



Submission for Inquiry into Biotxin-related Illnesses in Australia

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Introduction

The Australasian Society of Building Biologists (ASBB) is a group of building biologists involved in the evaluation and control of health hazards in the built environment. A significant proportion of our clients are living and working in water-damaged buildings (WDB), and we have noticed a consistent correlation between visible mould, damp/musty odour and a history of water damage, with various adverse health effects ranging from asthma and allergies to recurrent colds and flus and chronic fatiguing illnesses. This is in line with a growing body of evidence in the scientific literature, some of which is provided in this submission. A significant proportion of the work conducted by building biologists involves investigating WDB and almost half (46%) of our clientele have either been diagnosed with Chronic Inflammatory Response or alleged to have this condition.

There are systematic failures across multiple industries that appear to be exposing a significant proportion of the Australian population to biotoxins. We are deeply concerned by the number of clients in rental and/or public housing who are at the mercy of their landlords and/or property manager who ignore their tenants concerns about mould, and fail to act despite serious health consequences experienced by some of these tenants and their children following exposures to biotoxins in a WDB. Most of these people do not have the financial resources to take this to court. In addition, we frequently find problems with the way water damage is dealt with by insurance companies and restorers, and are concerned by the use of fogging, spraying and gassing of water-damaged buildings which only provides a band-aid approach to this complex issue. Furthermore, the building and construction industry are inadvertently putting themselves and the home occupants at risk when they expose hidden mold during renovations because of their lack of knowledge and skills in psychrometry, water damage and biotoxin exposure. Finally, we have observed that water damage may have serious implications on the structural integrity of a home, increased risk to pest infestations such as termites and, in some circumstances impact its energy efficiency.

The ASBB holds a position that occupants have a right to live in a dwelling that does not adversely impact their health. We also believe that property developers and landlords have a duty of care to disclose the history of water damage at a property to enable occupants who are at risk of health effects, to make an informed choice prior to signing a lease especially if they suffer from asthma, allergies, chronic fatiguing illness, have young children or are immunocompromised. This submission will provide our experience as building biologists auditing water-damaged homes, sources of moisture ingress, adverse health effects frequently observed in our clientele and research opportunities.

The Building Biology Industry in Australia

Building biology is the evaluation and control of health hazards in the built environment from allergens, toxicants and electromagnetic fields to biotoxins unique to a water-damaged building (WDB), with the aim to provide strategies to address exposure and/or source control and abatement.

The ASBB is a group of building biologists established in 2006 who have undertaken nationally accredited training (Advanced Diploma of Building Biology 10194NAT) through the Australian College of Environmental Studies (RTO 21740). ACES is the only registered training organisation offering nationally accredited training in Mould Testing (BLDBIO605 Conduct a mould assessment) in Australia. The industry was established in the early 2000s following a growing body of evidence correlating adverse health effects like asthma, allergies and chronic fatiguing illnesses with hazards in the home (Bijlsma, 2018).

The Australian College of Environmental Studies has noticed a steady increase in enrolments in the Building Biology course from Australia and abroad since 2005 (73 graduates and 69 currently enrolled) and a significant increase in the number of tradespersons in the building and construction industry who are enrolling in the Mould Testing subject. The ASBB currently has 44 members, which service most parts of Australia except the Northern Territory and Tasmania.

A building biologist is an indoor environmental consultant who is trained to identify and address health hazards unique to the built environment. This involves the knowledge and the skills to undertake a comprehensive exposure history, conduct a thorough site inspection, establish and test a hypothesis for hazards unique to that home, use technical equipment to conduct sampling of air, surface and dust, analyse laboratory results and coordinate and liaise with various professionals. Our work involves networking with various tradespersons like plumbers and builders as well as various professionals like hydrologists and other drainage experts, waterproof membrane experts, industrial hygienists, HVAC (heating, ventilation and air conditioning) consultants, IICRC accredited mould remediators, laboratory technicians and integrative clinicians familiar with environmental sensitivities (of which there are very few!).

Terms of reference 1: The prevalence and geographic distribution of biotoxin-related illnesses in Australia, particularly related to water-damaged buildings.

Terms of reference 2: The prevalence of Chronic Inflammatory Response Syndrome (CIRS) or biotoxin related illness in Australian patients and the treatment available to them.

Terms of reference 4: Any intersection with other chronic diseases

In the past five years, we have noticed a significant increase in the demand for our services especially in relation to conducting audits of water-damaged buildings (WDB). A recent survey of our members revealed that 65% of our work involves investigating biotoxin exposure arising from a WDB with some members devoting their entire business to this issue. The survey revealed that water-damaged homes were not specific to any architectural style or building construction method and in fact, there was an even spread

of water damaged homes regardless of the age of the home (new homes for example accounted for 13% of the homes investigated).

As an industry we have noticed a consistent correlation between visible mould, damp/musty odour and a history of water damage, with various adverse health effects in the occupants ranging from asthma and allergies (hayfever, sinusitis, rhinitis, bronchitis, eczema) to recurrent colds and flus and chronic fatiguing illnesses. Our survey identified almost half (46%) of the building biology clients in a WDB have either been diagnosed with Chronic Inflammatory Response or alleged to have this condition, even though only 6% of our clientele are referred by an integrative medical practitioner. It is important to note that part of the nationally accredited training requires the building biologist to take an extensive exposure history to identify potential health hazards in the built environment prior to formulating a hypothesis, conducting a site inspection or undertaking sampling.

Whilst the prevalence and geographic distribution of dampness in homes in Australia has not been established, a 2015 survey conducted by the Australian Building Codes Board identified one third of new builds were affected by condensation (ABCB, 2016) and the World Health Organisation estimates that between 10 to 50% of buildings in Australia maybe affected by dampness (Anderson et al 2011). This is consistent with research published by architectural scientists who demonstrated a substantial increase in condensation problems in new builds in the cooler temperate climates of Australia (Dewsbury et al, 2016). Archicentre Australia (2016) acknowledged that mould is frequently found in pre-purchase house assessments particularly in older houses, as well as new apartments that lacked adequate ventilation in wet areas. Clearly a nationwide survey to identify the prevalence and geographic distribution of dampness in Australian homes is warranted.

Whilst we acknowledge that we are not clinicians who diagnose diseases, we frequently work with clinicians to identify health hazards in the occupant's home. Water-damaged buildings contain a 'chemical stew' of airborne bioaerosols such as actinomycetes, lipopolysaccharides (LPS), bacteria, fungi and their by-products (endotoxins, mycotoxins); ultrafine particles; microbial volatile organic compounds; cell fragments; and inflammagens such as beta glucans, mannans, hemolysins and proteinases (Thrasher & Crawley, 2009; Tang et al, 2012; Shoemaker et al, 2013). This makes it extremely difficult to determine what people in a water-damaged building react to. Is it the mould and their by-products, or the gram-negative bacteria and their endotoxins, or microbial chemicals, particulates, or house dust mites and pests like cockroaches, rodents and termites which will be attracted to a water-damaged property? All of these may of their own accord contribute to adverse health effects, and research into this field is required. Nonetheless, it has long been established that the adverse health effects arising from exposure to dampness results in lung and skin problems like asthma, bronchitis, cold and flu-like symptoms, hay fever, pneumonia and eczema (Antova et al, 2008; Fisk et al, 2010; Mendell et al, 2011; Park & Cox-Ganser, 2011). This is a concern in light of the fact that Australia has one of the highest incidences of asthma in western countries (ASCIA, 2014). Furthermore, between one quarter to one-third of the respiratory health outcomes observed in New Zealand can be explained by indoor dampness (Prezant, 2011).

Terms of reference 3: The current medical process of identifying biotoxin-related illness in patients and the medical evaluation of symptom complexes attributed to biotoxins and CIRS;

Traditionally, the adverse health effects of mould exposure was thought to be associated with an IgE mediated (allergic) response, however, it is now known that microbial products may induce long-term inflammation in susceptible individuals (Portnoy et al, 2016). In healthy individuals, these microbes are identified by the immune system and cleared from the body via the bowels (bile) (Plato et al, 2015). However, advances in gene screening have identified that 24% of the population do not have the immune response genes (HLA-DR) that are required to form antibodies to biotoxins which means every time these individuals walk into a water-damaged building, a persistent inflammatory illness occurs which can affect almost any system of the body (Shoemaker, 2002).

There have been various diagnoses given to patients with biotoxin-related illnesses. Chronic inflammatory response syndrome (CIRS) was first described in 1997 by Shoemaker as a chronic, progressive, multi-system, multi-symptom illness characterised by fatigue and headache, brain fog (difficulty with recent memory and concentration, and loss of words mid-sentence), vertigo, metallic taste, aches and pain in the joints, numbness and tingling and sleep disturbances (Shoemaker, 1997; Shoemaker, 2014). These symptoms are similar to those diagnosed with Mast Cell Activation Syndrome (MCAS), Multiple Chemical Sensitivity (MCS) and Sick Building Syndrome (SBS). The prevalence of CIRS in children is estimated to be between 7% and 12.7% (McMahon, 2017). There are also concerns that a water-damaged building may cause sarcoidosis in susceptible individuals which is characterised by skin rashes and enlarged lymph nodes (Terceelj et al, 2011). Apart from Shoemaker, McMahon (2017) provided an alternate diagnostic protocol using clusters with screens or labs as a variation of Shoemaker's protocol, whilst Valtonen took a different approach and coined the term *Dampness and Mold Hypersensitivity Syndrome* (DMHS) which involved five clinical criteria: a history of mould exposure in a water-damaged building, increased rate of infections (sinusitis, tonsillitis, bronchitis, skin and eye infections), a history of sick building syndrome (symptoms worsen in certain buildings and diminish when they are not in the building) and the development of multiple chemical sensitivity and enhanced scent sensitivity especially to mould odours (Valtonen, 2017). Funding for research that can test these diagnostic protocols to determine which are most predictive for mould-related illnesses are warranted.

A recent study (conducted by the author of this submission) of expert clinicians in the field of environmental medicine in Australia and New Zealand, identified that an increasing number of their patients with chronic fatiguing illnesses appears to be associated with toxicant exposures and damp-related homes (Bijlsma & Cohen, 2018). The clinicians who participated in the study acknowledged that their training in environmental medicine was woefully inadequate, and despite having access to many tests, they all acknowledged that the most effective tool was to undertake a comprehensive exposure history survey which takes approximately 90 minutes. Remarkably the clinicians had to make up their own exposure history and refine it over years, as this was not taught in their undergraduate medical training or ongoing training with their respective associations which means the reporting of *Chronic Inflammatory Response Syndrome* or *Dampness and Mold Hypersensitivity Syndrome* is likely to be grossly underreported. The development of tools to assist clinicians in the diagnosis of syndromes related to damp exposure are urgently warranted.

What causes mould?

An important question the committee need to ask in relation to biotoxin-related illnesses is what causes it? The key to mould in a home, is dampness. A healthy building should reflect a Mediterranean type of environment – dry and stable. When we add moisture we transform a dry stable environment into a living thriving ecosystem where microbes will kill other competing organisms by secreting chemicals (mycotoxins, endotoxins and microbial volatile organic compounds) to enhance their own survival and take over that space (Prezant, 2011). As mould spores can remain dormant for many years, they will thrive when they are given food and water. As most conventional building materials and furnishings are the ideal food for fungi, the key to addressing mould-related problems is to identify the source of the moisture. Within 48 hours of moisture being present, the spores which are already sitting on all of the surfaces will begin to germinate. There are numerous sources of moisture which may impact the built environment and the following are just some of the many sources we come across as building biologists.

1. External sources

There are a myriad of external sources of moisture that may impact a home. Living in high humid climates where the relative humidity regularly exceeds 70%; natural events like storms and floods, or water damage after a fire; plumbing related issues such as pipe leaks (dripping taps, compromised braided water hoses, overflowing hot water tanks should be connected to sewer...), drain backups or pipe condensation (insulation deficiencies); rising damp from a high water table or inadequate drainage; moisture wicks through foundation causing subfloor dampness; sump pump failure; missing, inadequate or blocked drains; leaks through the building envelope arising from blocked and/or damaged gutters; missing or damaged flashing on the roof; cracks in cladding and deteriorating building materials, enclosed balconies and internal gutters are also a problem and wind driven rain through porous brick and/or concrete. During a rain event, buildings constructed from brick veneer cladding may get wet. Homes that lack eaves or don't have facings around windows are also susceptible to wind driven rain.

2. Internal sources

A frequent source of dampness in a home arises from plumbing issues and water proof membrane failures. According to an Australian insurer, over 20% of their water damage claims are due to splitting of flexible braided hoses (SMH, 2017). The move to use cheap flexible acrylic waterproof membranes with a service of life between 5 to 7 years that only just covers the building insurance warranty is abhorrent, as very few consumers can afford to renovate their bathrooms every 7 years. This may explain why almost every bathroom we moisture map, has some degree of water damage.

The move to create environmentally sustainable and energy efficient homes has correlated with a rise in adverse health effects in occupants associated with exposure to condensation and moisture related issues, and in some circumstances, elevated exposures to volatile organic compounds arising from various building materials, paint and sealants as well as imported furnishings. Part of the problem appears to lie with the use of impermeable vapour barriers, and the buildup of water vapour that cannot penetrate the building envelope because passive ventilation is inadequate. We frequently observe condensation in the bathroom and laundry arising from inadequate ventilation, lack of openable windows, undersized exhaust fans, and fans that exhaust

steam directly into the roof cavity resulting in the buildup of humidity. When this warm air makes contact with a cold surface such as a metal framing member or impermeable vapour wrap, it condenses forming water droplets that accumulate in the wall and/or roof cavity, which allow the microbes already present on the surface to utilize the water to support microbial growth. Changes in air pressure and temperatures within the building over the course of a day and seasonal variations, then enables biotoxins to flow to various parts of the building. These condensation and moisture-related issues are described in the ABCB Condensation Handbook which appears to be overlooked by the building and construction industry.

Failure of tradespersons in the building industry to take precautions to prevent the spread of biotoxins during renovations, may expose the occupants to high levels of biotoxins. Tradespersons should have a basic knowledge on psychrometry, personal protective equipment required to reduce exposure to biotoxins and the skills to set up containment and use negative air machines and scrubbers during renovations in the event hidden mould is discovered in order to prevent secondary damage.

Insurance companies frequently employ cleaners and/or restorers to dry water-damaged properties that do not appear to have the knowledge or the skills to remediate a WDB and consequently may exacerbate the spread of biotoxins. In addition, several of the IICRC mould remediators we deal with, are frustrated that they are unable to properly dry a property due to financial restrictions on the home insurance policy. There is no doubt that the remediation of WDBs is complicated and fraught with many challenges, including remediators signing off their own work, and even those accredited through the Institute of Inspection Cleaning and Restoration Certification (IICRC) not adhering to the protocol provided in their training and/or using a band-aid approach like fogging and spraying.

Occupant behavior and bathing techniques may contribute to the buildup of water vapour in the home. Each occupant in the home contributes around ten liters of water vapour per day as a result of breathing, bathing, cooking and laundering. Sometimes problems arise when two or three generations are living in a small apartment that has not been designed to accommodate that many people. Some cultures have unusual bathing techniques whereby they bathe outside of the shower cubicle, creating large amounts of water on the bathroom floor which subsequently flows into nearby rooms. Another common issue we frequently find are condensation problems arising from the use of humidifiers and unvented dryers releasing large volumes of water vapour.

Heating, ventilation and air conditioning systems maybe a source of biotoxins and many of the HVAC systems we inspect, have visible dust or mould, or increased microbial activity (ATP swabs). This appears to be due to lack of maintenance, or inadequate servicing, inadequate condensate drainage, moisture carries over beyond coils, excessive humidification or a design fault (sensor location, malfunction). As we are not experts in this field, we would like to see better training in relation to the installation, cleaning and maintenance of HVAC systems.

3. Construction moisture

There are various forms of water damage we observe in new homes and apartments that warrant mentioning. Homes and apartments made from concrete and/or concrete masonry, may experience high internal moisture levels for up to two years after construction especially if the concrete has not had enough time to cure. Consequently

it is essential that new apartments are well ventilated (open doors and windows) during the day to enable the unbound moisture in concrete slabs to evaporate otherwise the increased humidity may predispose to mould conditions, and damage floor and wall coverings. Building materials are frequently exposed to the weather and rain during construction, which may explain why many stick timber frames have visible mould. Water proofing is absent or incorrectly installed, or the damp proof course is damaged. Inadequate insulation in the home and/or single paned windows resulting in condensation issues.

Testing water-damaged homes

Conducting an audit of a WDB is not an exact science and there is no single method or instrument that can be used in isolation. Whilst the IICRC (Institute of Inspection Cleaning and Restoration Certification) provides a comprehensive protocol on how to remediate mould and water-damaged buildings, it stays clear of providing a testing protocol to assess a WDB because it is a conflict of interest for mould remediators to test and verify their own work.

Testing a water-damaged building requires a comprehensive knowledge of the various sources of moisture unique to that site, air pathways by which biotoxins may travel through the built environment, the genre of microbes typical in a WDB and their water activity, knowledge of the adverse health effects associated with a dampness in a building, the skills to conduct a comprehensive site inspection, use of technical equipment whilst understanding their limitations, ability to analyse laboratory results, understand basic principles underlying mould remediation, and the ability to establish and test a hypothesis. It also requires the ability to conduct research about the microclimate of the area, keep up to date with research on biotoxins unique to a WDB and the ability to develop a risk management strategy (identify hazards unique to the site, assess the likelihood of exposure, and where necessary implement controls). The Mould Testing course conducted through the Australian College of Environmental Studies is 150 hours in duration and involves field training.

Terms of reference 5: Investment in contemporary Australian research to discover and provide evidence of CIRS as a chronic, multisystem disease;

The impact of dampness on asthma and allergies is well established, yet the prevalence of dampness in Australian homes across geographical locations is unknown and few clinicians have an awareness of its impact on human health, let alone how to diagnose and treat chronic fatiguing illnesses. Economic modelling is required to determine the actual cost of dampness on human health in the Australian population and the burden it puts on the Medicare system. In addition, the impact of water damage on pest infestation and the structural integrity of the home, also needs to be established to determine the scope of the problem. Future research needs to focus on patients with chronic fatiguing illnesses brought on by WDB and to establish predictive tools to test and effectively remediate WDBs. This needs to include epidemiological research, economic modelling, collection of anecdotes, observational studies, before and after clinical studies, randomized control trials and targeted clinical research to determine the causes, implications and treatment for patients with chronic fatiguing illnesses brought on by WDBs. In addition, it will require educational programs that provide tradespersons and those in the building and construction industry to understand the principles underpinning psychrometry and water damage; resources to educate the community on how to reduce

water vapour in their homes and address water damage before it becomes a health hazard; and training allied health professions to diagnose and treat environmental related sensitivities.

The ASBB welcomes the opportunity to discuss how we could partake in working with clinicians to assist their patients diagnosed with CIR related illnesses and assist in the development, research and recommendations of tools to test biotoxins in a water-damaged building. Here is a brief list of research ideas:

Research topic 1:

Develop a *home health survey* to determine the prevalence of dampness in Australian homes and their correlation to adverse health effects. I (Nicole Bijlsma) and my supervisor Prof Marc Cohen are currently developing a survey but require funding to validate it. This will enable us to determine the proportion of asthmatics, allergy sufferers and CIRS sufferers who have visible mould, odour and a history of water damage in their home and/or workplace.

Research topic 2:

Undertake a literature review and explore various testing methods currently employed by environmental physicians in other countries (OATS test, urine test for mycotoxins, inflammatory markers used in Shoemakers protocol etc), to identify the most relevant biomarkers to diagnose CIRS.

Research topic 3:

Undertake a thorough assessment of the home and/or workplaces of patients diagnosed with CIRS to determine which markers in the built environment are most predictive of exposure. This would require a building biologist to use the Health Home History (above), conduct a thorough site inspection, undertake moisture mapping in addition to air, surface and dust sampling that is analysed by a NATA accredited laboratory.

Research topic 4:

Determine if CIRS patients improve when their house is remediated using the principles outlined in the IICRC S520.

Conclusion

A significant proportion of the work conducted by Building Biologists involves auditing water-damaged buildings. We have noticed a consistent correlation between visible mould, damp/musty odour and a history of water damage, with various adverse health effects and yet very few clinicians have the knowledge or the skills to diagnose these conditions. In light of the fact that the cause of mould is moisture, the sources of moisture that frequently impact the built environment from our experience, reveal a systematic failure of the Australian Building Code to protect new home owners from condensation issues, widespread incompetencies amongst the trades (building, plumbing and HVAC) and a lack of duty of care by property managers and landlords to address this issue. Whilst it is clear that the testing and remediation of a WDB is fraught with challenges, research funding will provide an opportunity to develop predictive tools to identify WDBs and provide clinicians with the tools and biomarkers necessary to effectively diagnose and treat patients with ailments brought on by exposure to the biotoxins in a WDB.

KEY POINTS

- In the past five years, our industry has noticed a significant increase in the demand for our services especially in relation to conducting audits of water-damaged buildings.
- We have noticed a consistent correlation between visible mould, damp/musty odour and a history of water damage with various adverse health effects.
- Whilst the prevalence of dampness and CIRIS in Australia has not yet been established, one third of new builds are affected by condensation (ABCB, 2016) and the World Health Organisation estimates that between 10 to 50% of buildings in Australia maybe affected by dampness.
- Water-damaged buildings contain a 'chemical stew' of airborne bioaerosols which makes it extremely difficult to determine what people in a WDB react to.
- It is already well established that the adverse health effects arising from exposure to dampness results in lung and skin problems like asthma, bronchitis, cold and flu-like symptoms, hay fever, pneumonia and eczema.
- Recent evidence has come to light that 24% of the population do not have the immune response genes (HLA-DR) that are required to form antibodies to biotoxins and in these people, exposure to biotoxins in a WDB appears to result in chronic low grade inflammation affecting multiple organ systems.
- Reporting of *Chronic Inflammatory Response Syndrome* established by Shoemaker and/or *Dampness and Mold Hypersensitivity Syndrome* developed by Valtonen is likely to be grossly underreported and the development of tools to assist clinicians in the diagnosis of these syndromes are urgently warranted.
- The key to mould in a home is moisture, and there are multiple sources of moisture ingress that may impact the built environment which require the integration and collaboration of various industries including building and construction, drainage consultants, insurance, mould remediation and restoration, and building biology.

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