Indoor study on fine particulates, mould and damp in vulnerable Welsh homes

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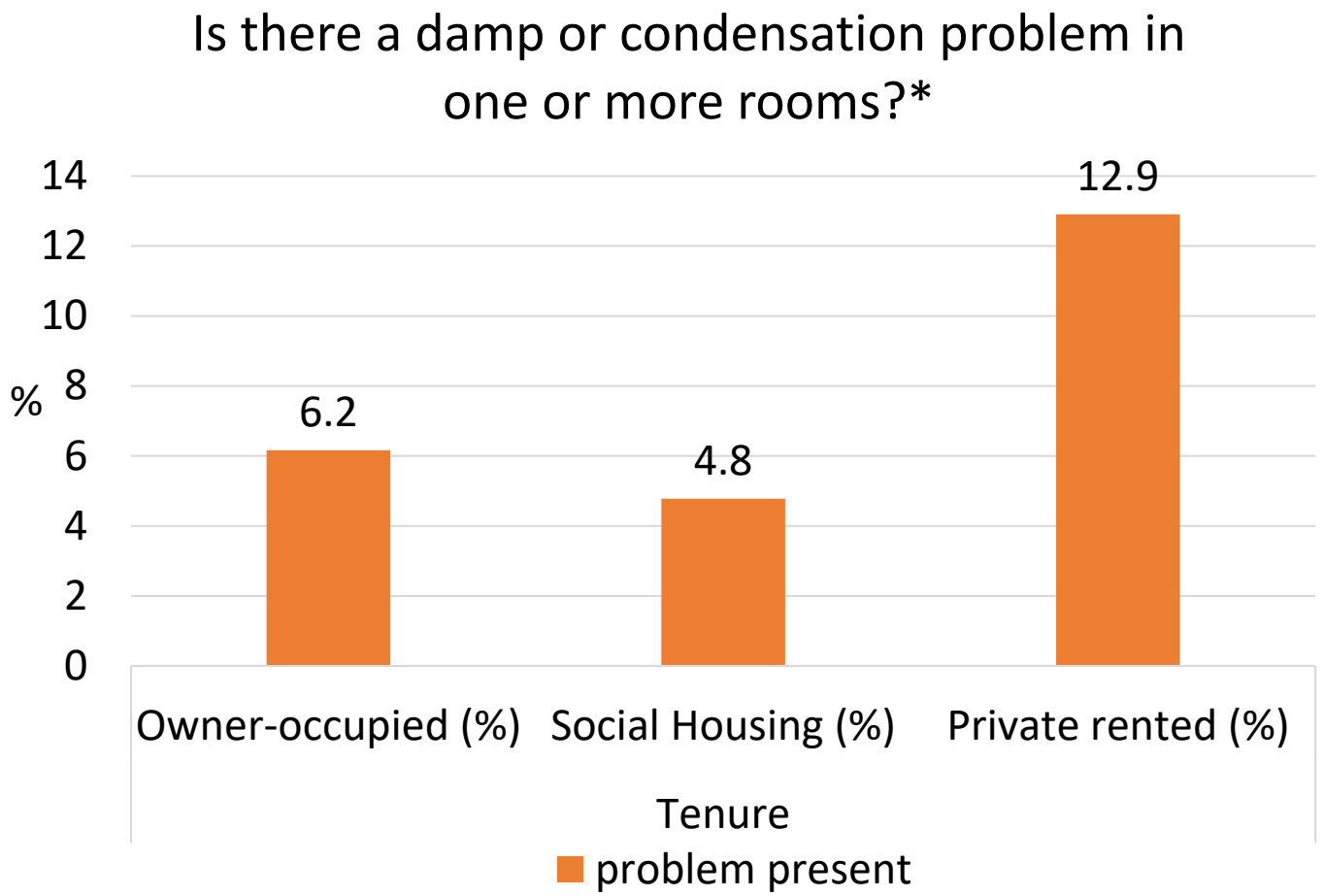
The vulnerable group - Cystic Fibrosis patient

- Cystic Fibrosis (CF) is the most common inherited diseases. More than 59% of CF patients are sensitive to **fungal spores**, mostly Aspergillus fumigatus
- Average survival in the UK is 41 years (Cystic fibrosis Registry)
- Average annual cost for a CF patient in the UK was €48,603 in 2012, including 57% for non-health care and indirect costs (https://doi.org/10.1186/s12913-015-1061-3)
- Respiratory disease costs £11.1 billion each year (2014, 0.6% UK GDP) (British Lung Foundation)
- Damp and mould are more likely to cause respiratory problems
- **Will improved indoor environment potentially reduce mould/damp and reduce the exposure to fungus?**

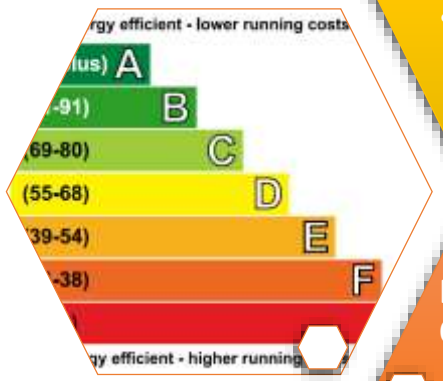
Damp and mould - a common problem in Wales

- Welsh Housing Conditions Survey 2017-18: 7% of homes have a damp or condensation
- English Housing Survey: 4% of homes (897,000 dwellings) had problems with damp (via physical survey)
- Around 7.0 million (30%) households reported an issue with condensation, damp or mould (EHS 2017)



*Source: National Survey for Wales, 2017-18. Sample size: 2,550

The multidisciplinary approach



Photographic Survey

- Photos
- Possible causes

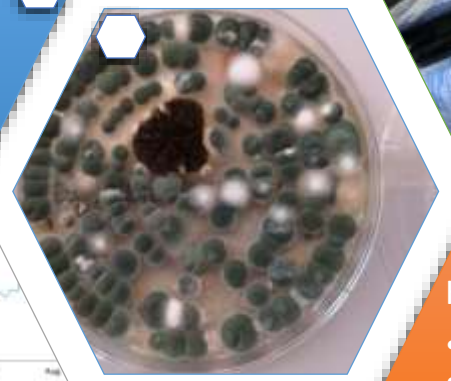
Indoor Environment

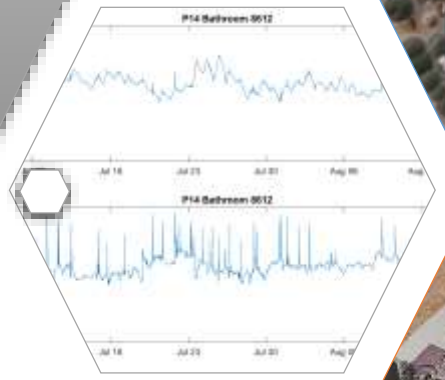
- Air quality measurement
- Temperature/RH monitoring

Microbiology Evidence

- Mould/damp/Air examples
- Microscopic observations

Clinical Evidence





Building and Occupancy

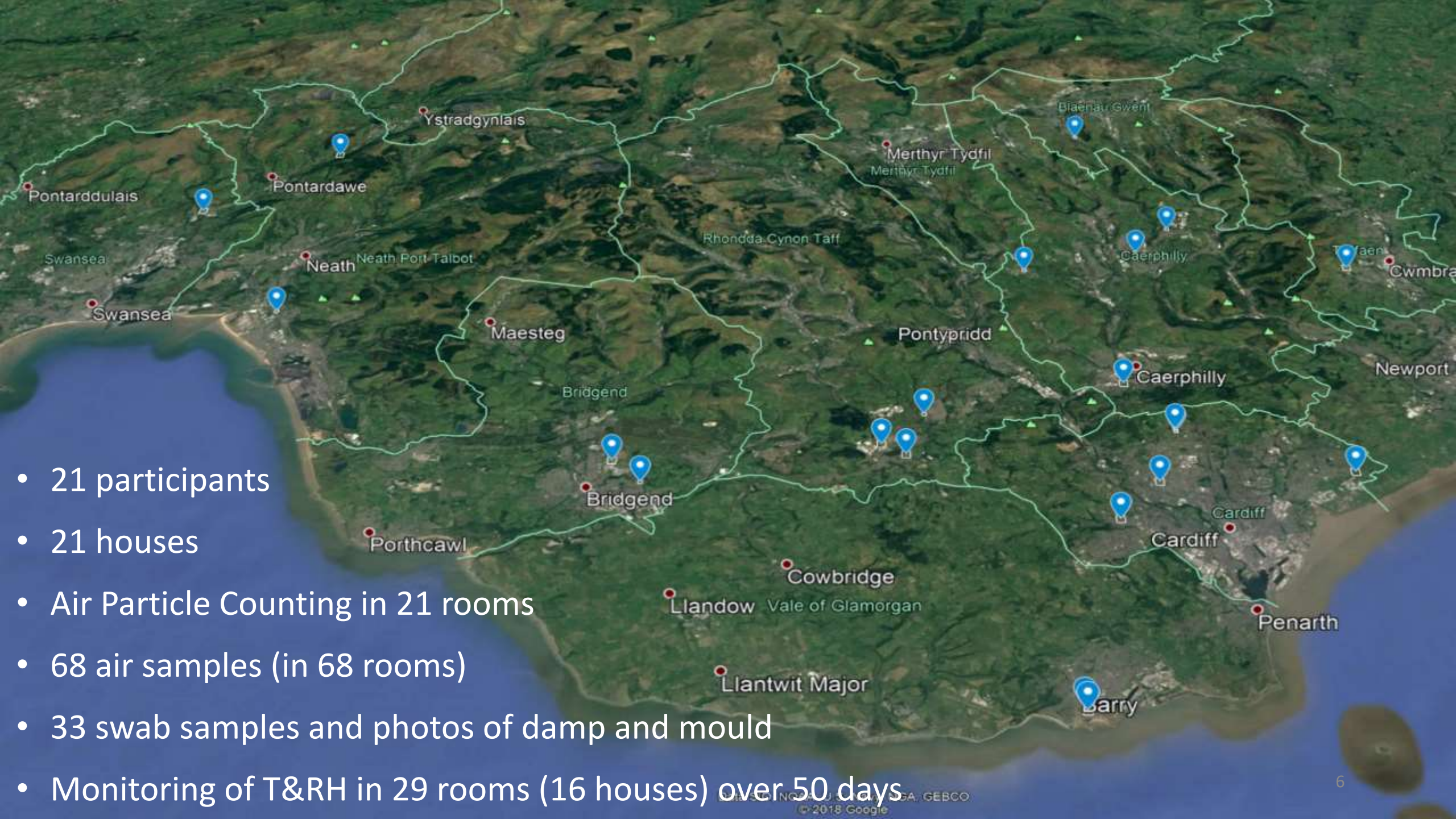
- Building information (EPC)
- Occupants survey (Questionnaire)

Health Cost

- SAIL
- Medical records

Project Timeline

- **Award letter** (10/2017)
- Project starts (12/2017)
- Grant joint award agreement (03/2018)
- SAIL IGRP approval (05/2018)
- Sponsor Approval (07/2018)
- IRAS ethical approval (10/2018)
- HRA and HCRW Approval (11/2018)
- Capacity and capability assessment(02/2019)
- DBS checks (01/2019)
- Occupational health check (01/2019)
- Material transfer agreement (02/2019)
- Letter of Access (02/2019)
- Portfolio listing (03/2019)
- Amendment for extension (04/2019)
- Recruitment (04/2019-10/2019)
- **Field visits and data collection** (06/2019-11/2019)
- **Data analysis** (12/2019-01/2020)
- Project event (01/2020)
- **Final report to the funder** (02/2020)
- Publications (03/2020 onward)



- 21 participants
- 21 houses
- Air Particle Counting in 21 rooms
- 68 air samples (in 68 rooms)
- 33 swab samples and photos of damp and mould
- Monitoring of T&RH in 29 rooms (16 houses) over 50 days

Cystic Fibrosis patient Cost Analysis

In **2017**

Total cost of **21** patients **£558,339***

On **average** **£26,588***

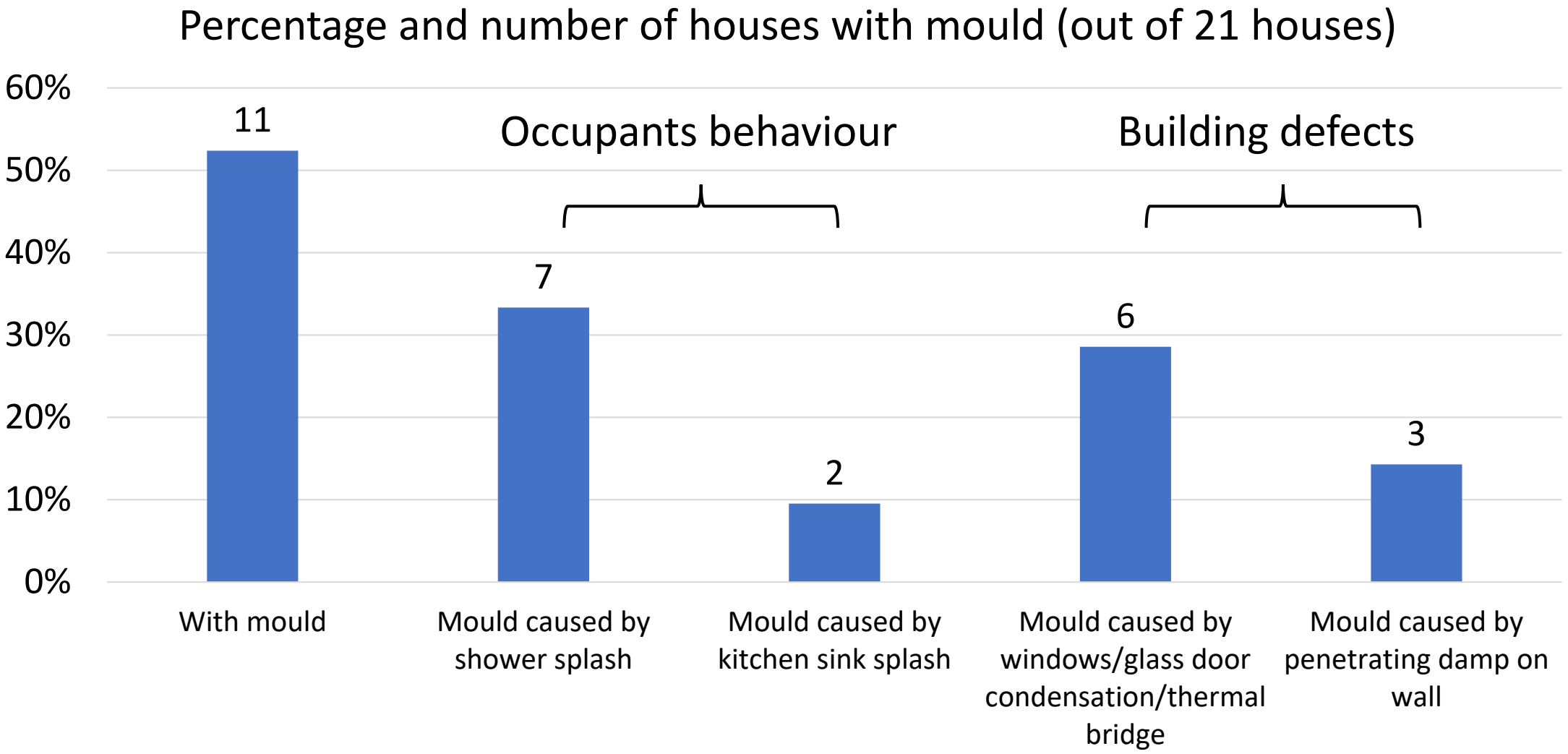
***Direct health care costs** from SAIL database only, not include nurse consultations, out-of-hour service, pathology tests (blood, urine..), non-GP prescriptions, admission costs, non-health care and indirect costs

Band	Costing of patient care	Number of recruited patients (21 in total)	Weighted average cost
1	£2418.93	2	
2	£7325.01	8	
3	£15252.34	8	£13,704.37
4	£34111.68	3	
5	£49915.22	0	

Cost of preventing mould and damp

Measures	Costs
• Replace/repair building defects (windows/wall/roof)	High £2k and above
• Clean or repair roof gutters • Mould-resistant paints • Installation of high-end dehumidifier • Installation of ventilation unit with humidity sensor	Medium £2k to £200
• Display/monitor humidity indoors • Mop/dry wet surface/floor • Open windows to improve air flow when necessary • Keep mould off household plants • Installation of dehumidifier for mould • Regular cleaning	Low/none £200 and below

Damp and mould - results from our visits



Over 50% of houses have mould, significantly higher than 30% from EHS.

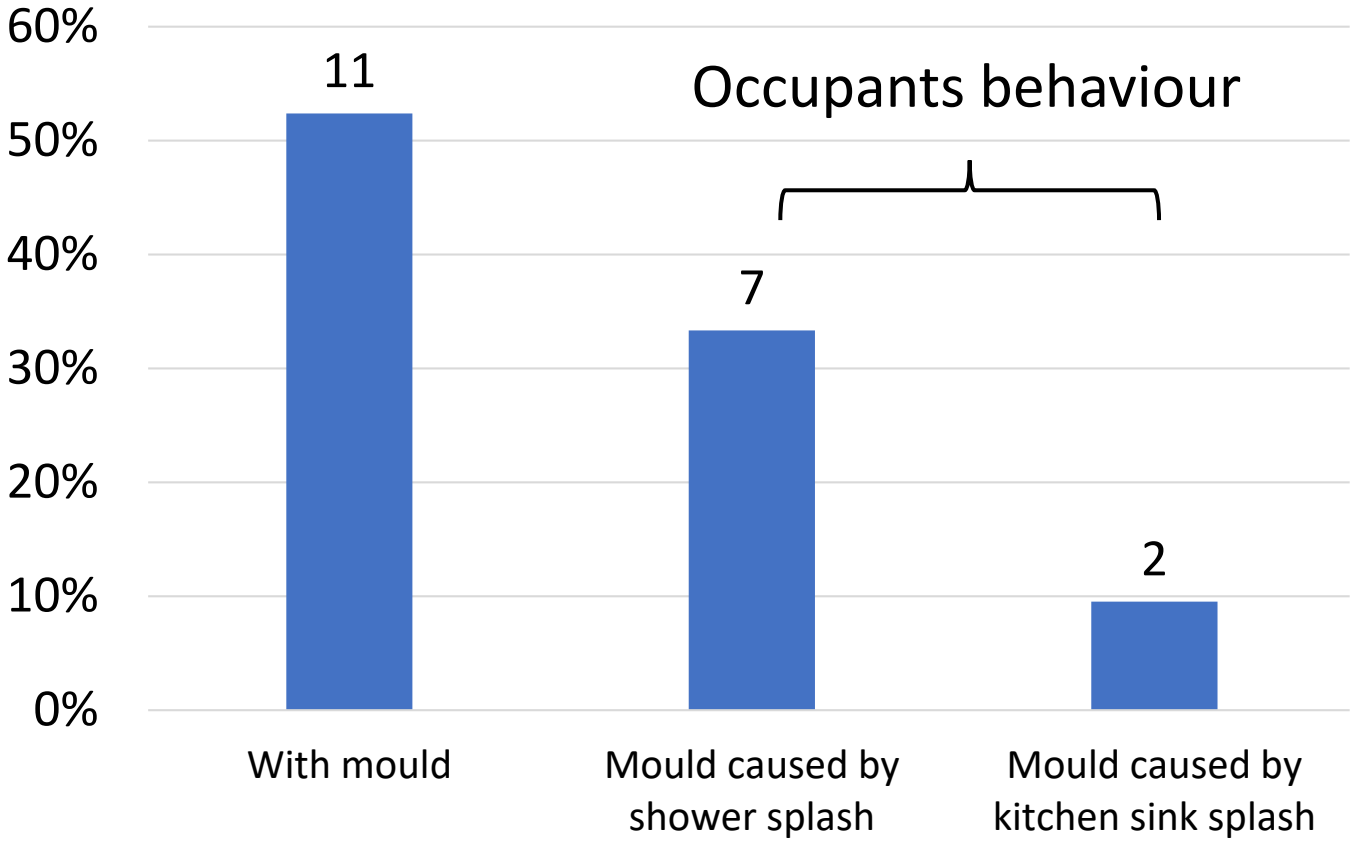
Damp and Energy Performance Certificates (EPC)

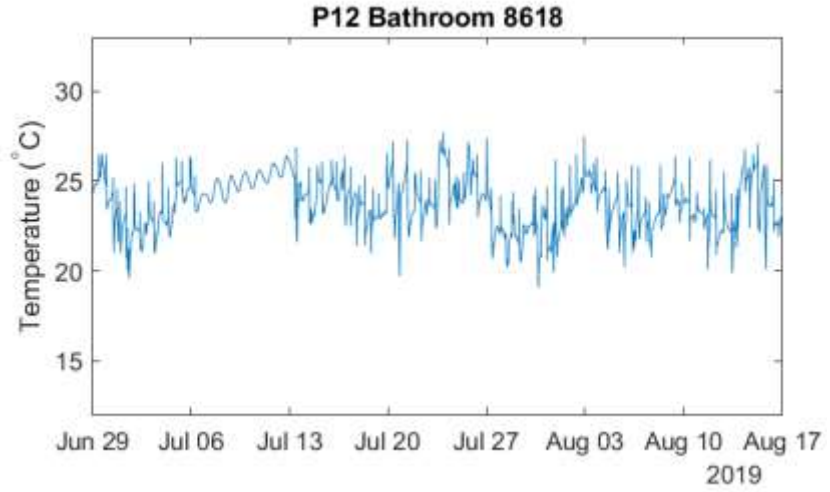
EPC Grade	EPC rating	Damp due to building envelope
B	86	
	82	
	82	
C	80	
	74	
	72	Y
	72	Y
	71	Y
	71 (10 yrs ago)	
D	68	
	68	
	63	
	59	Y
	58	Y
	57	Y
E	43 (10 yrs ago)	

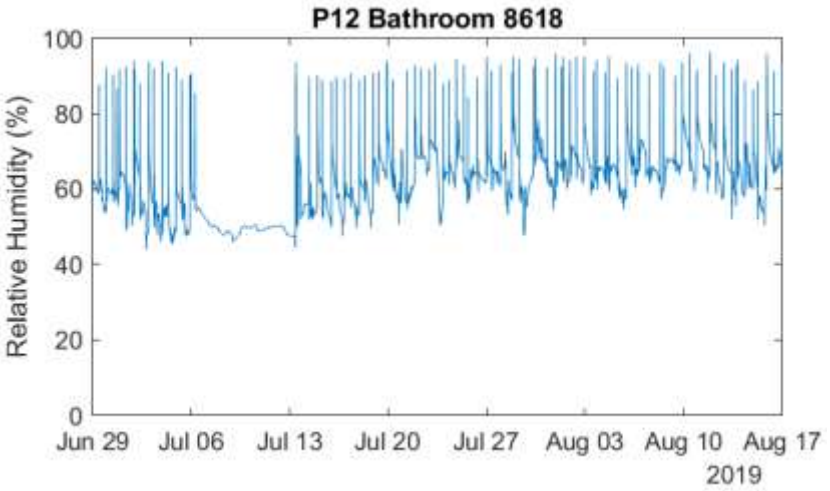
The lower EPC rating, more likely to have damp due to building envelope defects.

Damp and mould - results from our visits

Percentage and number of houses with mould (out of 21 houses)







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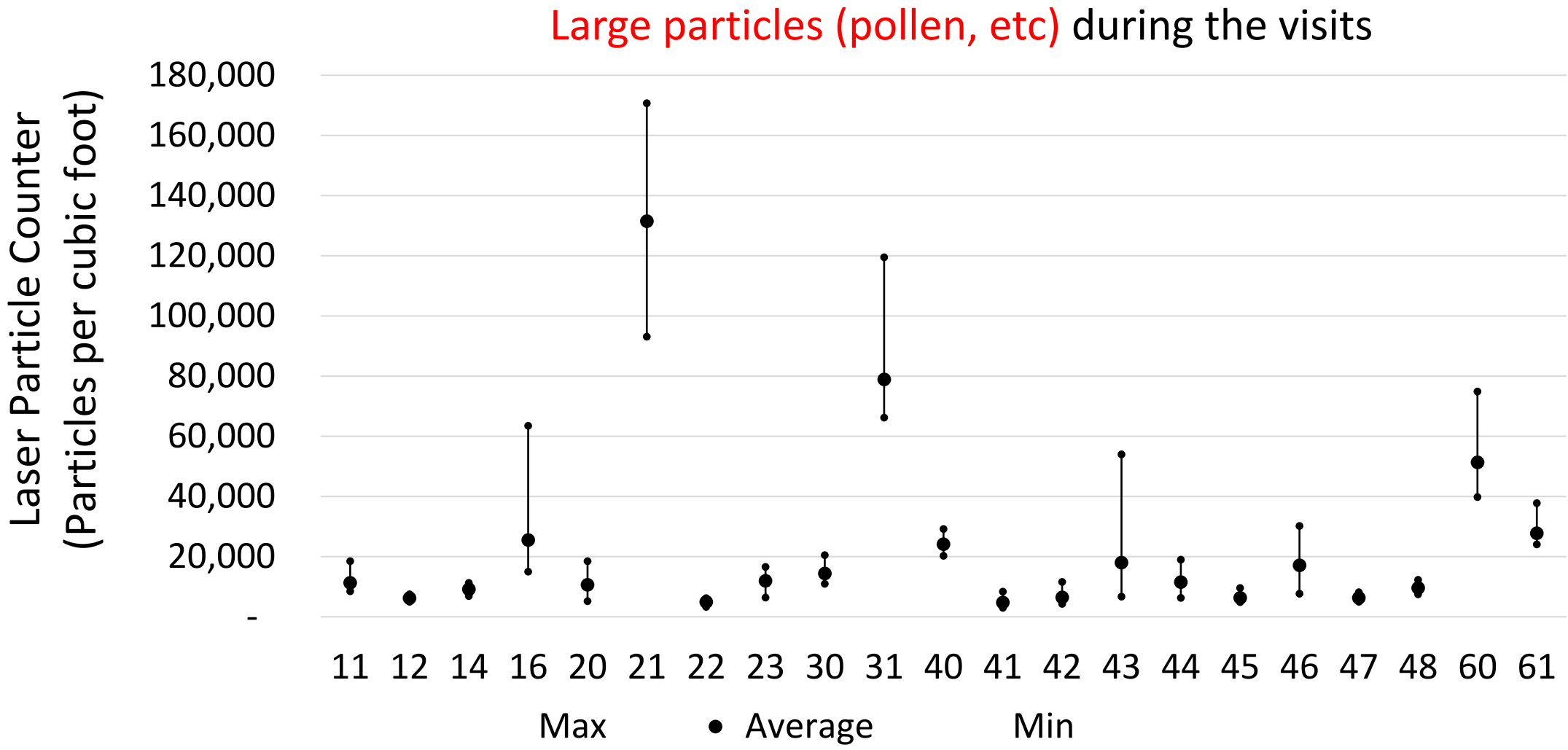
Air quality monitoring



16, 21, 31, 43 and 60 have higher values than others

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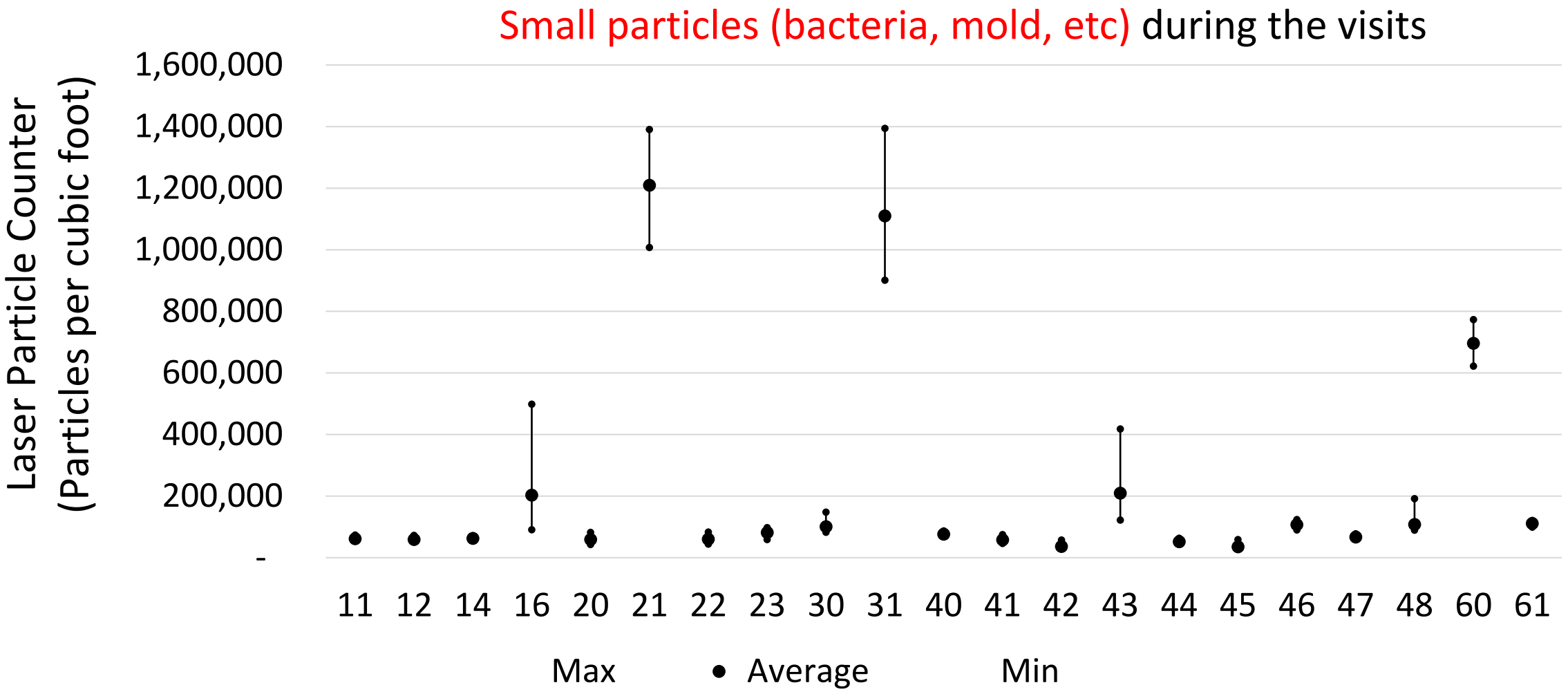

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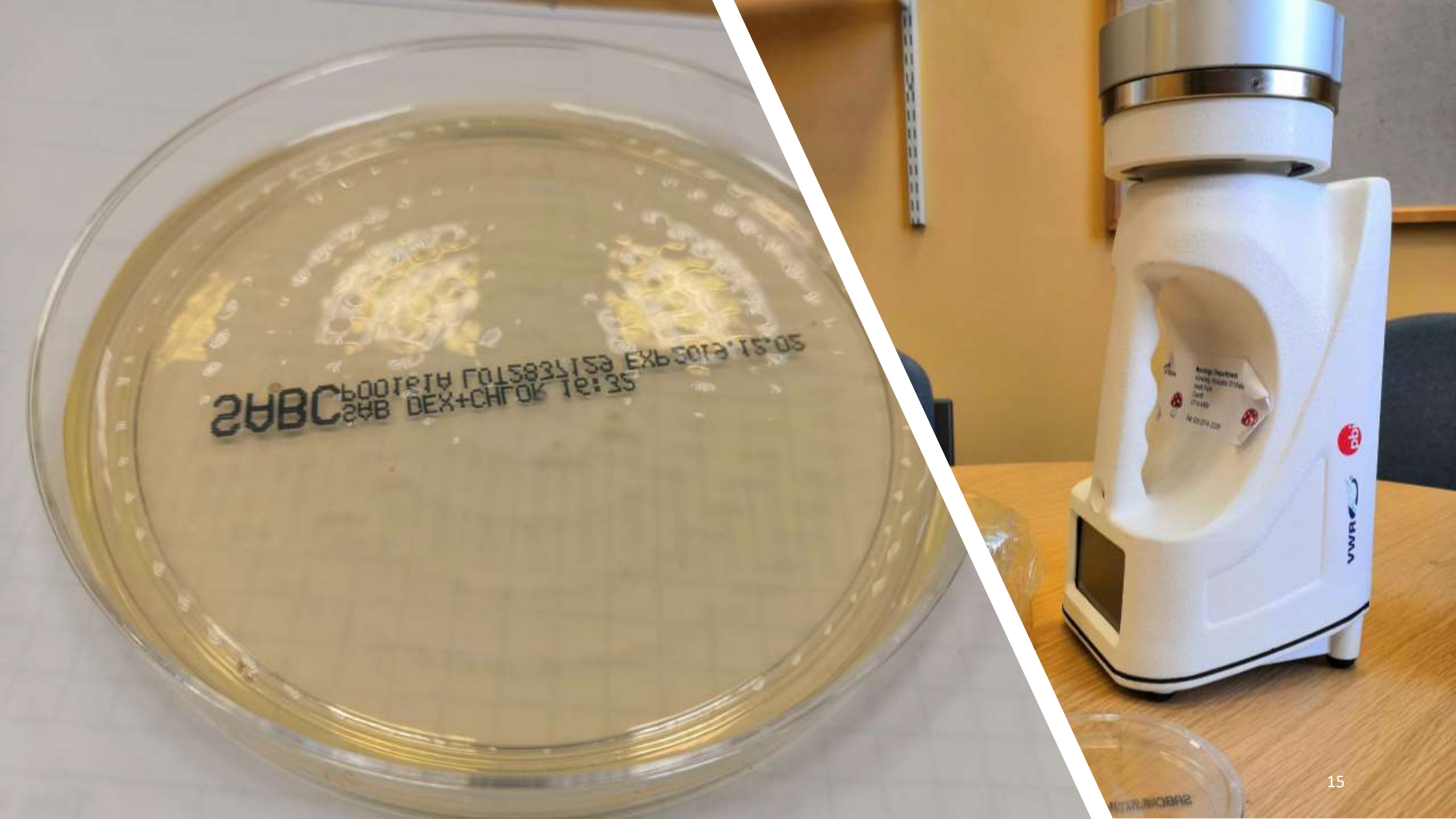
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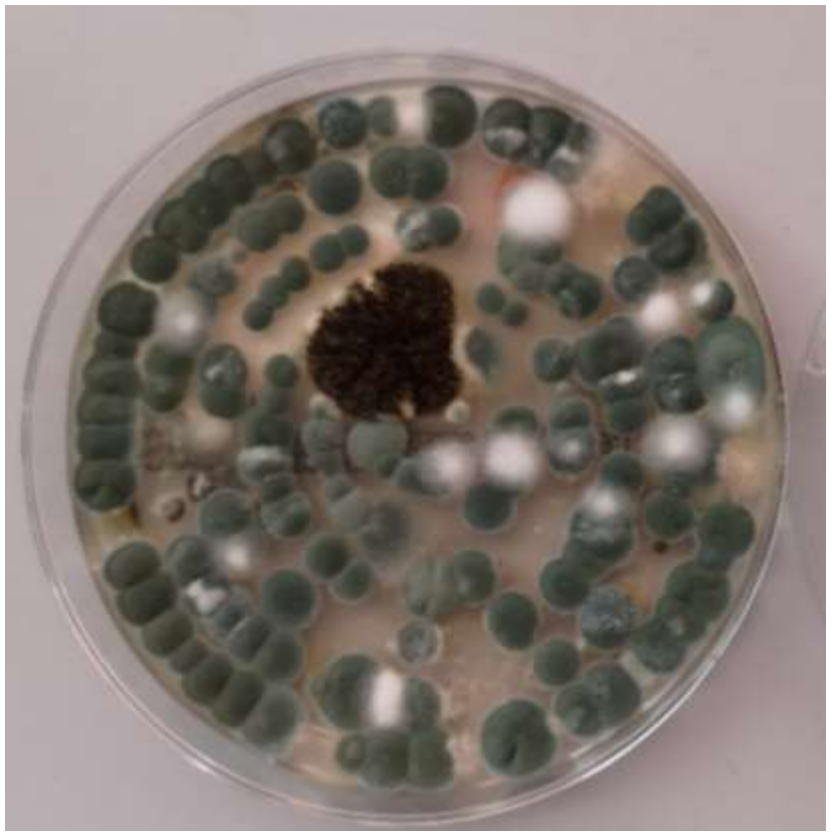
Source: American Society for Microbiology https://www.instagram.com/asmicrobiology/

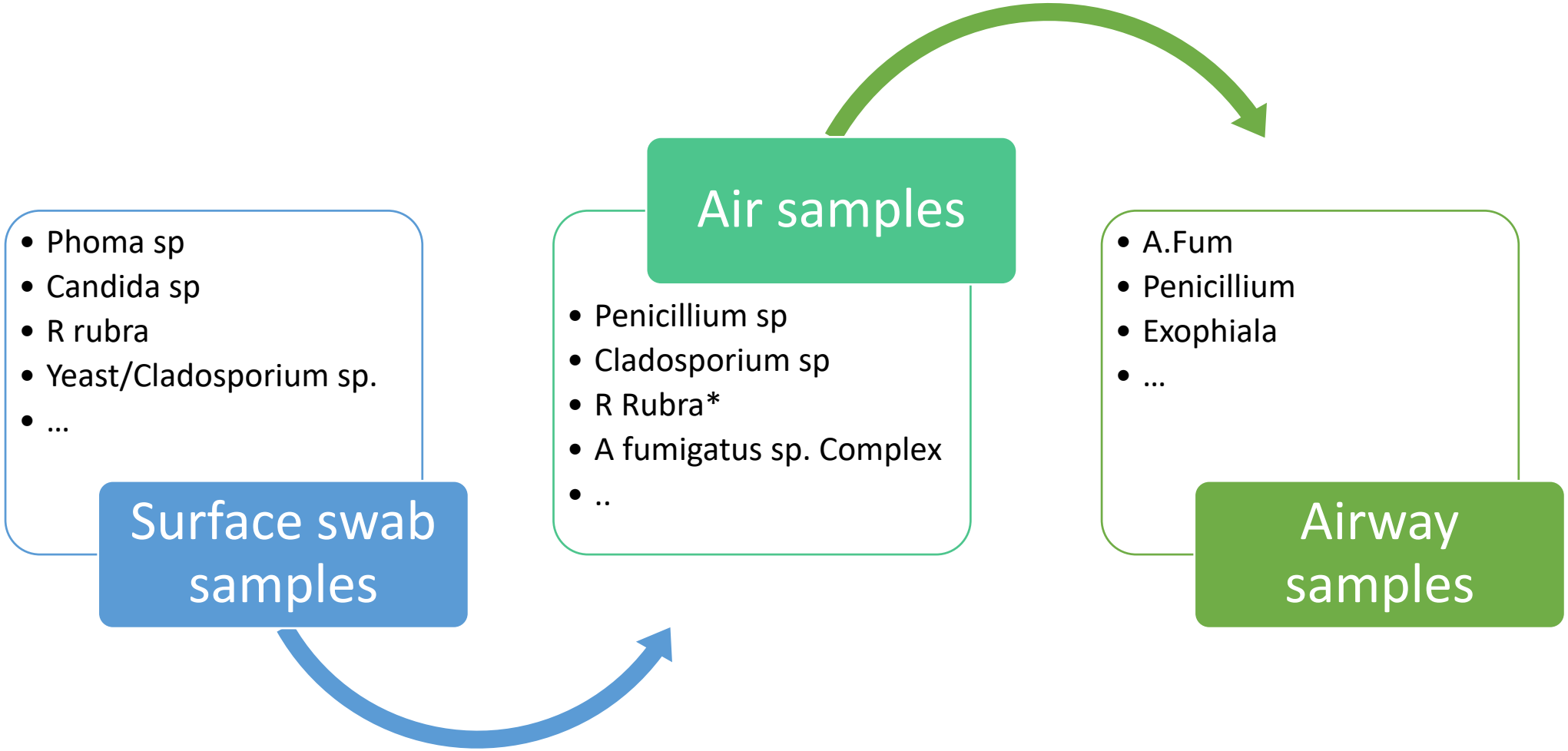
At Collection

At 48 hours



At 72 hours

Fungi grow and clinical test results



Mould/damp swab and agar plates results

	Air samples	Swab samples
Total number of samples taken	**68**	**33**
Total number of organisms isolated	**229**	**90**
Predominant organism isolated	**Penicillium sp.**	**No**

- All samples contained **more than one** organism; some have seven to eight different organisms according to phenotype study.
- **Penicillium sp.** and **Aspergillus fumigatus sp.** complex were the only isolates that were isolated from both air and swab samples.
- **Both** of them are prolific spore producers and have been **implicated** in either human allergic response or disease.

Final thoughts

- This study has a small number of participants
- It is a descriptive study
- No intervention
- Fungal presence as an indicator of building performance
- Fungi linked to relative humidity (should be below 75%)
- What is the acceptable airborne spores levels at …
  - home setting (e.g. 500 Colony Forming Units cfu/m3 when dry)
  - Vs. the clinically setting (<15cfu/m3),
- Patient are well looked after in hospitals. What about patients at home?

The Knowledge Economy Skills Scholarships (KESS) PhD project: Domestic ventilation technologies to improve air quality and reduce health risks (2019-2022)

- Analyse current practice of domestic ventilation technologies and strategies
- Gather monitoring data and establish validated CFD models to quantify the effectiveness of common ventilation technologies
- Develop optimal low carbon ventilation strategies for domestic buildings in the UK with the goal of good air quality and low energy consumption

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With special thanks to the team

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Swansea University	Professor Gwyneth Davies, Clinical Deputy Head Professor Deborah Fitzsimmons, Personal Chair in Public Health Dr Mohammad Al Sallakh, Researcher Professor Paul Lewis, Director of CHEMRI

“Good housing pays for itself over time. Provide better housing and you will need less hospitals!”

NHS Director of Sustainability