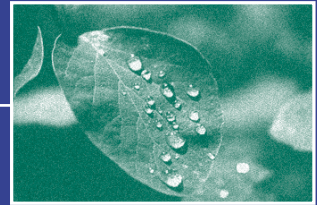


Environmental Health

The Journal of the Australian Institute of Environmental Health



*...linking the science and practice
of Environmental Health*



Environmental Health

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Environmental Health

The Journal of the Australian Institute of Environmental Health

ISSN 1444-5212

Linking the science and practice of environmental health

The Australian Institute of Environmental Health gratefully acknowledges the financial assistance and support provided by the Commonwealth Department of Health and Aged Care in relation to the publication of *Environmental Health*. However, the opinions expressed in this Journal are those of the authors and do not necessarily represent the views of the Commonwealth.

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Published by *Environmental Health*, The Journal of the Australian Institute of Environmental Health.

Correspondence to: Jim Smith, Editor, P O Box 278 Rosanna, Victoria, 3084, Australia.

Cover Design by: Motiv Design, Stepney, South Australia

Design & typeset by: Mac-Nificent, Northcote, Victoria



Environmental Health © 2004

ISSN 1444-5212

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Environmental Health is a quarterly, international, peer-reviewed journal designed to publish articles on a range of issues influencing environmental health. The Journal aims to provide a link between the science and practice of environmental health, with a particular emphasis on Australia and the Asia-Pacific Region.

The Journal publishes articles on research and theory, policy reports and analyses, case studies of professional practice initiatives, changes in legislation and regulations and their implications, global influences in environmental health, and book reviews. Special Issues of Conference Proceedings or on themes of particular interest, and review articles will also be published.

The Journal recognises the diversity of issues addressed in the environmental health field, and seeks to provide a forum for scientists and practitioners from a range of disciplines. *Environmental Health* covers the interaction between the natural, built and social environment and human health, including ecosystem health and sustainable development, the identification, assessment and control of occupational hazards, communicable disease control and prevention, and the general risk assessment and management of environmental health hazards.

Environmental Health is indexed in Ulrich's Periodicals Directory, the Australasian Medical Index, and APAIS

Aims

- To provide a link between the science and practice of environmental health, with a particular emphasis on Australia and the Asia-Pacific Region
- To promote the standing and visibility of environmental health
- To provide a forum for discussion and information exchange
- To support and inform critical discussion on environmental health in relation to Australia's diverse society
- To support and inform critical discussion on environmental health in relation to Australia's Aboriginal and Torres Strait Islander communities
- To promote quality improvement and best practice in all areas of environmental health
- To facilitate the continuing professional development of environmental health practitioners
- To encourage contributions from students

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The Journal is seeking papers for publication.

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Guest Editorials address topics of current interest. These may include Reports on current research, policy or practice issues, or on Symposia or Conferences. Editorials should be approximately 700 words in length.

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Short reports of topical interest should be approximately 1500 words. Book reviews should be approximately 700 words and Review Articles should not exceed 3000 words in length.

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EDITORIAL

Editorial

In this the second issue of the journal in its electronic format we see again the diversity of environmental health practice and policy interest with articles contributing to the areas of professional development; indigenous health; community education; law and reform; food safety and hygiene. One article provides an international flavour with an examination of pool hygiene standards in Iran.

Continuing professional development (CPD) and environmental health practitioners has been the topic of some discussion in recent years. Welsh in her paper provides insights into the critical need for CPD based on the rapid and continuing changes within the field reflected in changes in government policy and legislation. A professional image and, with this, community standing of practitioners is also seen to be an important outcome which can be served by practitioners undertaking CPD. This good standing of practitioners within the communities tends to provide or ensure a level of confidence that is critical in working within the community for the improvement of environmental health standards. Welsh concluded that there is a need for a structured CPD program managed by the AIEH. The theme of professional development and practice is also central to the article by Stephenson on the information needs of environmental health practitioners in indigenous communities. The survey that was undertaken by the author across remote, rural and urban locations in Australia indicated that there was a need for wide-ranging environmental health technical information. It is suggested that issues of accessibility may be overcome using current internet technologies. Subsequently a dedicated environmental health information resource can be developed for indigenous users based on the specific experiences of practitioners in the field which has been identified in the survey as being particularly important. The issue of adequate resources continues to be an issue

for community based indigenous environmental health. The article by Stephenson also serves to emphasise that the development of any structured CPD scheme will need to consider issues of access by environmental health practitioners around the country.

As Welsh commented in her article the practice of environmental health is very much influenced by legislation. Reynolds examines the nuisance provisions of the public health legislation found in all jurisdictions of Australia. Nuisance legislation is always a well discussed and debated (sometimes hotly debated) issue within environmental health practitioner circles. Reynolds argues that these specific provisions reflect the thinking and cultural values of the community in the 19th Century and would seem to be out of step with modern environmental health. He argues that there is a need to have environmental health legislative provisions relating to 'risk' and 'duty' with an emphasis on preventing environmental health hazards which is more consistent with modern day thinking and practice.

Three articles and one report in this issue are concerned with evaluating environmental health interventions. The first of these pertains to food safety and the evaluation of lead and cadmium in chocolates. Harcombe et al. undertook a survey of lead and cadmium content of chocolates sold through retail outlets in Western Australia and found that there was broad compliance with the Australia New Zealand Food Standards Code. There have been concerns about heavy metal contamination of food products and this survey tends to provide some evidence that there is compliance with the standards. A report by Nanbakhsh et al. confirmed that fungi in pools undergoing disinfection in accordance with appropriate standards do not seem to pose an environmental health risk.

The articles by Ling on wood heaters and Alexander et al. on immunisation focus on evaluation using community feedback.

Ling's article looks at the impact of introducing a wood heater replacement program whereby the program was able to change community behaviour to a significant extent. A strategy based on a person to person interaction seemed to be more effective than using the broad based community marketing type of approach in this case. Alexander et al. surveyed customers from different ethnic backgrounds using an immunisation service as to their satisfaction level with the service. While the survey results indicate high levels of satisfaction, a number of recommendations were made to further improve the immunisation service.

One article examines the possibility of further developments in bio-remediation of

contaminated sites and some interesting findings by Wenzel et al. in the use of white rot fungi in the presence of copper.

Suggestions have been made for special issues or supplements for the journal and these include emergency management and indigenous environmental health. The editorial team would be keen to hear from anyone having an interest in assisting in putting together these special issues. Obviously, we will need some relevant papers and we would be more than happy to assist anyone who wishes to make a contribution in this way.

Jim Smith
Editor

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‘Dangerous to Health or Offensive’: The Nuisance and Insanitary Conditions Powers - Some Arguments for Reform

Christopher Reynolds

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This paper explores the origins and scope of the power to order the abatement of nuisances and insanitary conditions in Australian public health acts. It argues that, paradoxically, these powers, often expressed in the language and ideas of the 19th century, are both too limited in focusing on the original sanitary roles of public health, and also are too wide in allowing its miasmatic traditions to characterise amenity issues as environmental health issues. This paradox is well reflected in the legal cases that have considered the scope of the powers. Yet the power to order the abatement of nuisances and insanitary conditions remains a central environmental health remedy even though it is of limited value and is often overshadowed by more comprehensive and powerful ways of protecting the environment. The environmental health response should be strengthened and broadened by rethinking the nature of the order power and by setting it within a coherent framework that supports a core idea of ‘harm to health’ around which the Act is organised¹.

Key words: Public Health Acts; Environmental Health Reform

The industrial world of the 19th century threw out desperate images of disease, despair, and unimaginable horror. In his *Bitter Cry of Outcast London*, Andrew Mearns (writing in 1883) describes the city’s poor, many thousands crowded together in “human rookeries”. To get to them, he wrote:

you have to penetrate courts reeking with poisonous and malodorous gases rising from accumulations of sewage and refuse scattered in all directions and often flowing beneath your feet; courts, many of them which the sun never penetrates, which are never visited by a breath of fresh air, and which rarely know the virtues of a drop of cleansing water ... You have to grope your way along dark and filthy passages swarming with vermin. Then, if you are not driven back by the intolerable stench, you may gain admittance to the dens in which these thousands of beings who belong, as much as you do, to the race for whom Christ died, herd together (Porter 1997, p. 400).

The vast scale of these problems provided a quite impossible task for governments. Yet their urgency, highlighted by recurring epidemics notably cholera, prompted urban reform and also the first public health acts. These introduced the power to order the abatement of insanitary and unhealthy conditions as the mainstay of local sanitary practice, a power that remains with us to the present day. Thus, in 1848, powers were given to local authorities in section 1 of the *Nuisance Removal and Disease Prevention Act* to order the removal of “nuisances”; where premises were in a “filthy and unwholesome condition as to be a nuisance or injurious to the health of any person” an order to remedy the condition could be made. These powers were first entrenched in English public health legislation, and a few years later also in Australia where colonial public health laws were passed from the 1850s onwards. The first Australian health act, the *Health Act 1854 (Vic)*, copied English legislation closely and provided local councils with a

range of powers to order the abatement of nuisances, not defined but impliedly “things of an offensive nature or likely to be prejudicial to health” (s13).

Nuisances as a Response to Miasmas

The focus in a health act on environments that were noticeably unpleasant and offensive (generally evidenced by their smells) was an expression of the prevailing idea about the way disease was spread through the atmosphere. Offensive conditions were unhealthy, it was said, on account of the “miasmas” or “effluvia” or exudation emitted by them. The visual and the malodorous became a telltale sign of the source of infections and things that were offensive were by their nature also prejudicial to health. The Marquess of Landsdown, in introducing the Bill, said that the causes of disease, notably cholera, “were atmospheric; that it was influenced by the exhalation of rivers, the currents of air, and certain meteoric changes and vicissitudes” (Hansard 1848, p. 614). This view drove the Act and while miasmas as the exudations or vapours emerging from unpleasant conditions are no longer offered as explanation for the transmission of disease (it was recognised that seemingly unpolluted water could still be a source of disease, and later the germ theory took hold) it remained a persistent idea (Halliday 2001). There are still echoes of it in the order making powers of some Australian states whose health acts continue to reflect the language and the key ideas that go back to the 19th century origins of public health. But in some ways the miasmatic responses proved correct: offensive conditions, such as privies overflowing into water sources, often signified the presence of bacteria, while dung heaps attracted flies and other vectors of disease.

If miasmatic theory directed the public health response it also had an important secondary impact, since its focus was on improving the environment and the elimination, in the name of public health, of

the smells, the waste, the sources of water pollution and the acrid smoke of factory chimneys. In this respect our first public health laws were also our first environment protection laws. This point remains true today, but in the 21st century the general environmental surveillance offered by public health powers has been complemented, perhaps overshadowed, by environment protection regulations that comprehensively regulate and monitor areas such as water and air pollution, the control of waste and contaminated sites and noise. All Australian jurisdictions have modern and extensive environment protection laws that impose substantial penalties and offer administrative flexibility and a range of options for dealing with the nuisances that fall within them. Zoning controls, imposed under planning laws, have also sought to keep housing and industry apart, minimising the daily impacts of nuisances on peoples’ lives.

Thus in many cases an environmental health remedy runs parallel with an environment protection remedy and either might be applied to the many cases where the complaint could relate equally to environmental health or environment protection. Further, local government legislation also provides some remedies, also in the form of order making powers, for situations that are aesthetically or otherwise undesirable and some of these powers might also apply in cases where an environmental health order could also have been made.

The overshadowing of the nuisance abatement power by the new environment protection laws might seem to erode its importance, but it still remains a key public health remedy in the health acts of Queensland (s77 *Health Act 1937*); Victoria (s39A *Health Act 1958*); Western Australia (s182 *Health Act 1911*); the Northern Territory (s4 *Public Health Act 1952*); and New Zealand (s29 *Health Act 1956*). South Australia (s3(2) *Public and Environmental Health Act 1987*) and the Australian Capital Territory (*Dictionary Public Health Act 1997*)

use the term “insanitary condition” which calls up similar ideas to “nuisance”. New South Wales (s124 *Local Government Act 1993*) and Tasmania (s199 *Local Government Act 1993*) rely on order making powers in local government legislation which relate to environmental health issues. The United Kingdom, which first put nuisance powers in place in 1848, has now transferred them to environment protection legislation (s79 *Environmental Protection Act 1990*).

A case exists to reassess the scope and value of the nuisance power. It now has significant ‘legislative competition’ from newer and more comprehensive environment protection legislation and is based on a flawed understanding of the way disease is spread. Yet, if reformed and used imaginatively, it also has the potential to provide important remedies in environmental health and remain a significant component of public health law.

The Scope of the Nuisance Power

It is remarkable that in an age of seemingly constant legislative change and reform, the language of our public health laws has remained unaltered for so long. The Queensland (*Health Act 1937*) and Western Australian (*Health Act 1911*) definitions of the term “nuisance” have changed little since they were first drafted. Queensland provides a list of things that might amount to a nuisance when they are “injurious or prejudicial to health”. Western Australia also offers a very long list of circumstances, which might amount to a nuisance, typically in the cases where they are found to be “offensive or injurious or dangerous to health”. The nuisance power, as expressed in the *Victorian Health Act 1958* still captures the essence of its original idea (which is discussed below). A more modern approach is taken in South Australia where an insanitary condition includes premises that give rise to a “risk to health” or whose conditions cause “justified offence” and also in the Australian Capital Territory where the key ideas against which the condition is

tested are whether it amounts to “a public health risk, damaging to public health or offensive to community health standards”.

Using Victoria as the example for a closer analysis of the term, a statutory nuisance is defined by s39A of the *Health Act 1958* (Vic) as nuisances “which are, or are liable to be, *dangerous to health or offensive*” in respect of buildings, land, water, animals, refuse, noise or emissions. Victorians have lived with this phrase for nearly a century, though in 1988, “offensive” was defined to mean “noxious, annoying or injurious to personal comfort”. The definition is interesting since it seems both narrow and wide at the same time. The idea of “dangerous to health” sets a high test, and appears to exclude a range of risks that should be of concern even though they lack the imminent threat implied by a danger. The idea of “offensive” even with the definition “noxious, annoying or injurious to personal comfort” at first glance covers a multitude of possibilities including concerns relating to amenity or the need for orderly planning.

How are we to give shape to the limits of the nuisance power, or its equivalent the insanitary conditions power? There is much case law ranging from the 19th century to quite recent times that provides important principles of its current scope and usefulness. Most importantly, courts have usually come to the term with an understanding of what public health legislation is seeking to achieve and, given the similar language in both the English and Australian statutes, the cases from both jurisdictions are worth considering.

The scope of the nuisance remedy was delineated in the English case *Queen v. Parlby* (1889) where the court commented, in relation to “premises in such a state as to be a nuisance” in the *Health Act 1875*:

we do not attempt to define every class of case to which the first head applies [i.e. a nuisance], but we think it is confined to cases in which the premises themselves are decayed, dilapidated, dirty, or out of order, as, for instance, where houses have been

inhabited by tenants whose habits and ways of life have rendered them filthy or impregnated with disease, or where foul matter has been allowed to soak into walls or floors, or where they are so dilapidated as to be a source of danger to life and limb. (p. 525).

A later case from New South Wales, *ex parte Harris* (1902) also tended to limit the application of the term, holding that premises, which required alterations and repair, did not amount to a public health nuisance even if there was evidence that they might be injurious to health. Rather the premises had to be “decayed, filthy, or impregnated with disease, or so dilapidated as to be dangerous” (p. 197). So, here, the court concluded (perhaps too narrowly and possibly on account of Sir Matthew Harris being Mayor of Sydney as well as a prominent landlord) that a nuisance did not exist even though there were problems with the ventilation and the drains of the premises.

The statutory nuisance had to have a sanitary significance and could not be relied on to sustain orders in cases that were more about the general unreasonable use of land. In *Great Western Railway Company v Bishop* (1872) water falling onto a public road was found not to be a statutory nuisance. Lord Cockburn said “[i]t is plain that the object [of the *Nuisance Removal Act*] was to protect the public health. ... I think that affords us a guiding principle by which to construe this Act, and that ‘nuisance,’ the general term used in the Act, must be taken to mean a nuisance affecting public health” (p. 552). This view was accepted in later cases, thus in *Springett v Harold* (1954) a house which was in need of decorating (the walls and ceilings were stained and peeling) was held not to be a nuisance. Nor was an unsightly rubbish tip where the health hazard was the dumping of materials, such as builders’ rubble, that could injure persons using the area (*Coventry City Council v Cartwright* (1975)). The view that physical injuries do not amount to a nuisance was upheld in *R v Bristol City, ex parte Everett* (1999), which

involved a very steep set of stairs. The Court of Appeal found that the scope of the term “prejudicial to health” or “injurious, or likely to cause injury to health” was not intended, when the Act was drafted, to cover physical injury and should not now extend to it, notwithstanding that the term was now in another Act (the *Environmental Protection Act* 1990). Since the terms “nuisance” and “insanitary condition” remain in health legislation in Australia, and principally are organised around sections and parts dealing with sanitation, there is an even stronger argument that this traditional interpretation (that excludes its application to physical dangers) will be applied here.

The position in Australia reinforces the English case law. In *McLaughlin v Halliday* (1985) the Victorian Supreme Court held that the term “offensive matter” as defined in the *Health Act 1958* (Vic) (“dust sludge mud soil ashes rags waste matter filth blood offal dung manure or any other material which is offensive or likely to become offensive.”) could not apply to cardboard and paper waste. The court found that this definition created a class of materials “immediately identifiable as being offensive in that they are essentially dirty or noxious or noisome or essentially injurious to human health, or inconvenient to human well-being” (p. 53). But the principle may not be universal and a statutory nuisance remedy was allowed in *Adams v Council of the Shire of Taringa* (1927) even though there was no obvious health impact and the problem seemed only to involve water that had accumulated on the plaintiff’s land.

Air quality issues (notably smells and visual pollution) whether of environment protection or environmental health concern have always been likely to amount to a statutory nuisance or insanitary condition. Miasmatic ideas were applied in this context in *Bishop Auckland Local Board v Bishop Auckland Iron & Steel Company* (1882) where an accumulation of cinders and ashes satisfied the court that a nuisance “producing noisome effluvia” existed and

therefore was injurious to human health. Obvious air pollution, for example the release of large quantities of smoke by a brick kiln in circumstances that clearly constituted a common law nuisance (washing was soiled by smuts and the amenity of the area was reduced) was allowed as a statutory nuisance (*McKell v Rider* (1908)). So was the release of “quantities of black smoke [from a brewery] as to be a nuisance” (*Weekes v King* (1885)). Granted, the health impacts of air pollution could often be quite significant, as seemed to be the case in *Whitehead v Victor Leggo Chemical Company* (1926) where the smoke coming from the defendant’s factory “appeared to be composed mostly of sulphuric fumes”. The emission of noxious and potentially toxic gasses as nuisances or insanitary conditions also have a relatively modern application in *Caruso v Boucher* (1974), which involved the escape of chloropicrin, a fumigant used in glass houses and said to be “injurious to health or offensive” within the meaning of s83(1) of the South Australian Health Act 1935 (people complained of sore throats and watering eyes).

Organic smells also qualify as nuisances and the early cases, if not the later cases, were also shaped by miasmatic thinking. In *Malton Board of Health v Malton Farmers Manure and Trading Company* (1879) the nuisance produced from the defendant’s manure works was said to be injurious to human health because the effluvia to which sick persons were exposed might cause them to become worse. Piggeries were also the subject of orders (*Banbury Urban Sanitary Authority v Page* (1881) and *Burton v Bysouth* (1900)). Other cases where a statutory nuisance was allowed include *Bullows v J Kitchen & Sons Ltd* (1910) which involved “very foul odours” coming from a noxious trade establishment, which were widely diffused and lasted for some hours and *Colville v Dale* (1899) which involved smells from a boiling-down works and bone-mill.

Noise has also been the subject of an

insanitary conditions order and is specifically included in a number of statutory definitions of nuisance (*Jurkovic v Corporation of the City of Port Adelaide* (1979)). While in the United Kingdom, a court accepted that the failure to insulate premises from outside noise meant that they were “in such a state as to be prejudicial to health” (*London Borough of Southwark v Ince* (1989)).

Assessing the Term “Nuisance” in the Light of Recent Case Law

Can we reconcile the cases and judicial approaches to the term “nuisance,” or its related term “insanitary condition,” in a way that gives us a useful guide to the scope of the power? We can conclude that the term emerged from a focused understanding of the visible environmental health issues of the day. As Richards J said in *R v Bristol City Council, ex parte Everett* (1998):

When powers to take action against premises that were “prejudicial to health” or “injurious to health” were conferred by the mid 19th century statutes, the object of concern was plainly the direct effect on people’s health of filthy or unwholesome premises and the like: in particular, the risk of disease or illness (p. 613).

However, a close adherence to the origins of the term can lead to odd decisions that are seen in some of the recent cases. In *Coventry City Council v Cartwright* (1975) putrescible waste was removed from the dump, while builders’ rubble that might injure persons as they walked across the land remained. The waste, had it not been taken away, might have constituted a nuisance, on the traditional grounds that it was offensive; the rubble, certainly the greater threat to health was not a nuisance. Another case, which illustrates this point, is the House of Lords decision in *Birmingham City Council v Oakley* (2003). The case involved premises that did not have a hand basin in the toilet, making it inconvenient for persons to wash their hands, and in the case of children perhaps making it unlikely that they would.

The local justices saw this as a problem, concluding that washing hands “is important to good hygiene practices especially with regard to the younger members of the household” and more particularly that “[i]t is unacceptable in the interest of hygiene having used the WC to expect persons to either: (a) wash [their] hands in [the] kitchen sink or (b) cross [the] kitchen to [the] bathroom as both of these involve the risk of cross infection within the kitchen area”. On this basis a statutory nuisance order was imposed.

The application of the statutory nuisance power in this case was challenged and when it reached the House of Lords a majority of the Law Lords hearing the case decided that the situation did not amount to a statutory nuisance. They took the view that, though unsatisfactory, the facilities were not in themselves defective. If there was a prejudice to health, this had nothing to do with the state or condition of the premises; rather it resulted “from the failure to wash hands or the use of the sink or the basin after access through the kitchen”. It was said by Lord Slynn that “[t]here must be a factor, which in itself is prejudicial to health. I do not think that the arrangement of the rooms ... not in themselves insanitary so as to be prejudicial to health falls within the [scope of a statutory nuisance]” (p. 1943). However, Lord Clyde who dissented found that the circumstances were prejudicial to health. “In the ordinary use of language it seems to me that the state of premises may include a deficiency due to the absence of a facility or a particular positioning of the facilities. ... There was clearly something inadequate with the premises themselves so far as health and hygiene were concerned”. In his Lordship’s view it was reasonable to conclude “that the risk of cross infection which [the justices] feared was due to the state of the premises” (p. 1952).

The majority view in this case leads to the odd conclusion that if the toilet smelt, that would quite possibly be the basis of a statutory nuisance order but if it lacked the

facilities necessary to protect health (the hand basin) then that was not in itself a nuisance. Such a conclusion goes against good public health sense, which advocates the provision of environments and facilities to make ‘healthy choices easy choices’. A technical interpretation such as this is only in the interests of landlords who try to evade their responsibilities to provide a safe and sanitary environment for their tenants.

However, in other respects the statutory nuisance or insanitary condition power can be read too widely. Its origins in nuisance more generally and its focus on amenity issues, perhaps given public health flavour by the idea of “effluvia”, means that there is always the possibility that environmental health grounds will be used to provide an environmental or amenity remedy or a land use planning remedy, with the environmental health nexus strained to say the least. A good example of this is illustrated by the South Australian District Court decision *Tavitian v Public And Environmental Health Council & City of Playford* (2003) where an insanitary conditions order was based on assorted clutter in the appellant’s premises including “garden waste, iron, timber, plastic, tyres, dilapidated motor vehicle bodies containing refuse and rubbish, motor parts, mattresses and a variety of metal frames, tubing, fencing materials and general refuse and rubbish”. It was said to amount to an insanitary condition “by reason of the fact that: (1) the premises are so neglected that there is a risk of infestation by rodents or other pests; and (2) the condition of the premises is such to cause justified offence to the owner of land in the vicinity of the premises”. The court took issue with the fact that the order seemingly had been made on the assumption that “a risk of infestation necessarily resulted from the mere existence of the accumulated clutter”. More particularly, there was no evidence that the premises were filthy “such as might, without more, give rise to an inference of a risk of infestation” (para 43). The fact that the

premises were unsightly was not enough to amount to an insanitary condition (para 49). Indeed, it was the appellant's view (which the court may have sympathised with) that the "Council's case against him was a planning objection to his use of his yard disguised as a public health objection" (para 48).

For the Future

The origins of the statutory nuisance and the rise of environmental controls raise significant questions for the future. The case law suggests that the term is locked within its historical sanitary context and could not be applied in a range of new circumstances where we might expect an environmental health response. Should we continue with the power, but remain mindful of the constraints and the limits alluded to by the courts? Should we continue to address environmental health at all, perhaps vacating the field and leaving environmental health as the sole responsibility of environment protection agencies? Is there a case for an independent environmental health approach and if so what form should it take? This author believes that the traditional values and ideas that encompass the 'environmental health approach' are worthwhile and should be defended. An environmental health approach is a holistic approach, reflected in the training of its practitioners. Environmental health draws links between the social and the environment and those complex relationships between history, place and opportunity that so powerfully shape people's health and wellbeing, the health and wellbeing of Aboriginal Australians being a powerful case in point. Our current environmental health practice is also a 'rich' and a 'deep' discipline, the product of a long tradition that urged, and continues to urge, social and environmental reform based on sound evidence drawn from epidemiology, medical investigation and social inquiry.

If the environmental health response is to

maintain its capacity to remedy environmental health problems, is there another way of crafting the power in order to free it from its constraints while strengthening the environmental health focus of the remedy? In 2000 the National Public Health Partnership released a discussion paper that advocated a "risk based" approach to environmental health legislation (National Public Health Partnership 2000). Rather than allowing the Acts to provide a range of specific remedies, it raised the possibility of having a concept, "risk to health", as the general idea or "spine" around which the administrative powers notably orders, or penalties should be organised. A statutory duty lay at the basis of this. It was a duty to avoid harm to health, which might be expressed as follows:

A person must not undertake any activity that may result in harm to health unless the person takes all reasonable and practical measures to eliminate the possibility of that harm occurring (National Public Health Partnership 2000 part 6.3).

Those who breached their duty might then be subject to an order to abate or remediate the problem.

A duty expressed in general terms restates the function of the public health acts, namely to prevent situations that pose a threat to human health. It should respond to all of the concerns legitimately caught by the nuisance or insanitary conditions powers, insofar as these are grounded in a concern for human health. Recognising that health is broadly defined to include states of "mental and social wellbeing" the adverse impacts of a poor environment, of noise and odour will, if justified, be calculated to harm human health and the duty would extend to these issues as well. But it would also cover the situations that, for the reasons alluded to in *Birmingham City Council v Oakley* (2000), lie beyond the scope of the 19th century sanitary concerns. Structures that are inherently unhealthy, rather than defective; premises that are dangerous in some way; procedures that potentially pose a risk of

harm such as colonic irrigation, solariums, rapid detoxification and, most recently 'sweat lodges' (procedures that are not in themselves regulated and whose operators and promoters often are not licensed health professionals); or cases where persons are being exposed to tobacco smoke (if not already covered by regulation) - all fall within the general duty. The point is that the duty and its order making power would operate against a general principle rather than within a defined area.

Thus a general duty would provide a remedy for the things that seem often to 'fall between the cracks' and in these cases the generic environmental health remedy operates as a safety net. The duty and its accompanying order could also cover cases where persons with a communicable disease might in some way be placing others at risk. But there are other cases where it would not be appropriate to issue an order. Such a case might be a 'fast food' restaurant, where the argument for issuing it is no more than that the food is unhealthy, leading to obesity. While obesity is an emerging environmental health issue of great concern, the singling out of one outlet makes no sense in dealing with a multi causal and complex issue, unless there is something in the restaurant's activities that makes it stand out from others. The issue of obesity and high-energy fast food is better dealt with through a mix of health promotion strategies and marketing controls and, where premises are in breach of their existing responsibilities, prosecutions or orders under the food laws.

The duty could go wider again; the causes of global warming and the problems that will emerge from unsustainable lifestyles together present our greatest identifiable risk to health. Potentially, our environmental health remedies, which hitherto have been so local and limited in their scope, might contribute towards our response to these very significant problems. The way it might contribute and the support it might offer to other 'whole of government' policies such as sustainability can only be

speculated on at this stage. But the recognition that our first order environmental issues will have dire impacts on human health must cause us to explore how environmental health can help address these questions.

For all the reasons outlined above, the duty has to cover a range of possibilities, especially future possibilities and it must necessarily be broad and general. It is not possible to spell out its scope or its range, rather we must allow the duty to 'unfold' and meet new issues as they arise. However, on occasions it may also be important to be more specific and to allow authorities to declare particular risks to health to fall within the duty or to authorise the publication of codes or guidelines that set out what amounts to compliance with it in particular cases. It may also be important to direct decision makers to formal criteria when deciding whether or not to issue an order. The Australian Capital Territory provides for this in s69(2) of its *Public Health Act 1997*. Here the person issuing the order must have regard to the number of persons affected by the problem, its significance (the degree of risk, damage or offensiveness that it presents), the extent to which the person responsible for the problem has taken reasonable precautions to "avoid or minimise [its] adverse effect" and the reasonable precautions that persons adversely affected have or have not taken to "avoid or minimise [its] effect".

The duty must also be enforceable. First, by the power to issue an abatement or compliance order and to specify the requirements for compliance, and second, with sanctions that apply for failure to comply with the order. The National Health Partnership Report also envisaged statutory offences for creating a risk to health, where the risk was significant and harm occurred or might have occurred as a result.

Conclusion

Over the past 10 years Australian governments have invested resources and energy into reviewing public health law and while issues such as HIV/AIDS and, more recently, the possibilities of bioterrorism and emerging pandemics have occupied much of this work, the sanitary origins of our laws should not be overlooked. The case for continuing a

human health directed 'gaze' on our local environments remains strong. But there is a need to rethink and modernise the basis on which environmental health can act and the remedies that it can offer. A generic approach offers a more relevant and versatile option, which can continue the legitimate concerns of 19th century environmental health but not be imprisoned by them.

Endnote

1. A note on the terminology: in this paper 'public health' tends to be used in relation to the legislation and the historical development of the discipline. 'Environmental health' is used more generally since it reflects the current interest and description of the work of practitioners in the field. In many respects the terms are interchangeable, with the latter being a more contemporary version of the former.

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Client Feedback as a Mechanism to Improve Immunisation Program Delivery for Ethnic Families in Greater Shepparton

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The objectives of the study are to report findings of two customer satisfaction surveys for program redevelopment, especially for newly arrived refugee families. Two groups of families were recruited to the study to assess customer satisfaction and identify gaps in the current immunisation service using questionnaires developed for this study. The Study Group (SG) was made up of ethnic families or clients of the Ethnic Council of Shepparton and District Inc. (Ethnic Council) and the Multicultural Education Centre Goulburn Ovens Institute of TAFE; where necessary, ethnic families were interviewed through an interpreter. The Control Group (CG) consisted of families who attended a Council immunisation session or a Maternal and Child Health Centre and were invited to complete a self-administered questionnaire. There were 42 respondents in the SG and 101 in the CG. Most respondents in both groups were satisfied with the current service including venues and times. Seventy four percent of the SG rated the service as 'excellent', 'very good' or 'good'. It was, however, indicated that there is room for improvement in the provision of information in other languages. While most respondents were satisfied with the current service, five recommendations have arisen from this study: i. The development of a working partnership between the Council's immunisation team and Maternal and Child Health Service; ii. The development of a working partnership between the Council's immunisation team and the Ethnic Council; iii. the development and adoption of education sessions for ethnic families; iv. the provision of cross-cultural communication training for the immunisation team; and v. the provision of an evening session once a month.

Key words: Client Feedback; Ethnic Families; Immunisation; Partnerships; Program Redevelopment

The Australian Government funds the National Immunisation Program that covers childhood immunisation, however, it is the responsibility of the states and territories to oversee the service delivery of childhood immunisation (Australian Immunisation Agreement 2004). A combination of different service delivery models has been used by each state and territory to administer childhood immunisation. These service delivery models include the use of council immunisation clinics, general practitioners, community health centres, school nurses and child health clinics

(Tasmanian Department of Health and Human Services Public and Environmental Health Service 2003; Northern Territory Government 2004; Department of Health Government of Western Australia 2004; New South Wales Health 2004; ACT Health 2004; Queensland Health 2004). In Victoria, local government is responsible for coordinating the immunisation of children living within the municipal district. Immunisation services often fall under the Environmental Health section of a council and immunisation is delivered through council immunisation clinics. Environ-

mental Health Officers often coordinate and administer these immunisation clinics. This model of service delivery differs from most other states and territories in Australia except for South Australia (Health Insurance Commission 2004). In Victoria, general practitioners are the other major provider of childhood immunisation.

The Greater Shepparton City Council (GSCC) is responsible for the local government area of the City of Greater Shepparton, a regional centre in Northern Victoria. The Greater Shepparton City Council provides a free, mobile immunisation service with nine sessions conducted each month at eight venues, including two urban and six rural or remote locations. The sessions are conducted by an immunisation team consisting of doctors, nurses and administrative staff. The City of Greater Shepparton has approximately 59,000 residents. Of these, 10-16% were born overseas of which 5% (or about 400 residents) did not state their birthplace (Department of Immigration and Multicultural and Indigenous Affairs 2003). These figures include recent arrivals and refugees. The top 10 countries of birth for those residents born overseas were Italy, England, New Zealand, Turkey, Iraq, Netherlands, Greece, Albania, Scotland, and India. In 2003, there were 206 new arrivals and 27 refugees who took up residence in the City of Greater Shepparton (Settlement Planning and Information Unit 2004). Thus, there is great ethnic diversity among the residents of the City of Greater Shepparton.

The Australian Childhood Immunisation Register (ACIR) accepts reports of immunisation from all immunisation providers, for all children under the age of seven years whether or not they are enrolled in Medicare. As of December 2003, immunisations given outside Australia may also be recorded (Murray, Davidson & Skull 2003). Coverage reports are available from the ACIR which provide information about coverage rates in local government areas.

Coverage reports for the Greater Shepparton City Council indicated immunisation coverage rates higher than the Victorian average rates in all three age categories: 12 to 15 months (GSCC: 94.85%, State: 91.49%), 24 to 27 months (GSCC: 94.57%, State: 92.39%) and 72 to 75 months (GSCC: 86.55%, State: 85.86%) (Health Insurance Commission 2004). ACIR data is not available for specific ethnic groups although anecdotally there is some concern that ethnic families may not be immunising their children at the same rates as Australian born residents in Shepparton.

In order to understand why this may be the case one needs to have an awareness of the two major challenges facing the immunisation team in dealing with new arrivals and refugees:

- i. Communication with the ethnic families and
- ii. Ascertaining immunisation history. Communication between members of the immunisation team and ethnic families can be a barrier where at least one member of the family does not have a working knowledge of English and an understanding of immunisation. For legal reasons informed consent is required prior to immunisation. In cases where communication is unsuccessful, informed consent is unlikely to be achieved, and immunisation is therefore not administered. English literacy and/or literacy in one's own language can also be an issue for new arrivals and refugees, especially where written information is used. Ascertaining immunisation history for new arrivals and refugees can be challenging. For example, incomplete immunisation records are provided, records are in another language or immunisation status is not routinely assessed in children

and adults prior to entering Australia. For refugees, due to the nature of fleeing a country of persecution and transit, records for immunisation are often unavailable. Additionally, self reported immunisation history has often been shown to be unreliable. Further, immunisation coverage is often low due to vaccines not being available or different vaccination schedules in the country of origin (Murray & Skull 2002). Where immunisation documentation is invalid or incomplete, a catch up program needs to be designed for the individual. This study examines childhood immunisation service needs of ethnic families in the City of Greater Shepparton.

Methods

Participants

This is a cross-sectional study of client feedback aiming to improve immunisation program delivery to ethnic families. The study population is ethnic families living in the Greater Shepparton area. Comparisons with families attending usual immunisation sessions or Maternal and Child Health Centres were also made in order to identify current service gaps. Participants in the study consisted of i. Study Group (SG) and ii. Control Group (CG). The SG was recruited from ethnic families who live within the City of Greater Shepparton and who used the services provided by either the Ethnic Council of Shepparton and District Inc. (Ethnic Council) or the Multicultural Education Centre Goulburn Ovens Institute of TAFE (MECGOIT). The CG was recruited from families who attended one of the Council's immunisation sessions or Maternal and Child Health Centres (MCHC). The SG included new arrivals and refugees as well as families who had lived in Australia for some years. The SG was recruited for an interview by staff at the

Ethnic Council or the MECGOIT. A self-administered questionnaire was provided to the CG participants when they used these services. Nine mobile immunisation sessions are conducted each month at eight urban and rural venues spread throughout the municipality. The Maternal and Child Health Service (MCHS) is comprised of 16 MCHC located in both urban and rural locations throughout the municipality. Participation in the study was entirely voluntary and the study was conducted between October 2003 and April 2004.

Questionnaires

The questionnaire that was developed to interview the SG was based upon a pre-existing questionnaire designed for the CG which had already been used and tested as part of the study. The pre-existing questionnaire featured questions that utilised a Likert scale for answers, however, the questionnaire used with the SG did not use a Likert scale. The two questionnaires featured common questions, both open and closed, to gather the following information: attendance at a Greater Shepparton City Council immunisation session, venue attended, source of information about the immunisation session, age of the individual immunised, suitability of current session times, most convenient day, most convenient time, preferred time for an evening session and whether an evening session would be attended if held monthly. Additional questions were developed for the SG, including: whether the individual had been immunised overseas, rating of service by Health Department staff, whether information was received at the session, if information was received whether it was easy to understand and available in a language familiar to their family, if information was not available in a familiar language what is the preferred language, the need for a professional interpreter at the immunisation sessions, and the preferred language.

Partnerships

The Ethnic Council was approached about potential involvement in the study and agreed to interview ethnic families. A presentation about the project was made at a meeting of the members of the Ethnic Council to advise them about the study. At this meeting, a representative of the MECGOIT offered to assist with additional interviews of ethnic families and these additional interviews were conducted. The Ethnic Council in Shepparton is a key provider and a 'safety net' for many new arrivals and refugees. 'Settlement', 'Family' and 'Children' are the Ethnic Council's three main service categories. A core business of the Ethnic Council is to meet the needs of ethnic families, including access to immunisation services. 'Immunisation' and 'Maternal and Child Health' are included under the area of Family Services. The Ethnic Council in Shepparton represents some 28 different ethnic communities. At the time of this study, the predominant ethnic groups who used the services provided by the Ethnic Council in terms of numbers were the Iraqi and Albanian communities with other nationalities represented but in smaller numbers (Personal Communication, Rhonda Ramadan, Ethnic Council of Shepparton and District Inc.). The Goulburn Ovens Institute of TAFE is one of the largest TAFE Institutes in northern Victoria with a major campus in Shepparton and a major provider of English classes to new arrivals. The Multicultural Education Centre at the TAFE conducts a range of English classes as a Second Language in conjunction with the Adult Migrant Education Service (AMES).

Data analysis

Quantitative data was entered into Excel spreadsheets and percentages of respondents were calculated. Individual comments, that is qualitative data, from participants were collated and analysed manually.

Results

In terms of the CG, a total of 101 families were invited to complete a questionnaire on the spot at either an immunisation session or during a Maternal and Child Health Centre consultation. All 101 families responded by completing the questionnaire. Forty-two (26, Ethnic Council; 16, MECGOIT) ethnic families took part in the survey and agreed to be interviewed. Table 1 compares responses to common questions between the two groups.

Table 1: Results of common questions asked of the control group and the study group

	Study Group (n=42)	Control Group (n=101)
Had attended an immunisation session in the City of Greater Shepparton	27 (64%)	93 (92%)
Had attended a session at the Shepparton immunisation venue	27 (64%)	71 (70%)
Source of information about immunisation sessions was the Maternal and Child Health Centre	17 (40%)	59 (58%)
Individual immunised aged 0-5 years	26 (62%)	60 (59%)
Considered current immunisation session times as suitable	21 (50%)	93 (92%)
Considered Monday the most convenient day for an immunisation session	5 (12%)	33 (33%)
Considered Thursday the most convenient day for an immunisation session	5 (12%)	24 (24%)
Preferred time for an evening session 5.30pm	14 (33%)	73 (72%)
Would attend an evening session if available once a month	17 (40%)	65 (64%)

Responses to additional questions for the SG are shown in Table 2.

Table 2: Results of questions asked of the study group only

	Study Group (n=42)
Individual immunised overseas	9 (21%)
Rated service by Health Department staff at the immunisation session as excellent, good or very good	31 (74%)
Received information about immunisation at the session	25 (60%)
Information received was easy to understand	20 (48%)
Information received was available in a familiar language	12 (29%)
Need a professional interpreter at the immunisation session attended	12 (29%)

Discussion

The response rates for both the CG and SG were comparable in that every family invited to participate in the study agreed to do so (CG: 101 families, SG: 42 families). The response to the questions asked of both groups was very similar. These findings indicated that most participants were satisfied with the current immunisation service. The sessions held at the Shepparton venue were the most highly attended by both groups. The participants in the SG had only attended the urban based sessions held at Shepparton and Mooroopna. This may reflect the fact that most of the population is based in the urban areas as immunisation sessions are readily accessible for families in outlying towns. Of those 36% in the SG who had not attended a Council immunisation session, the two main reasons for not attending were that they had visited their family doctor or they did not know about the session. Participants in both groups had found out about the immunisation sessions predominantly through the MCHC. From these results, it can be seen that the Council's MCHC play a key role in the provision of information about immunisation to families in the community.

Participants in the CG indicated Monday as their preferred day for an immunisation session, followed by Thursday. The SG equally preferred Monday, Thursday or Friday. Currently, immunisation sessions are held on a Tuesday (Tatura, Merrigum, Murchison), Wednesday (Mooroopna) and Thursday (Shepparton, Katandra, Tallygaroopna and Dookie). No sessions are currently held on a Monday. Morning was the preferred time of day for immunisation sessions for both groups. All of the nine immunisation sessions conducted by the immunisation team are currently held in the morning. Most participants from both groups indicated that they would attend an evening immunisation session, if held monthly. The preferred time was 5.30 pm which is after work for many

parents/guardians but before the evening meal.

Results specific to the SG indicated that there is room for improvement in the provision of information in different languages. Only 29% of the participants indicated that they had received information at the immunisation session in a language familiar to their family. The study results confirmed that the major ethnic groups attending the immunisation sessions are the Iraqi, Albanian and Turkish communities with a small number of participants from other ethnic groups. Immunisation information is currently available at the sessions in the Arabic language, for the Iraqi community, and Turkish language but not in Albanian. Opportunities for the improvement of the provision of information for ethnic families included: i. for the Department of Human Services Immunisation Program to translate immunisation fact sheets into Albanian; ii. the development of an information video about immunisation to families in relevant languages; iii. the use of ethnic television and/or radio programs; and iv. education sessions about immunisation targeted at ethnic families in relevant languages. These education sessions could include facts about immunisation and information about immunisation services.

The Greater Shepparton City Council's Health Services Immunisation Program 2004 listing the venues, dates and times of the Council's immunisation sessions has been translated into Arabic, Turkish and Albanian. Although most ethnic families indicated that they did not require a professional interpreter (45%), 29% indicated that they did need an interpreter. The need for an interpreter may be addressed if immunisation education sessions were conducted prior to families attending an immunisation session.

Concern has been expressed by the Greater Shepparton City Council's Health Care Access Task Force Group, under the Greater Shepparton Public Health Plan

2002-2004, about low immunisation coverage rates for families in the North Shepparton area. This issue has not been covered in this project; however, it is acknowledged that further work needs to be done in this area.

In general, most clients were satisfied with the Council's immunisation service. Areas identified for potential improvement in service delivery arising from this study are: i. The development of a working partnership between the Council's immunisation team and Maternal and Child Health Service; ii. The development of a working partnership between the Council's immunisation team and the Ethnic Council of Shepparton and District Inc.; iii. The development and adoption of education sessions for ethnic families prior to immunisation; iv. Provision of training in cross-cultural communication for members of the immunisation team, and v. Provision of an evening immunisation session once a month for all clients. These recommendations were derived by the authors of this paper.

MCHC play a key role in disseminating information to all families about the Council's immunisation service. A working partnership between the immunisation team and the MCHS must consider integration between the existing services provided by each department. The Ethnic Council has already included an article on the Council's immunisation service in their newsletter and has requested an information session on immunisation to be presented by a Health Department staff member. A working partnership between the immunisation team and the Ethnic Council in Shepparton must consider service gaps, especially culture and language specific requirements currently being addressed by main stream services. The Department of Human Services Hume Region has expressed interest in working collaboratively with the Greater Shepparton City Council's Health Department and the Ethnic Council to improve immunisation service delivery for ethnic families. Effective

service delivery rests on clear communication between the immunisation team and ethnic families. Clear communication can be achieved through an improved understanding of immunisation and immunisation services by ethnic families, as well as a working knowledge and skills in cross-cultural communications within the immunisation team. Currently, written information about immunisation is provided at the immunisation sessions both in English and different languages. Information dissemination alone does not lead to an understanding of immunisation and immunisation services; especially if the person cannot read in English or in their own language, or is unfamiliar with immunisation and immunisation services in the City of Greater Shepparton. Education sessions about immunisation and immunisation services in relevant languages prior to families attending an immunisation session can provide ethnic families an opportunity to understand and appreciate the service. In this way the study looks at specific ways that immunisation services can be made more inclusive by addressing real barriers that people face in immunising their children. The literature review and the results of the study indicate that the two most prominent ethnic groups within the City of Greater Shepparton are the Iraqi and Albanian communities (Personal Communication, Rhonda Ramadan, Ethnic Council of Shepparton and District Inc.). Cross-cultural training for the immunisation team can act to improve cultural awareness and sensitivity and in turn improve service delivery for ethnic families. Cross-cultural communication training must consider the different needs of diverse groups of settlers in the City of Greater Shepparton and that the mix of such diversity has its currency of immigration cycles. The findings of this study together with anecdotes indicated the need for a monthly evening immunisation session. A monthly session must be monitored and evaluated, and consider seasonal variation of needs. As a cross-

sectional study of client feedback, the findings of this study assisted the Council in addressing immunisation service gaps. The study subjects were relevant to the current migration mix in the City of Greater Shepparton. The results of this study may not be generalisable to other ethnic populations, as the service needs vary amongst ethnic populations. As an integral part of Council's Municipal Public Health Plan, a regular review of immunisation program service delivery is highly desirable. The study provides useful feedback on a partnership approach between local government and two ethnic service providers - the Ethnic Council and the Multicultural Education Centre Goulburn Ovens Institute of TAFE. This partnership model would be useful in other localities as a way of including feedback from a range of cultures and nationalities in making a service more inclusive and culturally relevant.

Recommendations

Five recommendations for improvement in service delivery have arisen from this study. They are: i. The development of a working partnership between the Council's immunisation team and Maternal and Child Health Service; ii. The development of a working partnership between the Council's

immunisation team and the Ethnic Council of Shepparton and District Inc.; iii. The development and adoption of education sessions for ethnic families prior to immunisation; iv. Provision of training in cross-cultural communication for members of the immunisation team; and v. Provision of an evening immunisation session once a month for all clients.

Conclusion

This study involved a collaboration between the Greater Shepparton City Council's Health Department, the Greater Shepparton City Council's Family and Children's Services and the University of Melbourne, Department of Rural Health. While most participants were satisfied with the current immunisation service, recommendations have been derived by the authors of this study that will aim to improve service delivery. These recommendations are being made to the Greater Shepparton City Council and they are based on evidence arising from the current review of the immunisation service. The implementation of these recommendations is an integral part of an immunisation service improvement program to address service gaps for ethnic families in the City of Greater Shepparton.

Acknowledgments

The authors would like to thank the families who participated in this study and staff from specific organisations who assisted with different aspects of the project. The staff involved were Kathleen McBain (Greater Shepparton City Council), Morrie Ramadan, Rhonda Ramadan, Jo Tartaglia, Virginia Contreras, John Coghlan, Leiona Cocker (Ethnic Council of Shepparton and District Inc.), Brenda Freeman (Goulburn Valley Health), Vicki Mitsos, Rosemary Refat, Intesar Moosawy, Judith Poole and Jennifer Joyce (Multicultural Education Centre Goulburn Ovens Institute of TAFE), Joanne Jordan, Helen Pitcher and Stephen Pellissier (Victorian Department of Human Services), Pota Froutzis (Health Insurance Commission).

Epilogue

At the time of preparing this paper, recommendation v. is being implemented with monthly evening immunisation sessions commencing from June 2004. A trial monthly immunisation session in the North Shepparton area is also planned for implementation in partnership with the Council's Maternal and Child Health Service.

The findings and recommendations of this project were presented as an oral poster presentation at the IUHPE 18th World Health Conference on Health Promotion and Health Education held in Melbourne, Australia, 26-30 April 2004.

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Effect of Copper on Growth and Laccase Production in Selection of *Pleurotus sajor-caju* for Bioremediation Studies

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The white-rot fungi Pleurotus sajor-caju and Hericium erinaceus were examined for their growth on malt extract agar and malt extract broth and for oxidase activity for possible use in bioremediation. Both grew well in the pH range 5 - 6 and showed enzyme activity. Pleurotus sajor-caju showed superior growth properties, particularly at pH 5 and evidence of a very active oxidase on the solid medium. Hericium erinaceus had a less reactive oxidase. Oxidase activity of Pl. sajor-caju was then examined in the liquid medium supplemented with copper ion to investigate the likely presence of laccase, a copper containing oxidase enzyme. The copper had little effect on the production of biomass but stimulated the production of the enzyme by approximately 100%. Analyses, conducted in the presence of an active catalase from Aspergillus niger, were of the same order as assays in the absence of the hydrogen peroxide metabolising enzyme suggesting that the enzyme was a laccase. A possible role for Pleurotus sajor-caju and its laccase in bioremediation of heavy metals, and detoxification of environmental organic pollutants, is considered, especially where the heavy metal, copper, may be present at greater than normal biological levels.

Key words: Pleurotus Sajor-caju; Copper ion; Laccase; Biomass Production

The work described in this paper has been directed towards the bioremediation of contaminated sites using organisms that are capable of producing laccase. Since laccase is a copper enzyme the effect of copper ion was assessed on the growth and laccase production on solid and in liquid cultures of two organisms belonging to the white-rot fungi as a prelude to investigating their role in a bioremediation process.

The three major ligninolytic enzymes are manganese peroxidase, lignin peroxidase and laccase. They are widely found in the white-rot fungi and may work cooperatively during lignin degradation. Manganese peroxidases are Mn-requiring extracellular haem enzymes (Glenn & Gold 1985) where the manganese as the oxidised form (Mn(III)) acts to initiate the ligninolytic oxidative reaction (Glenn, Akileswaren & Gold 1986). However, laccase has been shown to degrade lignin in the absence

of the other two enzymes (Have & Teunissen 2001).

White-rot fungi have been used to metabolise and degrade toxic organic chemicals (Bumpus et al. 1985). Fungal metabolism requires trace metals that may help to increase growth in low concentrations but be toxic to the fungus if in excess (Baldrian 2003). Copper, in particular, can cause severe oxidative damage to enzymes and the environment. It is toxic to humans in relatively small amounts, but low concentrations, in many instances, have been shown to stimulate extracellular laccase production without affecting moulds (Baldrian 2003; Hatvani et al. 2002; Hatvani & Mécs 2003; Leatham & Stahman 1981).

Laccase activity is thought to be induced in *Pleurotus sajor-caju* in response to copper ions in the growth medium (Palmieri et al. 2000). Copper may stabilise laccase activity

in vitro (Leatham & Stahman, 1981) and it has been suggested that the enzyme may act to chelate copper ion in an induction process (Soden & Dobson, 2001). The effect of manganese, zinc and a number of organic chemicals has been examined using the same organism (Soden & Dobson 2001). *Herecium erinaceus* was examined because, as a white-rot fungus that grows on lignin, it might possibly contain the enzymes necessary for lignin substrate degradation.

Methods

A range of chemicals and mycological and analytical enzymic methods was used in the development of the project. The methods included procedures for growth under specified conditions, assessment of growth by dry weight determinations and analysis for oxidase activity.

Chemicals and instrument

Copper sulphate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) was purchased from BDH Chemicals, Media (malt extract broth-MEB) and MEA were obtained from Oxoid, Australia and Boehringer brand 2,2'-azino-bis-(3-ethyl-benzothiazoline-6-sulphonic acid) diammonium salt (ABTS) was used for detection of oxidase activity.

A Cary 3E UV-visible spectrophotometer was used throughout.

Fungi

Pl. sajor-caju and *H. erinaceus* were investigated. The fungi were maintained at 4°C on malt extract agar (MEA). One 5 mm diameter plug of the MEA was taken from the growing front of the mould on the plate and used as a central inoculum when solid media was used or as a single inoculation for liquid media (Lonergan et al. 1995).

Growth of fungus

MEA was generally adjusted to pH 5 and 20 mL aliquots dispensed into Petri dishes after autoclaving at 115°C for 10 min. To examine the optimum conditions of growth

and enzyme production the agar was adjusted to pH values of 4, 5, 6, 7 or 8. Sterile MEB was used in 20 ml aliquots in 100 ml Erlenmeyer flasks after adjustment to pH 5 and autoclaving at 115°C for 10 min. Flasks were incubated at 20°C, 25°C, 30°C and 35°C respectively.

Measurement of growth

Growth was measured by the diameter of the radial growth that occurred after central inoculation of a plug containing the fungus onto the MEA plates. Measurements were made on triplicate plates every second day for 17 days.

Growth in liquid cultures was measured from dry weight determinations. A similar plug to the above containing fungal growth was also used to inoculate the sterile MEB in Erlenmeyer flasks (in triplicate). In experiments involving Cu(II), using *Pl. sajor-caju*, the trace metal was added to the broth at 10, 20, 40, 60 and 80 µg/ml concentrations. Flasks were incubated in the dark and growth recorded by visual inspection.

For dry weight determinations, the inoculated flasks were incubated for 60 days at 25°C. Seventy-two flasks were used and half (36) contained copper. Triplicate samples were taken at day 4, 10, 16, 19, 20, 22, 25, 28, 31, 40 and 60. They were filtered through Whatman filter paper (0.45 µm). The filtrate was collected for enzyme analysis and stored at 4°C. The contents of the filter paper was washed three times with 10 ml of deionised water, and the biomass determined after drying at 50°C to constant weight.

Measurement of oxidase activity against ABTS

Organisms were tested qualitatively for oxidase production by scraping the mycelium from the culture and adding 0.1 ml of an ABTS solution (1 mg/ml) to the exposed agar underneath and examining for colour development.

The activity of oxidase was measured as described by Niku-Paavola (1990) and enzyme activity was expressed as units/ml

where 1 unit (U) is the amount that catalyses the oxidation of 1 μmol per min at room temperature. Because heavy metals were present the later estimations were performed with EDTA in solutions which also contained catalase from *Aspergillus niger* to ensure that the H_2O_2 had disappeared (Baker et al. 1995) and hence oxidase activity (most likely laccase) was being measured. On sampling days triplicate 200 μl samples were taken with a sterile pipette, centrifuged for 5 min (13,000 rpm) and the supernatant fluid used for assay.

Results

Growth of organisms in presence and absence of copper ions

The organisms were tested for temperature and pH effects on growth using MEA. All fungi showed maximum rate of growth at 25°C. *H. erinaceus* grew well at pH values of between 5 - 6 while *Pl. sajor-caju* grew more rapidly at pH values between 5 and 8 but more slowly at pH 4. The most suitable growth temperature of each organism on solid medium was at 25°C although they could grow quite well to 35°C (Table 1). Above this temperature radial growth was much slower.

Table 1: Effect of temperature on radial growth (mm) of *Pl. sajor-caju* and *H. erinaceus* on Malt Extract Agar (pH 5)

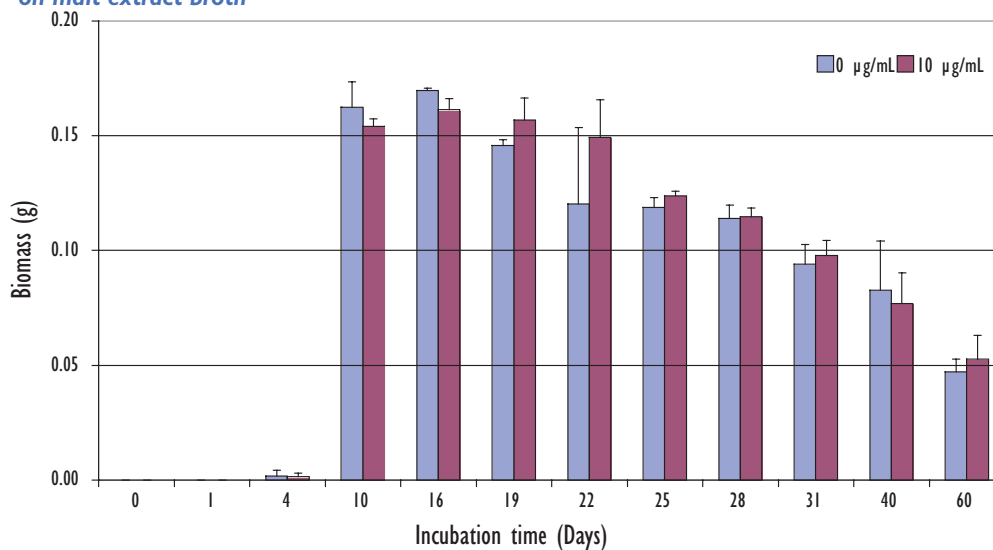
Temperature	<i>Pl. sajor-caju</i>	<i>H. erinaceus</i>
20	44 \pm 45	32 \pm 13
25	81 \pm 2	42 \pm 2
30	72 \pm 7	38 \pm 7
35	56 \pm 4	18 \pm 6

Growth on liquid medium

H. erinaceus grew very slowly on MEB requiring 18 days to give confluent surface growth. By day 40 the *H. erinaceus* showed some sites of tissue differentiation with primordia formation and the beginning of fruiting body formation. *Pl. sajor-caju* grew more rapidly on the liquid medium than *H. erinaceus*. Biomass was negligible on day 4 of the incubation but within the next 6 days growth was prolific (Figure 1). The surface was completely covered after 12 days and maximum biomass was obtained after 16 days. Mycelium mass seemed to diminish after 30 days and was followed by differentiation of the hyphae probably related to primordia formation.

The presence of Cu(II) in the medium only had a marginal effect on biomass

Figure 1: Measurement of dried biomass with incubation time for *Pleurotus sajor-caju* grown on malt extract broth



First column in each category (■) refers to organism grown on the absence of Cu(II) and second column (■) in the presence of 10 $\mu\text{g/mL}$ Cu(II).

accumulation but stimulated oxidase activity (see below). The marginal increase in the biomass produced after day 10 did not justify an extension of the incubation beyond that time.

Detection of oxidase

Using the spot oxidase test, described above, *Pl. sajor-caju* very rapidly oxidised the indicator agent. *H. erinaceus* also oxidised the ABTS suggesting that an oxidase was present in these two organisms. This was confirmed by examination of the liquid cultures which showed maximum quantitative activity at 20 days but which declined over 30 and 40 days.

Pl. sajor-caju was used for further investigation because it demonstrated relatively rapid and very consistent growth on the liquid medium and a very rapid response to the oxidase reaction.

The effect of Cu(II) on oxidase activity of *P. sajor-caju*

Soden and Dodson (2000) showed that Cu(II) at 300 µM (19.4 µg/ml) induced laccase activity 4.9 fold. This is a rather high biological concentration of a trace metal. In their work the effect was not correlated with the amount of biomass production. An investigation of the optimum concentration of Cu(II) showed that after 10 days growth the maximum enzyme activity was seen in the fungal broth containing 10 µg/ml Cu(II). Twenty µg/ml Cu(II) gave marginally lower results (Table 2) and activity was lower in solutions with Cu(II) between 40 - 80 µg/ml. Although the biomass was declining after the sixteenth day of incubation, the enzyme levels were still quite high, especially in the flasks containing the Cu(II) (Table 2).

Cu(II) (10 µg/ml) induced oxidase activity by over 100% over controls but had no effect on biomass lacking the trace element (Table 2).

Very little difference was noted in results when the assay mixtures contained catalase. For example, an assay of the broth from a 20 day culture (no Cu(II)) gave 0.08 units/ml

Table 2: Oxidase activity of *Pl. sajor-caju* grown in presence of Cu(II)

Cu(II) µg/mL	Activity of Extracellular Fluid (Units/ml)		
	Day 10	Day 20	Day 30
0	0.04 ± 0.01	0.1 ± 0.02	0.08 ± 0.01
10	0.16 ± 0.09	0.23 ± 0.06	0.19 ± 0.03
20	0.14 ± 0.02	0.2 ± 0.02	0.19 ± 0.05
40	0.08 ± 0.07	0.15 ± 0.01	0.12 ± 0.02
60	0.07 ± 0.06	0.15 ± 0.10	0.13 ± 0.07
80	0.06 ± 0.02	0.19 ± 0.02	0.17 ± 0.01

±0.02 in the absence of catalase and 0.08 units/ml ±0.02 in its presence. The respective enzyme activities in the solutions containing Cu(II) were 0.15 units/ml ±0.01 and 0.16 units/ml ±0.02. As the catalase is a very active enzyme against hydrogen peroxide it is concluded that the observed oxidase activity was due to a laccase, a copper containing enzyme but it is uncertain whether Cu(II) is solely incorporated into the fungal laccase (Soden & Dobson 2001) or adsorbs to the mycelium as well.

Discussion

Soden and Dobson (2001) have shown that laccase isozymes of the fungus *Pl. sajor-caju* are induced by carbon, nitrogen, Cu(II), manganese ion and 2, 5-xylidine and 4-hydroxy-3-methoxycinnannamic acid. Induction occurs at the level of gene transcription. The growth of the fungus was undertaken in a low carbon and nitrogen medium containing 300 µM Cu(II). This level of copper is considerably higher than biological levels (Underwood 1977) and potentially dangerous to health.

Laccase from *Pycnoporus cinnabarinus* has been used to decolourise a number of industrial dyes (Lonergan et al. 2001; Schliephake et al. 2000). Laccase has also been used to detoxify a number of industrial effluents (Blanchette et al. 1992). Many industrial effluents contain high levels of metals that are expected to be quite toxic to microorganisms. Growth of *Lentinus edodes* was sensitive to cadmium and mercury but less sensitive to copper (Hatvani & Mécs

2003). However, all heavy metals increased laccase production by this organism (Hatvani & Mécs 2003).

In the present work, using *Pl. sajor-caju*, an increase in extracellular oxidase activity was noted as the copper ion increased to a non-biological concentration of 20 µg/mL. However, there was only a marginal increase in biomass of the fungus. This significant increase in oxidase activity in the presence of Cu(II), without biomass production, could be useful in bioremediation of contaminated sites (Blanchette et al. 1992; Bumpus et al. 1985) and is a significant gain with respect to solid waste minimisation. It suggests a possible usage of this organism and its laccase for detoxification of environmental organic pollutants and dyes especially under conditions where the heavy metal, copper, may be present in concentrations greater than the usual

biological level. This fungal laccase seems particularly suitable for purification, immobilisation and recovery and re-use experiments (Leonowicz, Sarkar & Bollag 1988) either in columns or in batch processes.

Conclusion

Pl. sajor-caju was superior to *H. erinaceus* in the growth and production of a laccase. Addition of copper ion to the growth medium did not significantly affect the biomass of *Pl. sajor-caju* but it did stimulate the production of the oxidase by about one hundred percent. Analyses performed in the presence of an active catalase did not affect the results tending to identify the oxidase as a laccase. This enzyme may possibly have a role in the bioremediation of sites contaminated with copper.

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Knowledge for Practice: Information Needs of Environmental Health Practitioners for Indigenous Communities

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This paper presents the findings of a study into the information needs of Indigenous Australians who study and/or work in the field of environmental health. A questionnaire concerned with computer use, information need and recent on-the-job experiences from practitioners and students Australia-wide was used to source data. Respondents from remote, rural and urban locations were targeted using a multi-recruitment strategy. The results show that Indigenous practitioners across all locations identified a need for technical information covering a broad range of environmental health issues. Respondents wanted to learn from the experiences of others and placed a high value on Indigenous specific case studies from the field. In addition they desired strategic knowledge and resources to support program planning and action; development of their profile within the community; and raising environmental health awareness amongst their people. The findings confirm that current professional development and networking opportunities for community practitioners are few and that relevant and useful educational resources are limited for practitioners-in-training. An Internet resource is put forward as one potentially powerful means of filling this knowledge, practice and communication void. The study has reinforced the need for a dedicated, user-friendly environmental health information resource for Indigenous users - a resource that could see the students and practitioners themselves as key contributors.

Key words: *Indigenous Practitioners; Indigenous Environmental Health; Knowledge; Practice*

The need for supportive environmental health programs in Indigenous communities is most recently reflected in the Steering Committee for the Review of Government Service Provision (2003) identifying environmental health systems as one of seven strategic areas for action in overcoming Indigenous Disadvantage. As a key environmental health justice issue the enHealth Council (2000a), Australia's lead agency in environmental health, has called upon Indigenous communities, Indigenous organisations and government at all levels to collaborate to address the key environmental health determinants of Indigenous health. A central player in any such successful collaboration is the Environmental Health Worker. These mostly community-based practitioners have repeatedly been identified

as key on-the-ground agents for positive public and environmental health change in community settings (ABS & AIHW 2003; Bailie et al., 2002; Clark 1999).

Well before the development of Australia's first National Environmental Health Strategy (NEHS enHealth Council 1999) there was wide recognition for the need for an Indigenous environmental health policy, particularly one with significant Indigenous ownership (Brown, Nicholson & Stephenson 2002). There is now a dedicated section for Indigenous environmental health in the NEHS and a strong Implementation Plan, one that has a funding allocation in the Federal Budget to address environmental health justice issues for the first time in history (Stephenson 2002a). During the mid to late 1990s State, Territory and

Commonwealth health agencies began developing and refining mechanisms to assist Indigenous practitioners deliver environment and health programs at the local scale at the same time as they increased practitioner representation and support at state and national policy development levels. A range of interrelated issues concerning environmental health development in Indigenous communities nationally has come under the spotlight throughout this period. Some of these include:

- an analysis of environmental health services and gaps to services in Indigenous communities (urbis keys young 2002)
- an exploration of education and workforce capacity building issues (Stephenson 2002b)
- a Commonwealth Government review of education and training, employment and career pathways, government and professional support structures, and decision-making processes (enHealth Council 2004)

The enHealth Council, together with State and Territory health departments and the Australian Institute of Environmental Health, now sponsor a National Indigenous Environmental Health Forum with Indigenous representation from each State and Territory. This Forum provides advice on Indigenous environmental health issues direct to the national enHealth Council and steers a biennial national conference series for practitioners and policy makers.

At one such conference, in Alice Springs in 2000, practitioners called for, in part, “a central national information resource on Indigenous environmental health [to] be developed” (enHealth Council 2000b). In 2001, with ATSIC and the Commonwealth Department of Health and Ageing support, the Regional Integrated Monitoring Centre

at the University of Western Sydney (UWS) commenced development of this resource. A national survey of potential users of the resource was administered in 2002, the findings of which form the basis of this paper. The survey aimed to gain direction and advice on content needs and preferred delivery methods from its end users.

Method

A questionnaire and dissemination plan was developed so as to determine from the prospective users the scope and nature of material and resources to be included and how the information should best be presented and distributed. Ethics clearance was granted through the Human Ethics Research Committee at the University of Western Sydney.

Questionnaire

A 30-item questionnaire was developed and pilot tested using a sample of approximately 25 students studying environmental health at tertiary level. The survey contained descriptor items related to socio-demographic characteristics, work history and educational qualifications. The survey contained the following domain areas: computer use, information needs and most recent environmental health issues encountered in the workplace. The items were derived from over six years of experience by the research team in Indigenous environmental health issues and were refined through feedback from students involved in the pilot testing. All responses were confidential.

Sample size

The questionnaire sought the views of Indigenous people who work or study in the area of environmental health. An estimate of the possible sample size was calculated from a range of sources, including student graduation and enrolment lists and health department mailing lists. The initial target

groups of this research were all of Aboriginal and Torres Strait Islander descent, grouped into 5 categories listed in Table 1.

Table 1: Questionnaire target groups and potential respondents

Category	Participants	Possible sample size nationally
1	Community-based Environmental Health Workers, operating mostly out of rural/remote/island communities	200
2	Environmental Health Workers with community based training now working for government health agencies	10-15
3	Environmental Health Workers currently undergoing formal community based training ¹	100
4	Qualified Indigenous Environmental Health Officers working in mainstream health agencies	6
5	Indigenous students and trainees currently undergoing accredited professional training	20

Note 1. some of these also fall into categories 1 and 2

Based on a recommendation from a steering group, a small sample of non-Indigenous professionals who work specifically in the field of Indigenous environmental health were sent the same questionnaire.

Dissemination strategy

Multiple sampling strategies were used to obtain responses from a broad cross section of Indigenous practitioners across remote, rural and urban locations. Accessing a reasonable sample size necessitated one, or a combination, of the following distribution regimes:

- Direct mail - using existing mailing lists of practitioners and students already on the investigating team's databases or through obtaining mailing lists from other organisations such as health departments in each State or Territory.
- Face to face dissemination - using classroom teaching time for students to complete the questionnaire and return directly to members of the investigating team.

- Dissemination through educational institutions - using key contacts in educational institutions to administer the questionnaire when students were in attendance at block release workshops.

Completed questionnaires could be faxed back to the University using a toll-free fax number or posted back using a postage paid pre-addressed envelope.

Statistical analysis

Completed data were analysed using SAS software. Chi-square analysis using Fisher's Exact Test was used at times to determine significance between respondent groupings, and was selected on the basis that it can be used effectively with low volumes of data.

Results

Response rate

An exact response rate is difficult to calculate because of the multiple dissemination approach, in particular, knowing with certainty the number of questionnaires distributed when using third parties such as teachers and lecturers in educational institutions. The following identifies the known response rate by each sampling strategy.

Direct mailing strategy

There were 143 questionnaires posted to Indigenous environmental health practitioners, of these there were 27 sent to an incorrect or old address and returned to sender, and 47 responses providing a response rate of 41%. Seventy-six questionnaires were sent to non-Indigenous environmental health practitioners and 34 were returned providing a response rate of 45%.

Face to face dissemination

Thirteen questionnaires were distributed during an environmental health workshop and all were returned providing a response rate of 100%.

Dissemination through educational institutions

Forty-two questionnaires were distributed to educational institutions and 23 were returned providing a response rate of 55%.

Overall, 247 questionnaires were distributed (wrong address is not included) and 117 questionnaires were returned, a response rate of 43%. Of the 117 returned, 113 (95%) met the inclusion criteria of needing to work in and/or study environmental health.

Socio-demographic variables

The majority of responses were from people who worked in Queensland (28%), Western Australia (24%), Northern Territory (17%) and New South Wales (14%). There were no responses from the Australian Capital Territory or from Victoria.

The majority of respondents was male (74%), was of Aboriginal or Torres Strait Islander descent (70%) and had either a certificate, diploma or university degree as the highest qualification (66%). Sixty percent of the respondents held a qualification in environmental health. Forty-nine respondents were studying toward a certificate or diploma (38%), a university undergraduate degree (36%) or a post-graduate qualification (18%). The majority of respondents had permanent full-time employment (68%) or full-time work on a long-term contract of more than 12 months (13%). Nine percent of the sample worked part-time.

Of the 107 respondents who identified the main location of their work: 39% worked in a remote location, 28% worked in a country location and 28% worked in a city location. Prior to administering the questionnaire it was felt that remote practitioners might experience great difficulty accessing resources for their work and study. The relatively high response rate from 'remote' practitioners thus enabled closer analysis of the results against locality of practice, with 'urban' and 'rural' results combined for comparison against 'remote' practitioner responses.

Computer use

A large number of the respondents had access to the Internet at work (70%) consistent with the fact that a high proportion (59%) held jobs in, or were funded by, government departments and regional agencies servicing the community practitioners, yet significant differences were found in the remote group with access to the internet at work. Table 2 describes the differences between 'Remote' and 'City/Rural' practitioner access to the Internet and e-mail at their workplace. Fewer remote practitioners had access to both the Internet and e-mail at work compared to practitioners working in city/rural locations. The majority of practitioners who did not have access to e-mail and Internet at work used a TAFE, college or university to gain access.

Table 2: Differences between city/rural practitioners and remote practitioners on access to the Internet and e-mail

Access to the Internet or E-mail (N=107)	Remote %	City/Rural %	TOTAL %
Internet access at work	23	47	70 ¹
E-mail access at work	31	49	80

Note 1. Significant at p<0.01

The majority of respondents stated that they enjoyed using the computer (93% from N=99) and that they would like to use the Internet more often for getting information about environmental health (95% from N=96). A self assessment of skill level by respondents revealed remote practitioners to be significantly less (at p<0.05) confident in their Internet experiences and abilities than those working in city and rural locations.

Information needs

The selection of thirty-seven (37) topic areas from which respondents could choose information needs is presented in Table 3. This list originated out of earlier nationwide consultations on environmental health practice (Brown et al. 2001; Nicholson

2001) and was further developed through literature analysis and field research (Stephenson 2002b). Results are listed in descending order of the most to least commonly identified topics across the full sample size. When broken down against locality, the three highest priority information needs for remote area practitioners are given as: (i) dust prevention and management, (ii) dog health, and (iii) housing design, construction and maintenance. City/rural practitioners on the other hand identified their top three information needs in the categories of: (i) pest control (ii) regulation and legislation, and (iii) septic and sewerage systems.

Table 4 lists in descending order the most to least useful means for information dissemination. The three most preferred means for information dissemination, across all respondents, included (i) fact sheets, (ii) documents to print out, and (iii) stories and case studies. Significant differences were found between remote practitioners and city/rural practitioners on three items. Remote practitioners had a significantly higher need for “Examples of similar work to what you do” while city/rural practitioners favoured “Reference list of where you can get information” and “Newsletters” in their work.

Table 5 illustrates the areas of work that respondents wanted the most help with. Both groups identified a broad spectrum of job-related activities for which they need assistance. Remote practitioners had a higher need for help than their city/rural counterparts in two distinct areas: (i) running groups and meetings, and (ii) securing resources to do the job (such as the phone, tools, or office support). The highest priority across the total group was for assistance in educating their communities about environmental health issues.

Table 3: Environmental health information need against locality of practice

Item	Remote Agree %	City/Rural Agree %	TOTAL Agree %
Pest control (n=100)	40	54	94
Regulation and legislation (n=97)	37	54	91
Water supplies (n=100)	38	52	90
Septic and sewerage systems (n=98)	36	53	89
Food safety (n=102)	39	50	89
Infectious disease control (n=99)	37	51	88
Dust prevention and management (n=94)	45	43	88
Hazardous waste (n=99)	40	47	87
Mosquito control (n=99)	34	53	87
Dog health (n=95)	42	44	86
Developing management plans (n=92)	38	48	86
Domestic hygiene (n=100)	40	45	85
Housing design, construction and maintenance (n=98)	41	43	84
Training opportunities (n=98)	37	47	84
Water safety (n=97)	35	48	83
Solid waste (n=100)	34	47	81
Developing grant applications (n=92)	37	41	78
Environmental pollution control (n=87)	33	43	76
Environmental management systems (n=95)	34	42	76
Environmental auditing (n=94)	34	40	74
Drug and alcohol issues (n=85)	33	40	73
Food availability (n=92)	36	37	73
Poisons (n=98)	33	40	73
Report writing (n=97)	33	40	73
Toxic chemicals (n=98)	32	41	73
Occupation health and safety (n=100)	35	36	71
Cyclone clean-up (n=71)	31	39	70
Cultural heritage (n=88)	32	36	68
Running meetings (n=92)	35	33	68
Family violence (n=73)	37	30	67
Social equity (n=93)	26	41	67
Air quality (n=93)	26	38	64
Energy efficiency in buildings (n=90)	33	30	63
Accident prevention (n=85)	29	33	62
Drowning (n=66)	26	26	52
Noise control (n=89)	18	33	51
Counselling services (n=103)	22	16	38

Table 4: Preferred mechanism for receiving information

Item	Remote Agree %	City/Rural Agree %	TOTAL Agree %
Fact sheets (n=91)	38	58	96
Documents to print out (n=96)	39	57	96
Stories and case studies (n=88)	39	57	95
Examples of work similar to what you do (n=94)	51	43	94 ¹
Links to useful websites (n=90)	37	57	93
Reference list of where you can get information (n=90)	39	54	93 ¹
Policy documents and guidelines (n=88)	36	56	92
Model designs and specifications such as graphics, photos and other images (n=93)	40	53	92
Newsletters (n=83)	37	51	88 ¹
Videos (n=92)	41	47	88
CD ROM (n=84)	35	50	85
Artwork (n=69)	38	42	80
Audio recordings such as lectures and people telling stories (n=79)	32	42	74

Note 1. Significant at $p < 0.05$

Table 5: Areas of practice that require help from others

Item	Remote Agree %	City/Rural Agree %	TOTAL Agree %
Pest control (n=100)	40	54	94
Educating the community on environmental health problems (n=99)	35	52	87
Researching problems and solutions (n=93)	35	40	75
Enforcing legislation (n=88)	34	34	68
Running groups and meetings (n=91)	34	33	67
Team building (n=92)	33	34	67
Securing resources to be able to do your job such as the phone, tools, or office support (n=83)	37	29	66
Fundraising (n=85)	31	34	65
Collecting information (n=93)	31	33	65
Speaking up for others (advocacy) (n=92)	29	30	59
Finding volunteers (n=87)	23	36	59

Discussion

The range of activities in which Indigenous environmental health practitioners could be engaged (see Table 3) demonstrates the cross-disciplinary, diverse and continually broadening nature of their work. Further, it illustrates the significant role they play in protecting public health through:

- creating and maintaining health hardware
- surveying the community environment
- coordinating or conducting minor repairs
- delivering community education (ABS & AIHW 2003; Bailie & Carson 2004; Heggie 2000).

A strong case exists for field practitioners to engage in regular networking and professional development in their specific field. However few opportunities currently exist for community practitioners to gain continuing professional development. In some jurisdictions post-study training or regional conferences and workshops are available. Queensland Health, for example, delivers workshops every six-twelve months in regional areas, with the central focus of the programs developed in consultation with practitioners and delivered with support from industry/technical experts. In other jurisdictions professional development opportunities are not as routine, are too expensive for community practitioners to attend, or are not available. Biennial national conferences specifically targeting Indigenous practitioners are highly valued as networking opportunities and as forums for sharing experiences, knowledge, skills and resources at the practitioner level. Costs associated with accommodation and travel to such conferences make attendance prohibitive for many students and practitioners. A strong argument therefore exists to provide community practitioners with a dedicated, reliable and interactive information resource - one that enables users to gain knowledge and share experiences, and one that can be accessed from the practitioners' home communities or local training venues.

The Internet can be a helpful tool in delivering such a resource in that it offers a rapid and useful means of information

distribution and exchange (Staton, Harding & Blackmore 2001). In Australia, the HealthInfoNet already acts as a major Internet-based clearinghouse on health related information for medicos and other health professionals working with Indigenous populations. The site claims to reach Indigenous health workers in community (HealthInfoNet 2003). As a successful Australian health-related website it provides valuable lessons for the development of a parallel and linked site for community-based environmental health practitioners and the professional environmental health network that services their communities. In order to respond to the concerns of Kostoloulos (1998) and White, Sheedy and Lawrence (2002) that telecommunications in remote areas are often under-developed, unreliable or too expensive, alternative or complementary strategies for information dissemination would also need to be developed. This might require for instance the distribution of CDROM versions of the website material to practitioners without Internet access. Update arrangements may need to be included in this option until greater network access becomes available to the most remote communities or server/browser incompatibility issues are addressed. Alternatively, where computer and Internet access is unavailable or where the practitioner is unskilled in the use of computer technology, some sections of the site might better be reproduced in hardcopy booklet form for distribution to practitioners in communities. In parallel, and in order to react to the high percentage of respondents who needed more training on the use of the Internet, the development of a web-based information resource would need to be accompanied by information technology training. Similarly, formal educational programs for environmental health workers would need to teach students to use the Internet in their study program and promote it as a tool of trade and as an on-going professional development device.

The preference of remote respondents to learn from the experience of others reveals an appreciation for the specific challenges of their peers, who tend to be burdened with day-to-day tasks in an environment of poorly defined roles and responsibilities and a limited sense of control over programs (Bailie & Carson 2004). It also points to the scarcity of useful, practical and relevant resource materials for the regional practitioners whose jobs seek to service a number of communities. With both remote and regional practitioners placing such a high value on case studies, fact sheets and other practice-oriented materials, the importance of a collaborative approach to resource development emerges. Such an approach could potentially see practitioners as co-developers of material where workplace and field challenges and responses become the feature of practitioner contributions.

When interpreting the results of this study, a number of factors need to be considered. First, a reliable estimate of the number of practitioners and students was not available at the commencement of the survey. This is because community environmental health positions tend to be insecure and underpaid (urbis keys young, 2002). There are many reported cases of community practitioners 'giving the job away' soon after completing their training; being 'poached' by other programs for better wages and career prospects; or simply having no job to go to once trained (Stephenson 2002a). This, combined with a history of weak strategic and policy support from both government and community, limited operating budgets, unclear work roles, poorly defined career pathways and undetermined award structures, has resulted in an unstable workforce population.

Second, the means of questionnaire dissemination depended greatly on the reliability of existing contact databases held in State and Territory governments, student attendance at 'block release' courses, and teacher involvement in the distribution and collection of surveys. The number of student

practitioners completing the survey was well below expectations because: 68 questionnaires were not distributed to students at one training venue due to staff illness; three other training providers (27 students in total) did not return completed forms and gave no explanation; and one trainer of remote students claimed that despite testing, the questionnaire was too complex for the community-based students of that region, that the survey would require too much time to translate, and that the environmental health workers in that region have no access to, or experience with, computer use and web-based technology. The exercise has confirmed the difficulty of obtaining an accurate number of Indigenous practitioners in the environmental health field, and has re-stated the challenge of accessing community practitioners through questionnaire instruments.

Finally, whilst respondents desired information resources on a comprehensive range of environmental health topics they also claimed a need for resources that supported them with program planning, action and review. On the one hand, there was a predictable demand for resources that relate to knowledge and skill development across all three key areas of day-to-day environmental health activities in communities, namely:

- health hardware and community infrastructure management in areas such as water supply; solid waste and sewage treatment and disposal; housing design, construction and maintenance;
- food safety promotion through community store improvement and public education in homes;
- infectious disease control through effective animal, pest and vector control.

On the other hand, practitioners prioritised a need for strategic tools and

techniques, those that could assist them to plan and act for sustainable change. The wide range of issues identified by respondents demonstrated their awareness of the scale and complexity of environment and health issues; the need for concerted and collaborative action; and the importance of systematic, coordinated approaches to change management in the community setting. This finding is consistent with the views expressed by a broader range of non-Indigenous groupings of environmental health stakeholders, including environmental health professionals, policy makers and community activists operating at local-global scales (Brown et al. 2001).

Conclusion

Despite increased attention to the field of environmental health practice for Indigenous communities over recent years, the job of the community based practitioner remains incredibly demanding, poorly recognised and under-resourced, particularly in the more remote regions of Australia. The establishment of an interactive information resource is viewed by the workforce itself as one of a number of strategies that could help address this problem and position the workforce to take an even more active role in overcoming Indigenous disadvantage.

The potential value and benefit of such a resource lies then as much in supporting Indigenous students and practitioners working at the community scale as it does those taking positions in government agencies and training institutions. Such a resource also has a role in educating mainstream professionals, program providers, community contractors, decision makers and funding agency representatives who work with community practitioners. The findings from this survey therefore sets the foundation for prioritising information needs and for developing a centralised, national resource on Indigenous environmental health.

Acknowledgments

Thanks go to the participants for their contributions to this study and the following educators for assisting with recruitment: Fred Joseph at Cairns TAFE; Melissa Elkin-Hawkins at University of Queensland and Greg McKonkey of Empowerment Education in Western Australia. Dr Maggie Haertsch is acknowledged for her work in questionnaire design and data analysis. The study was sponsored by the Aboriginal and Torres Strait Islander Services (ATSIS) and the Environmental Health Section of the Commonwealth Department of Health and Ageing as part of the Indigenous Communities Environmental Health Workforce Capacity Building Program at the University of Western Sydney.

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The Need for Continuing Professional Development for Environmental Health Officers

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Within the Australian environmental health profession many research papers have been published, which discuss the reintroduction and maintenance of a continuing professional development scheme (CPD) monitored by the Australian Institute of Environmental Health (AIEH). According to the Australian Institute of Environmental Health by-laws, continuing professional development is to be administered and reviewed by each state. This paper demonstrates the need for an effective continuing professional development scheme, and the necessity that a national body, such as the Australian Institute of Environmental Health, should instigate and control its implementation and maintenance.

Key words: Continuing Professional Development; Environmental Health Officer;
Australian Institute of Environmental Health

The field of environmental health is a diverse discipline, encompassing topics as broad as human health, environmental management, and regulation of legislation. Of the many attempts to define this field, perhaps the most encompassing definition is that provided by the World Health Organization (WHO): "The control of all those factors in man's physical environment that exercise, or may exercise, a deleterious effect on his physical development, health or survival" (Bassett 1995, p. xxiii).

People who work within this broad field are generally known as environmental health practitioners, within which the environmental health officer is but one profession. The National Environmental Health Strategy describes the role of environmental health officers as: "...covering the assessment, correction, control and prevention of environmental factors that can adversely affect health, as well as the enhancement of those aspects of the environment that can improve human health". It encompasses all the measures necessary to deal with issues such as environmental degradation and climate

change, and hazards including contaminated water and food, and chemical exposure (enHealth 1999, p. 3).

Environmental health officers play a key role in providing a safe environment for the general population. They are required to be highly skilled, well trained and possess a multitude of competencies to facilitate a healthy environment (Koren & Bisesi 1996). While the majority of training and education is acquired before entering the profession, ongoing personal and professional development is important to assist environmental health officers to continue to meet the ever-changing challenges of the vocation in Australia.

The National Environmental Health Strategy recognises this issue, reporting: "there needs to be a strong recognition that environmental health practitioners need to constantly update and adjust their skills and knowledge base" (enHealth 1999, p. 29). The Strategy goes on to identify that Continuing Professional Development (CPD) programs are an ideal way to assist environmental health practitioners to remain up-to-date with the many changes that occur within the field of environmental health (enHealth 1999).

The peak national body representing environmental health officers in Australia, the Australian Institute of Environmental Health (AIEH) currently operates a non-compulsory CPD program (enHealth 1999). The AIEH has a by-law, which requires each State Council to “administer and review the Continuing Professional Development Program for the State” (AIEH 1995, p. 4). In practice, however, this has not led to the operation of an effective continuing professional development scheme in all states, as Tasmania has not had a scheme for over three years (Stagg, D. 2003, pers. comm.).

Continuing Professional Development Programs

Before discussing the merits of CPD programs, it is important first to gain an understanding of what CPD programs actually are. The Chartered Institute of Environmental Health (UK) produces a detailed guidebook about CPD for its members. In the guidebook, the Institute defines CPD programs as:

The systematic maintenance, improvement and broadening of knowledge and skills and the development of personal qualities necessary for the execution of professional and technical duties throughout the practitioner’s working life (Chartered Institute of Environmental Health 2002, p. 2).

Various professional institutions, including the Australian Society of Certified Practising Accountants, the Chartered Institute of Environmental Health (UK) and the Institute of Engineers Australia, all implement mandatory CPD schemes. The promotion of a mandatory CPD program by these professional institutions is a mechanism to maintain the competence of their members and to keep them up-to-date with developments within their area of expertise.

The Chartered Institute of Environmental Health (UK) determines competence of their members, not only on the application of knowledge and skills which a professional

may be expected to possess, but also on the expectation of the consumer, which is a reflection of the current attitudes, beliefs and behaviours of society at large (Chartered Institute of Environmental Health 2002).

Components of a Continuing Professional Development Program

It has been noted above that a Continuing Professional Development Program offers the opportunity for practitioners to not only maintain, but also to update and improve their skills throughout their careers, allowing them to provide more valuable service to their profession and community. Consequently, we should consider the role and function of CPD in the field of environmental health, and this will be done by examining the following four key areas:

- the need to promote the field of environmental health as a profession;
- the need for environmental health officers to remain up-to-date with changing practices and technologies;
- the necessity of environmental health officers to remain up-to-date with legislative, regulatory and policy changes; and
- the need for environmental health officers continually to broaden their knowledge and skills to cope with occupational changes.

Professionalism

Are environmental health officers professional? This statement has created wide debate within the field of environmental health officers since the 1930s (Jeffes 1993). Jeffes (1993) states that there is no doubt that environmental health officers carry out their work in a professional manner, but that there are several structural

deficiencies within the vocation as a whole which underpins the acceptance of the vocation within the professional ranks. The Chartered Institute of Environmental Health (UK) (1999) states in its guidebook on CPD that two of the primary reasons for establishing the program were to assist members to demonstrate their professional competence to the general community, and to promote the vocation as a profession. Tenkate and Smith (2002) support this latter point by saying that most professional bodies acknowledge that there is a defined pathway toward the development, recognition and acceptance of a particular vocation as a profession, and this includes “the development of professional accountability through the development of ethical standards, practice standards, and continuous professional development” (Tenkate & Smith 2002, p. 81).

Harding (1998) takes this point further by stating that taking on the role of a professional also involves meeting a number of specific expectations and responsibilities. These responsibilities are mainly determined by society, which places a great deal of trust in professionals. Many community members regard professionals highly, largely because they perceive them as providing an ‘educated’ citizen’s opinion (Harding 1998).

From the above points it is therefore clear that continuing professional development programs have much to offer the field of environmental health in terms of it being regarded externally as a profession, and its members regarded as professionals.

Currency of practice and technology

A second area where a CPD can support environmental health officers is to assist them to remain up-to-date with new practices and technologies (Greenspan 1980). To enter the field of environmental health, one must undertake several years of tertiary education and training, and then back this up with the development and application of practical skills and knowledge

on the job. Due to the ever-changing nature of the profession, however, skills, knowledge and technologies can quickly date, thus a mechanism such as a continuing professional development program could play a vital role in assisting practitioners to update continually their skills and knowledge, and remain competent throughout their career.

An example of where an effective CPD program could assist environmental health practitioners quickly to grasp and apply new practices was the introduction of new guidelines for skin penetration, issued by the New South Wales Health Department in 1999. In 2000, Oberdorfer and Wiggers (2002) conducted a survey to examine how well environmental health officers understood the new guidelines. Oberdorfer and Wiggers (2002) found that of the 247 environmental health officers from local government and 30 environmental health officers from public health units surveyed, approximately 50-70% believed that they needed more skills to encourage compliance effectively among operators of places of skin penetration (Oberdorfer & Wiggers 2002). This suggests that not only was the initial transfer of information from the Department to the environmental health officers lacking in effect, but also the environmental health officers had not maintained their regulatory inspection skills to ensure compliance with the new guidelines. If these officers had been able to access a CPD program, they might have received ongoing training in regulatory inspection and achieved a higher compliance with the new guidelines.

Work done by Greenspan (1980) in the sciences further demonstrates the problems of keeping up-to-date in the absence of a formal ongoing development program. Greenspan (1980) found that due to the increase in technology, most scientists are technically obsolete within 10 years of graduation, as not only do they lack the latest information in their own technological fields, but they also might be unfamiliar with new technologies and sciences that have arisen since

graduation. Greenspan (1980) contends that the only way to avoid this is through continued education throughout a person's working life.

Policies, legislation, and regulations

Today's society sees rapid changes in policies, legislation, and regulations, and it is critical that all environmental health practitioners remain up-to-date with these changes. This is particularly important for those who deal with the public on a daily basis such as officers employed by local government (Warner 1992). Not only does policy and legislation change on a regular basis, but implementation of the legislation is also subject to increasing scrutiny, as Richards explains (2002, p. 13), "there are very few decisions, even those of a routine nature, that are not reviewable by some outside body such as the courts, tribunals and ombudsman".

In a different paper, Richards (1998) identifies and discusses the importance of environmental health officers accurately carrying out their requirements under law, and notes that failure to do so can result in officers being found negligent in a court of law.

Environmental health officers undertaking regular continuing professional development so that they remain aware of, and keep abreast of changes to policy, legislation, and regulations, could avoid situations such as these. A situation of concern was the recent change from the old *Food Act 1998* (Tas) to the *Food Act 2003* (Tas), which came into effect on the 15th October 2003. The new Act had several significant changes, however, only one training session was provided to assist environmental health officers to become conversant with its implementation, and this session was conducted over a month after the Act came into effect (Atkinson 2003). If a CPD program had been in place it would have been an ideal vehicle to offer more comprehensive training in a timely manner.

Broadening of skills and knowledge

The final key area in considering the merits of a continuing professional development program is that of broadening the skills and knowledge of environmental health practitioners. The importance of acquiring new skills and knowledge is demonstrated by the historic change in the role of the environmental health officer, from that of 'Sanitation Officers', dealing with the adequate removal of waste and disease prevention, to the role of 'Environmental Health Officers', which encompasses far more complex issues of environmental viability and human health (Purdom 1971). These changes have led to the need for officers continually to expand and develop their expertise, skills and knowledge to respond to and cope with the increased complexities and demands placed upon them (Bassett 1995).

A recent example where the need for ongoing training to assist environmental health officers adapt to meet new legislation is the transfer of the regulation of licences to 'muddy the water' under the new *Water Management Act 1999* (Tas). Before the new Act came into force, the State Department of Primary Industries handled these licences, however, the new Act delegated this responsibility to local government with the expectation that it would be enforced adequately within the planning scheme of each council (Harradine, A. 2000, pers. comm.). For councils, such as Meander Valley, their environmental health, engineering and planning officers, did not possess sufficient skills to meet the requirements of issuing such licences, and those officers had to seek additional training to acquire these skills. If a continuing professional development program operated by the AIEH had existed in Tasmania at the time, it would have been an ideal vehicle for the environmental health officers quickly and efficiently to gain the necessary knowledge and skills.

Conclusion

Rapid changes in the field of environmental health have resulted in a continual demand for environmental health officers to acquire and utilise new knowledge and skills to remain proficient (Tennant 1991). These changes have been brought about by legislative amendments, community and environment needs and technological progress. To meet this demand, environmental health officers must be able regularly to access appropriate training materials and information resources.

Continuing professional development programs are an ideal way to facilitate the transfer and uptake of new knowledge and skills in many professions, and it is

recommended that a CPD program would be of great benefit in the field of environmental health. A CPD program could also facilitate understanding of and ability to comply with regulatory duties, and assist practitioners to remain up-to-date with changing legislation and policies, and to maintain a more professional image.

A CPD program run by the State chapters of the AIEH may demonstrate to other professional entities that the AIEH takes seriously the continued challenge of maintaining the competency of its members, and will allow its members to project a more professional image of themselves to the community.

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Legislation (As amended)

Food Act 1998 (Tas) (repealed)

Food Act 2003 (Tas)

Water Management Act 1999 (Tas)

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Level of Lead and Cadmium in Chocolates, with an Emphasis on Children's Chocolates

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In 2001 a survey was conducted on the level of lead and cadmium content in chocolate and chocolate products sold at retail outlets in Western Australia to assess compliance with the requirements of the Australia New Zealand Food Standard Code and public health implications. Both lead and cadmium are known to cause degenerative health conditions in humans, particularly in young children where developmental processes may be hindered or interrupted by high levels of these metals in body systems. The survey focused on chocolates or chocolate products marketed to children. The maximum permitted level of cadmium is 0.5mg/kg, while the calculated maximum level of lead was determined to be 0.12mg/kg. The survey revealed that no chocolate products sampled were in excess of the statutory level for cadmium or the lead level calculated for chocolate. The survey data indicated 85% of product sampled was below 0.05mg/kg lead and 93% of product sampled was below 0.05mg/kg cadmium. A slight trend indicating higher concentrations of both contaminants in darker chocolate products was noted, however, this may not be an identifiable trend if more dark chocolate samples had been taken. These results provide evidence that although low levels of lead and cadmium are present in chocolate and chocolate products, the public health implications from lead or cadmium have been found to be low, even for vulnerable populations such as children.

Key words: Heavy Metals; Lead; Cadmium; Health Effects; MRL; Food Standards Code; Chocolate Products; Children

As a result of the Industrial Revolution in the 19th century, lead has become ubiquitous in the human environment (US Food and Drug Administration [FDA] 2001). Studies have shown that leaded gasoline as well as lead and cadmium in pesticides and fertilisers are likely sources of heavy metal contamination in chocolates (International Cocoa Organization [ICO] 2001). This may indicate a poor manufacturing process, inadequate equipment cleaning methods and ventilation or contamination of raw materials.

Lead is one of the most toxic heavy metals. It binds to haemoglobin and plasma proteins, causing inhibition in the synthesis of red blood cells. Long term exposure to lead results in impaired intellectual

development and brain tissue in the central nervous system, kidney and liver dysfunction, damage to reproductive organs, anaemia and metabolic deficiencies (USFDA 1998). Of particular concern are the organic lead derivatives that can interfere with mental development in children (National Lead Information Centre 2004).

Cadmium is a naturally occurring toxic metal. Industrially it is produced in large quantities as a by-product from the extraction of zinc and lead from ore. Two thirds of cumulative world production has taken place in the past few decades and concerns over its toxic effects are also comparatively recent. Cadmium is also present in phosphate fertilisers (Total Environment Centre 1998).

Some of the chronic effects of exposure to cadmium include obstructive lung disease (chronic inhalation), kidney dysfunction from accumulated ingested cadmium, kidney stones or skeletal collapse due to interference with metabolism of calcium (itai-itai disease), hypertension and cancer (Total Environment Centre 1998).

Findings by the American Environmental Safety Institute (AESI) that chocolates tested in America contained small amounts of lead and cadmium combined with concerns of Western Australian residents on the same matter, lead the Steering Committee of the West Australian Food Monitoring Program (WAFMP) to undertake a survey of the lead and cadmium content of Australian made and imported chocolate products that are marketed to children.

Methodology

Survey design

The dominant chocolates in the retail market are by far light chocolate products, dark chocolate is traditionally more popular in Europe whereas Australians prefer creamier milk chocolate (Business 2000).

These can include solid bar chocolate, drinking chocolate, chocolate drinks, and chocolate toppings/sauces. Additionally, these are the products that are primarily marketed to younger children and their parents. This group of products was therefore the main focus of the sampling program.

Other products sampled include solid dark chocolates as well as dark cooking chocolates that may be utilised in preparing foods that may be consumed by children.

The final sampling plan was broken down into:

- fifty samples of light chocolate, including: Easter eggs (rabbit), chocolate sauces, bar chocolate and drinking chocolate;
- six samples of white chocolate, including bar chocolate and mini candy chocolate;

- four samples of dark chocolate, including bar chocolate, chocolate sauce and cooking chocolate.

Although this sampling regime gives heavy emphasis to light chocolate products, as children mostly consume these types of commodities, it meets the intent of the survey by focusing in this manner.

Materials and methods

Sub samples were taken from chocolate products, from which accurately weighed portions were used for analyses. A Sartorius Model 1603 MP 8 analytical balance was used to weigh 2.0 g (minimum) samples to 3 decimal places.

As organic material is present in the matrix of chocolate products, this was removed by digesting the samples using a combination of nitric acid (redistilled grade 15.9M) and hydrogen peroxide to remove fats and sugars from the chocolate matrices.

Digestion was performed for a minimum of 3 hours at 200°C. The clarified digest was diluted in 1% nitric acid and then analysed in a FISIONS Model Plasma Quad ICP-MS (Inductively-Coupled Plasma Mass Spectrometer) at the specific mass numbers for lead and cadmium (Melnik et al. 2003).

Absorbances from each analyte were used to extrapolate heavy metal concentration against a calibration curve. Results were reported as parts per million (ppm).

Determination of acceptable level of lead

Standard 1.4.1 of the Australia New Zealand Food Standards Code sets maximum limits for metal contaminants in food. As part of the process of developing the new Code, Food Standards Australia and New Zealand (FSANZ) conducted scientific, risk-based assessments to determine whether or not to retain these maximum levels. The assessment indicated that many of the current maximum limits were not justified on public health and safety grounds and were subsequently

deleted from the Standard. Where this was the case - they have not been included in Volume 2 of the Food Standards Code.

The Standard notes that for enforcement purposes a representative level has been assigned to those foods that do not have an assigned level of lead or cadmium in the Standard. These levels are set at the limit of quantification (LOQ), and are 0.01mg/kg for lead and 0.005 mg/kg for cadmium (FSANZ 2000).

The maximum limit for 'all other foods' as specified in the previous Food Standards Code, Standard A14 Volume 1, that pertained to lead in chocolate has been replaced by a calculation incorporating the above representative level. The calculation is specified in the Code as:

Formula

$$ML1 = \frac{(MLA \times \text{Total A})}{\text{Total}} + \frac{(MLB \times \text{Total B})}{\text{Total}} + CF \times \frac{(\text{Total} - (\text{Total A} + \text{Total B}))}{\text{Total}}$$

In this instance the equation has two unknowns, therefore, the acceptable level of lead has been calculated by taking the "per body mass" RDI for lead from the 2001 Australian Total Dietary Survey (ATDS) (0.25µg/kg) and multiplying it with the average weight of a child aged 12 (32.5kg), as specified in the CDC Age to weight body mass indexes (Centre for Disease Control [CDC] 2000).

In this instance, the calculated acceptable daily intake of lead is: ~ 0.12mg/kg per day.

Results and Discussion

Sixty samples were analysed from 30 distinct brand names. The following results were found.

Lead

The concentration of lead ranged from undetectable levels, to a high of 0.09 mg/kg in dark cooking chocolate. In drinking chocolate the highest level detected was 0.07 mg/kg.

No samples exceeded the appropriate calculated level for lead of 0.12 mg/kg per day.

Nine samples of chocolate (approximately 15%) presented with more than 0.05 mg/kg lead.

These findings are summarised in Figure 1 overleaf.

Cadmium

The same samples were analysed for cadmium content. The highest level of cadmium was found in drinking chocolate, at 0.11 mg/kg, followed by a dark cooking compounded chocolate 0.06 mg/kg and an Easter bunny 0.06 mg/kg.

Only 4 (7%) samples presented with 0.05 mg/kg or more of cadmium. None of the samples exceeded the 0.5mg limit specified by Standard 1.4.2 for cadmium. These findings are summarised in Figure 2.

Conclusion

The survey indicates that there is broad compliance with the Australia New Zealand Food Standards Code that regulates the levels of cadmium permitted in chocolate and chocolate products. There is also compliance with the permitted level assigned to lead for this survey.

Concerns about high cadmium and lead levels in chocolates available for retail sale in Western Australia, are not supported by the results of products tested. Additionally, lead levels are not in excess of an amount calculated on the basis of the ATDS and the mean body weight of children in the age group to whom chocolate products are marketed. This survey concentrated on light chocolate products, which due to market share, would be consumed in higher proportions by children than other products (Business 2000).

Few imported products were tested, however, the results from analysis do not suggest that they are any higher in lead or cadmium than Australian produced brands. Samples of dark and drinking chocolate seem to contain higher levels of cadmium and lead than milk chocolates, though still within maximum limits. Darker products are more likely to be used in liqueurs, cooking

Figure 1: Number of samples below or above 0.05mg/kg Lead

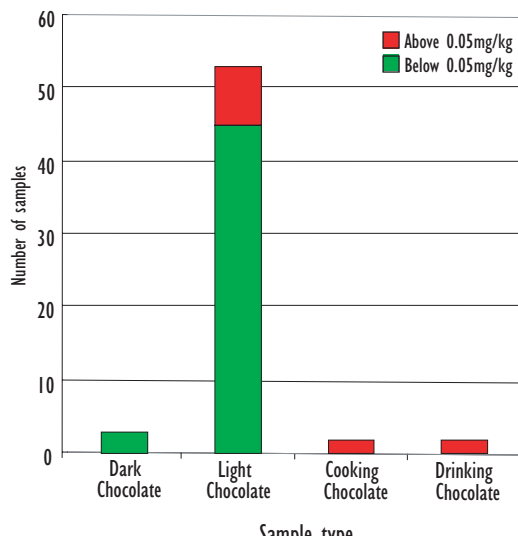
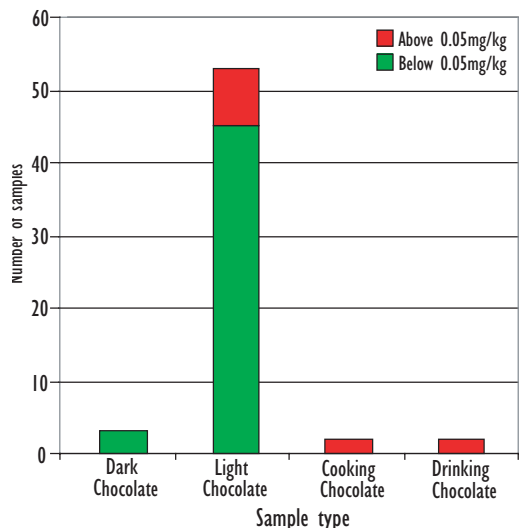


Figure 2: Number of samples below or above 0.05mg/kg Cadmium (limit 0.5mg/kg)



bases (for cakes/slices) and rum and raisin block chocolate that are generally not marketed to children. However, the number

of samples taken for analysis does not allow a conclusion to be drawn as to whether this is a significant public health concern.

Acknowledgments

The Department of Health (WA) would like to thank the following analysts from the Chemistry Centre of WA for their analytical work and assistance in preparing this article: Dr Kevin Ho - analytical work and co-author, and Mr Darryl Collett and Lyn Dixon - analysis and sample preparation.

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Targeted Education of Woodheater Users in Launceston

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Increasing community concern regarding poor winter air quality in Launceston resulted in the introduction of a woodheater replacement program in 2001. To complement this program, an education program aimed specifically at users of woodheaters that produce excessive smoke was instituted in 2002. The Targeted Education Program, which is reported on here, involves personally contacting users and encouraging improved operation practices. By the end of 2004, over 2000 woodheater users had been contacted. The evidence available suggests the program was successful in changing the behaviour of over 80% of users following a single contact. It is believed that the personal nature of the contact is a key to the success of the program.

Key words: Woodheater; Woodsmoke; Launceston; Education

Launceston is located about 50km from the Northern coast of Tasmania in the Tamar Valley. The city has a population of almost 100,000 people (ABS 2001). During cool, calm periods, meteorologic phenomena including cool air drainage and temperature inversions, concentrate air pollution around the city area. These conditions, combined with the extensive use of residential woodheaters, has resulted in breaches of the recommended National Environment Protection Measures (NEPM) for PM₁₀ (particulate matter less than 10 microns in diameter) in every year since monitoring began in 1992. Monitoring every day of the winter months began in 1997, the mean winter particle concentration was 40µg/m³ (Power 2001) and the PM₁₀ NEPM was exceeded on 45 days in that year (Department of Primary Industries, Water and Environment [DPIWE] 2004). The most recent National Pollutant Inventory estimate for sources of PM₁₀ in the air-shed is from 2000-2001; it attributes 85% of winter PM₁₀ to woodheater use.

Launceston City Council conducted small scale, low profile woodheater use education campaigns from 1992 until 2001. In 2001,

the Federal Government allocated \$2.05m to improving winter air quality in Launceston. The Atech Group (2001) suggested that the greatest net reduction in PM might be realised by the implementation of two simultaneously conducted programs. Consequently, a woodheater replacement program began in late 2001. It offered an incentive of up to \$500 for residents to change from woodheating to another cleaner heating type. Targeted education, which is reported on here, began at the commencement of winter in 2002. Both were conducted as pilot programs.

The Targeted Education Program

Todd (1997) estimated that prior to the utilisation of education programs, poorly operated woodheaters made up around 15% of the woodheater population in Australia. The primary aim of the Targeted Education Program (TEP) was to locate these poorly operated woodheaters and to encourage the users to learn better combustion and maintenance procedures. The secondary aim was to encourage changeover from woodheating to other cleaner forms of heating.

In 2004 the TEP constituted two full-time employees and two volunteers, the latter each working 1.5 days a week. Employees were funded by the Federal Government under the *Air Pollution in Major Cities Program* and by the Launceston City Council. The volunteers were provided by the federally funded *Conservation Volunteers*, under the *Work for the Dole* scheme.

Making consistent observations of woodsmoke proved quite challenging, as officers had to estimate the concentration of PM emissions visually. This is clearly a quite subjective method. The 'check your chimney' fridge magnet (produced by Environment Australia [EA]) was used in the field to assist in keeping estimates as consistent as possible. It provided a visual reference for excessive, moderate and acceptable smoke levels, see Figure 1.

excess smoke is not produced for more than 10 minutes (Todd 2003a). The second observation was made within an hour of the first to ensure that the heater was not being reloaded at the time of both observations.

Depending on the number of smoky chimneys, it was usually possible to cover about one suburb per day. This allowed the entire city to be systematically surveyed every three to four weeks. The surveys were conducted predominantly during business hours.

Brief attempts were made at conducting smoke surveys during the evening when natural light conditions were poor. Officers reported that this proved difficult on a number of levels. Not only was it more difficult to observe the smoke, but it was usually difficult to see the house number, record the observations and to follow the location on a map.

Figure 1: The check your chimney fridge magnet, illustrating (from left to right) excessive, moderate and acceptable smoke levels



Another difficulty in keeping observations consistent was the background at the time of the observation. The concentration appears greater when the smoke is viewed with a darker background colour. It was often necessary to view the smoke from a number of angles to get the most accurate estimate possible.

Two observations of a smoking chimney were made, between 30 and 60 minutes apart. The observations were made at least 30 minutes apart to allow for unavoidable excess smoke created during ignition and reloading phases. Studies have shown that when using most heater models correctly,

All information was recorded in an Access database, as well as the general council database. Data entry proved to be a highly time consuming process, generally it required just as long as the actual smoke surveys to complete.

Action Taken

If a chimney was observed producing excessive smoke on both occasions, a card was left in the letterbox of that property. The card was meant as a friendly notification that between these times, on this day, their chimney was producing unacceptable levels of smoke. The card

provided the invitation to contact the TEP for assistance and advice in reducing smoke output. The use of these cards was implemented under the assumption that they result in greater behavioural change than the usual broad scale media advertising alone. Market research conducted in Launceston also showed that this was an appropriate method of contacting residents. Between 2002 and 2004, a total of 2126 properties had cards placed in their letterboxes.

A second set of observations were made three to four weeks following the initial contact. This period gives the resident time to improve the operation of their heater. If excess smoke was observed again, an addressed 'First warning' letter was sent to the householder. These warn that a \$200 'on-the-spot' fine under the *Tasmanian Environmental Management and Pollution Control Act 1994* may be issued. They also warn of the serving of an abatement notice, which if issued, would legally request the user to cease producing excess smoke. Again, these letters offer the invitation to contact the TEP for assistance. A total of 356 of the First warning letters were sent between 2002 and 2004.

If a chimney was observed producing excess smoke on a third occasion, a 'Final warning' letter was sent to the householder. These letters inform the resident that if further observations of excess smoke are made, action will be taken against them. A total of 27 of these letters were sent out over the three winters. As of late 2004, no fines had been issued, but one abatement notice had been served.

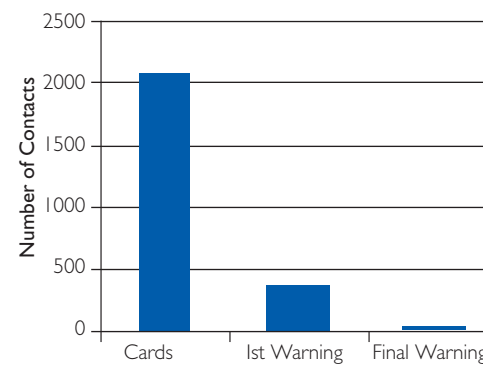
Impact of Contact

When a property has been left a card or sent a letter, and is observed producing acceptable levels or no smoke on subsequent random visits, it is presumed an improvement in operation has taken place. Using the above as evidence of improvement, the proportion that improved their operation after receiving a card was found to be over 80%. In 2003,

most properties were revisited on one or two occasions, with 83% of properties observed not smoking on the subsequent visits. In 2004, with increased resources, properties were revisited on between two and five occasions, resulting in 81% being observed producing zero or acceptable smoke levels on all occasions after the initial contact. For the most part, these houses were not observed to produce excess smoke in subsequent years. About 12% of all properties contacted have had cards left in two of the three years, while 1.4% have been left cards in all three years.

Letters aim to put more pressure on people who may not have amended their actions after receiving the card. Of the 356 First warning letters sent, 7.5% required a Final warning letter. It appears that the threat of a fine is enough to make most operators take note. Of the 2126 properties identified as producing excess smoke by the TEP, only 27 required a final warning. Figure 2 illustrates these statistics.

Figure 2: Extent of repeat contact required



The use of cards and letters by the TEP facilitates a changeover from woodheating to cleaner home heating alternatives. At the time the woodheater replacement program closed in April 2004, 150 people who had been contacted regarding excess smoke had applied for the rebate.

Undesirable outcomes

Leaving cards and sending letters has the potential to contribute to situations adverse

to the aims of the TEP. Such undesirable outcomes have come to light since the commencement of the program, usually involving elderly residents. One such example is that of an elderly gentleman who received a card. He then climbed up on his roof and attempted to clean the flue himself. He had overrated the seriousness of receiving a card and put himself in danger. Another possibility is that a resident may choose to stop using their heater altogether, which could result in far more serious health consequences for that individual than poor air quality.

Generally, it was not possible to distinguish the age of the occupier prior to leaving a card. Using council records, however, it was often possible to establish age prior to sending a letter. If evidence suggested the user might be elderly, an edited letter was hand delivered. By speaking with the resident, it was possible to ensure the letter was not interpreted incorrectly.

People Making Contact with the TEP

Despite the invitation to contact the TEP for advice, only a small percentage of people who received a card actually rang up. In 2004, 10% of people who had been left a card rang, while 30% of those sent a letter contacted the program.

Of those who contacted the TEP in 2003 and 2004, 49% were calling to ask for assistance, 33% were calling to inform the program that the occasion was 'a once off and won't happen again', while 18% were calling to say that their heater 'does not smoke!'

If the person was reasonably affable, it was usually possible to give at least one piece of advice. Many of these people were also sent a copy of the *Hot-Tips for Cleaner Woodheating* booklet (EA 2003). If it was not possible to identify the cause of excess smoke over the phone, a home visit was organised. A total of 38 of these home visits were conducted in 2004.

Percentage of home-owners

Using council records it was possible to determine the relative percentages of owner-occupier properties, rental properties, and properties owned by the State Government for Public Housing contacted by the TEP. Of all the properties located in the Launceston City Council Municipality that were left a card in 2003, 71% were owner-occupier properties, 15% were rental properties and 14% were public housing properties. Of the 95 properties sent a First warning letter in 2003, 63% were to owner-occupier properties, 16% were to rental properties and 21% were to public housing properties. With public housing making up only 6.1% of all the residential properties in Launceston, it could be argued that public housing contributes disproportionately to Launceston's air quality problem.

Public Complaints

Members of the public can make complaints to local councils regarding nuisance woodsmoke in the same way they can complain about excessive noise. Despite a steady decrease in the number of woodheaters used in the city per year, the number of public complaints has grown. In 2002 there were 63, in 2003 there were 79, and in 2004 there were 88 public complaints. Anecdotally, this increase has been attributed to a decrease in the tolerance level of the public to nuisance woodsmoke and an increase in awareness of the existence of the TEP.

Common causes of excess smoke

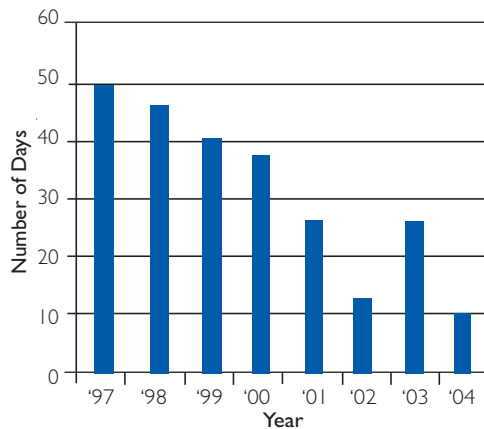
The most common cause of excessive smoke identified through the course of this program was restricting air too soon after reloading. Air controls should be kept fully open for 20-25 minutes after reloading (Todd 2003b). The other common cause was loading pieces of wood which are too large on too few hot coals. The quality of fuel was occasionally also a problem. It was sometimes stored under a tarpaulin and/or in thrown piles on dirt or grass. Availability of

dry wood for purchase proved a problem later in the winter season.

Change in air quality

Traditionally in Launceston, the number of days where the daily average for PM₁₀ is above 50µg/m³ per year is used as the indicator of changes in air quality. Since daily monitoring began in 1997, there has been a long-term downward trend in the number of high pollution days (Figure 3).

Figure 3: Number of days per year when the daily PM₁₀ average was above 50µg/m₃ in Launceston (DPIWE 2004)



It is presumed that the apparent increase in 2003 was related to unusual local climatic variables in 2002, resulting in fewer than expected exceedences in that year. Additionally, six of the exceedences in 2003 were associated with hazard reduction burns and bush-fires. It is possible that 2004 was also subject to unusual climatic conditions, resulting in fewer exceedences than expected.

The TEP cannot and does not take sole credit for the improvement in air quality witnessed between 2001 and 2004 in Launceston. This improvement is the result of many factors, including the woodheater replacement program, other communication activities, meteorology, and improvements in PM emissions by industry, among other factors. A study

conducted by CSIRO for the Department of the Environment and Heritage may shed light on the degree to which targeted education has contributed to the observed improvement. The report is slated for release in 2005.

EnergyConsult (2005) conducted a phone survey of Launceston residents in April 2004. The survey included some questions partly aimed at evaluating the impact targeted education has had on local knowledge of woodsmoke control practices. In regard to the TEP, the results were inconclusive.

Conclusion

The most note-worthy outcome drawn from the operation of the TEP is the low number of repeat contacts required. The evidence available suggests that over 80% of those contacted for emissions of excess chimney smoke improved their operation after just a single contact. Only 27 of the 2126 properties identified as producing too much smoke required more than two contacts in a season. The observed low number of contacts allows this style of program to be relatively cost effective in areas where woodheaters are a significant source of air pollution.

The low degree of contact required can be taken as an indication that the TEP was successful in changing operation practices, but with only this limited data as evidence, the result is far from definitive. A comprehensive independent evaluation involving those contacted and those not contacted is required to determine the extent of impact the program has had on changing operational practices.

One of the enduring lessons of the TEP is that the apparent success of the program is primarily related to the personal nature of the cards and letters. It is thought that this results in greater behaviour change than the usual broad scale media advertising.

Acknowledgments

The author would like to thank the following people who worked on the targeted education program as employees or as volunteers: Rosemary Norwood, Adele Gliddon, Alison Mokany, David Sayer, Elwyn Bennet, Dennis Donnelly, Lorraine Hjort, Kim Davidson, Karen Robinson and Chris Zolyniak. John Todd, the Atech Group, Victor Haysham, Rosemary Norwood and Alison Mokany are also acknowledged for their input into the design of the smoke surveying method.

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Exposure to Environmental Tobacco Smoke in Licensed Premises on the Central Coast of New South Wales

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The aims of the study were to determine the compliance of all registered Clubs and licensed Hotels on the Central Coast with the signage provisions of the Smoke-free Environment Act 2000 (NSW) and the smoke-free requirements of the 'Share the Air' agreement. A survey was carried out in all 43 registered clubs and 33 licensed hotels in the Gosford and Wyong LGAs to assess the extent to which the 76 premises were observing criteria established by the Smoke-free Environment Act 2000 (NSW) and the 'Share the Air' agreement. Ninety-one percent of all 76 premises complied with signage provisions of the Act and 74% with agreement requirements. This study demonstrates that most Pubs and Clubs are gradually moving toward a smoke free environment by complying with the Act and with the agreement. However, some barriers still remain. The needs of small Pubs and Clubs should be specifically addressed. In addition, it would be useful to increase the total proportion of smoke-free areas in licensed premises.

Key words: Smoke-free Environment; Pubs; Clubs

The adverse effects on health from exposure to environmental tobacco smoke (ETS) have been widely documented (Hackshaw, Law & Wald 1997; Miller et al. 2002; National Health and Medical Research Council [NHMRC] 1987, 1997; Walsh et al. 2002). The first study of ETS on the Central Coast area demonstrated that there were significant differences in the carbon monoxide levels exhaled by staff working in a smoking environment compared with staff working in a smoke-free environment (Tutt & Harris 1990). A report commissioned by the Cancer Council of New South Wales has suggested that, with given assumptions, the annual ETS mortality rate for the NSW bar workforce ranges from 73 to 97 deaths per year, regardless of smoking status (Repace 2004). In contrast, the reduction in ETS exposure occurring after the implementation of smoke-free workplace legislation was associated with improved adult respiratory health during a short observation period (Eisner, Smith & Blanc 1998).

On 12 October 2004 a NSW government media release announced that from July

2007 all indoor areas of licensed facilities in the state would be smoke free and that smoking would still be permitted in outdoor areas such as beer gardens. The bans were to be phased in gradually. Most hotels and clubs would be restricted to a single smoking room from July 2005 and smoking would be banned on dance floors, and in thoroughfares, toilets and foyers. The size of the smoking rooms was to be reduced by half by July 2006.

In other states, progress towards reducing ETS has also been made. Tasmania will be the first state to have smoke-free Pubs and Clubs in January 2006, followed by Queensland in July 2006, ACT and Northern Territory in November 2006, NSW and Victoria in July 2007 and South Australia in October 2007. Only Western Australia has made no plans for smoke-free Clubs and Pubs.

In view of some research findings which suggest that ETS remains a current problem (Cains et al.; Cameron et al.; Repace 2004), it was decided to carry out the present study.

The introduction of the *Smoke-free Environment Act 2000* required most enclosed public places in New South Wales to be smoke-free. Exemptions were provided for some licensed premises, including Hotels (Pubs), Nightclubs, Registered Clubs (Clubs) and the Star City Casino bar and gaming machine areas. The Act also required Pubs and Clubs to display appropriate signage.

'Share The Air' was an agreement created in 2002 between government, industry and union representatives, to establish a policy for extending non-smoking areas in licensed premises. The agreement was to be phased in over two years and was designed to reduce smoking areas in licensed premises up to the July 2007 non-smoking deadline.

Method

Between August and October 2004 a survey instrument was developed and administered in all 76 premises by two Environmental Health Officers of the Central Coast Public Health Unit.

Aims

The two aims of the study were:

- to quantify the extent to which separate categories of Clubs and Pubs are complying with the smoke-free requirements of the 'Share the Air' agreement, and
- to quantify the extent to which Clubs and Pubs are complying with signage provisions of the *Smoke-free Environment Act 2000* (NSW).

Criteria of compliance

With respect to the requirements of the 'Share the Air' agreement:

- Single bar premises must have a designated no-smoking area within the bar.
- Premises with two or more bars must have at least one designated as smoke-free.

- Premises with two or more recreational areas must have at least one designated smoke free.
- Premises with two or more gambling areas must have at least one designated smoke free.

With respect to the signage provisions of the *Smoke-free Environment Act 2000* (NSW):

- All premises must display no smoking signage at bar and service counter areas.
- Signage must be that prescribed under the *Smoke-free Environment Act 2000* (NSW) where applicable.

Results

All 76 Central Coast premises participated in the study, with 91% complying with signage provisions of the *Smoke-free Environment Act* (NSW) and 74% with the 'Share the Air' agreement requirements.

Table 1 shows the degree of compliance with the smoke-free requirements of the agreement and the signage provisions of the Act.

Table 1: General compliance of Clubs and Pubs

SHARE THE AIR AGREEMENT	Clubs	Pubs	Total
One bar	11/15 (73%)	7/14 (50%)	18/29 (62%)
More than one bar	27/28 (96%)	15/19 (29%)	42/47 (89%)
One gambling area	N/A	N/A	N/A
More than one gambling area	9/12 (75%)	1/1 (100%)	10/13 (77%)
One recreational area	N/A	N/A	N/A
More than one recreational area	5/7 (71%)	Nil	5/7 (71%)
Smoke-free Environment Act			
Total	34/43 (79%)	22/33 (67%)	56/76 (74%)
Appropriate signage	43/43 (100%)	26/33 (79%)	69/76 (91%)

Note: N/A not applicable

Table 1 shows the substantial numbers of Clubs and Pubs complying with particular requirements. It does not describe the proportion of bar, gambling or recreational

areas that are smoke-free in each sector. For example, a Club with one of five bars designated smoke-free has complied with the agreement but provided a smoke free environment for only 20% of its total bar area. The important proportions of smoke-free areas are given in Table 2.

Table 2: Clubs and Pubs with designated smoke-free areas

	Clubs	Pubs	Total
Bars	50/179 (28%)	14/85 (16%)	64/264 (24%)
Gambling sites	10/54 (19%)	1/32 (3%)	11/86 (13%)
Recreational rooms	7/31 (23%)	0/25 (0%)	7/56 (13%)
TABs	17/40 (43%)	9/30 (30%)	26/70 (37%)

Discussion

Compliance with the signage provisions of the *Smoke-free Environment Act 2000* was high with all Clubs and 79% of Pubs conforming to the provisions of the Act. Compliance with the smoke-free requirements of the 'Share the Air' agreement was generally not as good, but still indicates significant progress towards the July 2007 deadline.

While collecting data for the study, the Environmental Health Officers also observed that strict compliance with the agreement did not necessarily translate into a reduction in ETS. For example, in a premises with several bars, the non-smoking bar was sited in the little-used auditorium.

Acknowledgment

The authors wish to thank Andrew Dixon for assistance with analysis and Dr Peter Lewis for editing comments.

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Similarly, it was found that the management of four premises had also complied by setting aside 2-4 tables for non-smokers and at least 40 for smokers.

In addition the Environmental Health Officers noted particular difficulties faced by small establishments in complying with the agreement. While a small bar may have had non-smoking tables, it was difficult to see how the patrons would not be exposed to ETS from the adjacent smoking areas.

In some cases, the relatively small size of the premises was a factor limiting compliance. The licensee of a small Pub could find it difficult to establish smoke free areas that would not be affected by ETS. In contrast large clubs with many rooms made it relatively easy for management to designate smoke-free areas.

Conclusion

The degree of compliance with the agreement and the Act indicated that Clubs and Pubs were gradually moving towards the establishment of a totally smoke-free environment for patrons. Small Clubs and Pubs could experience some difficulties in complying with the agreement. In this interim period before the legislation is enacted, it would be useful to identify a reasonable proportion of the total area of the premises which should be smoke-free.

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REPORTS AND REVIEWS

Study of Fungal Contamination of Indoor Public Swimming Pools in Uromia, Iran

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*Fungi are found in different environments with variable distribution patterns depending on various factors. The aim of this study was the determination of fungal contaminants in public swimming pools in Uromia. The fungal contamination of four indoor swimming pools was studied by using a membrane filtration and swab sampling method. Samples were collected by using a manual plastic pump delivered into a 200 ml sterilised bottle. All samples were collected within two hours and then transferred to the laboratory. A total of 384 samples, from water and from surfaces in the general environment of the pool, were collected and tested for the presence of fungi in different seasons within one year. In addition to the above information, some physical and chemical parameters such as temperature, residual chlorine, pH, turbidity of water, and the number of swimmers, were studied. Findings indicated that the average temperature, pH, residual chlorine, and turbidity of water in the swimming pools within one year were 29.9°C, 8.1, 0.6 ppm and 0.8 NTU respectively. The most common fungi recovered were *Aspergillus* spp. 56.25%, *Candida* spp. 22.9%, *Rhizopus* spp. 4.16%, other filamentous fungi 16.6%, and other yeast species 2.8%. Fungi such as *Alternaria*, *Cladosporium*, *Philophora* and *Trichophyton mentagrophytis* were isolated from dressing rooms, bathing rooms and other places outside of pools. According to these results and previous studies on pools, it has been indicated that contamination by fungi in pools is not significant in water and the environment of the pool. The presence of dermatophytic fungus in dressing rooms is probably due to human contact.*

Key words: *Fungi; Fungal Contamination; Uromia; Iran*

The water in swimming pools is not a good carrier for transmission of fungal diseases but can be a source of fungi, so other surfaces in the general environment of the pool may be contaminated by many species of fungi, and can then be transmitted to swimmers. Public indoor swimming pools are one of the recreation centres which many people use every day so infectious agents, saprophytic fungi and other microorganisms (Lee, Deininger & Fleece 2001) can contaminate them.

Fungi are found in different environments with variable distribution patterns depending on various factors, the most

important of which is human association (Detandt & Nolard 1988; Hausser & Ippen 1985). In order to control this endemic problem, adequate preventive measures must be taken. It has been found that swimming pools may contribute to the spread of fungi, and according to these results be a source of fungal infections. Fungal infections related to pools may be dermatophytosis or otomycosis, or other diseases (Al-Doory & Domson 1984; Bolanos 1991; Detandt & Nolard 1988; Porter 1988). People using swimming pools are susceptible to fungal infections due to the wet conditions of the external ear, and between fingers and toes, and the inguinal tract.

Bolanos in 1991 studied *Tinea pedis* among students enrolled in swimming courses held at the university pool. *Tinea pedis* was determined in 12 swimming pools. The most common agent of *Tinea pedis* in a study was *Trichophyton rubrum* (82%), whereas infections by *Trichophyton mentagrophytis* (9%) and *Epidermophyton floccosum* (9%) were less common. Results also showed that, no dermatophyte was recovered from any of 30 floor samples taken from the bathroom and pool facilities. In another study the following dermatophytes were isolated from the student's feet: *T. mentagrophytis* (70%), *T. rubrum* (17.6%) and *Candida albicans* (11.8%). On this occasion *T. mentagrophytis* was recovered from 5 out of 30 floor samples. Another study was carried out regarding athlete's foot (Zaror et al. 1985) and the results showed a significant incidence of occult athlete's foot in swimmers. They concluded that in controlling this endemic problem adequate preventive measures must be taken.

In this case, fungi such as *Aspergillus*, *Candida*, *Penicillium*, *Rhizopus* and dermatophytes have pathogenicity for otomycosis and wrinkle skin (Rippon 1998). Several authors have reported on the occurrence of dermatophytes, as well as other fungi, from swimming pools (Bagy 1989; Detandt & Nolar 1988; Fisher 1982; Maghazy, Abdel-Mallek & Bagy 1989; Mangiarotti & Caretta 1994). The main objective of this research was to determine the fungal contamination of four indoor public swimming pools in Uromia, in order to promote the knowledge among swimmers that it is important to observe health regulations to control and prevent fungal disease.

Materials and Methods

In this research, a descriptive cross sectional method was used. Samples from the water of four indoor public swimming pools, 1. Shardary, 2. Janbazan, 3. Haft-Tir, and 4. University of Uromia, were taken in four seasons during one year, 2001. A plastic

manual pump was used to take samples from the swimming pools. From a total of 348 samples, 248 samples were collected from disinfected swimming pools in compliance with the American Public Health Association (APHA 1985) standard methods. A sufficient amount of sodium thiosulfate was present in the sampling bottles to neutralise the chlorine residual in the samples. All samples were processed immediately upon arrival. For each swimming pool, sampling was carried out twice per month, the first and fifteenth were filtrated through millepore filters with 0.45-micrometer size. Filters were transferred to three different culture media: Saboroud dextrose agar, Saboroud+chloramphenicol+cyclohexamide, and malt extract agar 2%. The plates were incubated at 25°C for 3 weeks and examined at frequent intervals. Other samples (n=100) were collected from the general environment of swimming pools, such as the foot-washing sink, bathrooms, sauna rooms, and the walls and floor around the pools. Sampling was carried out by using pieces of carpet (a piece of sterilised carpet 4x6 cm² in size) for the dried surfaces, and swab sampling for wet samples, which were rubbed against the surfaces and then wrapped in sterile aluminium foil and transferred to the laboratory. All carpet pieces were shaken over the culture media and the swabs were rubbed so as to inoculate agar under a biologic hood. The plates were incubated for three weeks at 25°C and tested at frequent intervals and fungal growth was determined by routine laboratory methods, especially slide culture (Campbell & Stewater 1980; Rippon 1998).

Results

The findings from this research regarding the physical and chemical parameters indicated that the average temperature, pH, residual chlorine, and turbidity of water were: 29°C, 8.1, 0.6, mg/l and 0.8 NTU respectively. Moreover, the average daily number of swimmers during the summer

Table 1: Frequency and percentage of fungal groups in water and environmental surfaces

cases/ pool	place of sample	Dermatophyte		Yeast		Filamentous	
		N	%	N	%	N	%
1	water places	0	0	2	18.2	17	45.9
		1	100	10	35.8	74	37.3
2	water places	0	0	3	27.3	12	32.4
		0	0	5	17.8	43	21.8
3	water places	0	0	5	45.5	5	13.5
		0	0	12	42.8	61	30.7
4	water places	0	0	1	9	20	8.2
		0	0	1	3.6	20	10.2
total	water places	0	0	11	100	37	100
		1	100	28	100	198	100

season was higher than in the other seasons (Mean = 385). The fungi isolated from the water in the swimming pools included saprophytic filamentous fungi and species of yeasts. The fungi isolated from environmental surfaces were saprophytic filamentous, yeast species, and a dermatophytic fungus, *Mentagrophytis* (isolated from dressing rooms). Table 1 shows the frequency and percentage of the above fungi in each swimming pool with related environmental surfaces. Findings indicated that no dermatophyte was recovered from water samples, indeed the fungi isolated from water samples were common saprophytic flora and their presence in pool water was not significant. The frequency and percentage of the fungi isolated from the different environments of

the swimming pools are shown in Table 2. According to results the species of fungi such as *Aspergillus*, *Penicillium*, *Cladosporium*, and *Candida*, isolated from environmental surfaces were in high frequency. Moreover, the dermatophytic fungus, *Mentagrophytis*, was the most important fungus isolated from the dressing room. The most frequent fungi isolated from environmental surfaces were: *Aspergillus* 53%, *Penicillium* 51%, *Cladosporium* 45%, *Candida* Spp 23% and least frequent were *Exophila*, *Crysosporium*, and *Phoma*. Results also showed that from total 284 samples of water pools 48 cases (18.6 %) of fungal contaminations were observed and the most common of them were: *Aspergillus* 56.25%, *Rhizopus* 4.16%, *Candida* 29.9% and 16.6% others (Figure 1).

Figure 1: Types of fungi isolated

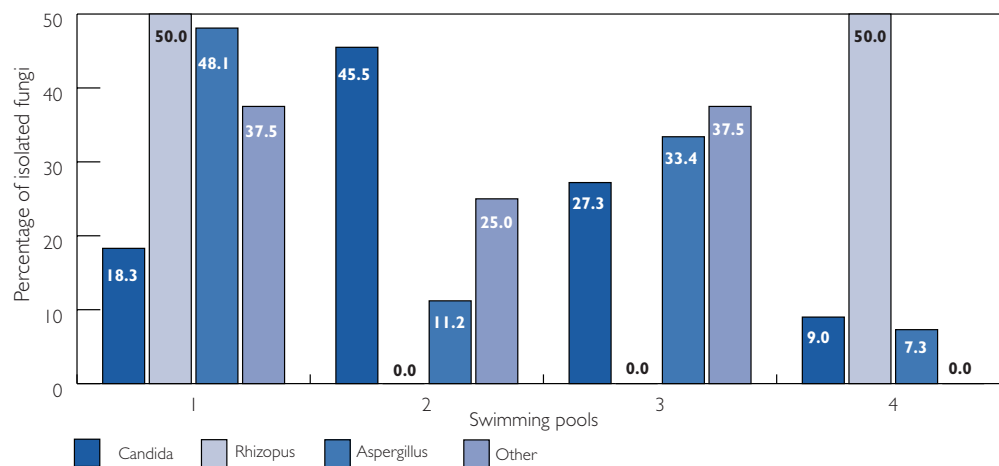


Table 2: Types of fungi in different places of four swimming pools

pool/ fungi	1		2		3		4		total	
	N	%	N	%	N	%	N	%	N	%
Ulocladium	2	100	0	0	0	0	0	0	2	100
Aspergillus	21	39.6	8	15	16	30.1	8	15	53	100
Alternaria	1	14.2	1	14.2	5	71.4	0	0	7	100
Fusarium	2	40	1	20	2	40	0	0	5	100
Rhizopus	5	41.6	3	25	4	33.3	0	0	12	100
Penicillium	21	41.1	13	25.6	17	33.3	0	0	51	100
Acremonium	3	60	1	20	1	20	0	0	5	100
Cladosporium	16	41.1	10	22.2	11	24.4	8	17.7	45	100
Arthriniumq	0	0	2	100	0	0	0	0	2	100
Rhodotorub	3	60	1	20	1	20	0	0	5	100
Candida	7	30.4	4	17.39	11	47.8	1	4.34	23	100
Phialophera	4	57.1	1	14.2	1	14.2	1	14.2	7	100
Exophila	0	0	1	100	0	0	0	0	1	100
Crysosporium	0	0	1	100	0	0	0	0	1	100
Phoma	0	0	1	33.3	2	66.6	0	0	3	100
Trichophyton	0	0	0	0	0	0	1	100	1	100
Mucor	0	0	0	0	2	40	3	60	5	100

Discussion

Many studies have indicated that the sanitary quality of indoor public swimming pools is a concern for swimmers due to swallowing and contact with water. Further, it has been shown that swimming pools contribute to the spread of fungi and other organisms (Detandt & Nolard 1988; Lee, Deininger & Fleece 2001). Thus, the sanitation of swimming pools is important. Testing of factors such as pH, temperature, and residual chlorine are critical for swimming pools. A study carried out in the United States showed that assessing the above factors with 95% confidence level could justify the contamination of swimming pools (Roy 1972). In the present study, we examined the factors during one year (4 seasons) for swimming pools, water and the pool environments, and then compared them with standard levels. The average of free residual chlorine in swimming pool water was 0.6 ppm, that is less than the standard level of 1-2 ppm (American Department of Health and Human Services 1988; American Public Health Association 1985). Moreover, 85% of swimming pools

had free residual chlorine less than the standard level. Fisher in 1982 stated that the normal concentration of chlorine does not inhibit the growth of fungi. The mean temperature of the water was 30.1°C, that is it was higher than the standard level of 24.5°C-25.5°C (Fathy et al. 1998). Raising these factors to more than the standard level may create the growth of biological agents in the swimming pools. Anderson (1979) showed that the optimum temperature for the growth of fungi is between 20°C and 30°C, while temperatures higher than 45°C caused the growth of fungi to stop. Feuerman (1977) showed that in swimming pools that have been disinfected with chlorine no dermatophytes were isolated.

Some authors have done studies on the presence of dermatophytes in the water and different parts of swimming pool areas (Detandt & Nolard 1988; Maghazy, Abdel-Mallek & Bagy 1989). A study was carried out in Teheran and four (10%) dermatophytes were isolated (Nomayendeh 1993). Shadzi et al. in 2001 investigated four indoor swimming pools in Isfahan and concluded that dermatophytes were only isolated from dressing rooms and bathrooms.

Moreover, the occurrence of dermatophytes and some fungal species, which are known to be opportunistic pathogens, might be related to the low concentration of disinfectants, the daily average of the number of swimmers, and the presence of bathers with fungal infections in public swimming pools. Vissent (1973) in France isolated *T. mentagrophytes*, *T. rubrum* and *Epidermaphytone floccosum* from the water of swimming pools. In Austria some fungi were isolated from the floor of swimming pools and dressing rooms through carpet sampling (Kraus & Tiefenbrunner 1975).

In our study a strain of dermatophytic fungus, *Mentagrophytis* was only isolated from one dressing room. The presence of this dermatophyte could be related to the contact of swimmers who had *tinea pedis*, *tinea corporis* or other types of dermatophytosis with the floor or walls of the room. Some authors (Attye, Auger, & Joly 1990; Bolanos 1991; Reiffers & Laugier 1977) indicated that, swimmers with *tinea pedis* could spread debris containing dermatophytes on the floor of pools. Maghzay, Abdel-Mallek, & Bagy (1989) isolated *Terrestre*, *T.mentagrophytis* and *Microsporum gypseum* from the water of two swimming pools in Egypt. The authors stated that the isolation of the above dermatophytes might be a continuous contamination of the swimming pool water

by fungi from the air, soil or human bodies. In our study, no dermatophytes were isolated from water; the reason may be related to the different techniques used for research or the residual chlorine in water. Zaror et al. in 1985 isolated *T.mentagrophytis* from bathrooms, which supports our findings. Our findings showed a relationship between the numbers of swimmers and the number of isolated fungal cases. The higher the number of isolated fungal cases may be related to the higher number of swimmers (average daily 385) and lowest amount of residual chlorine (0.06mg/l) whereas, swimming pool No. 4 with the lowest number of swimmers (150 daily) and the highest amount of residual chlorine (1.5mg/l) had the lowest number of isolated fungi (Figure 1).

Conclusion

Through this study we can conclude that rarely is the occurrence of dermatophytes and some pathogenic fungi in swimming pools related to the control of hygiene of pools, or the efficiency of residual chlorine for inhibiting growth of fungi. However, it is recommended that the managers of swimming pools pay more attention to the residual chlorine based on standard levels and the environmental sanitation of swimming pools because of the high frequency of the isolation of saprophytic filamentous fungi and yeasts.

Acknowledgments

We would like to thank Dr Salari, Vice Chancellor for Research of Urmia University Medical Science who funded this research.

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