Sick Building Syndrome

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Overview

• Sick Building Syndrome – what is it?
• What causes it?
• Why is it important?
• SBS vs. building related illness.
• The role of moulds in building related illness.
• How to investigate it.
• What to do about it.
Sick Building Syndrome – what is it?

- SBS – ‘a group of symptoms of unclear aetiology’ (Burge, 2004) divided into:
  - Mucous membrane symptoms related to eyes, nose & throat;
  - Dry skin;
  - General symptoms of headache and lethargy.

- Common in general population – what makes them part of SBS is temporal relation with work in particular building.

- Most should improve within hours of leaving the problem building.
SBS – where does it happen?

- Most clearly recognised in office environment.
- Similar problems could occur in schools, hospitals, care homes.
- Indoor air problems in domestic dwellings, esp. associated with water damage (Nordic countries’ definition).
SBS symptom questionnaire

• In the past 12 months have you had >2 episodes of:
  – Itchy or watery eyes;
  – Blocked or stuffy nose;
  – Runny nose;
  – Dry throat;
  – Lethargy and/or tiredness;
  – Headache;
  – Dry, itchy or irritated skin.

• If ‘yes’, was it better on days away from office?

(Raw, 1995)
Factors related to increased prevalence of SBS

• Personal factors:
  – Female gender; Lower status in organisation/menial job.

• Individual factors:
  – Paper dust; cigarette smoke; office dust; more use of computers.

• Building factors:
  – High indoor temp.; low fresh air ventilation; poor individual control of temp. and lighting; air conditioning; poor maintenance; poor cleaning; water damage.
The ‘Whitehall II’ SBS study

• Ongoing health survey of office based civil servants - longitudinal study of 10,308 m+f aged 35-55 at baseline.

• Self-report questionnaire 10 symptoms:
  – Headache; cough; dry eyes; blocked/runny nose; tired for no reason; rashes/itches; cold/flu; dry throat; sore throat; wheeziness.

• 4052 participants (42-62 yrs, m+f) in 44 buildings.

(Marmot et al, 2006)
‘Whitehall’ SBS study – key findings

• 25% of men and 15% of women reported no symptoms; but 14%/19% reported 5+.
• Physical environment had less effect than psychosocial work environment – including airborne fungi against ‘acceptable limit’ of 500 cfu/m³ and bacteria of 1000 cfu/m³.
• Control over local workstation related to lower reported symptoms.
SBS and mould exposure

• No clear evidence that SBS is linked with mould exposure.

• However – building related disease:
  – Infectious disease associated with building services (e.g., Legionella);
  – Disease from worker to worker;
  – Toxic reaction to chemicals in building;
  – Fungi, bacteria or their toxins present in buildings.
Mould exposure in buildings – why is it important?

• More extensively researched in USA – more problem there or more aware?
• 4345 adult residents surveyed – association between dampness, air conditioning & respiratory ill health.
• Significant positive association between workplace dampness and sick leave with respiratory symptoms.
• Estimated cost burden of US$1.4 billion.

(Sahakian et al, Indoor Air Feb 2009).
Factors and causes of mould exposure in buildings

No surprises here:

• Food – construction materials, furnishings.

• Water – high humidity (>60% RH).

• Warmth.

Exacerbated by:

• Inadequate ventilation; poor maintenance; water intrusion; HVAC systems.
Mould contamination in buildings – examples

- Evidence of fungal growth in HVAC condensate drain pan

(Image courtesy CDC NIOSH)
Mould contamination in buildings – examples

- Fungal growth following roof leak.
- Fungal growth under carpet

(Images courtesy CDC NIOSH)
Mould contamination in buildings – examples

• Behind wallpaper

• Undiscovered roof leak

(Images courtesy CDC NIOSH)
Mould contamination in buildings – examples

- Water damage on suspended ceiling panels
- Mould growth behind panels.

(Images courtesy CDC NIOSH)
Flood damage and mould contamination in buildings

• Sheffield floods 2007.
• Government buildings flooded – personal documents from members public affected.
• Cannot discard – how to retrieve, remediate and recover?
• Lack of generally available information.
• HSL provided practical advice.
Flood damage and mould contamination in buildings

- Mould damaged dwelling after Hurricane Katrina

(Image courtesy CDC NIOSH)
Guidelines for reducing mould exposure in building – when to act?

• US OSHA - >1,000 cfu/m$^3$ = probable contamination source.

• EC - >500 cfu/m$^3$ = intermediate; >2,000 cfu/m$^3$ = high.

• Investigation & remediation >500 cfu/m$^3$ and health complaints.

• Not just based on numbers, but predominant taxa.
Prevention measures to reduce potential for mould in new buildings

- Minimise exposure of interior building products to exterior.
- Monitor & maintain integrity of building impermeable envelope.
- Check material delivered clean & dry – reject wet or mouldy material.
- Protect stored material from moisture; prevent spillage of water; minimise moisture accumulation; balance control of thermal comfort & humidity.

(European Risk Observatory Report, 2007)
Remediation of mould problems in existing buildings – assessing the problem

- Walk-through inspection – premises including HVAC system.
- History of water damage.
- Temperature, humidity, air movement.
- Visible mould, mould odours.
- Hidden mould (intrusive inspection behind wallpaper/panels, under carpets, in ceiling or wall cavities).
- Air, surface sampling.

Air sampling for mould exposure in buildings

- Agar plate impaction;
- Filtration.
Other assessment methods for mouldy buildings

• Smoke pencil – air movement

• Checking moisture levels
Mould problems in buildings – the culprits

Gravesen et al, 1997:

- Penicillium 68%
- Aspergillus 56%
- Chaetomium 22%
- Ulocladium 21%
- Stachybotrys 19%
- Acremonium 14%
- Mucor 14%
- Paecilomyces 10%
- Alternaria 8%
- Verticillium 8%
- Trichoderma 7%

Highly recommended reading (soon to be revised 2nd edition)
Actions to remediate mould problems in buildings

- Remove people from exposure.
- Identify and fix the underlying problem.
- Remove affected material – protect remediation workers from exposure and minimise spread of contamination.
- Chemically treat remaining materials if possible.
Conclusions

• SBS – no evidence of microbial involvement. However…..
• Building related illnesses associated with mould exposure.
• Poor maintenance or water damage → mould → health problems → social & economic cost.
• Monitoring reveals wide range of species.
• Aggressive remediation needed to prevent continued problems.
Other recommended reading

• US Institute of Medicine Committee on Damp Indoor Spaces and Health, 2004: http://www.nap.edu/openbook.php?isbn=0309091934