data to help interpret indoor findings
  - We don't live in a bubble. Sample interpretation goes beyond the indoor numbers. In addition, visual and historic observations are a very important part of the interpretation process. **Knowledge and experience working with these types of samples are highly recommended.**

MSQPCR SURFACE DUST SAMPLING *THE OUTDOOR ENVIRONMENT*

Conclusions:

- Anecdotal evidence indicates that persons with CIRS-WDB can be affected by components of an outdoor environment and not just a water damaged building
  - Having data that indicates indoor exposure does not (necessarily) mean that the source/s are coming from indoors.
- Once exposure is suspected, the next step is to identify the source. Outdoor sampling can be an important tool to help interpret indoor environmental conditions.
- **FURTHER RESEARCH NEEDED:**
  - We are interested in continuing our research of the outdoor environment and it's influence on Indoor Environmental Quality.
  - Do you have patients who have had indoor remediation/cleaning but still show environmental mold sample results (or symptoms) that indicates unresolved exposure? (Assuming bacteria, TVOCs exposures are not suspected)
  - We are interested in more formally establishing this connection.
  - **How can we help you practice evidence-based medicine?**

MSQPCR SURFACE DUST SAMPLING *THE OUTDOOR ENVIRONMENT*

HOW TO SAMPLE OUTDOORS

Methods for sampling:

- Use nitrile gloves (can purchase at drug store or on Amazon) for the sampling. Wash gloved hands/dry before sampling.
- Sample using a dry (unscented) Swiffer cloth around the perimeter of the home, from ***man made objects*** that are undisturbed (avoid bushes, trees). Don't just sample from one location.
- Collect dust from 3 feet or higher from ground (unless a hypothesis suggests sampling from lower surfaces are warranted)
- Square footage to sample, if possible: For indoor samples we suggest 18 sq ft of surface area total per Swiffer cloth (think of 18 squares that are 1 square foot each). For outdoor samples, we want to make sure *enough* dust is collected, but also that the sample isn't overloaded with excessive amounts of dust. So use your best judgment for this process.

MSQPCR SURFACE DUST SAMPLING *THE OUTDOOR ENVIRONMENT*

HOW TO SAMPLE OUTDOORS

Examples of areas to sample from:

- Horizontal surfaces (e.g., glass/ceramic top patio table, solar panels, top of stainless steel barbeque (no rust, oxidation, grease), tops of gas/electrical boxes (no rust, oxidation), barbeque/furniture vinyl covers in good condition).

- If no horizontal surfaces consider vertical surfaces (e.g., vinyl cladding of building, vinyl window frames, window glass that is inoperable and that are ~10 ft away from operable windows/doors, tops/sides of vinyl fencing, etc.

Beware of sampling from surfaces with "flat" or "porous" paint, lead-based paint or other metal oxides (e.g., rust, copper/aluminum oxides), or clay - this may cause inhibition. Wipe a potential sample area with a gloved finger - you should not see any evidence of the above.

CONSIDERATION OF OUTDOOR MOLD LEVELS ("ERMI") WHEN EVALUATING INDOOR ENVIRONMENTAL CONDITIONS

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