Environmental Health

The Journal of the Australian Institute of Environmental Health

...linking the science and practice of Environmental Health

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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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Call for Papers

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.

Research and Theory

Articles under Research and Theory should be 3000-5000 words in length and can include either quantitative or qualitative research and theoretical articles. Up to six key words should be included. Name/s and affiliation/s of author/s to be included at start of paper and contact details including email address at the end.

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Articles and reports should be approximately 3000 words in length and can include articles and reports on successful practice interventions, discussion of practice initiatives and applications, and case studies; changes in policy, analyses, and implications; changes in laws and regulations and their implications, and global influences in environmental health. Up to six key words should be included. Name/s and affiliation/s of author/s should be included at start of paper and contact details including email address at the end.

Reports and Reviews

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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The Environmental Health Officer Workforce

The World Bank Group (Cartwright 2005) predicts that in 2008 for the first time in history that more workers will leave the workforce than enter it as the baby boomers are now reaching retirement. In 2003, nearly 1 in 3 participants in the Australian labour force were aged 45 to 64 years and over the next decade the proportion of the workforce over 45 years will reach 86% (Cartwright 2005). Also, Australian skills are readily exported as in 2003, 48 000 people of the skilled workforce left Australia, of which 72% were professionals with 45% aged between 25 and 34 years (Cartwright 2005). This has ramifications for the environmental health officer (EHO) who is the cornerstone of the public health workforce.

One of the most worrying trends is that most universities are informally reporting a decrease in the number of students choosing to be or being retained, in environmental health officer courses, which are those courses that are accredited by the Australian Institute of Environmental Health (AIEH). There are more positions vacant for environmental health officers than students graduating in most States or Territories. Employment in any of the three levels of government, where the EHO qualification generally leads, may be seen by some prospective students as traditional and not particularly enticing. As an EHO, you might be surprised if you count the number of your fellow graduates who are employed as EHOs. My observation is that many EHOs specialise away from the role of an EHO or leave the profession altogether after a time. While this is not only recognition of the versatility of the skills and training in the accredited courses, it also means constant replenishing of the workforce. Add to this the positive changing demographics where more women are entering the workforce as environmental health officers leading to demands for more flexibility in the workplace with family friendly polices and support to attract and retain employees.

There are several studies recently completed or being undertaken that are assessing and will eventually impact on the environmental health officer workforce. A study of the environmental health officer workforce in South Australia conducted by the State's Department of Health in 2004 (Greaves 2004) found that all indicators predict a workforce shortage of qualified EHOs which will be magnified in rural and remote areas. A Queensland study (Queensland Health 2004) found similar issues with recruitment and retention of qualified EHOs to undertake the public health functions of local government. These studies in Queensland and South Australia consistently show a need to produce more graduates with degree qualifications and issues with retention once they are employed. The National Environmental Health Strategy (Commonwealth Department of Health and Aged Care 1999) also recognises this environmental health workforce issue by noting the need to increase the capacity of the workforce through increasing the number of environmental health practitioners, which would include EHOs.

While the shortage of qualified employees is not new for many professions, I believe that some proposed solutions are 'off the mark'. There is a belief that since there is a shortage, then the standards of the EHO profession or competencies to manage environmental heath standards must be lowered. Recent issues of detrimental health outcomes at the Bundaberg Hospital in Queensland suggest that there is a need to assure competency to satisfy the professional demand in an area. I believe the public expect (and I expect industry as well) that a person, who is employed to undertake a skilled job, has all the competencies based on knowledge and education to do the required tasks. It is noted in the Queensland Health Report (Queensland Health 2004) that where there is a likelihood of adverse

impacts on public health, a local government authority that does not take action on delegated state public health legislation faces 'a real risk of legal action', as does Queensland Health in such circumstances.

The quality of the skills in the environmental health officer profession must be maintained, but I acknowledge that it requires lateral thinking to find a range of solutions, particularly for our rural and remote areas. In some areas, the environmental health officer is the only health professional who is available. Options that are to be considered are various entry pathways into a university qualification, either undergraduate or postgraduate, with a suitable science related undergraduate degree (environmental health is based on science), regional employment solutions, promotion of a career in environmental health management, support for new or recent graduates in rural and remote areas, access to on line resources (such as this journal), continuing professional development, and professional networks to support environmental health officers to assist with the ongoing retention of EHOs in an area. The above mentioned South Australian and Queensland studies provide a range of considerations to improve the recruitment and retention of qualified EHOs.

From an employer's point of view, while salary might be considered to be the draw card, it is not always the case, benefits such as professional development, leave entitlements, fringe benefits, mentors, and regional environmental heath management and support for the workforce, might provide incentives. However, employers like local government which are offering the base salary in a rural or remote area without any further incentives or support, will always find it difficult to compete with metropolitan and novel employers. Therefore, employers have to be innovative in their recruitment processes and retention management, benchmarking competence and ability against all other professions in the workplace, particularly in local government where it is seen that other professional groups might have an advantage.

While these might be some of my ramblings, the solutions to the environmental health officer workforce management are as varied as the role of the EHO itself and are certainly not confined to our profession. Therefore, we could collaborate with other professions to identify suitable solutions to workforce needs for professionals.

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LETTER TO THE EDITOR

Following the recent publication of a paper detailing Health Team 'Foxtrot' support to Banda Aceh, the Journal was interested in obtaining further papers regarding environmental health issues and emergency responses to mass disasters. The Hon. Robert Hill was contacted to obtain a perspective on the humanitarian aid provided to Indonesia by members of the Australian Defence Force. The Hon. Robert Hill responded directly, providing the following synopsis of the ADF's involvement in Australia's recent disaster relief operations.

2nd June 2005

Senator the Hon. Robert Hill
Leader of the Government in the Senate
Minister for Defence
Parliament House
Canberra ACT 2600

Following the December 2004 tsunami the Government of Indonesia accepted an offer of Australian humanitarian assistance focused on the northern Sumatra province of Aceh. Indonesia requested medical stores, shelter, food, water, power generation and water purification equipment. Operation SUMATRA ASSIST was the Australian Defence Force (ADF) contribution to the whole-of-government effort to provide that assistance. The first humanitarian aid and ADF personnel deployed on 27 December, arriving in Indonesia on 28 December 2004. The numbers deployed quickly grew to over 1000 and was predominantly in the Aceh region providing:

- A field hospital staffed by members of the ADF and New Zealand military. This hospital treated the full range of post-trauma surgery and medical conditions. Staff also supplemented the ward staff of the Indonesian public hospital in Banda Aceh.

- Engineers improved sanitation at the camps for internally displaced persons and established three water purification plants providing locals with potable water at the field hospital, and internally displaced persons camp and a convent.

- The ADF also deployed up to six RAAF C-130 aircraft and four Army UH-1H utility helicopters to move humanitarian aid and provided air traffic control services at Banda Aceh airport.

- HMAS Kanimbla was deployed off Banda Aceh providing support and conducting relief activities ashore. The ship carried two army landing craft, two Sea King helicopters and an engineering group along with its equipment, and also operated a Primary Casualty Reception Facility.

As the situation moved from an emergency relief operation to reconstruction, the ADF's role diminished. The Government of Indonesia and civilian aid agencies established a reconstruction program that enabled a phased withdrawal of the ADF by mid March.

ADF achievement in Operation SUMATRA ASSIST included:

- 1200 tonnes of humanitarian aid distributed by air;
- 70 aero-medical evacuations;
- 2530 people transported by air;

- 3700 medical treatments;
- 4.7 million litres of clean water produced;
- 9000 cubic metres of debris cleared;
- 1000 metres of road cleared;
- 1700 large drains cleared; and
- 6 large fishing boats salvaged.

Following the 29 March 2005 earthquake near Nias Island the Government of Indonesia again requested Australian assistance. Australia sought to provide the most immediate and appropriate response possible. HMAS Kanimbla was still in the region and was made available for humanitarian assistance operations. After loading relief stores in Singapore and sailing on 30 March, the ship was on-station at Nias by 2 April providing medical support, helo operations and surface transport tasking.

In addition, two C-130 aircraft, conducted air bridge operations between Jakarta and Sibolga on the North West coast of Sumatra, opposite Nias Island. These aircraft also transferred ADF medical personnel and equipment delivered to Jakarta by an RAAF B-707 aircraft.

After consultation with Indonesian authorities, Australia commenced the final withdrawal of our assistance provided under Operation SUMATRA ASSIST in April.

ADF achievements in Operation SUMATRA ASSIST II included:

- 133 tonnes of rice delivered;
- 5000 litres of water provided;
- 570 patients treated ashore by medical staff;
- 13 surgical and further treatments conducted on board HMAS Kanimbla;
- 7 Sea King aero-medical evacuations;
- Lahewa town water pump and generator repaired; and
- Over 138 tonnes of stores moved by C130 Hercules.

Additional information and photographs on Operation SUMATRA ASSIST is available on the defence web site at www.defence.gov.au.

Tragically, vital succour and relief that our personnel provided to the people of Sumatra in their time of need was not without cost. Nine fine young Australians were killed in the crash of a Sea King helicopter during a medical flight on Nias Island. Despite this terrible event, the ship's company continued on with their mission, and during my visit to HMAS Kanimbla I was impressed to see their morale high and their pride in assisting our neighbours in need.

Senator the Hon. Robert Hill
Leader of the Government in the Senate
Minister for Defence

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Call for Papers

Have you been involved in Emergency Response or Disaster Management?

The Journal is planning a special issue relating to Environmental Health aspects of planning and response to mass disasters. If you, or someone you know, has been involved in planning, policy, research or fieldwork in this area, now is the time to submit your papers to Environmental Health.

For further information, please contact Jaclyn Huntley at: journal@aieh.org.au

Listeriosis Awareness among Pregnant Women in the Loddon-Mallee Region of Victoria

Paul Jackson[1], Maria Sheldon[2], and Dianne Katscherian[3]

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Listeriosis is a rare but serious food-borne illness with particular implications for pregnant women. The study investigated the understanding of listeriosis among recent mothers in the Loddon-Mallee region of Victoria, Australia, and examined the effectiveness of listeriosis educational material. A postal survey was undertaken of all women in the Loddon-Mallee region who gave birth in the month of June 2003. Of the 303 women who had live singleton births in the region in June 2003, 129 consented to be contacted and 83 responded. Nineteen women had never heard of listeria and seven had done so only after their pregnancy. The study found that pregnant and post-partum women in the region had poor knowledge and awareness of listeriosis and its consequences. Awareness of the mild, flu-like symptoms that can affect pregnant women was particularly lacking. The listeriosis pamphlets currently available were neither effectively distributed nor well known. Further research across larger areas and including women from culturally and linguistically diverse (CALD) backgrounds is recommended. The results indicate a need for a new approach to the dissemination of listeriosis information to this high risk group.

Key words: *Listeria; Listeriosis; Pregnancy, Food-borne Infection; Loddon-Mallee; Awareness*

Listeriosis is a rare, food-borne disease, but one with high public health significance. Listeriosis is caused by ingestion of the *Listeria monocytogenes* bacterium and is a serious disease to which neonates, pregnant women, the immunocompromised and the elderly are particularly susceptible (Altekruse et al. 1997; Wing & Gregory 2002). Infection during pregnancy can be transmitted to the foetus. Affected infants may be stillborn, born with septicaemia, and/or develop meningitis in the neonatal period (Roche et al. 2001). As a food-borne disease, listeriosis is a relatively new and emerging condition, which has not yet achieved high community recognition or understanding (Torvaldsen et al. 1999).

Characteristics of *Listeria Monocytogenes*

Listeria monocytogenes historically has been one of the most important but least recognised microorganisms transmitted by food. The microorganism is ubiquitous in soil and water. It is commonly found in the gastrointestinal tracts of animals and up to 5% of healthy human adults (Wing & Gregory 2002). Despite the organism being widespread, most listeria infections result from eating contaminated foods (US Department of Health and Human Services and Department of Agriculture [USDHHS & DA] 2001). Two unusual features of the organism are its ability to multiply between 1°C and 45°C and at relatively high salt concentrations (Chin 2000; Wing & Gregory 2002). Hence *L. monocytogenes* can

grow well at refrigeration temperatures and in foods that are preserved in brine, such as soft cheeses and ready-to-eat foods. These foods therefore have the potential to be the vehicles for listeria infection.

Reservoir and sources

Listeria monocytogenes is ubiquitous in the environment, and human exposure is frequent. The organism is commonly isolated from sewage, silage, sludge, birds, and wild and domestic animals (Department of Human Services [DHS] 1996, 2001b). Fresh produce such as cabbage, potatoes, asparagus, broccoli, cauliflower, corn, green beans, lettuce, and radishes have been shown to be sources of *L. monocytogenes*, and products upon which the organism can grow and proliferate (Bell & Kyriakides 1998).

Mortality rates

In Western countries, listeriosis has the highest mortality rate of any food-borne pathogen. The US Department of Health and Human Services and the Department of Agriculture recently projected that there would be 2500 serious cases of listeriosis, with 500 deaths, in the United States each year (USDHHS & DA 2001). This equates to a mortality rate of 20%. By comparison, Salmonella enteritidis infections have a mortality rate of 0.38% (Mishu et al. 1994), Campylobacter species infections range from 0.02% to 0.1%, and mortality rates for infections from Vibrio species range from 0.005% to 0.01% (Altekruse et al. 1997).

Outbreaks of listeriosis

Most human cases of listeriosis are not outbreak related, but occur rather as a sporadic illness confined to a single individual (McLauchlin 1990). However, most of our knowledge comes from the study of outbreaks. Although long suspected, food was not strongly implicated in the transmission of *L. monocytogenes* until a 1981 Canadian outbreak in which coleslaw was shown to be the vehicle responsible (Bell & Kyriakides 1998; Donnelly 2001). Many subsequent outbreaks, including one in Massachusetts (1983), and another in Los Angeles (1985), relating to pasteurised milk and Mexican-style soft cheese respectively, confirmed the risk of ingesting contaminated foods (Fleming et al. 1985; Linnan et al. 1988). In December 1998, an outbreak of invasive listeriosis was identified in which *L. monocytogenes* was spread by hot dogs and processed meats produced by Sara Lee Foods in the United States. Over 100 people became ill during the outbreak and 21 people died, including five miscarriages or stillbirths (Centers for Disease Control and Prevention 1999; Jacobsen 2000).

Outbreaks continue to be reported around the world but are relatively uncommon in Australia. In 1990, a listeriosis outbreak involving ten pregnant women and resulting in six stillbirths was reported in Western Australia (Watson & Ott 1990). During the 1990s small outbreaks continued to occur in Australia and in the period 1998-2000, there were five outbreaks, three in healthcare settings (Kirk et al. 2003). The mean rate of listeriosis in Australia for the 1997-2000 was 3.0/106 cases, and the mean rate for non-pregnancy related listeriosis infections was 2.4/106 cases. In Victoria, the number of materno-foetal cases in 1997-2001 decreased 50% when compared to 1991-1996 (Kirk et al. 2003).

When compared to countries such as the United States, England and France, the number of listeriosis cases in Australia has been relatively low for many years (DHS 2001a; McLauchlin 1990; Roche et al. 2001; Wing & Gregory 2002). There is some evidence that it has even been declining in recent years (Kirk et al. 2003). Whether this is due to the success of educational and awareness programs, or to higher standards in food processing industries leading to reduced exposures, or both, or to other reasons is difficult to ascertain. One factor that could be impacting upon the number of listeriosis cases is the use of convenience

foods. Usage of pre-cooked, chilled foods is lower in Australia than many other countries and it is these foods that are very often implicated in major outbreaks overseas. If this is correct, and should the usage of these types of foods grow in Australia we might see an increase in the number of listeria cases in years to come. When this is combined with the increase of listeriosis among other risk groups such as the elderly and the immunocompromised in the period 2000-2003 (Gregory, J. 24 October 2003, personal communication; Kirk, M. 27 October 2003, personal communication), it would seem imperative for agencies, such as the Victorian Department of Human Services (DHS), to increase their role in the promotion of listeria awareness and in being more proactive in delivering the message to the public in general and to high risk populations in particular.

Occurrence and public health significance

Listeriosis is an uncommon disease in humans. Estimates of four cases per million in the UK, and of 7.1 cases per million population in the USA have been reported (DHS 1996). Mean rates in Australia for 1998-2000 were three per million (Kirk et al. 2003). Listeriosis notifications in Australia have steadily increased from 1984 until 1999 when there were 63 cases reported (DHS 2000).

In Victoria in 1999, there were 12 notifications of listeriosis, consisting of five materno-foetal cases and seven notifications in other at-risk persons. No clusters were identified in 1999, and notifications were received throughout the year. Of these, five were materno-foetal cases that resulted in only two live births, but there were no maternal deaths (DHS 2000).

In 2000, in Victoria there were 11 reported cases of listeriosis, consisting of two materno-foetal cases and nine notifications of other at-risk people. The notifications were spread throughout the year (DHS 2001a). The two materno-foetal cases resulted in two live births, but one neonate died 36 hours after delivery. There were no maternal deaths. Both cases occurred in the metropolitan area (DHS 2001a). There were no outbreaks identified in 2000. Table 1 summarises the listeriosis notifications and deaths from 1996 to 2000.

Table 1: Listeriosis notifications and deaths, by category, Victoria, 1996-2000

Year	Materno-foetal cases		Other Cases		Total cases	
	Notifications (Deaths)[a]	Case fatality rate %	Notifications (Deaths)	Case fatality rate %	Notifications (Deaths)	Case fatality rate %
1996	3 (1)	33	17 (9)	53	20 (10)	50
1997	4 (1)	25	11 (3)	27	15 (4)	27
1998	5 (4)	80	10 (3)	30	15 (7)	47
1999	5 (3)	60	7 (1)	14	12 (4)	33
2000	2 (1)	50	9 (6)	66	11 (7)	64
Total	19 (10)	53	54 (22)	41	73 (32)	44

a Materno-foetal deaths include stillbirths, neonatal deaths and miscarriages.

Source: Victorian Perinatal Data Collection Unit 2001

Listeria during pregnancy

Pregnant women have 20 times the risk of acquiring listeriosis when compared with the wider population (Donnelly 2001). Listeriosis occurs most often during the third trimester of pregnancy, resulting in one of three outcomes: an asymptomatic maternal infection and an infected infant; a severely ill mother who enters labour prematurely and delivers a stillborn or severely ill infant; or an unaffected foetus but the mother usually dies (Donnelly 2001). In most cases of perinatal listeriosis, the mother is mildly affected, exhibiting flu-like symptoms, but neonatal mortality is common (Donnelly 2001).

Listeriosis generally manifests as meningoencephalitis and/or septicaemia in newborns and adults and abortion in pregnant women (Chin 2000). However, Mylonakis et al. (2002) also reported that maternal listeriosis often resulted in a non-specific febrile illness that was seldom diagnosed pre-partum. Serious illness was

rarely noted in a studied group of 222 pregnant women. Infection, however, often resulted in spontaneous abortion, stillbirth, death of the newborn within hours after birth, or neonatal sepsis (Mylonakis et al. 2002). Although listeria infections occur most commonly in the third trimester, the prognosis is worst if the infection occurs in early pregnancy. Of the surviving infants born to listeria-infected mothers, about two-thirds develop neonatal sepsis (Wing & Gregory 2002). Pregnancy related cases in Victoria between 1996 and 2000 had fatality rates ranging from 25-80% (Victorian Perinatal Data Collection Unit 2001).

Listeria awareness

The symptoms of listeriosis generally take a few days or even weeks to appear and can be mild, thus pregnant women might not even know they have it (Chin 2000). Therefore, it is very important to take appropriate dietary and food safety precautions during pregnancy. It is vital that pregnant women become appraised of the dangers of listeria infection and the precautions that should be taken as early as possible during the pregnancy or, preferably, before becoming pregnant. The main forms of education in Australia are provision of information in pamphlets and use of on-line material. In an American study, Woteki (2001) reported that many women are not properly advised about the risks of listeria infection, even when they have specifically asked their health care provider for information. Only Torvaldsen et al. (1999) in their study in Western Australia have made any assessment of the understanding of pregnant women of the issues associated with listeriosis and the effectiveness of the awareness campaigns. Torvaldsen et al. concluded that rural women were less likely to have heard of listeria, less likely to have knowledge of listeria, and less likely to initiate appropriate dietary changes during pregnancy. Exploration of this conclusion in relation to rural women formed, in part, the motivation for this study of women in regional Victoria.

Australian health agencies have sought to increase listeriosis awareness through public awareness campaigns but the effectiveness of these campaigns and the levels of awareness have not been well examined (Kirk et al. 2003). While there is some evidence of falling rates of listeriosis in Victoria, reasons for the decline are not clear (Kirk et al.). Only one study (Torvaldsen et al. 1999) has examined the sources of information about listeriosis used by pregnant women and it concluded that:

> *The listeria pamphlet is an effective medium for educating pregnant women about listeria. Rural, young, single and non-English speaking background women may require a different or supplementary approach* (Torvaldsen et al. 1999, p. 362).

Torvaldsen et al. (1999) also reported that 11% of the study population had not heard of listeria and that this group had lower odds of correctly identifying risk foods.

Aim

The principal aim of this project was to assess awareness and knowledge relating to listeriosis among recent mothers (8-12 weeks post-partum) in the Loddon-Mallee region of Victoria and to test the hypotheses that listeriosis is not well understood by pregnant women. Subordinate objectives were to ascertain from which sources pregnant women obtain information about listeriosis; to compare results with previous research into the area of listeriosis awareness; to assess whether women who report having received advice on listeriosis had better knowledge of the associated risks.

Method

A quantitative, cross-sectional study of women was undertaken 12 weeks post-partum. A questionnaire was developed by selecting questions relating to listeria previously used in the Western Australian Pregnancy and Infancy Survey 1997-98 (Torvaldsen et al. 1999). The five-page, self-

reported, pen and paper questionnaire consisted of 24 questions to gather quantitative data about knowledge, events and behaviours relating to listeriosis awareness during pregnancy.

Sample

The study examined a small, cross-sectional cohort of women in the Loddon-Mallee region of Victoria. The 303 women who gave birth to live singleton infants in the region during June 2003 were approached to participate. In total, 129 women gave consent and 83 (27%) completed the questionnaire. The study sample was recruited through each of the 11 regional hospitals with maternity facilities or wards. Midwifery staff sought agreement to participate from each new mother before she left the hospital. At that time, mothers were advised of the general nature of the interview and asked to participate in two to three month's time. Every new mother who met the study criteria was approached to participate. Women were approached for recruitment shortly after delivery, but while still in hospital. They were asked at this time for their name and address and consent to participate in the study. Ethics approval was obtained from each of the participating hospitals in accordance with National Health & Medical Research Council guidelines.

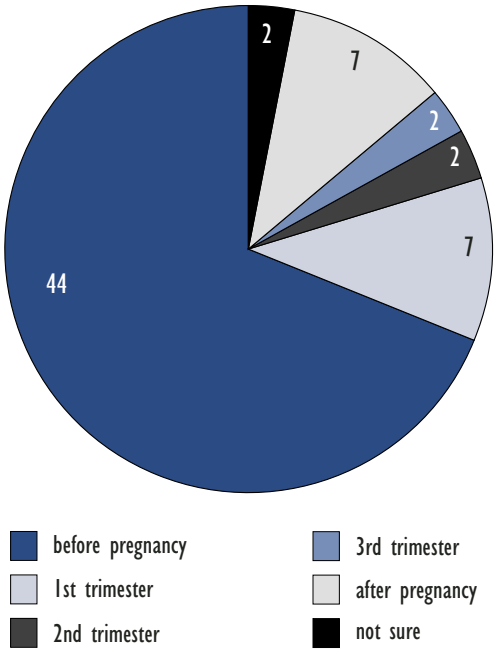
Results

The 83 women who responded, were all aged 18-42 with a median age of 31 years. All reported English as the language normally spoken at home and only one reported having been born overseas.

Listeria awareness among respondents

Of the 83 respondents, 19 (23%) had not heard of listeria. Of the remaining 64 who had heard of listeria, 7 (13%) heard about it only after their pregnancy. Of the 64 respondents who had heard about listeria, most (69%) had heard about listeria prior to their pregnancy. Others received the information at diverse times throughout the pregnancy. Two women could not recall when they had first heard of listeria. The information in Figure 1 shows details of the results.

Figure 1: Number of women who had heard of listeria and the time in pregnancy at which the mother first heard of listeria



To assess which risk factors might influence women being aware of listeria, their age, marital status and education levels were examined (Table 2). No significant differences were found in knowledge of listeria among women who were married, single, divorced, or in de facto relationships. However, women who had not heard of listeria were significantly more likely to be younger and less well educated. When compared to the reference group (i.e. women over 29), women under 25 were less likely to have heard about listeria (OR 5.6; 95% CI 1.2-27.1). Women who had not completed tertiary studies were less likely to have heard of listeria than those who had (OR 4.4; 95% CI 1.1-17.6).

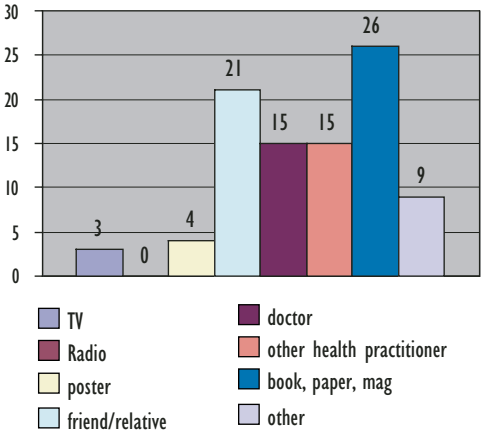
Table 2: Factors potentially influencing whether women had heard about listeria

Potential influencing factors	N(%) of those who had not heard of listeria (*n*=19)	N(%) of those who had heard of listeria (*n*=64)	Unadjusted odds ratio for not having heard of listeria (95% CI)
Single/separated/de facto	8 (42)	15 (23)	2.4 (0.7-8.0)
Education			
Tertiary degree or diploma	6 (32)	38 (59)	1 (referent group)
High school or other	9 (47)	13 (20)	4.4 (1.1-17.6)
Not completed high school	4 (21)	13 (20)	2.0 (0.4-9.7)
Age			
>29	7 (37)	46 (72)	1 (referent group)
25-29	6 (32)	11 (17)	3.6 (0.9-15.4)
<25	6 (32)	7 (11)	5.6 (1.2-27.1)

Sources of information about listeria

Survey respondents who had heard of listeria were asked about their sources (Figure 2). There were 33% of the women who reported having heard about listeria from relatives or friends while 40% obtained their information from magazines, books, or newspapers. The various other sources mentioned included pamphlets (4), the Internet, antenatal sessions, and hospital maternity admission information kits.

Figure 2: Sources of listeria information



Awareness of listeria pamphlets

Respondents who reported having heard about listeria were then asked specifically whether or not they had seen any pamphlets relating to information about listeria during pregnancy. Those who had seen the pamphlets were further asked where they saw or obtained them. Of the 64 women who had heard of listeria, 36 (56%) had not seen any pamphlets. The 28 (44%) who now reported having seen a pamphlet, had obtained it from doctors (10), other health practitioners (8), health centres (7) and 'others' (9). Women were able to report more than one source. The 'other' sources included almost exclusively the information kits supplied by the hospitals upon booking for the birth.

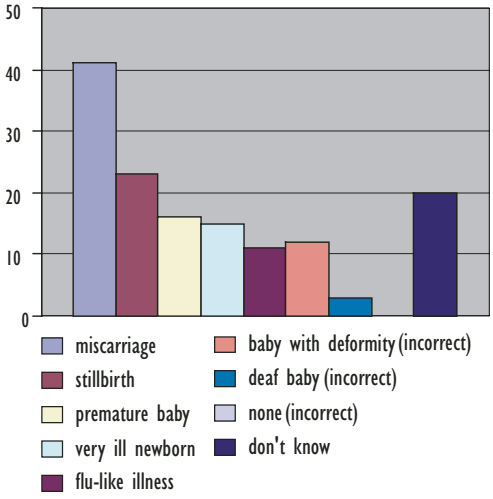
Of the 28 women who reported having seen a pamphlet, 25 found it very useful or useful. Two women found it neither helpful nor unhelpful and one woman could not remember. When asked to comment on what further information could be included in the listeria pamphlet, five women commented that they would like more information on topics such as risk foods, food preparation, symptoms in the mother, symptoms and illness in the foetus, and infection transmission times.

Knowledge of outcomes and transmission of listeria infection

Survey respondents who reported having heard of listeria were asked to identify the possible outcomes of listeria infection during pregnancy. Respondents were offered five correct responses (a stillbirth, a very ill newborn baby, premature birth, miscarriage and flu-like illness) and three incorrect ones (a baby with deformity, a deaf baby and no effect). Only two of 64 respondents (3%) correctly identified all five correct responses

and no incorrect ones. Twenty respondents (31%) indicated that they did not know and 42 (66%) answered incorrectly or partially correctly (see Figure 3). Of those who ticked one or more symptoms, all correctly identified miscarriage as an outcome, but 45% failed to identify stillbirth, 64% failed to identify premature birth, 67% failed to identify very ill newborn baby and 73% failed to identify flu-like symptoms.

Figure 3: Knowledge of symptoms caused by listeria



When asked to identify the stage in pregnancy at which listeria infection could be transmitted from mother to child, only 18 (29%) of survey respondents correctly identified that transmission could occur at any time during pregnancy. Five women (8%) said the first trimester, one (2%) said third trimester, two (3%) said never, and 36 (58%) said they did not know. No one selected the second trimester as a time during which transmission could occur.

Discussion

Awareness of listeria

Almost one quarter (23%) of the women surveyed had never heard of listeria. This contrasts with the findings of Torvaldsen et al. (1999) that only 11% of new mothers in Western Australia were unaware of listeria. Results of this study, however, support Torvaldsen's conclusion that rural women are less likely to have heard of listeria (OR 4.6, 95% CI 2.5-8.6). The high percentage (23%) of respondents who had not heard of listeria points to the need for education programs to be improved and revised particularly in rural areas. Torvaldsen et al. also hypothesised that the low rates of knowledge among rural women were due to their relatively poor access to health promotion materials compared with metropolitan-based women. Medical providers and services such as private hospitals and other alternative birthing centres or practitioners are also notably fewer in regional areas (Duckett & Kenny 2000; Wilkinson & Symon 2000). This is of importance given that these services are often the source of information about conditions such as listeriosis.

Younger women and women with lower education levels were found to be less likely to have heard of listeria. In particular women under 25, when compared with the reference group of women over 29, were almost six times less likely to have heard of listeria. This has important consequences as these women are therefore less likely to control dietary risks associated with listeria infection. There are also higher rates of early motherhood in rural districts compared to metropolitan areas (Victorian Perinatal Data Collection Unit 2001). Although most respondents (69%) heard of listeriosis before their pregnancy, there is still a significant group who are receiving their information at stages which might be too late.

Sources of information

Doctors and other health professionals were equally significant sources of information for respondents who had heard about listeria. The role of other health care professionals should therefore not be underestimated when developing strategies for listeria awareness campaigns or programs. Nevertheless, a significant number of women obtained information about listeria

from areas and sources other than health professionals. These included books, papers and magazines (reported by 40%), friends and relatives (reported by 33%), and a range of other sources (reported by 14%). It is encouraging to note a diversity of information sources regarding listeria risks and infection to women. Nevertheless, there is a need to ensure that information is accurate, reliable and up-to-date.

Information gained from a listeria pamphlet

Torvaldsen et al. (1999) reported that 86% of their survey respondents had seen a listeria pamphlet. However, of the respondents in this current study who had heard of listeria, only 28 (44%) reported having done so. Furthermore, 19 respondents had never heard of listeria, implying that only 35% of all the participants in this current study had actually seen a listeria pamphlet. Although the Victorian DHS sends the listeria pamphlet regularly to its offices throughout the state and to local councils, no respondent cited councils or government agencies as a source of the pamphlet. Further examination of the distribution of the pamphlet should be undertaken.

It was encouraging to note that the majority of those women who had seen the pamphlet regarded it as being useful or very useful. However, revision and expansion of the pamphlet in the areas such as risk foods, food preparation, symptoms in the mother, symptoms and illness in the foetus, and infection transmission times should be considered.

Knowledge of listeria transmission during pregnancy

Overall, the survey respondents displayed a poor knowledge of the stages of pregnancy during which transmission of listeria infection can occur. Over half of the new mothers ticked "don't know" to this question and a further 13% answered incorrectly. This is of particular concern as a sound knowledge of transmission risks is vital to the prevention of infection in this high-risk group.

The levels of knowledge indicated were in contrast to the findings of Torvaldsen et al. (1999) that 83% of new mothers from metropolitan areas knew that transmission could occur at any time during pregnancy. This suggests that future campaigns in rural areas should emphasise the importance of avoiding the consumption of high risk foods during pregnancy. It is possible that this lack of knowledge may be related to the preferred information sources utilised by this group. Magazines, newspapers, friends, and relatives might focus more on the often dramatic outcomes of listeria infection than on the less newsworthy aspects such as transmission times.

Knowledge of symptoms and outcomes of listeria infection

Only two survey respondents were able correctly to identify all possible outcomes of listeria infection in pregnancy while not ticking any of the incorrect ones. However, all respondents who attempted this question were able to nominate at least one of the correct symptoms. This is critical as far as the public health and behaviour implications are concerned. Although 20 of the respondents indicated that they were unaware of the symptoms of listeria infection during pregnancy, it was encouraging that the remaining 44 (69%) recognised miscarriage as an outcome. Of some concern, however, is that 73% failed to recognise that flu-like symptoms in a pregnant woman could be a sign of listeria infection. As this is often the only noticeable indication of listeria infection for a pregnant woman, it is important for them to be able to recognise and report it to their medical practitioner (Donnelly 2001; Mylonakis et al. 2002). This is a key issue, which needs to be addressed by listeriosis educators.

Demographics and recruitment

Reasons for the overall low involvement rate (23%) might be related to the poor cooperation of hospitals and their participating staff. There was a particular lack of involvement from two of the hospitals that had given ethics approval. It is also possible that the chosen time of recruitment, that is 1-2 days after birth, had a negative impact upon the willingness of new mothers to participate. It is likely that many women were still recovering from the emotional and physical impact of birth and feeling the burden of responsibility of caring for a newborn infant. Midwifery personnel are also often under work pressures during the early post-natal periods, which might have made it difficult for them to recruit participants.

It may also be possible that the recruitment method was subject to influence. It was the role of individual nurses in the midwifery wards to give information to new mothers and discuss the research with them. It is feasible that some nurses thought that, with the other pressures of work, it was too difficult to approach women who had poor English skills. It might also have been that those mothers from non-English speaking backgrounds found the information or the questionnaire too difficult and did not agree to participate or did not complete the questionnaire.

Conclusion

The hypothesis that listeria is not well understood by young mothers in rural areas has been supported by this research, in so far as the results indicate a notable lack of understanding by this group of a number of key factors pertinent to the risks and consequences of listeria infection in pregnancy.

The results of this study did not confirm the findings of Torvaldsen et al. (1999) in relation to general listeria awareness among new mothers. Whereas Torvaldsen et al. reported awareness levels of 89%, this figure was only 77% in the Loddon-Mallee region. Nor could we confirm the findings of Torvaldsen et al. that over 80% of women were able to identify correctly the stages of pregnancy when infection transmission could occur, with only 29% of mothers correctly answering this question. While our results support findings by Torvaldsen et al. that listeria information pamphlets are useful if used, the DHS strategy on listeriosis awareness at the time focused on the distribution of the pamphlet *Listeria: The Facts* to hospitals and other health agencies and our results indicate that these pamphlets were under-utilised.

Torvaldsen et al. (1999) reported that pamphlets are an effective medium for educating women about listeria. That finding was not fully supported by this research as the majority of women who had heard of listeria could not recall having ever seen a listeria pamphlet.

Recommendations

Future studies should include non-English speaking women and women born overseas. This could be facilitated by the development of information sheets, consent forms and questionnaires in languages other than English.

It would seem that a reorientation of official information into sources such as books, papers and magazines would be beneficial and successful in reaching a greater percentage of women. Education strategies need to focus the awareness campaigns to reach women before they become pregnant. Future studies should have a specific emphasis placed upon assessing rural women's access to education programs, sources of information about listeria, and the availability of medical practitioners and other health service providers.

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Comparison of the Biologically Effective UV in the Shade for Three Action Spectra

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There have been numerous studies associated with the measurement of biologically effective UV (UVBE) irradiances for the solar zenith angles (SZA) observed during summer. However, only a small amount is known about UVBE levels related to the larger SZA seen during the autumn and winter months. Spectral UV irradiance measurements were made under clear sky conditions at a sub-tropical Southern Hemisphere site. Biologically effective UV levels for fish melanoma, DNA damage and cataract induction was investigated beneath four specific shade settings, for relatively cloud-free sky conditions, and a changing solar zenith angle (SZA) between 33° to 63°. The biologically damaging UV in the shade was significant for fish melanoma. Compared to that in full sun, the UVBE associated with DNA damage, cataract, and fish melanoma were at levels of approximately 76, 78 and 65% respectively beneath the shade umbrella. DNA damage, cataract and fish melanoma irradiance levels in the shade of a northern facing covered veranda were significantly less than those beneath the shade umbrella, with levels of approximately 19, 19 and 15% respectively. Although no action spectrum exists for human melanoma and cataract development, the fish melanoma and porcine cataract action spectra might provide an indication of the effective wavelengths. The relative UVBE in the shade compared to full sun depends on the action spectrum that is being considered. The reduction in the UVBE for the different action spectra is not related to the reduction in the unweighted total UV. Shade is important as a UV minimisation strategy, but for long periods, shade alone does not provide enough protection from some biologically damaging UV.

Key words: *Shade; UV; Melanoma; Cataracts; DNA Damage*

Australia has one of the highest rates of skin cancer incidence and mortality in the world, with two out of three Australians developing some form of skin cancer during their lifetime (ACCV 1999; Roy & Gies 2000). Melanoma is rated fourth of all cancers in Australia as a cause of morbidity and mortality before the age of 70 (Green 1984).

UV radiation is a carcinogen and repeated exposure to sunlight is now widely accepted as the major environmental cause of skin cancer and sun related eye disorders in all skin types which are genetically predisposed (Carter et al. 1999; Longstreth et al. 1995; National Health & Medical Research Council (NHMRC) 1996). UV-induced types of skin cancer include basal cell carcinoma, squamous cell carcinoma, and melanoma. There is a clear relationship between UV dosage and the incidence of squamous cell skin cancer. Although sunlight exposure is implicated in melanoma development, the relationship with exposure is not completely certain as melanoma is not

generally located on highly exposed areas of the body (Preston & Stern 1992; Setlow et al. 1993; Urbach 1997).

It is thought that intermittent severe exposures (severe enough to cause sunburn) are critical for UV-induced melanoma and that UV exposures in infancy are more dangerous than exposures later in life (Ambach & Blumthaler 1993; Stanton et al. 2000). Although cutaneous melanoma is generally a disease of adulthood, children in Queensland, Australia, showed the highest incidence rates of melanoma in the world (Whiteman et al. 1997). Godar et al. (2003) concluded from their work that individuals receive approximately 25% of their total lifetime UV radiation exposure by the age of 18.

Even though sunlight exposure is agreed as being one of the main etiological agents in the development of malignant melanoma and cataracts in humans, the wavelengths responsible are not yet fully known (Oriowo et al. 2001; Setlow et al. 1993). If an estimate of the biological sensitivity of organisms to UV radiation is desired, responses to changes in wavelength dependence must be calculated (Jagger, 1967). Action spectra are used to show the relation between the irradiating photons and the effect on certain biological processes. Although no action spectrum exists for human melanoma, the fish melanoma action spectrum may provide an indication of the wavelengths effective in human melanoma development (Gasparro et al. 1998; Setlow et al. 1993). Research on cataract development using whole porcine lenses has also produced an action spectrum that may be used as an indicator of the wavelengths effective in cataract induction in the human eye (Oriowo et al. 2001).

The development of non-melanoma skin cancer as a result of induction by UVB radiation is accompanied by damage to the DNA and its repair system, and by an alteration of the immune system (Ambach & Blumthaler 1993). DNA is believed to be the target because individuals defective in the repair of UV damage to DNA are more highly prone to the disease than the average person (Setlow et al. 1993). The UVB (280-320 nm) wavelengths of the DNA damage action spectrum are more effective than are the longer UVA (320-400 nm) wavelengths (Setlow 1974). UV induced damage in DNA is repaired by a cascade of enzyme reactions and years of over exposure to UV cause errors to accumulate in replicated DNA (Urbach 1997). These errors (mutations) can make certain genes, that are crucial for cell regulation, dysfunctional, and such an association was found in genes in human skin cancer (Urbach 1997).

Shade is highly sought after to find solace from the sun's harmful rays during the day, but the levels of biologically effective UV radiation that exist in different shade environments are not fully understood. Past research has looked at the erythemal UV irradiances in various types of shade (Moise & Aynsley 1999; Parisi et al. 2000; Parisi et al. 2001; Toomey et al. 1995; Turnbull & Parisi 2003; Turnbull et al. 2003; Turnbull & Parisi 2004a; Turnbull & Parisi 2004b; Wong 1994), but none have described a comparison of the biologically damaging UV associated with melanoma, DNA damage and cataract induction underneath specific shade structures. This research reports on the biologically effective UV that is associated with melanoma, DNA damage and cataract induction beneath four different shade environments during the months associated with autumn and winter for a Southern Hemisphere site. The months of March to August were selected because of the higher proportion of diffuse UV, caused by an increasing SZA, seen in the shade.

Method

Spectroradiometry

A scanning spectroradiometer fitted with a 15 cm diameter-integrating sphere (model OL IS-640, Optronics Laboratories, Orlando, FL, USA) that can be manually orientated was employed. For this research, the integrating sphere was 1.0 m above

ground level. The spectroradiometer has a double holographic grating (1200 lines mm^{-1}) monochromator (model DH10, Jobin-Yvon, France) connected to a R212 photomultiplier tube (Hamamatsu Co. Japan) temperature stabilised by a Peltier cell temperature controller to 15.0 ± 0.5°C. Stray light rejection is of the order of 10^{-8}.

Prior to each series of scans, the spectroradiometer was wavelength calibrated against UV mercury spectral lines and absolute irradiance calibrated against a quartz tungsten halogen lamp (250 W) operated at 9.500 ± 0.005 A d.c. and with a calibration traceable to the National Standards Laboratory at the CSIRO, Lindfield. The current was supplied to this secondary standard lamp from a regulated power supply (model PD36 20AD, Kenwood).

For each shade setting, measurements were at two specific periods of the day (11:30-12:30 Eastern Standard Time (EST), referred to as noon and 14:30 - 15:30 EST, referred to as afternoon) and for increasing solar zenith angle between 33° and 63°. The measurement protocol has been previously described (Turnbull & Parisi 2003). Briefly, this involved: measurement of the UV spectrum in the sun on a horizontal plane (with the entrance aperture of the integrating sphere directed upwards) at a distance of 20 m or as far as possible from the shade; measurement of the UV spectrum in the approximate centre of the shadow cast by the shade structure; and then measurement of the UV spectrum in the sun a second time. The measurement planes were a vertical plane, horizontal plane and on a plane 45° to the vertical for each of the shade settings. For the shade umbrella and sandpit, the measurements on the vertical and 45° planes were directed towards the sun. For the covered veranda and covered walkway these measurements were aimed in a northern direction for two reasons: i. the sun is to the north at solar noon; and ii. these positions gave the maximum irradiances in each case.

Day-to-day total column ozone levels were obtained from the TOMS (Total Ozone Mapping Spectrometer) web page. The data collected showed that the total ambient air ozone levels varied from 281 to 326 Dobson Units (DU) during the research period.

Shade structure description

The research was conducted using four different shade structures located at the University of Southern Queensland (USQ), Toowoomba (27.5°S). The structures were a shade umbrella, a covered veranda, a covered sandpit and a covered walkway. These were selected because they are regularly used by the public. Previous research (Turnbull & Parisi 2003) found that there were relatively high erythemal irradiances under these shade structures. Brief details of the shade structures are described below:

- The diameter of the shade umbrella was 1.8 m and a height at the apex of 2.1 m. The ground cover was dry grass with an albedo of approximately 0.04;
- The northern facing veranda covering was approximately 7.0 m long, 1.5 m wide from the building wall and the eaves were 2.5 m high. A number of trees are located near this site and therefore have some influence over the scattered UV levels in the shade;
- The sandpit covering was 2.6 m in diameter, approximately 3.0 m high at the apex and 2.0 m high at the eaves. Trees, shrubs and a building are located near the shade structure. The albedo of the sand was approximately 0.1;
- The height of the walkway was approximately 4.0 m, the depth 2.5 m, length 6.0 m, and with an east/west path.

The shade umbrella and sandpit

coverings were made from various woven materials. The transmittance through each of these were previously measured and reported (Turnbull & Parisi 2003). Briefly, the UV transmittance of the shade umbrella material was determined with the scanning spectroradiometer on four separate occasions, scanning the incoming spectrum from 280 to 400 nm on a relatively cloud free day. The solar spectral UV irradiance, $S(\lambda)$ was measured in 1 nm increments and then the shade umbrella fabric was placed directly over the opening of the integrating sphere in a stretched state similar to that when fully deployed. The spectral irradiance of UV passing through the fabric, $S_T(\lambda)$, was then measured and the UV transmittance, UV_T, was calculated using the following equation:

$$UV_T = \frac{\sum_{200}^{400} S_T(\lambda)}{\sum_{200}^{400} S(\lambda)} \quad (1)$$

It was not practical to employ the scanning spectroradiometer to measure the transmittance of the covering material over the sandpit, because of the fixed nature of the shade structure being too high for the integrating sphere. As a result, the UV irradiances were measured in the shade with a radiometer (model 3D V2.0, Solar Light Co., Philadelphia, PA) fitted with a UVA detector and an erythemal UV (UVery) detector. The radiometer was calibrated to the spectroradiometer with the solar UV as the source. The transmittance measurements were made on relatively cloud free days by placing the entrance optics of the radiometer directly beneath the shade cloth (approximately 2.3 m above the ground), facing directly towards the sun. Full sun measurements were made by placing the radiometer at the same height, same orientation and approximately 1.5 m from the shade structure. The transmittance was calculated as the ratio of the shade measurements to full sun measurements. The UV transmittance through the material of the shade umbrella was calculated as being 0.5% for total UV and 0.9% for erythemal UV. There was no spectral dependency observed for the transmittance through the shade umbrella fabric. The erythemal UV through the material over the sandpit was equated to a transmittance of 4.8%, and with a corresponding UVA transmittance of 2.1%.

Biologically effective UV

To calculate the biologically effective UV irradiance in the shade, UVBE, the spectral irradiance, $S(\lambda)$, may be weighted with the action spectrum for a particular biological process, $A(\lambda)$, according to the following equation:

$$UVBE = \int_{UV} S(\lambda)\, A(\lambda)\, d\lambda \quad (2)$$

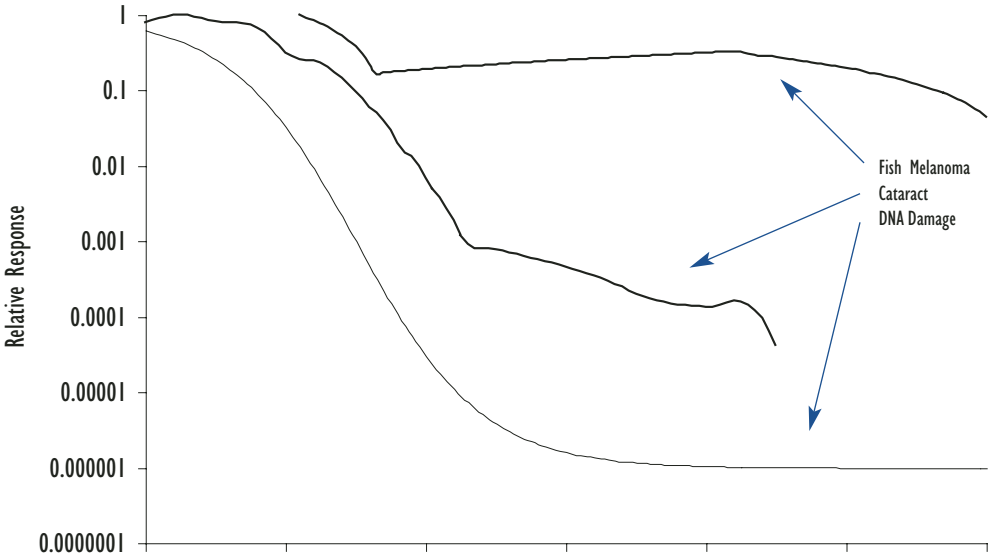
For this research, the fish melanoma (Setlow et al. 1993), DNA damage (Setlow 1974) and cataract (Oriowo et al. 2001) action spectra have been employed (Figure 1). Linear interpolation was used for the fish melanoma and cataract action spectrums for wavelength points not present in the action spectra. Action spectra are normalised; therefore the plots provide a detailed change with wavelength for a specific effect, rather than an absolute quantity to compare between different action spectra.

Results

Biologically effective UV

Spectral irradiances taken beneath the four shade structures for a SZA of approximately 61° have been weighted by the fish melanoma, DNA damage and cataract action spectra (Figure 1) and are shown in Figures 2a, b and c. Overall, the spectral irradiances generally increased with increasing wavelength from a cut-off wavelength between 295 and 305 nm, with maxima occurring at 400 nm. All spectral irradiance calculations are from 300-400 nm due to the high levels of noise in the shade irradiances below 300 nm. This may cause a

Figure 1: Action spectra for fish melanoma, DNA damage and cataract induction



slight underestimation in the UVBE levels for DNA damage and cataracts. The fish melanoma action spectrum (Figure 2a) illustrates that there is a significant biological response over the entire UV waveband, where as in Figures 2b and c the response is far more effective in the UVB waveband.

Table 1 shows the highest UVBE irradiance levels observed in the full sun and in the shade. The full sun and shade UVBE measurements are not relative to each other, they are only the maximums observed during the research. As can be seen from Table 1, UV irradiance levels associated with fish melanoma were significantly higher both in the full sun and in the shade compared to those for DNA damage and cataract induction.

Table 1: Select data of the highest UVBE levels observed in the full sun and in the shade for any shade structure. These are not corresponding full sun and shade measurements

		UVBE (Wm^{-2})		
		Melanoma	DNA damage	Cataract
Full Sun	Autumn	15.01	0.0110	0.300
	Winter	12.84	0.0076	0.170
Shade	Autumn	5.59	0.0028	0.126
	Winter	5.87	0.0014	0.065

UVBE levels for DNA damage, cataract and melanoma induction in the shade of the four structures for winter and autumn are plotted in Figures 3 and 4. All three measurement planes are graphed to show the variation of UVBE levels with the changing angle of the incident radiation. Overall, UVBE levels were the highest beneath the shade umbrella for all instances, whereas the sand pit and covered walkway received the lowest irradiances especially in winter.

Shade ratios

Average shade ratios for DNA damage, cataract, fish melanoma and total UV, for relatively cloud free skies and two different times of day are shown in Table 2. The shade ratios are based on the angle (horizontal, 45°, and vertical) that received the highest UV irradiance in the shade. The shade umbrella received the highest relative proportion of UVBE in the shade, as the SZA increased. Compared to that in full sun, the UVBE beneath the shade umbrella associated with DNA damage, cataract and fish melanoma were at levels of approximately 76, 75, and 65%, respectively

Figure 2: Spectral irradiances for the shade umbrella at a SZA of approximately 61°, weighted by the fish melanoma (a), DNA damage (b) and cataract induction (c) action spectra for the shade umbrella (1), covered veranda (2), covered sand pit (3) and covered walkway (4)

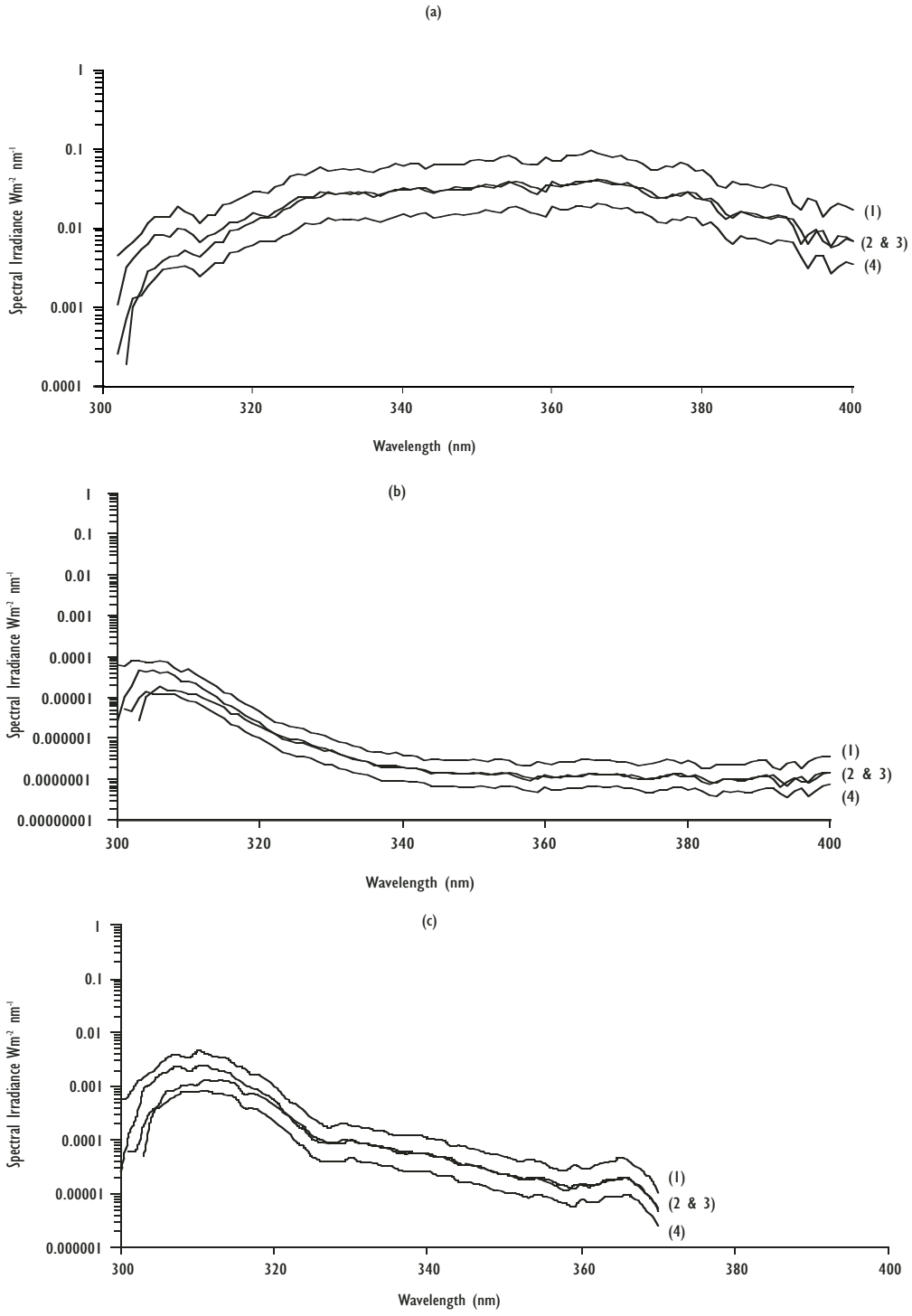
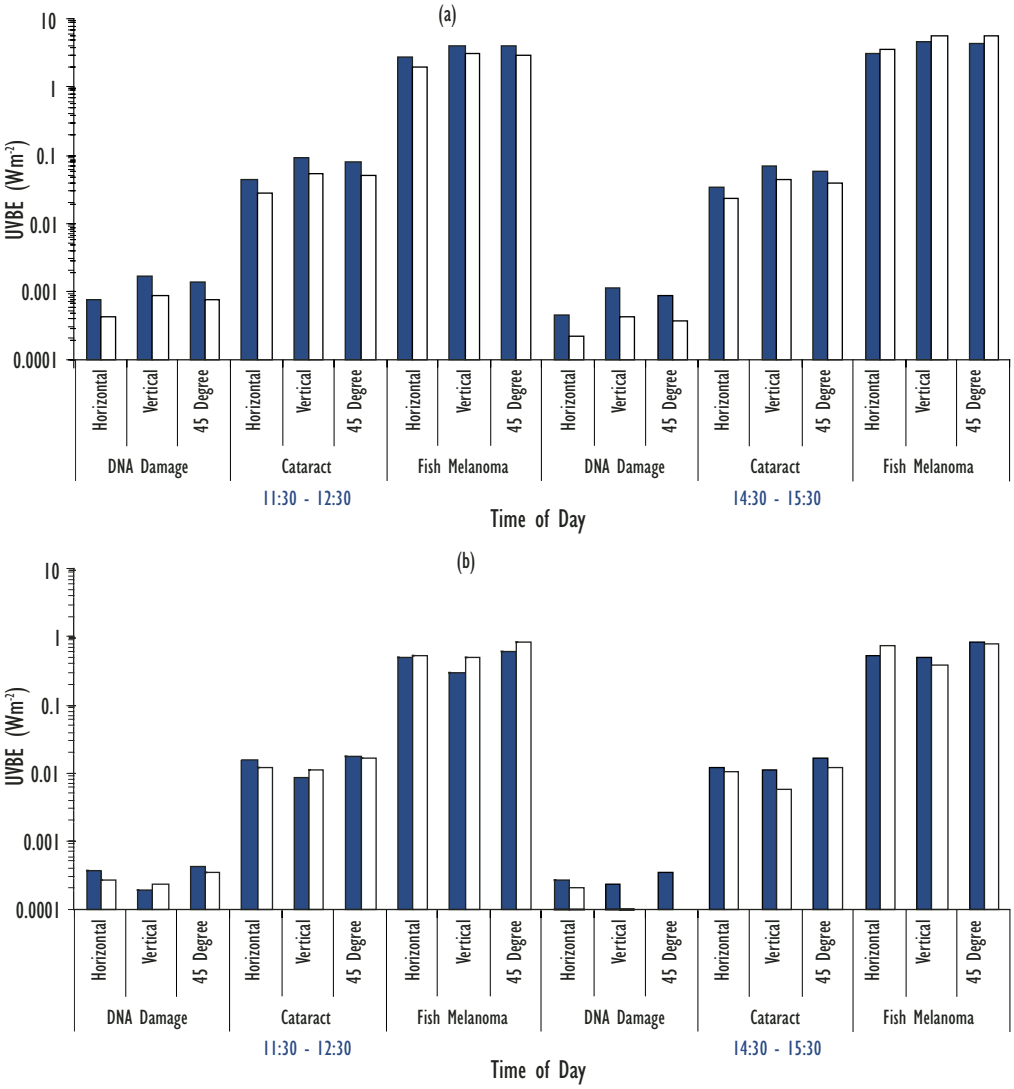


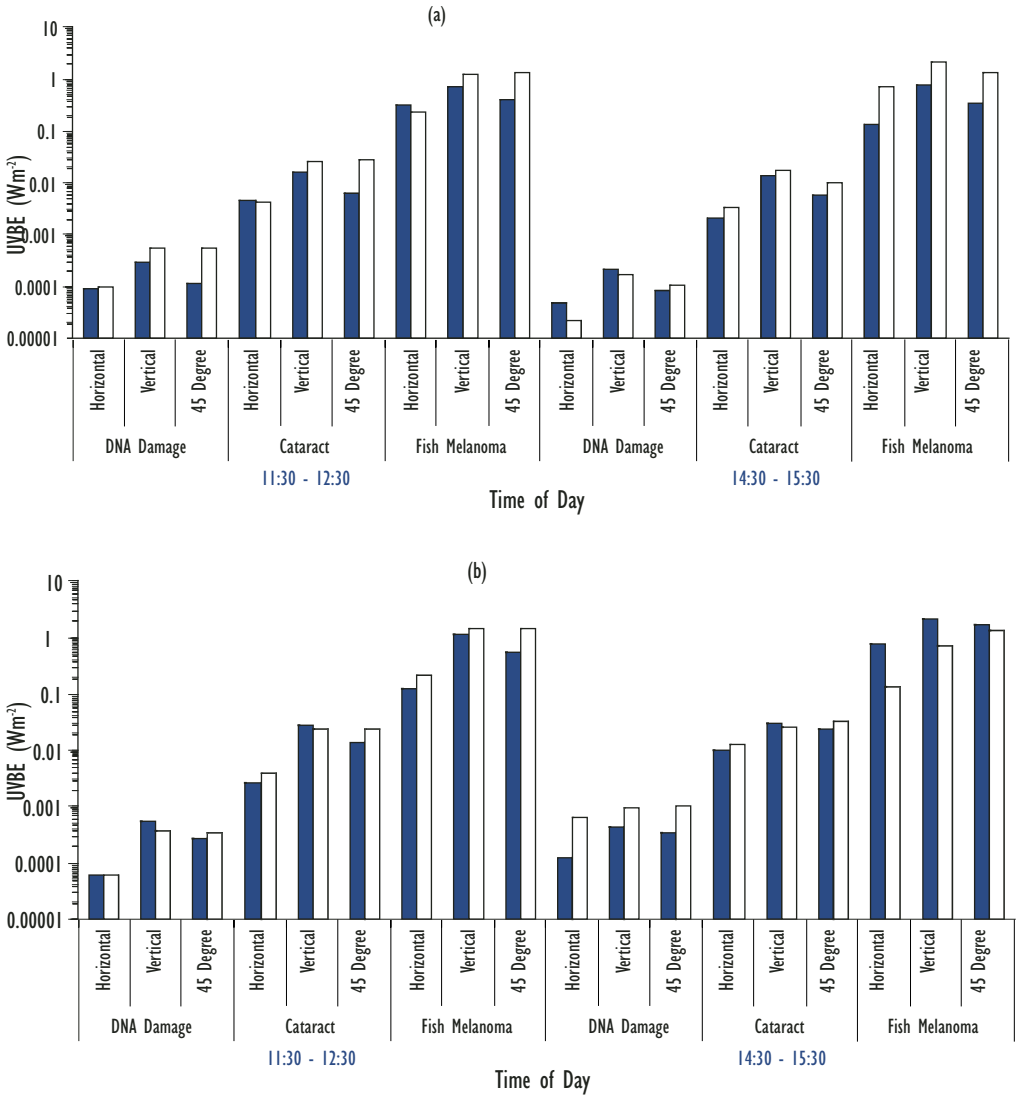
Figure 3: Comparison of both autumn (blue) and winter (white) UVBE levels on a clear day for the shade umbrella (a) and covered veranda (b), at both time periods and for the three orientations



for the larger SZAs.

The shade ratios in the shade for DNA damage and cataracts were greater than those for melanoma because of the higher relative effectiveness of the DNA and cataract action spectra in the UVB waveband compared to the UVA waveband. This results in a higher spectral effectiveness in the UVB compared to the UVA for the DNA and cataract action spectra. In comparison, the spectral effectiveness for the fish melanoma action spectrum is higher in the UVA compared to the UVB (Figure 2). As a result, due to the relatively higher degree of scattering of the shorter UVB wavelengths, the shade ratios for DNA damage and cataract induction in the shade are proportionally higher. Although the shade ratios for DNA damage and cataract induction are quite high in the shade, this

Figure 4: Comparison of both autumn (black) and winter (white) UVBE levels on a clear day for the sand pit (a) and covered walkway (b), at both time periods and for the three orientations



does not necessarily translate across to meaning greater UV energy levels in the shade (Table 1).

The northern facing covered veranda with surrounding trees received the lowest proportion of UVBE in the shade for an increasing SZA, with the highest levels at 22% for DNA damage, 19% for cataract and 15% for fish melanoma. Peak levels of UVBE beneath the sandpit covering were of the order of 44% for DNA damage, 33% for cataract, and 26% for fish melanoma. UVBE levels beneath the covered walkway exhibited the sharpest increase for an increasing SZA, with maximum measured UVBE levels of 73% for cataract, 71% for DNA damage, and 39% for fish melanoma. Once again, the shade ratios were higher for DNA damage than for melanoma, because of the increase in scattering of the shorter

Table 2: Summary of average seasonal shade ratios with standard deviations in parenthesis for each shade structure and relatively cloud free skies

		Seasonal Shade Ratios							
		DNA		Cataract		Melanoma		Total UV	
		Autumn	Winter	Autumn	Winter	Autumn	Winter	Autumn	Winter
Shade	Noon	0.50(0.20)	0.49(0.26)	0.57(0.26)	0.45(0.16)	0.41(0.18)	0.33(0.08)	0.39(0.18)	0.31(0.07)
Umbrella	Afternoon	0.70(0.10)	0.76(0.12)	0.75(0.13)	0.78(0.08)	0.51(0.05)	0.65(0.07)	0.49(0.05)	0.64(0.06)
Veranda	Noon	0.04(0.00)	0.22(0.01)	0.06(0.01)	0.13(0.04)	0.05(0.01)	0.10(0.04)	0.05(0.01)	0.10(0.04)
	Afternoon	0.14(0.03)	0.19(0.02)	0.14(0.04)	0.19(0.02)	0.11(0.04)	0.15(0.01)	0.11(0.04)	0.15(0.02)
Sand Pit	Noon	0.11(0.07)	0.44(0.14)	0.10(0.02)	0.33(0.05)	0.07(0.01)	0.20(0.04)	0.07(0.01)	0.19(0.04)
	Afternoon	0.27(0.03)	0.31(0.03)	0.23(0.02)	0.34(0.01)	0.14(0.02)	0.26(0.03)	0.13(0.01)	0.25(0.01)
Walkway	Noon	0.26(0.11)	0.35(0.06)	0.23(0.14)	0.41(0.18)	0.13(0.08)	0.26(0.03)	0.12(0.08)	0.25(0.07)
	Afternoon	0.71(0.13)	0.62(0.08)	0.69(0.09)	0.73(0.13)	0.39(0.04)	0.39(0.04)	0.37(0.09)	0.36(0.06)

UVB wavelengths associated with the DNA damage action spectrum.

Conclusion

From this research it can be concluded that the relative UVBE in the shade compared to full sun depends on the action spectrum being considered. The reduction in the UVBE for the different action spectra is not related to the reduction in the unweighted total UV. DNA damage and cataract induction had the highest proportion of UVBE in the shade, but the lowest irradiances in the shade. To the authors' knowledge, this research is the first research to compare the UVBE for DNA damage, cataracts, and fish melanoma in the shade.

When constructing shade structures, careful consideration must be used, because, even though summer has the highest UV levels in the full sun, winter has the highest relative proportion of scattered UV in the shade (Turnbull et al. 2003). Shade is important as a UV minimisation strategy, however, for long periods, shade alone does not provide enough protection from some biologically damaging UV.

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Improving the Feedback of Housing Information to Indigenous Communities

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The standard and functionality of housing are key determinants of health in Indigenous community settings. This paper reports on a study of the perceptions of Indigenous Community Housing Organisation (ICHO) staff on feedback they received from the Northern Territory Indigenous Community Housing Survey (ICHS). Data from this study were generated through telephone interviews with 22 staff working within ICHOs in the Northern Territory (NT) in December 2004. A semi-structured, open-ended questionnaire was used to elicit perceptions of the process, content, and format of the feedback report and subsequent actions taken. The results showed that multiple approaches to report dissemination are necessary in order to respond to the varied capacity of ICHOs. There may be particular benefits from face-to-face communication on key findings with housing managers. The study identified potential improvements to the format of the report and a range of items that participants thought should be removed or included in future housing survey instruments and reports. Feedback from the housing survey enabled staff within ICHOs to organise and carry out urgent repairs and provided an evidence base when applying for funding. The paper concludes with the proposition that feedback could be improved by using a continuous quality improvement process as a basis for planning and capacity building within ICHOs.

Key words: *Indigenous Housing Organisation; Housing Survey; Feedback; Information; Continuous Quality Improvement*

Housing condition is an important determinant of health. This was recognised by public health practitioners in the United States and Europe in the early 1800s, and since then interest in housing as a determinant of health has fluctuated in response to housing related infectious disease outbreaks (Krieger & Higgins 2002). Poor housing conditions are particularly associated with enteric diseases such as infantile diarrhoea and parasitic infections, respiratory diseases such as tuberculosis, pneumonia and other chest infections, and above-average numbers of home accidents (Ranson 1991).

The issue of poor housing and environmental conditions in Indigenous communities was brought to prominence by the Uwankara Palyanyku Kanyintjaku (UPK) report in 1987 (Nganampa Health Council 1987). In 2003 the Australian Bureau of Statistics reported that of the permanent dwellings managed by Indigenous housing organisations in remote or very remote areas, 19% required major repair and 10% required replacement (Australian Bureau of Statistics 2003). This means that nearly one third of Indigenous houses in remote or very remote areas are in an unreasonable state for habitation. Not surprisingly, Indigenous rates of hospital separations for respiratory disease were about three times the non-Indigenous rates for 2000-1 and the rate of hospital admissions for intestinal infections was 2.3 times higher for Indigenous people than it

was for non-Indigenous people (Australian Bureau of Statistics 2003). Improved housing and infrastructure is widely regarded as one of the critical requirements for improving health outcomes for Indigenous people, particularly in remote areas.

In 1995, under an Agreement between three government sectors, the Indigenous Housing Authority of the Northern Territory (IHANT) was established. IHANT allocates maintenance grants of $1700 per house per year to eligible housing organisations to help meet the costs of specific repairs and maintenance that are necessary to make houses safe to live in. In 1998, IHANT introduced annual Environmental Health Surveys (EHS) for all community managed houses. After three consecutive surveys an internal review showed that the EHS was not meeting its primary objectives (Slavin 2003). Evaluation reports over the three years recommended that measures should be taken to improve standardisation in data collection, timeliness and appropriateness of feedback to Indigenous communities on the survey findings, and ongoing quality control both in relation to data collection and data entry (Bailie & Main 2002; Runcie & Bailie 2000; Stevens et al. 2002; Stevens & Bailie 2002). In 2004, the EHS was redeveloped and was subsequently renamed the Indigenous Community Housing Survey (ICHS) better to reflect its purpose. The 2004 ICHS was undertaken by Environmental Health Officers (EHOs) with assistance from Community Development Officers and community members. At the completion of each survey, the survey data was transported onto an Access database and Community Reports were generated and sent to the IHANT Program Manager and the relevant Indigenous Community Housing Organisation (ICHO).

Prior to 2004, there had been no systematic feedback of EHS results to communities. Communicating public health information is important because it has the capacity to illicit change among individuals and populations by raising awareness, increasing knowledge, shaping attitudes, and changing behaviours (Bernhardt 2004). Public health communication is defined as the scientific development, strategic dissemination, and critical evaluation of relevant, accurate, accessible, and understandable health information communicated to and from intended audiences to advance the health of the public (Bernhardt 2004). The feedback of information from the ICHS to ICHOs following the surveys is not only an ethical requirement (National Health and Medical Research Council 2003) but is important in stimulating discussion around health and housing issues, guiding the delivery of services, spurring wider community action and supporting written submissions for funding (Allen 2002; Weeramanthri & Plummer 1994). It can also demystify an issue, process or structure by breaking down complex issues into simple components (Weeramanthri 1996).

As part of the feedback mechanism for the ICHS a Community Report was developed in consultation with ICHOs, the Department of Health and Community Services, EHOs and the Department of Community Development, Sport and Cultural Affairs in order to routinely and systematically provide housing and maintenance information to ICHOs. The Community Report has two main features: a summary of community statistics and maintenance information for houses (Table 1).

This paper outlines and presents the findings of a study into:

- how the process, content and format of the Community Report was perceived by staff working within ICHOs in the Northern Territory (NT),
- the actions that resulted from this feedback, and
- how the Community Report and feedback process could be improved upon for subsequent surveys.

Table 1: Content of the community report

Community Summary	Maintenance Reports	
Survey Method - when the survey was done and by whom	Full Maintenance List	Summary by Trade
Lot Numbering and Bedroom Numbering - how to distinguish lot and bedroom numbers	Maintenance items for *each house*, categorised as 'urgent', 'essential', 'routine' or 'whitegoods'	Maintenance items for *each trade* - electrical, plumbing and structural - categorised as 'urgent', 'essential' or 'routine'
Survey Statistics - number of houses surveyed and number not surveyed		
Population - number of adults and children recorded during the survey		
Residents Per Bedroom - graph showing the number of people per bedroom in community houses		
Functionality of Health Hardware - indicates the percentage of houses with functioning facilities in the community: hot water, laundry facilities, toilet facilities, effluent disposal and kitchen facilities		
Animals, Insects and Vermin - recorded dog population and number of houses where insects, rodents or termites were a problem		
Safety - number of houses with smoke detectors and residual current devices		
Maintenance Requirements - description of 'urgent', 'essential' and 'routine' maintenance and a graph of the average number of maintenance items per house by trade and urgency		
Carrying Out Maintenance - description of the full maintenance list and summary reports by trade. Details of IHANT requirements		

Method

Ethics approval for this research was obtained from the Human Research Ethics Committee of the NT Department of Health and Community Services and Menzies School of Health Research.

Study setting and sample size

ICHOs are Indigenous organisations that own, manage or provide support services for Indigenous community housing (Spiller Gibbins Swan Pty Ltd 1998). ICHOs often have several roles, their principal function being asset and tenancy management including the maintenance of housing stock. These organisations are in direct receipt of IHANT funding and are responsible for carrying out maintenance work detailed in the Community Report. ICHOs are usually situated within the local community government council structure and report to the community council. ICHOs are headed by a housing manager, and depending on their funding, might employ a number of staff such as housing officers, environmental health workers and tradesmen.

Forty-four ICHOs had received the Community Report when this research commenced and attempts were made to contact all 44 organisations by telephone over a three week period in December 2004 (Table 2). Twenty-two ICHOs took part in the study, 11 declined (often because they were too busy or simply because the organisation was not staffed) and 11 could not be contacted during the three weeks in which the interviews took place.

Table 2: Regional distribution of ICHOs in the study sample

Regional Council	Number of ICHOs in the Region*	Number of ICHOs Received Report#	Number of ICHOs Surveyed	% of Possible Sample Surveyed
Garrak-Jarru	22	4	1	25%
Jabiru	15	7	6	86%
Miwatj	17	10	3	30%
Papunya	24	13	7	54%
Alice Springs	4	0	0	N/A
Yapakurlangu	7	5	2	40%
Yilli-Rreung	5	5	3	60%
Total	94	44	22	50%

** Source: Department of Community Development, Sport and Cultural Affairs*

 # Source: Department of Health and Community Services, Environmental Health

Questionnaire

A qualitative survey instrument was developed to elicit information from staff responsible for housing maintenance. The questionnaire consisted of 29 open-ended questions (appendix A) and was pilot tested and refined with three staff working in three different ICHOs in the NT. There were five categories of inquiry:

1. The individual - their position, education, language and indigenous status.
2. The process - useful ways of receiving the report and how the process could be improved.
3. The content - what sections were most useful, and what should be omitted or included in the future.
4. The format - whether the text, graphs and tables were understood, and what improvement should be made.
5. Action - whether the report was used to carry out maintenance, the barriers to using the report and the provision of this information to others.

Data analysis

Notes were taken during the interviews and interviews were not tape-recorded. More elaborate and detailed notes were entered on to a computer directly after each interview. Salient quotes were taken from these notes. For each category of inquiry a thematic analysis of the data was done using NVivo, version 1.3 (QSR International Pty Ltd). In each category different responses were coded. Responses were tallied to provide an indication of whether they were strong themes or isolated views.

Results

Characteristics of participants

In most cases the CEO of the council was identified as the spokesperson for interviews because they coordinated and oversaw housing and maintenance. Almost all participants (82%) had been in the position for less than 5 years, and 18% had been there for six months or less (Table 3). One third of participants were of Aboriginal origin (36%), and one third of participants had a tertiary education (32%).

Table 3: Profile of participants

Characteristic	Number	Percent
Position CEO of Community Council	12	55
Housing Manager	6	27
Housing Officer	3	14
Environmental Health Worker	1	5
Duration of Employment 3 weeks - 6 months	4	18
1 year - 5 years	14	64
10 years - 30 years	2	9
Information not provided	2	9
Number of Houses Managed 1 - 50	10	45
51 - 100	7	32
101 - 150	1	5
151 - 200	2	9
Information not provided	2	9
Education Level Primary	3	14
Secondary	9	41
Tertiary	7	32
Information not provided	3	14
Indigenous Status Aboriginal	8	36
Non-Indigenous	12	55
Information not provided	2	9
English 1st Language	17	77
2nd Language	3	14
Information not provided	2	9

Process

Mail versus electronic copies

All communities received a hard copy of the report, usually by mail. The report was also hand delivered by the local Environmental Health Officer to two communities. Mailed reports were favoured because of convenience and cost.

Nine participants (41%) said that email would be a helpful way of receiving the report because it was fast, easy to handle, it could be stored on computer and multiple copies could be printed off. However, four participants (18%) said email would not be helpful because of the large size of the document, the unreliable nature of email and lack of access to and confidence using computers. Six participants (27%) said that having the report on CD Rom would be the most beneficial. Seven participants (32%) expressed interest in having a database for

organising the maintenance requirements for community houses.

Communicating information

Only one participant had the report presented in person. As this was the first time this reporting process was used it was suggested that face-to-face explanation of the findings should have occurred, as well as increased dialogue on how the report could be used. It was noted that communities, who have less capacity, in terms of resources and experienced staff, would benefit more from having the report presented to them. "Having it presented was more useful than getting it by mail. He [the Environmental Health Officer] explained the statistics at the front of the report, he told me which houses have the same problems, he explained how to use the maintenance reports and how to prioritise by health".

In most cases, after finishing the survey the surveyor discussed major health and safety issues and left a list of urgent maintenance requirements. This was considered useful because participants were able to get a more complete understanding of what was regarded as urgent. Presenting this information immediately after the survey was appreciated, and provided an opportunity for staff to ask questions. It opened up lines of communication between EHOs and ICHOs, which continued subsequent to the report being received.

Content

Community summary

Seventy percent of participants said the community summary was helpful for providing specific information on housing stock, even if they could not directly use the information (i.e. because it was out of date, they had limited funding, or were using their own maintenance system). Those who had good information systems on the community said it backed up their data.

Emphasis was placed on the importance of having qualified, independent surveyors documenting the housing situation and the summary statistics were said to be "good ammunition" to back their case when applying for funding. "The stats and the graphs, the government departments love that. We will refer to the Community Report, otherwise they think we are making it up".

The data on functionality of health hardware were said to be useful for providing an overview of the housing situation and for indicating priority areas that needed attention, such as hot water systems and toilet facilities. Participants said they would like these statistics in comparison with other communities.

The population figures generated a large amount of concern. Most participants indicated that population figures were inaccurate, usually a gross underestimation. One participant highlighted that "we have 1200 people in the community, and the report says 483". It was pointed out that population fluctuates immensely throughout the year and a rudimentary count during the survey was probably incorrect. Other participants said that as long as the figures counted in the survey were not going to "become gospel" then they could be used as a comparison with population figures from other sources.

Four participants (18%) said that the crowding information was useful, particularly having the number of people per bedroom. "It showed that there were two houses with 10 people per bedroom. It gives you an idea of the pressure for housing".

Maintenance reports

There were some strong reactions to the maintenance reports. Some participants thought these reports were the best thing that has happened in Indigenous housing, while others vehemently protested against them. Seventy-three percent of participants responded positively to the maintenance reports, 18% responded negatively and 9% were neutral.

On one hand, of those in favour of the maintenance report, 32% said they found the summary of maintenance items by trade the most useful because it was easy to work with, could be given directly to tradesmen, and provided the option to prioritise trades, as well as maintenance items. On the other hand, 27% of participants said they thought the full list of maintenance requirements had more value because it provided a snapshot of each house to inform new housing staff, and could be used as a reference document to compare with local data.

Those who did not support the maintenance report felt that there was too much detail in the maintenance reports, and that it could never be completed. Thirty-two percent of participants said that at least some items should be removed from the survey instrument, particularly commonly reported items such as whitegoods, scale on the toilets and missing doorstops (Table 4). However, there were four participants (18%) who said that nothing should be taken out. "The simple things that people think are ridiculous should stay in there because they are important for health."

Table 4: Suggested items to be removed or added to the community report

Removed	Added
• Whitegoods	• Whether asbestos should be a concern
• Cleaning scale from the toilets	• Reason why no power available to the house
• Doorstops	• Information on septic systems, correct installation
• Residual Current Devices (RCDs)	• Place the lot numbers in order
• Shelving in the toilets	• Put a dollar figure on all reported maintenance
• Shelving in the bedrooms	• Indicate maintenance that is capital upgrade, ICHOs responsibility or tenants' responsibility
• Repainting	• Inappropriate use of facilities i.e. rags in the toilet, teabags blocking the sink
• Wardrobes	• Comparison with other communities or an NT average
• Ceiling fans	• Distinguishable names and different coloured cover pages for the three separate reports
• Towel rails	
• Hot/cold water indicator buttons	
• Security screens	
• Dust control	

Format

All participants were satisfied with the format of the report. They said it was clear, simple, easy to read and well set out in plain English. They pointed out that this was a pleasant change from the complex documents they often receive from government departments. Participants also responded well to the written text, the graphs and the maintenance tables, however, there were some suggestions for improvement (Table 5).

Table 5: Participants' views on the format of the community report

Format	Strengths	Weaknesses
Written Text	• Easy to understand	• Term 'method' too academic
	• Terms clearly defined	• Community may not understand some terms such as 'crowding'
Graphs	• Easy to understand	• May not be accurate (using population figures)
	• Will show trends over time	
	• Provides a good overview	
	• Can be used in funding applications	
	• Good to show to council	
Maintenance Tables	• Easy to understand	• Font size too small
	• Includes surveyors' comments	
	• Space for work comments	

If photos were to be included in the report, participants suggested that there should be photos of urgent items or situations that create health and safety hazards, such as exposed electrical wiring. Participants said that this could be useful when talking to the community about these issues, particularly in remote areas and for "showing people how bad the housing situation is on communities."

Action

Of the 16 participants who responded positively to the report, all used the information in some capacity. Of the four

Table 6: Uses and barriers to using the community report

Uses	No. Responses	Barriers	No. Responses
Provide information to council	13	Lack of funding	11
Provide information to tradesmen	11	Too much information	5
Carry out urgent repairs	6	Using own maintenance system	3
Compare with own information	6	Too much detail	3
Carry out work specific to a trade	6	Figures inaccurate	3
Support funding applications	5	Report was out of date	2
Prioritise maintenance	3		
Plan for upgrades	3		
Highlight recurring issues	3		
Compare population figures with other estimates	3		
Learning about housing requirements	3		
Provide information to health clinic	2		

who responded negatively, two used the report and two did not. The report was used most often to carry out maintenance, to compare with existing maintenance information, and to support funding applications (Table 6).

Thirteen participants (59%) said they had either presented the information to council or were planning to present it at the next council meeting (Table 6). When presenting to council, most participants said they went through the whole report, focusing on the full maintenance lists, highlighting recurring issues and what this costs the community. When prompted about disseminating the information more widely throughout the community, participants were hesitant. They said that this could cause problems for the council because of the large responsibility and the limited resources available to carry out repairs. "We don't have an adequate management structure to put the time into talking about it more."

Participants said it would be helpful to have a separate report oriented toward tenants, because "it is hard to explain what makes a healthy house". This is where photographs, pictures and dot points would be useful. There was also a call for specific information relating to behavioural aspects that affect the viability of the home, such as broken locks because people lose their keys, people using rags in the toilet, teabags blocking the sink, kids putting rocks down the inspection openings. There was recognition of the need to develop living skills programs to deal with these specific issues and for the report to support this information

Discussion

ICHO staff generally found the Community Report to be a useful document that enabled them to organise and carry out urgent repairs, facilitate the work of tradesmen and provide an evidence base when applying for funding.

The response rate was 50%, which means the sample is not necessarily representative and the results may not be generalisable to all ICHOs across the NT. It is probable that people who were available and agreed to an interview were working within ICHOs that had more capacity than those who were not available, or did not agree to an interview. This might have biased the results in that the Community Report would appear to be used by ICHOs more than it actually was. Nevertheless, this research does provide a perspective from those who are using the report and it pinpoints specific areas for improvement relevant to ICHOs that were interviewed.

There is potential for the ICHS and the Community Report to facilitate continuous quality improvement (CQI) strategies for housing in Indigenous communities. CQI is

a systematic approach to management that facilitates ongoing improvement by using objective data to analyse and improve processes (Clark et al. 1999; Graham 1995). The housing surveys and reporting process have the potential to improve outcomes for Indigenous housing by providing an objective assessment of housing conditions and reporting this to communities as part of a planning, developmental and capacity building process. The results indicate that there are a number of improvements that can be made to the process, content and format of the Community Report to facilitate a CQI approach. There is strong evidence to suggest that communicating information in person is a much more effective way of disseminating information than secondary approaches such as mailing the report (Brown, Hunter, & Whiteside 2002; Hunter 1992; Kimberley Aboriginal Health Workers 1992; Weeramanthri 1996). This study has shown that there were noticeable benefits from having the surveyors present preliminary findings directly after the survey. This increased participants' understanding of urgent maintenance and the community's housing issues, and related this back to health and safety.

An important function of this preliminary feedback was to open up avenues for further communication between ICHOs and EHOs, not simply on the survey and maintenance, but on broader issues of environmental health. The benefits exhibited from this preliminary feedback can be built upon to include the presentation of the Community Report by EHOs. It might be particularly important to identify those ICHOs with limited capacity, in terms of resources and experience, and explain the report to them in person to ensure they get a thorough understanding of IHANT requirements, health implications, and efficient and cost-effective procedures. An important part of the CQI process is feeding back information, goal setting and strategic planning with ICHOs so that outcomes can be identified in the next survey.

Related to this approach is the requirement for EHOs to take a member of the community with them when conducting housing surveys (Menzies School of Health Research et al. 2004). This study showed that involving the community in the survey process was a positive learning experience for those who accompanied the EHOs. The knowledge transfer that occurred during this process highlights the potential for more extensive participation and on-the-ground training during the survey. Working closely with the community during the survey can also provide an opportunity to identify houses that are not economical to repair, and assist the community to develop a maintenance and management system rather than simply providing long lists of work that cannot reasonably be done. Supporting communities to develop a planning process and management strategy for housing is an important part of the CQI approach, and may be facilitated by a user-friendly, NT-wide database to support local maintenance systems.

The reporting framework that is part of the current ICHS is similar to the reporting for other housing surveys, such as the Housing for Health programs (Pholeros, Rainow & Torzillo 2002) and housing surveys by Katherine West Health Board (Hardy 2002). These models focus on listing maintenance requirements for Indigenous houses and provide information on the functionality of houses to allow comparisons over time. The ICHS differs from the above-mentioned surveys in two main ways. First, it provides information on Indigenous housing in every community in the NT rather than within one region or in a relatively small number of selected communities. Second, it offers a means to assess the relative need of all communities throughout the NT. In all housing survey models, maintenance lists are passed on to tradesmen who then respond to repairs. At best, routine maintenance is completed and communities continue to operate with a 'report and fix' system.

The National Indigenous Housing Guide stresses the importance of functioning maintenance systems and good initial design and construction of houses and health hardware (Department of Family and Community Services 2003). In addition to this, long-term strategies need to be developed with communities at the local level. There is much potential for the Community Report to contribute to this. This research shows that the report was often disseminated to the community council, but there was reluctance to share this information with the wider community. Information is powerful, and there is scope to adapt some information from the summary statistics and the maintenance reports to develop a 'community friendly' report to disseminate to council, tenants and more widely throughout the community to increase the community's understanding of the situation, develop long-term strategies and create opportunities for change. The specific recommendations on best practice for feeding back information (Table 7) are based on the findings from this research and a review of the literature on the feedback of housing and health information to Indigenous communities (Wayte 2005).

Table 7: Best practice for feeding back housing information to Indigenous communities

Process
1. Present information in person
2. Ensure information is understandable and relevant to the community
3. Discuss options and goals
4. Plan for change and develop strategies
Content
5. Provide information on maintenance items
6. Summarise functionality of housing stock
7. Disseminate a community oriented report linking housing to health
Format
8. Use plain English
9. Present data in pie charts and graphs
10. Illustrate key issues with pictorial displays and photographs

Conclusion

In order to deal with the true complexity of housing in Indigenous communities, coherent strategies must address the multiple factors that influence housing and health outcomes. The Housing and Health Improvement Framework (Figure 1) has been adapted from the Hygiene Improvement Framework, which was developed by the USAID Environmental Health Project to prevent diarrhoeal disease (EHP et al. 2004). This framework operates on the premise that strategies to improve housing and health must address all three areas:

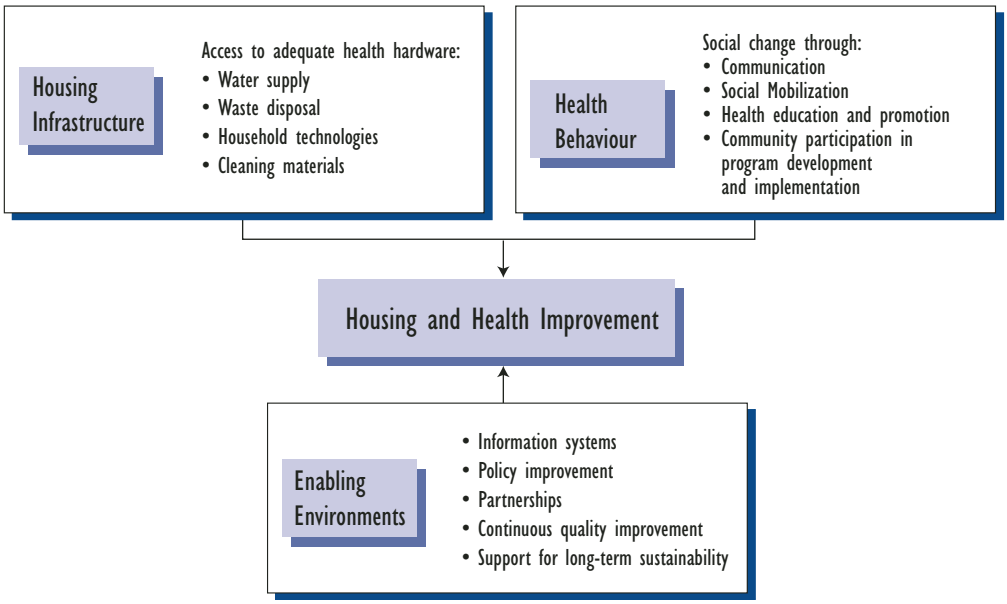
1. prevention of infectious diseases through access to health hardware;

2. health behaviour of individuals and populations, respecting existing knowledge and beliefs; and

3. the wider environment that enables improved outcomes such as partnerships, sound policy, good information systems and high quality, two-way communication.

This study has highlighted how the reporting framework for the NT Indigenous Community Housing Survey can be enhanced by taking a continuous quality improvement approach. The survey and reporting process has the potential to support ICHOs in the development of comprehensive strategies to improve community housing. It would be valuable to further explore how the survey and report could support the communication of housing and health information to the wider community and how Government departments can work together to assist ICHOs in developing a housing and health improvement strategy at the local level.

Figure 1: Housing and health improvement framework



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A team from the Menzies School of Health Research was involved in the development of the feedback framework for the Indigenous Community Housing Survey. The first author's involvement in this process provided a base to explore further the feedback of housing information, as a partial fulfilment for a Master of Public Health.

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Appendix A

Improving the Feedback of Housing Information to Indigenous Communities

Interview Schedule

Individual

1. What is your position?
2. How long have you been in this position?
3. What is your role (prompt: do you organise for maintenance to be done)?
4. How many houses/communities are you responsible for?
5. What is the highest level of schooling you completed?
6. Are you of Aboriginal or Torres Strait Islander origin?
7. Is English your first language?

Process

8. How did you obtain a copy of the Community Report?
9. Was the report provided to you in any other form (prompt: email, mail, fax, in person)?
10. If the report was presented in person, explain what they presented and by whom.
11. Which ways of receiving the report were most useful? Why?
12. What suggestions do you have on how to improve this process of obtaining the report (prompt: electronic database)?

Content

13. Looking first at the summary information, what pieces of information do you find useful (prompt: houses surveyed, population data, improvised dwellings, functionality, crowding, dogs and pests, health, safety, maintenance requirements, carrying out maintenance)?
14. What pieces of information did you think were not required?
15. Is there any other information that you think should be in this report?
16. Looking now at the maintenance reports, which reports to do you find useful (prompt: summary maintenance reports, full maintenance lists)?
17. Is there any information here that you think was not required?
18. Is there any other maintenance information that you think should be in this report (prompt: summary of maintenance information for establishing workscopes)?

Format

19. What do you think about the format of the report, or how it looks?
20. Were you able to understand and use the written text? Why/why not?
21. Were you able to understand and use the graphs? Why/why not?
22. Were you able to understand and use the tables? Why/why not?
23. Do you have any suggestions on different formats for presenting this information that would make it easier for you to use (prompt: photographs, pictures, pie charts)?

Action

24. Have you used the information provided to carry out maintenance?
25. If yes, can you explain what information you used and how?
26. Have you used any of the other information in the report for any reason? What information and for what purpose?
27. Have you provided any of this information to anyone else? What information, to who and why? (prompt: tradesmen, council, health centre, community groups, other individuals inside or outside the community)?
28. What are the main barriers to using the information in the report?
29. Are there any other reasons for not being able to carry out maintenance?
30. Are there any other issues you would like to discuss?

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A Study of Temperatures Achieved during Underground Cooking of Pork

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The pilot study reported here was designed to identify potential food safety hazards associated with the underground cooking methods of food for sale in north Queensland by determining the time/temperature relationships of the cooked food. Four Indigenous communities participated in the project and are identified as Loc 1, Loc 2, Loc 3 and Loc 4. Four underground cooking events were monitored by the project officer utilising a data-logging thermometer. The project officer observed the process of setting up an underground cooking oven. The methods were as consistent as possible with respect to methodology recognising the variability of different methods of underground cooking due to the geographical and cultural uniqueness of the areas. Samples of food cooked underground were submitted for microbiological analysis. The pilot study found that the temperatures achieved during the underground cooking process are similar to those achieved in non-traditional methods of cooking. This type of study has not been conducted previously and there is little information on the effectiveness of the method. Results from the study reinforce that food-handling standards, both before and after the food has been cooked, must be maintained to ensure the integrity of the food. The conclusions from the study are that it is important for the users of this method of cooking to be well versed in the method so that the temperatures achieved in the food can be relied on as a pathogen reducing step.

Key words: *Hangi; Kup Mari; Underground Cooking; Public Health; Food Safety; Cultural Practices*

With the increased interest in Indigenous culture within the general population, there is increased likelihood of the sale of food cooked underground occurring more frequently, yet there appeared to be no evidence of research having been done in Australia into the effectiveness of such a cooking method. Subsequently, there was growing concern within the environmental health profession that the temperatures achieved during the cooking process were less than ideal. This, combined with a perception that the food might be contaminated during the cooking process, has historically made local governments wary about allowing the sale of food cooked underground to take place at cultural festivals and similar events. There has been work conducted in New Zealand on food handling practices of food that had been cooked underground. Wilson (1998) looked at cooking underground and conducted a Hazard Analysis Critical Control Point (HACCP) evaluation of the process. This work identified that the temperature achieved in the underground cooking process was a critical control but did not study temperatures achieved during this process.

The process of cooking food underground is undertaken by numerous cultural groups and is known by a number of names including hangi, kup mari, motu and bei. Underground cooking, has hybridised over time utilising less traditional foodstuffs and modern food protection materials such as aluminium foil. The cooking process is lengthy with no control over the temperature of the underground oven once it has been set. The food may be subject to

contamination before and/or during cooking. There has been no reported incidence in Queensland in the past of foodborne illness associated with this cooking method, and a recent literature search failed to locate any documented knowledge of its microbiological risks.

Methods

Consultation with Indigenous communities was conducted utilising contacts that Indigenous Environmental Health Workers had within the communities where the cooking events took place. It was important to try to form links with the Indigenous communities to establish ownership of the project with them.

There were four events performed in north Queensland. Other Environmental Health Services in Queensland were asked to approach Indigenous communities after reviewing the styles of underground cooking used throughout Queensland. Two communities were Aboriginal Australian, one was a Torres Strait Island community, and one was a South Sea Islander community. Pork was determined to be an example of food that is used widely throughout the different population groups in underground cooking. As such it was used as a reference food. To remove bias all meat used was pork leg of approximately 7kg each.

The study involved observation of the preparation of the underground oven and the food which was to be cooked in that oven; recording measurement of temperatures achieved during cooking; and microbiological sampling of cooked foods. The temperature in the underground cooking ovens was monitored for all events utilising a data-logging thermometer (Centre 304 type K). Probes were inserted to approximately the centre of the joint through a slit made with a knife. Where there were two joints available, one probe was placed in either end of each joint. This resulted in one probe positioned in the narrow portion of the joint and one probe being positioned in the thick portion of the joint. Where there was only one joint available two probes were inserted into either end of the joint.

Samples of the cooked food were taken and forwarded to Queensland Health Scientific Services for microbiological analysis for food-borne pathogens. Samples were packaged in sterile sampling containers and transported with ice packs in insulated containers utilising overnight transport with a view to getting the samples to the laboratory within 24hrs from time of sampling.

Results

Temperatures

The pilot study determined that the temperature reached using different methods of underground cooking rarely reaches over 100°C (Table 1). Food cooked in this method needs to be thoroughly defrosted prior to placing into the underground cooking oven. Correct food hygiene procedure is paramount to ensuring that food-borne illness does not occur in consumers of foods cooked underground. There is a potential to introduce pathogenic organisms to foods cooked underground if traditional methods of food protection are used.

Figures 1 to 4 show the temperatures logged at various locations.

Figure 1: Underground Cooking - Loc 1. 29 April 2003

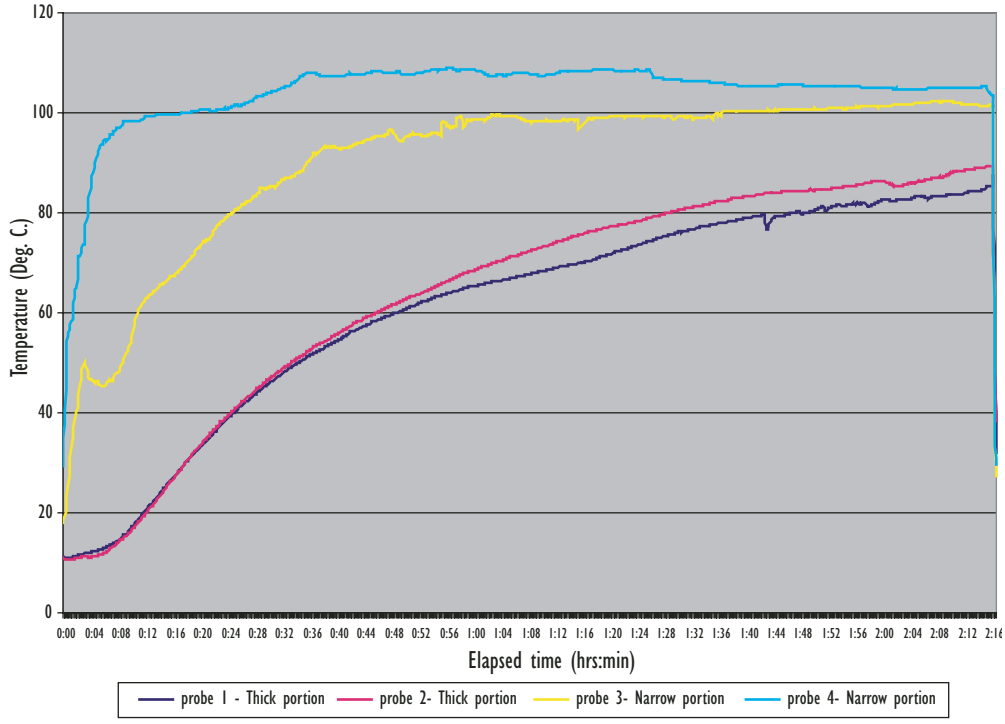

Figure 2: Underground Cooking - Location 2, 26 June 2003

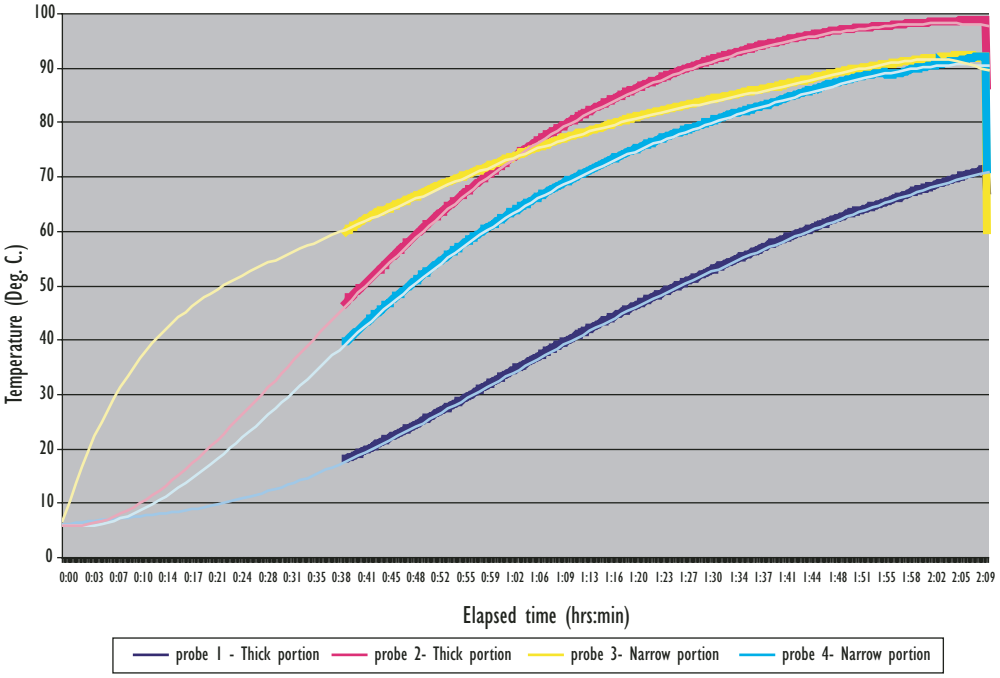

Figure 3: Underground Cooking - Location 3, 05 July 2003

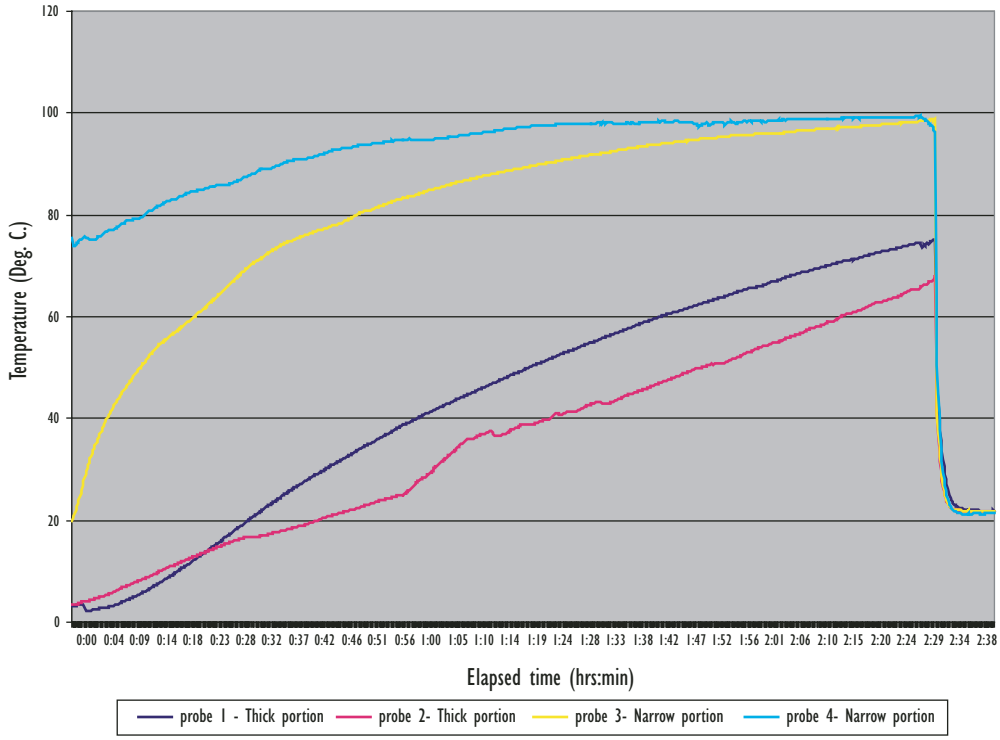

Figure 4: Underground Cooking - Location 4, 08 April 2004

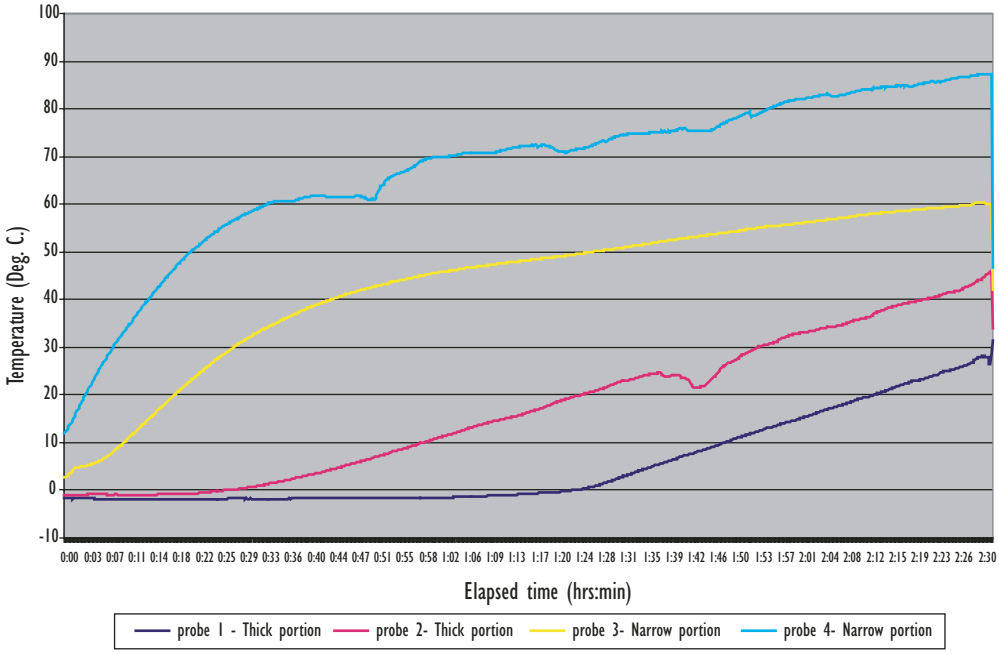

Table 1: Temperatures achieved in cooking in the different communities

		Start temperature	Max temperature achieved	Time to reach 75°C (hrs)	Maintained above 75°C Y/N	Total cooking time (hrs)
Location 4	Probe 1	11.9	87.4	1:01	Y	2:32
	Probe 2	-1.0	45.8	DNA	DNA	
	Probe 3	-1.7	28.3	DNA	DNA	
	Probe 4	2.7	60.4	DNA	DNA	
Location 1	Probe 1	17.9	71.3	DNA	DNA	1:30
	Probe 2	46.4	98.7	0:25	Y	
	Probe 3	59.7	92.2	0:26	Y	
	Probe 4	39.4	92.0	0:41	Y	
Location 2	Probe 1	11.2	87.4	1:27	Y	2:16
	Probe 2	17.9	102.3	0:21	Y	
	Probe 3	29.4	109.0	0:03	Y	
	Probe 4	10.9	89.5	1:14	Y	
Location 3	Probe 1	19.9	98.7	0:38	Y	2:42
	Probe 2	3.2	75.3	2:31	Y	
	Probe 3	3.2	68.1	DNA	DNA	
	Probe 4	75.4	99.4	0:00	Y	

Note: DNA = Did not achieve specified temperature

All samples returned results showing no food-borne pathogens except the event held in Loc 1. The microbiological result for the Loc 1 cooking returned high levels of *Bacillus cereus* at a level (>2.5 x 104) that was considered to be a potential food hazard. It was difficult or impossible to achieve 75°C in portions that had a start temperature of 4°C or less.

Times

Generally, the consensus was that the food was left to cook for 2-3 hours depending on the size of the cuts of meat that were being cooked. It is considered to be very shameful to the cooks to have undercooked food being served at a gathering after being cooked underground.

Foods are all placed in the underground cooking oven at the same time. Separation from the heat source is used to control the time needed to cook the different foods. The larger cuts of meat are placed on the bottom of the oven, chickens and damper next and then vegetables on the outermost layer of the oven. Some people use multiple underground cooking 'ovens' to cook different foods, especially if the gathering is very large.

Aluminium foil was used in the majority of locations, first, to protect food from contamination and, second, to hold the leaves that are used in this method of cooking to flavour the food in contact with the food.

Discussion

There is virtually no limit as to what can be cooked using the underground cooking method. It is used extensively in indigenous communities throughout North Queensland especially when there is a large gathering of people that need to be catered for. Whole deer, pigs and turtle can be easily cooked using this method by building a bigger underground cooking oven, that is, making the fire and mound of stones larger to accommodate the carcass of the animal that needs to be cooked.

Even though temperatures achieved with this cooking method are similar to those achieved in non-traditional cooking methods, the preparation and handling of the food still needs to be conducted in a

hygienic manner to prevent contamination by, and subsequent growth of, pathogenic bacteria.

Traditional methods of food preparation often involve wrapping foods in leaves, in part to protect food from contamination, but also to give the foods distinctive flavours. This process might be a vehicle for contamination of the food. The *Bacillus cereus* found on the food from the event in Loc 1 may have come from the banana leaves that were used to wrap the meat prior to cooking. No samples of banana leaves were taken to verify this. *Bacillus cereus* is a ubiquitous organism found in the soil and in the general environment. Levels of ≥104 cfu per gram are considered potentially hazardous as consumption foods with this level of contamination might result in food-borne illness (Food Standards Australia and New Zealand 2001).

The practice of gathering leaves used to insulate the cooking mound and also to wrap the food was observed on two occasions. The coconut fronds that were used in Loc 4 were not exposed to the soil for any significant amount of time. The banana leaves used in Loc 1 were folded underfoot and had significant contact with the soil.

It is imperative that leaves that come into contact with foodstuffs are free from contamination, whether this is chemical or organic. The leaves used to wrap the pork leg used in the underground cooking method in Loc 1 were gathered from banana plants that were growing wild. They were unlikely to contain any chemical contamination given that they were not part of a commercial banana farm.

Discussions held with the people who were conducting the underground cooking might have skewed the results somewhat, in that they were asking how hot the food should get and then they were attempting to use the thermometer to gauge when the food was cooked properly. Further consultation could have been held with community leaders in order for them to identify the persons in their particular community who are regarded as the experts in the field of underground cooking.

Food needs to be defrosted before it is cooked underground. Once the fire has died down and the food is added to the underground cooking oven, there is no way to add heat if the food is found to be undercooked.

There was a small error in the Loc 2 event in that the data logger did not record for a period after the underground cooking event had been initiated. The time was noted when the food was placed underground and commenced cooking. Data have been extrapolated from the temperature when the food was placed underground until the data logger commenced recording data (Approximately 42 minutes).

Conclusion

The study found that the temperatures achieved during the underground cooking process are similar to those achieved in non-traditional methods of cooking. This type of study has not been conducted previously and there is little information on the effectiveness of the method. Results from the study reinforced that food-handling standards, both before and after the food has been cooked, must be maintained to ensure the integrity of the food.

The conclusion from the study is that it is important for the users to be well versed in this method so that the temperatures achieved in the food can be relied on as a pathogen reducing step. The following five recommendations are therefore important for users of this method of cooking.

Recommendations

1. Only meat that has been thoroughly defrosted under refrigerated conditions is cooked using the underground cooking method.

2. Care is taken when gathering leaves to be used to wrap foods that are to be cooked underground so as to minimise contamination of these leaves as much as possible. These leaves should be free from any visible contamination.

3. Food cooked in the various underground methods is handled in a hygienic manner once it has been removed from the heat source. The food should be served and consumed immediately, or stored under temperature control to maintain temperatures above 60°C. If food is to be stored for later consumption it should be cooled to below 21°C within 2 hours and then to below 5°C within a further 4 hours in accordance with Standard 3.2.2 clause 7 (3) of the Australian Food Standards Code.

4 Food prepared for sale is protected from contamination by wrapping in aluminium foil or similar substance rather the traditional method of using leaves to protect the food. Should leaves be used for flavouring the food, these leaves need to be sanitised before use.

5 Further studies of this nature should allow more time for consultation with Indigenous communities with a focus on approaching the elders within each community.

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Mobile Phone Use among Full time Students of Edith Cowan University: A Pilot Study

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A cross-sectional survey among students at Edith Cowan University quantified mobile phone use patterns and symptoms associated with the use of mobiles. Individuals may be exposed to 239 476.22 J per kilogram measured over 10 grams of tissue per year through conventional use. SMS messaging could expose the hand to 252 562.13 J per kilogram measured over 10g of tissue per year. Seventeen percent of the students reported headache, 38% heat sensations in the ear, and 6% pain in the region where the mobile is worn. Mobile phone use among Australian teenagers has grown significantly over the last decade. Young adults are particularly at risk, as they will use mobile phones for many years. In planning for the protection of this group, current and predicted levels of exposure need to be quantified. Exposures of the hand during SMS messaging, and of the groin and waist region where mobiles are carried need further investigation. A cohort of young mobile phone users needs to be established to determine long term health impacts. There is sufficient concern to employ a precautionary approach and children and young adults should be advised to minimise their exposure to mobile phones.

Key words: *Mobile Phone; Dose; Health Effects*

Mobile phones transmit and receive radiofrequency (RF) electromagnetic energy (EME) and as such pose a potential health risk to regular users. In Australia, mobiles operate between 800 MHz and 1800 MHz depending upon the network subscribed to. Bluetooth operates at 2400 MHz. The Australian Communications Authority (ACA), the industry regulator, published a human exposure standard in 2003. The permissible exposure, expressed as the standard absorption rate (SAR) is 2 watts per kilogram of tissue, averaged over 10 grams. A further health concern relates to the microwave emission from the mobile phone antenna which is mounted in the handset of most conventional mobiles, which is held very close to the user's head during normal use (Australian Radiation Protection and Nuclear Safety Agency 2003).

The International Agency for Research on Cancer (IARC), a World Health Organization (WHO) agency, recently classified electromagnetic fields (EMFs) as human carcinogens. Further, the WHO has initiated an International electromagnetic field (EMF) project. The major goal of the International EMF Project is to develop a new environmental health criteria (EHC) review on EMF exposures, including exposures associated with mobile phone use. During 2005 the IARC will review the findings of the International EMF project to determine if mobile phone use is associated with increased health related head and neck concerns. The WHO EHC on EMF will commence immediately after the IARC review and a new published EHC is scheduled for 2007 (WHO 2004).

There exists a strong body of evidence that supports the hypothesis that mobile phone use is related to a range of subjective symptoms, including acute sensations of heat or headaches in the occipital-temporal regions of the head, during a call or later that day. The symptoms usually disappear

soon after use of the mobile phone. Some individuals have also reported complaints of pain at the waist in the case of belt worn phones. Further, there is a statistically significant risk for warm sensations in the proximity of the ear, and headache and fatigue among mobile phone users (Hocking 1998).

Symptom prevalence is dose related with a statistically significant association between symptoms and calling time and number of calls per day. Other symptoms reported include discomfort, tingling and tightness, concentration problems, memory loss, and burning skin sensations (Chia 2000; Mild & Oftedal 2003). Microwave radiation reduces nocturnal melatonin levels in animals as well as in humans. Nocturnal melatonin is related to sleep quality and certain cancers, such as breast cancer (Hyland 2000).

The evidence surrounding brain or head tumours is less conclusive. The following authors concluded that their data did not support a connection between the use of mobile phones and brain or other facial tumours, although the authors generally stated that insufficient evidence existed to evaluate the risks of long-term, heavy users, or use for long periods of time (Ahn 2001; Cook et al. 2003; Inskip & Linet 2003; Johansen 2001; Warren et al. 2003).

Stang (2001) as part of a larger hospital and population-based study on occupational risk factors for rare cancers, noted a relationship between uveal (eye) melanoma and exposure to mobile phones (*n*=18) (OR = 4.2, 95% CI = 1.2-14.5). The author did conclude that limitations such as small sample size prevented him from drawing clear conclusions about the hypothesised association. A Danish study conducted in the following year refuted the Stang hypothesis (Johansen 2002).

Muscat (2002) reported a non-significant but seemingly dose-dependent elevation of rare neuroepithelioma (non-malignant tumours often developing in or near the ventricles). In Finland a study of patients presenting with brain (n=398) and salivary gland (n=34) tumours during 1996 were interviewed to determine their mobile phone exposure. A very slight but statistically significant association was reported for gliomas (OR 1.5, 95% CI 1.0-2.4), in particular with analog phones (OR 2.1, 95% CI 1.3-2.4). There was a weak increasing trend with duration of subscription. The authors concluded that larger studies with longer follow-up times are necessary (Auvinen et al. 2002).

A large Swedish case-control study (1429 cases and 1470 controls) of brain tumours and mobile phone use was conducted during the period 1997 to 2000. The authors reported an association between mobile phone exposure and non-malignant ipsilateral (occurring on the same side of the head as phone use) tumours (OR=2.45). The authors also reported a shorter ipsilateral tumour induction period with exposure than for contralateral (occurring on the opposite side of the head as phone use) tumours, and hypothesised that there is a tumour promoting effect associated with mobile phone use. In an expanded subsequent analysis that included 1617 additional brain tumour cases, a statistically significant association was reported for phone use and benign acoustic neuromas (OR 4.4, 95% CI=2.1-9.2), but not for malignant tumours (Hardell et al. 2003).

The evidence surrounding health effects of mobile phones is still emerging, however, there is sufficient cause for concern to implement precautionary principles. The aim of this study was to pilot test an instrument that can be used to measure exposure patterns among users of mobile phones in order to quantify absorbed dose and predict long-term health outcomes.

Method

Study design

The study was a cross-sectional survey of mobile phone use patterns and subjective symptoms of exposure among students at Edith Cowan University (ECU) in Perth,

Western Australia. These data were utilised further to quantify potentially absorbed lifetime dose. In most instances it was not possible to do a statistical test of significance due to small numbers. Results are therefore presented as descriptive summary statistics.

Data collection and ethics

A questionnaire was developed in electronic format and emailed to a random sample of 500 ECU students. Students received a covering letter explaining the aims of the study. Students were informed that the data would be treated as confidential and that completion of the survey form would be deemed to constitute informed consent.

The Human Research Ethics Committee of Edith Cowan University approved the study protocol prior to the collection of any data.

Once students completed the on-line survey the questionnaires were electronically transferred to a Microsoft Excel spreadsheet. Mobile phone emission data was obtained from the web sites of the manufacturers of mobile phones used in Australia.

Data analysis

The SPSS, computer software package was used for data entry and analysis. Rates of mobile phone use and subjective symptoms of exposure were determined. The sample was stratified, as appropriate and mean lifetime dose (77 years for males, 83 years for females) was predicted using published mobile phone emission data.

Demographic data

Seventy one percent (71%) of the 97 respondents (n=69) were aged between 18 and 24 years. It was therefore decided to analyse the data for this group separately. Of the 18-24 age cohort 98.6% (68 of 69) owned a mobile phone, 56.5% (39) were female and 43.5% (30) were male.

Exposure data

Mobile phone use data for weekday and weekends was gathered separately as it was assumed that there might be variations in the use patterns on weekends that might differ from normal weekday use.

Table 1 is a summary of weekday use data. Most respondents use a mobile phone in the conventional manner (held to the ear) for a mean of 15.7 minutes per day (SD 23.8) with a maximum exposure of 170 minutes per day and SMS mean 16.7 minutes per day (SD 21.8), with a maximum exposure of 120 minutes per day. It is interesting to note that the minimum 'minutes used' per day for all responses was 0. It can therefore be inferred that some people might not use a mobile in the conventional manner at all and probably only use SMS, and conversely that there are individuals who never use SMS, or in fact any of the other options listed.

Table 1: Typical weekday use patterns

Weekday use (minutes)	N	Minimum (minutes)	Maximum (minutes)	mean (minutes)	standard deviation
Held to ear	68	0	170	15.7	23.8
With extension earpiece	67	0	60	1.27	7.4
hands free	68	0	30	1.1	4.2
SMS	68	0	120	16.7	21.8
other (games/calculator)	68	0	60	3.91	9.1

Table 2 is a summary of typical weekend use data. Weekend use follows the same trend with conventional (mean 18.03 minutes, SD 20, maximum 120 minutes) and SMS (mean 18.66, SD 25.15, maximum 180 minutes) being the most important use patterns.

Table 2: Typical weekend use patterns

Weekday use (minutes)	N	Minimum (minutes)	Maximum (minutes)	mean (minutes)	standard deviation
held to ear	68	0	120	18.03	20.0
With extension earpiece	68	0	30	1.03	4.17
hands free	68	0	0	0	0
SMS	68	0	180	18.66	25.15
other (games/calculator)	68	0	60	2.85	8.96

Phone models

Thirty-seven of 65 respondents (57%) reported that they own one particular brand of phone. Ten different companies

manufactured the other phones used. There was also a large variation in different models used. Standard absorption rate (SAR) data on maximum phone output was sourced where available from the World Wide Web. The mean output of the most commonly used models was 0.67 W/Kg over 10 grams of tissue. It must be noted that the phones continually adjust their output depending upon a number of factors that influence signal strength. The mean maximum output was used as a default value to calculate the weekly absorbed dose.

Dose assessment

Total mean exposures for a whole week are presented in Table 3.

Table 3: Total mean exposures (minutes per week)

	weekday x 5	weekend x 2	total weekly exposure in minutes (t)
held to ear	15.7 x 5 = 78.5	18.03 x 2 = 36.06	114.56
With extension earpiece	1.27 x 5 = 6.35	1.03 x 2 = 2.06	008.41
Hands free	1.1 x 5 = 5.5	0	005.5
SMS	16.7 x 5 = 83.5	18.66 x 2 = 37.32	120.82
other (games/calculator)	3.91 x 5 = 19.55	2.85 x 2 = 5.7	025.25

Note: The mean maximum output of various models of the most popular mobile (Nokia) is 0.67 W/Kg over 10 grams of tissue

Based on the assumption that the most potentially dangerous method of use is conventional (held to ear) communication, it was calculated that it is quite possible that an individual might be exposed to approximately 4605.31 Joules of energy per kilogram over 10 grams of tissue, in the region of the ear and neck per week. This equates to 239 476.22 J per kilogram over 10 grams of tissue per year. SMS text messaging and 'other' hand held uses would produce an annual exposure to the hand of 252 562.13 J per kilogram over 10g of tissue per year.

Further, the age at which people start to use mobile phones will impact significantly on their total lifetime dose. The mean age at which respondents acquired their first mobile was 16.75 (sd 1.54) with the minimum age being 13 and maximum 21. If the mean life expectancy for this cohort is 80 years, then life time absorbed dose (to the head) at current exposure levels would be 15 087 002 J per kilogram over 10 gram of tissue. Exposure of the hand would amount to 15 911 414 J per kilogram over 10 grams of tissue.

Exactly how the body will cope with such a long-term burden is as yet unknown. It must be noted that individuals, in particular people who carry their phone on their person (in a pocket or on a belt) would also have a constant source of exposure while the phone is switched on. This source of exposure in the waist and groin region needs to be further assessed.

Reported symptoms

In analysing the symptom prevalence data, respondents who reported exposures of less than 10 minutes per day were used as a 'low exposure' control group and compared to the respondents who have higher exposure levels. The differences in reported headache symptoms were not significant (OR 0.15, $p = 0.13$).

Headache

Eight out of 47 (17%) individuals reported experiencing headache related to mobile phone use between 1 and 5 times per week, mean 2.29 (SD 1.5). Onset of symptoms occurred after 3-60 minutes of use, mean 36 (SD 24.68).

Heat in ear

Eighteen (38%) respondents reported a heat sensation in the ear occurring between 1-20 times per week, mean 3.12 (SD 4.74). The onset of symptoms occurred after 1-40 minutes, mean 14.22 (SD 9.66).

Pain where worn

Three (6%) individuals reported sensations of pain in the region where the mobile is worn. Onset of symptoms varied greatly from 4-180 minutes after exposure, mean 51 (SD 86.14).

No respondents reported numb sensations, fatigue, or memory loss, and only 1 or 2 individuals reported general discomfort, tingling and tightness, concentration problems and burning sensations.

Gender differences

Some important gender differences in mobile use patterns, exposures and symptom prevalence were noted. Mobile phone use, particularly over weekends, is higher among females than males.

Table 4: gender difference in mobile phone use (weekdays)

weekday use (minutes)	n		Mean (minutes)		standard deviation	
	male	female	male	female	male	female
held to ear	29	39	12.70	18.26	15.9	28.25
with extension earpiece	29	38	0.52	1.84	2.0	9.8
hands free	29	39	0.34	1.67	1.86	5.3
SMS	29	39	13.52	20.15	14.5	26.06
other (games/calculator)	29	39	3.69	4.21	7.95	10.0

Table 5: gender difference in mobile phone use (weekends)

weekday use (minutes)	n		Mean (minutes)		standard deviation	
	male	female	male	female	male	female
held to ear	29	39	12.47	22.49	13.88	22.80
with extension earpiece	29	39	0.00	0.00	0.0	0.0
Hands free	29	39	0.34	1.54	1.86	5.25
SMS	29	39	15.52	22.15	15.47	30.45
other (games/ calculator)	29	39	2.89	2.95	8.05	9.69

Age

The mean age at which females first owned a mobile was reported to be 16.4 (SD 1.39) and males 17.14 (SD 1.66).

Exposure site

There is a significant (p=0.00) difference in exposure patters among males and females, which is related to the positioning of the mobile when not in use. Males appear to be more 'at risk' from this frequently ignored source of exposure as many people do not realise that the phone is constantly transmitting even when not in use. Twenty-nine out of 38 females (67%) carried their mobile away from their body (in a handbag). Males on the other hand tended to have their mobiles either clipped on to their belt or in their pockets 23/24 = 96%.

Headache

Three out of 17 (18%) males reported experiencing headache 1-3 times per week (mean 2, SD 1.4) associated with mobile phone use. The onset of symptoms was after 5-30 minutes exposure, (mean 18.33; SD 12.58). Thirteen percent of 30 females reported experiencing headache 1-5 times per week (mean 2.5 SD 1.9). The onset of symptoms was after 3-60 minutes exposure (mean 43.25, SD 27).

Table 6: Gender differences in headache prevalence

Prevalence		Times per week		Time (minutes) of exposure before onset	
male	female	male	female	male	female
18%	13%	2	2.5	18.33	43.25

Heat in ear

Four males (24%) reported heat sensations in the ear between 1 and 3 times per week (mean 1.75 SD 1). The onset of symptoms was after 1-20 minutes (mean 9.2 SD 9.5). Ten females (33%) reported experiencing symptoms between 1-20 times per week (mean 4.3, SD 6). The onset of symptoms was after 5-40 minutes use (mean 17.5, SD 10.61).

Table 7: Gender differences in heat in ear prevalence

Prevalence		Times per week		Time (minutes) of exposure before onset	
male	female	male	female	male	female
24%	33%	1.75	4.3	9.2	17.5

Discussion

Limitations

Response rate and sample size

Every student at ECU has an email account and the university communicates with students by email. It was therefore decided that a random sample of 500 student emails would achieve a satisfactory response rate. The questionnaire was developed to be completed and submitted on-line and a follow up email was sent out two weeks after the initial distribution. However, only 97 (19%) of the 500 students submitted completed questionnaires. In future studies alternative strategies need to be investigated to improve the response rate.

Variability of mobile phone emissions that adjust constantly prevents the accurate calculation of absorbed dose and therefore a dose response relationship could not be established.

Conclusion

The literature around the safety of mobile phones is not conclusive at this stage. However, the fact that the IARC has classified EMF exposure as a carcinogen in humans is indicative of a very high level of concern.

Mobile phones are a relatively new phenomenon in epidemiological terms thus there have not been many long-term exposure studies or cohorts large enough to allow for conclusive results. Some of the latest research in this area is, however, starting to sway the body of evidence towards the potential for head and neck tumours. Other less serious health impacts, such as headache and local heating or warm sensations, and lack of sleep are well documented (Auvinen et al. 2002; Cook et al. 2003; Hardell 2003; Hocking 1998; Inskip 2001; Muscat 2002).

Mobile phone use and ownership among Australian teenagers has grown significantly over the last decade. Teenagers and young adults are a group of people deemed to be particularly at risk, as they will continue to use mobile phones for the remainder of their lives, equating to significant lifetime exposure. In order to plan adequately for the protection of this group of people, current and predicted future levels of exposure need to be quantified.

When the WHO publishes their exposure data, health risk assessments for exposed populations can be conducted. This will enable policy makers to recommend intervention strategies, such as health promotion interventions, mobile phone use guidelines, and policies regarding the safe use of mobiles (especially by children) and in the workplace or public places.

Exposures of the hand during SMS text messaging and exposures in the groin and waist region where mobiles are frequently carried need further investigation.

A national cohort of young mobile phone users needs to be established and followed up over a long period of time to determine health impacts associated with mobile phone use.

Since there is sufficient reason for concern a precautionary approach needs to be followed and people, in particular children and young adults, should be advised to minimise their exposure to mobile phones as much as possible.

Recommendations

- When not in use keep mobiles away from the body and head
- Do not use a mobile when a normal phone is available
- Limit the duration of the calls made from a mobile
- Do not use a mobile in a car as it transmits at maximum power to maintain a signal (Australian Radiation Protection and Nuclear Safety Agency 2003).

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The Bellevue (WA) Chemical Fire 2001: An Environmental Health Management Review

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Hazardous waste management is a growing concern both for environmental and health reasons, which is aggravated in emergency situations such as chemical incidents at hazardous waste facilities. Although adverse health impacts have been associated with hazardous waste management, causal links are difficult to establish, due to confounding factors and a lack of exposure data, especially after major chemical incidents. This complicates the development and implementation of effective hazardous waste management policies designed to minimise the environmental and human health impacts. This paper describes the chemical fire at Waste Control Pty Ltd in Bellevue, Western Australia. This incident is analysed to review the environmental health assessment and management procedures, using a four-step strategy for the prevention, preparedness, emergency response, and follow-up of chemical incidents. The review demonstrated that ongoing non-compliance with environmental and safety regulations was not acted upon, leaving the plant in operation without appropriate emergency preparedness, response plans, and provisions. Moreover, the case study demonstrates the importance of informing the public in order to enhance public health outcomes, as well as the need for pre and post-incident health surveillance systems to improve understanding of the health impacts and to advise policy decision makers.

Key words: *Chemical Incident; Prevention; Preparedness; Emergency response; Follow-up*

Hazardous waste management increasingly raises concern about the possible health effects on populations both nearby and further away. Although controlled by national and international regulations, hazardous waste still poses a threat due to its physical, chemical, and/or other properties. In addition, the danger caused by hazardous waste is complex, and generally poorly understood due to the lack of available data on its nature and composition, the quantities, and the environmental and health impacts, which in turn makes the implementation of effective management policies for hazardous waste difficult.

The situation is even aggravated in emergency situations such as accidental releases of hazardous materials and fires at hazardous waste facilities. Human exposure to contaminants, even at low levels may cause adverse health effects. The serious potential risk to human health of chemical exposure was emphasised by major incidents in the 1980s, such as those in Bhopal, India, in Chernobyl (former USSR), and in Seveso (Italy). There were also some incidents without fatalities or measurable health effects that have been documented (e.g. Upshur et al. 2001). The acute and long-term health impacts of incidents have been widely discussed (e.g. Cullinan, Acquilla & Dhara 1997; Dhara & Dhara 2002; Eskenazi et al. 2002; Warner et al. 2002). Causal links are, however, difficult to establish due to the various confounding factors; the lack of exposure data; and the absence of effective post-chemical incident health surveillance systems (WHO Collaborating Centre for an International Clearing House for Major Chemical Incidents 1999). As a

consequence little is known about the short and long-term health impacts of acute chemical incidents where the exposure is short-term and the chemical levels range from low to extremely high. Up-to-date knowledge about the environmental health impact of chemical incidents is important to provide evidence-based advice to the government and thus to policy decision makers on appropriate measures to minimise and mitigate the decreases in health status in future incidents.

As a response to the chemical incidents in Seveso and Bhopal, the Organization for Economic Co-operation and Development [OECD] (2003) developed best practice international standards for chemical incident prevention, preparedness, emergency response, and follow-up, aimed at the prevention of chemical incidents, minimising their consequences, and with the ultimate aim to protect public health and the environment.

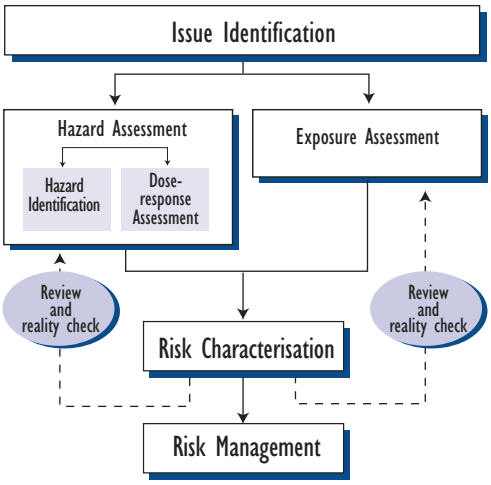
This paper focuses on policy issues and management implications of environmental health assessment and management, in particular with regard to hazardous waste management in Western Australia. The Bellevue fire (2001) is used as a case study to appraise and evaluate the current environmental health assessment and management procedures and practices in the context of best practice guidelines developed by the OECD.

Environmental Health Management Models

Health risk assessment in Australia

Until 2002 there was no national consensus on a methodology to assess public health risks associated with environmental hazards in Australia, and thus national guidelines were not available. Until then, public authorities often based management decisions on risk assessment methods obtained from other countries, often without a clear understanding of the assumptions, which underpinned such methods (Department of Health and Aged Care 1999). This resulted in ineffective and inappropriate risk management decisions, which in turn led to avoidable overexposure of the community to environmental hazards, and overly expensive remediation strategies. To address these issues, the Department of Health and Ageing and enHealth Council (2002) developed the *Environmental Health Risk Assessment: Guidelines for Assessing Human Health Risks from Environmental Hazards* (the 'Guidelines'). The document presents a comprehensive environmental health risk assessment methodology applicable to a wide range of environmental health hazards, including chemical incidents (Figure 1). The model is largely based on the National Academy of Sciences (1983) model with the addition of a critical first step, 'Issue Identification', which establishes a context for the risk assessment by identifying the concerns that the risk assessment needs to address.

Figure 1: Model of Risk Assessment used in Environmental Health Risk Assessment - Guidelines for assessing Human Health Risks from Environmental Hazards



Source: Department of Health and Ageing & enHealth Council 2002

Once the risk has been assessed, management strategies can be evaluated to

ensure that the most appropriate risk management practices can be applied. Omenn et al. (1997) defined risk management as the process of identifying, evaluating, selecting, and implementing actions to reduce risk to human health and to ecosystems. The risk management process with regard both to chemical hazards and incidents essentially focuses on incident prevention, preparedness, emergency response, and follow-up. Risk management is included in the 'Guidelines', but no advice is provided on how this should be done. However, these specific 'Guidelines' can in principle be combined with generic guides to manage risks, such as the AS/NZS Risk Management Standard (Standards Australia/Standards New Zealand 2004). Although key underlying principles are valid, the generic Risk Management Standard is not applicable for environmental health risk management as the Standard considers risks within the context of a given organisation, while in the case of environmental health risk, the health and environmental impact of the risks are felt outside the organisation that poses the risk.

OECD Framework

Various international publications have addressed the issue of chemical incident prevention, preparedness and emergency response (Bertazzi 1999; United Nations Environment Programme Industry and Environment 1988; WHO 1997; WHO Collaborating Centre for an International Clearing House for Major Chemical Incidents 1999). Most recently, the OECD (2003) developed the *Guiding Principles for Chemical Accident Prevention, Preparedness and Response*. This comprehensive framework addresses chemical incident prevention, preparedness, emergency response, and follow-up, thereby assigning individual roles and responsibilities to the various stakeholders, including public authorities, industry, and the community (Table 1).

Table 1: Summary of OECD Framework

Stage	Role and Responsibility		
	Public Authority	Industry	Community
Prevention	Develop, establish, and improve policies, regulations, and practices	Establish and monitor safety management systems Promote corporate safety culture	Be aware of the risks of incident Have representatives who serve as a link between the communitys and other stakeholders
Preparedness	Develop and implement emergency plans	Develop adequate on-site emergency plans	Participate in the development of emergency plans
Emergency Response	Activate emergency plans	Activate on-site emergency plan Alert emergency response authorities	Ensure risk awareness and adequate emergency response
Follow-up	Conduct EIA Observe, monitor and register exposed population Investigate the incident Publish investigation reports	Notify/report incident to public authorities Ensure root investigation of the incident	Be involved in debriefing and incident investigations

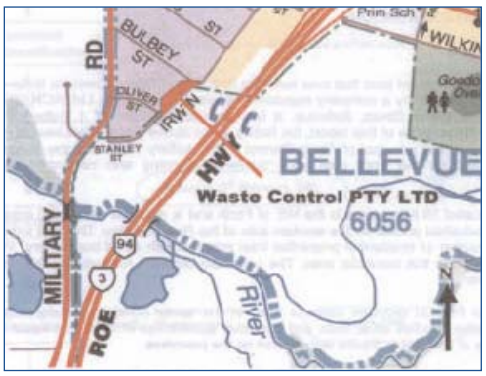
The Bellevue Fire in Perspective[1]

Pre-Incident

Since 1989, the Waste Control Pty Ltd operated a waste collection and recycling facility in a light industrial area in Bellevue, Western Australia. In 1990, the Department of Environmental Protection (DEP) and the Department of Minerals and Energy (DME) simultaneously licensed the company to operate a chemical recycling and waste processing facility, including the storage of dangerous goods. The premises were located in an industrial area, however, within a distance of 500 metres from the Bellevue Primary School, 200 metres from residents,

and 100 metres from a major thoroughfare, Roe Highway (Figure 2). Although the Environmental Protection Authority (EPA) recognised that the plant was close to other developments, it recommended that the location was environmentally acceptable.

Figure 2: Location of Waste Control



Source: Street Smart, 2001, Map Number 346-D1

Waste Control collected industrial wastes from a range of sources, including solvents from the dry-cleaning, printing and motor repair industries, and other hazardous waste, such as pesticides and acids. At various times, Waste Control stored up to 2000 drums - well in excess of its license limits - of waste material, consisting of solvents, metallic sludges and hydrocarbon residues. From 1996 until February 2001, it was the primary, and for some time the only, company in Western Australia, which provided a treatment or disposal option for, in particular, solvent wastes.

As a condition for the granting of its licence from the DEP, Waste Control was required to maintain an up-to-date manifest of all chemicals on site. Despite repeated requests, the DEP, however, neither received a copy of the manifest, nor saw evidence of comprehensive lists of chemicals and their volumes on-site.

The company was under-capitalised and the tight commercial margins upon which the business operated became an impediment to the company undertaking necessary improvements to comply with its licence conditions. In addition, due to new and tighter *Landfill Waste Acceptance Criteria*, Waste Control experienced difficulties disposing of the waste at the Red Hill Waste Disposal Facility, a low hazardous waste disposal/treatment site. This resulted in a large stockpile of wastes being accumulated on the site, since the company was unable to dispose of the non-recyclable materials. The unsatisfactory performance of Waste Control was a matter of concern both to the DEP and the DME. Competing industrial, economic, social and environmental considerations, however, maintained the view that working with the company and keeping it operational was the best option, as the DME feared illegal dumping of waste or continued build-up of storage at waste generators located in the community (e.g. universities and hospitals).

Hence, the regulatory agencies kept the facility operating while maintaining pressure on the company to improve performance. Inspections of the premises by both the DEP and the DME revealed continuous and varied breaches of licence conditions, while repeated undertakings to remedy non-compliances of licence conditions were never fully met.

In September 1999, the DEP presented the then Minister for the Environment six policy options for intervention into the operational and licensing failure evident at the site. Cabinet subsequently approved a loan of $100 000 to remove the backlog of 1000 waste drums from the stockpile. Waste Control agreed to repay the state the principal sum and interest in accordance with a repayment schedule. Approximately 1000 drums were removed to Teris Pty Ltd in Victoria by November 1999.

Waste Control's continuous failure to comply with the licence conditions, its failure to repay the $100 000 for removal of the drums, and its failure to submit a management plan to achieve licence conditions, resulted in both the DEP and the DME undertaking enforcement actions. These included infringement notices,

including unsatisfactory site inspection reports, and 'show cause' warning letters. In October 2000, the DME accumulated further evidence for breaches of the *Explosives and Dangerous Goods Act 1961 (EDG Act)* (WA). In April 2001, some two months after the fire, the DME successfully prosecuted Waste Control, resulting in fines totalling $200 000.

The Health Department of Western Australia (HDWA) does not have a legislative role regarding the regulation, treatment, storage or disposal of hazardous substances. However, the Environmental Impact Assessment process under the *EP Act 1986* (WA) allows for a health risk assessment, and in this way, the HDWA can be involved in the EIA process (Economics and Industry Standing Committee 2001b). Since both the DEP and the DME did not conduct a formal EIA, the HDWA was not involved in any environmental or health risk assessment at any time during the operation of Waste Control. Moreover, in their evidence to the Economics and Industry Standing Committee (2001b), the HDWA indicated that it had no knowledge of the Waste Control site prior to the fire.

Incident

The fire incident at the Waste Control facility occurred at approximately 11.00 p.m. on Thursday 15 February 2001. When the first crew of fire fighters arrived at the scene, the fire in the drum storage area was well established. In evidence to the Economics and Industry Standing Committee (2001a, p. 15), a Fire and Emergency Services Authority (FESA) representative stated that: "They saw explosions and drums flying all around the place [and] were in some fear for their safety".

At 11.41 p.m. FESA senior officers assessed the situation and implemented command and control structures, including the Incident Management Team (IMT). No Emergency Manifest of stored quantities of waste was available, but the proprietor of Waste Control, who was present at the site, advised the FESA that 300 000 litres of white spirits, paint thinners, paints and mixed liquids, and 30 000 litres of perchlorethylene were stored on the premises.

To increase command and control functions, the Incident Controller initiated sectorisation of the fire area, that is, the site was divided into smaller, manageable sections, each controlled by a Sector Commander. The Waste Control site was established as sector 1, while sector 2 consisted of other industrial areas in the vicinity. The IMT decided to let the fire in section 1 burn freely to consume the flammable liquids in the drums and to concentrate on cooling the exposures to on-site property threatened by the fire, such as the house and the laboratory. In sector 2 the fire fighters were hampered by fencing, strong winds, and limited water supply, due to the high usage in sector 1. Sector 2 was extended to encompass the spreading fires, which were contained and monitored throughout the night. Adjacent grass and bush fires continued to burn, leading the IMT to establish a third sector to cover these areas. Some of these fires were in inaccessible land located on the river flats, and as a result these fires were left to burn until they reached the roads or firebreaks where they could then be extinguished. At approximately 4.30 a.m. on 16 February, FESA advised that all fires had been contained with two hot spots remaining at the site. Fire crews remained at the fire emergency site until Saturday 17 February.

One of the issues, which arose during the night, was the absence of an Emergency Manifest, as prescribed in the *Explosives and Dangerous Goods (Dangerous Goods Handling and Storage) Regulations 1992*. The Emergency Manifest was required to have been stored with the fire-plan, indicating the category or class of hazardous substance, the product name, and the quantity and location of goods stored at the site. As a result of the absence of the Emergency

Manifest, the risk faced by the fire fighters was substantially increased, as the emergency officers were unable to determine the correct safe distances from the fire. In addition, it increased the level of anxiety and stress experienced by the fire fighters and the community, as they did not know what they had been exposed to. It must be noted that even if the Emergency Manifest was there, it is likely that the real exposures could not have been assessed, as they were dealing with combustion products of mixtures. This does not imply, however, that an Emergency Manifest is not essential for various factors, including the assessment of the explosion potential, possible toxic releases, and strategies for dealing with the impact of a fire.

Although it has been widely reported that over 50 residents were evacuated from the area, the accuracy of this claim cannot be confirmed, as a list of evacuees was not maintained. The police initiated the evacuation, in order to protect life and property from the immediate threat from the fire and from the exploding drums. At 05.30 hours, the IMT decided to allow residents to return to their homes, after the main fire had been extinguished. At that stage, however, the fire had not officially been declared a HAZMAT incident, and consequently information on the health hazards was not available. A second evacuation occurred at approximately 09.00 hours in the morning of 16 February, after the fire was officially declared a HAZMAT incident.

Post-incident

The Waste Control premises were substantially damaged by the fire, with the exception of the office building, and the laboratory, situated in a recycled sea container. The fire caused toxic fumes to be discharged into the atmosphere and contaminated fire-fighting water, which ran down into stormwater drains, leading directly into the Helena River. In addition, contaminated water flowed from the site to the low-lying area to the east of the premises. In an effort to prevent contamination of the Helena River, the DEP installed bunding close to the site, and blocked the drains.

Post-fire clean-up operations were undertaken over the following months to enable the safe reoccupation of the area by residents and businesses. On completion of the post-fire clean up, a contaminated site assessment was undertaken by URS Australia Pty Ltd, *The Detailed Site Investigation: Waste Control Site Bellevue, Western Australia* (URS Australia Pty Ltd 2002) reported on-site soil and groundwater contamination, associated with both the historical operations at the site and the fire. The contamination was found to be migrating off-site across three of the site boundaries in two different aquifer systems. A second URS report (URS Australia Pty Ltd 2003) revealed groundwater contamination in shallow and intermediate water tables with potential to leach into the Leederville aquifer and the Helena River. Of note is that the Helena River is a tributary to the Swan River and the Leederville aquifer is a valuable source of drinking water to Perth.

In response to concerns and anxiety of the community, a survey was undertaken to examine the health effects associated with the fire. The survey report suggested an association between proximity to the fire and the two symptoms headache and shortness of breath, with the risk of headache largely restricted to the area close to the fire, and the risk of shortness of breath more widespread (HDWA, University of Western Australia Survey Research Centre & Curtin University of Technology 2001). A Parliamentary Inquiry into the Bellevue fire provided findings and recommendations as a basis for changes to environmental and planning laws (Economics and Industry Standing Committee 2001a, 2002).

Environmental Health Management Review

This section assesses the appropriateness of the environmental health assessment and management procedures and practices implemented at the Bellevue fire in the context of international best practice.

Prevention

The primary objective of safety-related programs at hazard facilities is the prevention of incidents that could cause harm to health and the environment. Prevention includes all aspects of managing, operating, and controlling a hazard facility, and is aimed at avoiding incidents, minimising impacts, and learning from experience to reduce vulnerability and to increase resilience. Prevention is the concern of all stakeholders including industry (owners and operators of hazardous installations and their employees, contractors, and customers), public authorities at national and local levels, and the community. Although preventive actions vary by stakeholders, the overall aim is to reduce chemical risks and incidents, in order to protect health, the environment, and property.

Table 2: Prevention - Best Practice and the Situation at Bellevue

Best Practice	Bellevue Situation	Appropriate Actions	Environmental Health Benefits
Establish safety strategy and control framework Binding requirements, set out in laws and regulations Provisions for enforcements of requirements	EP Act 1986 and EDG Act 1961 controlled both environmental protection and dangerous goods storage and handling Despite non-compliance with license conditions, DME and DEP continued to issue licenses to Waste Control Both DEP and DME undertook only 'weak' enforcement measures, such as infringement notices and "show cause" warning letters	Various departments should have promoted inter-agency co-ordination, in order to minimise overlapping activities and conflicts in the implementation of requirements The control framework should have included provisions for effective enforcement of requirements, including sanctions, with penalties applicable in the event of non-compliance	Effective enforcement of risk reduction and safety strategies would have reduced the probability of incidents, as well as their likely severity, both minimising exposure of the public
Develop and implement land-use planning arrangements	Location was found acceptable by EPA, despite proximity of other developments Local Government agreed with the proposed development of Waste Control, as its plan permitted activities under the City of Swan General Industry Zone	In order to make land-use planning decisions, formal risk assessments should have been conducted to identify, estimate and evaluate the hazards and risks	Containment of the site would have minimised exposure of the public during the incident
Conduct EIA of proposed hazardous installations	A formal EIA was not conducted at the Waste Control site, as the EPA advised that the site did not require a formal EIA under the EP Act	Public authorities should have undertaken EIA, taking into account the full range of implications of the particular location proposed for the new installation	EIA, HIA and safety performance and review programmes will identify the potential health impacts for the public This would have provided a basis for the risk management of the installation, aimed at minimising the probability and severity of incidents and subsequent adverse health impacts
Conduct prospective HIA	No legal requirement	HIA should be incorporated in the EIA	
Establish safety performance and review programmes, including inspections	Various inspections were carried out by both DEP and DME, followed by instructions to address multiple non-compliances, which were not followed up appropriately at any time	For monitoring to be effective and credible, the process should be transparent, i.e. objectives, policies, procedures, and outcomes of the monitoring should be publicised	
	Risk assessment of the various dangerous goods operations at Waste Control was not conducted by the DME	Public authorities involved in the monitoring process should co-operate and co-ordinate in the area of inspections	

Source: Compiled from Ison 2000, Economics and Industry Standing Committee 2001a & 2002, URS Australia Pty Ltd 2002 & 2003, Lloyd-Smith & Bell 2003, OECD 2003

Table 2 summarises the key preventive measures that were developed and implemented at the Bellevue Waste Control site. There is, however, paramount evidence of a lack of systematic and comprehensive approach to the prevention of chemical incidents both by the public authorities and Waste Control:

- The problems started at the time of the establishment of the Waste Control site, where insufficient consideration was given to the likely environmental and health impacts of the Waste Control operation. No formal risk assessment was undertaken, EIA was not mandated, and the hazardous waste operation was considered to be commensurate with general industrial development, as catered for in the local planning scheme.

- Although licenses were in place through the DME and DEP, these were not effective in establishing a safety culture and achieving minimum standards of risk and incident prevention at Waste Control. DME and DEP failed to establish effective enforcement actions, and continued to license Waste Control, despite ongoing evidence of non-compliance with license conditions. Waste Control appears to have ignored instructions to improve its performance and correct breaches of license conditions, resulting in for example environmental damage occurring prior to the fire, and the non-availability of a manifest of dangerous goods stored at the site, on the night of the fire.

Preparedness

The overall aim of preparedness is to mitigate the adverse health and environmental consequences of incidents through the development and implementation of on-site and off-site emergency plans. For the emergency planning to be effective, the process requires co-operation and information sharing among the various stakeholders including, industry, public authorities, response personnel, health and medical personnel, and representatives of the public.

Table 3 summarises the situation with regard to preparedness at the Bellevue site. The following shortcomings emerged in regard to preparedness for chemical incidents at the Bellevue site:

- There appeared to be a breakdown in the enforcement actions regarding the on-site emergency planning at *Waste Control*. *The Explosives and Dangerous Goods Regulations 1992* prescribe the requirements for an emergency plan, including a manifest of stored dangerous goods. The DME held a copy of the 1993 emergency plan, and therefore requested Waste Control to provide an updated document. Although the DME did not receive it, there is no evidence that appropriate follow-up actions were undertaken. As a result, the emergency manifest, which was required to be stored in a canister at the site, was not available at the time of the incident.

- Insufficient interagency collaboration and co-ordination on emergency plans and procedures undermined the overall preparedness for dealing with an incident of the scale of the Bellevue fire.

- The existing Western Australia Hazardous Materials Emergency Management Plan (WESTPLAN-HAZMAT) did not recognise the importance of having a HDWA representative as a core member in the Hazardous Emergency Advisory Team (HEAT).

Table 3: Preparedness - Best Practice and the Situation at Bellevue

Best Practice	Bellevue Situation	Appropriate Actions	Environmental Health Benefits
Establish guidelines and standards for developing on-site and off-site emergency plans Ensure the development, implementation, testing and updating of on-site and off-site emergency plans for every hazardous installation	DME has established "Guidelines for the Preparation of an Emergency Plan" DME held a copy of a 1993 emergency manifest prepared by Waste Control DME never received an updated copy, despite requesting such document	Public authorities should have established general principles concerning emergency planning Public authorities should have undertaken regular audits to ensure that off-site and on-site emergency plans were developed and updated	The presence of an emergency plan would have decreased the exposure risk faced by the first responders and the population, as emergency officers would have been able to determine appropriate safe - evacuation - distances
Identify and train all parties and personnel who are expected to participate in an emergency response, and set up multi-disciplinary work arrangements	WESTPLAN - HAZMAT provides an overview of participatory parties in an emergency response, including a State training program HDWA is not a core member of the HEAT, but only required to attend when specifically requested	Emergency plans, in identifying the roles and responsibilities of all parties concerned, should have indicated the chain of command and co-ordination, including lines of communication HDWA should have been a core member of the HEAT, in order to form a key part of the assessment	An appropriately coordinated emergency approach would have resulted in a more effective response, and hence would have contributed to less exposure in the population
Ensure access to information sources, databases, and people with expertise	FESA maintains a database of information on first strike action/protective clothing/safety, and has access to (inter) national 24 hour hazardous materials advice centres	Public authorities should have determined the best approach for ensuring access to essential information	Providing appropriate information during and after an incident would have reduced the level of anxiety and stress in the community
Ensure the availability of adequate medical facilities	Evidence unavailable	Public authorities, in co-operation with hospitals should have established back-up procedures and systems for moving and treating large numbers of victims	
Ensure that systems are in place to provide information to the public following an incident and the emergency response	WESTPLAN-HAZMAT provides for a Emergency Coordinator whose role is to coordinate media releases and public information	Response authorities should have been able to continuously provide timely, credible, sensitive, factual and accurate information to the public	

Source: Compiled from FESA 2001, Economics and Industry Standing Committee 2001a & 2002, OECD 2003

Emergency response

The emergency response to chemical incidents is aimed at minimising the adverse consequences to health, the environment, and property. The emergency response activities should consist primarily of implementing the emergency plans, assuming that the planning process was complete and effective. The most important areas in the emergency response are incident combat (i.e. extinguishing the fire), medical treatment, and most importantly from the point of view of the affected public and the emergency services, dealing with the questions and uncertainties about the likely health effects.

The emergency response measures and activities undertaken by the public authorities during the Bellevue incident are summarised in Table 4.

- Although the WESTPLAN-HAZMAT was activated and the HEAT was assembled with representatives from FESA, Police, DEP, DME, HDWA, Waters and Rivers Commission, and the Water Corporation, the incident was not officially declared a HAZMAT incident until *eight hours* after the fire started.

Table 4: Emergency Response - Best Practice and the Situation at Bellevue

Best Practice	Bellevue Situation	Appropriate Actions	Environmental Health Benefits
Activate emergency plans	WESTPLAN - HAZMAT was activated and HEAT assembled with Government representatives	Public authorities should have localised the incident, contained it, and should have ensured that the public was notified of the incident and informed about what actions to take	Activating prepared emergency plans would have resulted in a structured and more effective emergency response, aimed at minimising the harmful effects on health, the environment, and property
Decide on the immediate actions to take to avoid or limit exposure of humans to hazardous substances	Incident Controller initiated sectorisation of the area to increase command and control functions, continuously assessed the situation, and decided accordingly Immediate area was cordoned off to minimise the risks associated with the fire, exploding drums and flying debris The fire was not officially declared a HAZMAT incident until eight hours after the fire started	Incident Controller should have decided on measures to avoid/limit exposure of employees, rescue workers and the public He should have obtained information from the management of the facility, as well as from other experts, and should have conducted best outcome assessment	A more accurate estimation of the risks of the plume would have triggered action to minimise human exposure to the plume Fire fighters and other first responders would have been instructed to wear appropriate PPE Residents would have been instructed to immediately close doors and windows and switch off A/C units
Decide on whether the public should shelter indoors or be evacuated, based on likely exposure and possible health effects	Emergency services were unable to determine correct safe evacuation distances, due to the absence of adequate toxicological data Police evacuated initially 'three streets in the surrounding area' based on the proximity to the fire rather than exposure to the toxic plume	Incident Controller should have arranged to keep the threatened and potentially threatened community advised of the situation and what action to take	A targeted and coordinated evacuation strategy would have caused less anxiety and stress among the local population (both during and after the incident), and most likely also avoidable exposure to the plume .
Provision of first aid and other medical treatment	No evidence available	Equipment and supplies should have been readily available to administer near the incident site	In the event of injured people, they would have received immediate treatment, before being taken to hospital
First responders have sufficient information, education, training and experience to be able to assess whether they can deal with the situation or whether additional support should be summoned	Continuous communication difficulties during the emergency, resulted in inappropriate responses regarding deployment of personnel, public health precautions, and fire fighting, wash-down and environmental protection strategies Absence of adequate toxicological data for dangerous goods	Systems should have been available, in order to provide immediate information to be used to assess and respond to the emergency, including information on quantity and nature of the hazardous substance(s) involved; levels of acute exposure to various hazardous substances, and adverse effects	Well-informed assessment of the severity of the incident would have resulted in: Fire fighters and other first responders wearing appropriate PPE and not being unnecessarily exposed to the plume Residents being evacuated from areas with potential exposure to the plume
Hospitals and other treatment facilities put their emergency plan into effect as soon as they are alerted that there is a possibility of patients arriving as the result of chemical inciden	Hospitals were not alerted at the time of the incident, as the potential health risks from plume exposure were not recognised	Medical personnel should have been part of the response team and information chain Hospitals should have been provided with information on the incident, the hazardous substance involved, the likely number of victims, including nature of injuries	Activating emergency plans and following treatment protocols would have contributed to making an early determination of the possible human health effects
Official spokespeople have the necessary knowledge, skills, authority, and credibility to effectively communicate with the public	HDWA arranged seminars to inform the exposed population and to address concerns Local residents and fire fighters were concerned about the health impacts from the fire Anger and anxiety existed over the perceived lack of information	In providing information, spokespeople should have: • Been as open as possible • Been timely • Admitted when information was not available • Avoided making promises that could not be fulfilled • Been the first to give bad news • Ensured that the messages provided were consistent with the actions taken	Appropriate and effective communication with the public would have minimised the level of experienced anxiety and stress
Availability at an early stage of psychological support	Apparently not considered at the site at the time of the incident	Counsellors should have provided emotional support to victims and response personnel	Early psychological support would have reduced the levels of anxiety, stress and concern of residents and response personnel
Document decisions and actions, in order to review the effectiveness of the interventions, to learn from experience, and to improve emergency plans	A list of evacuees was not established, nor were the exposed people registered initially HDWA and FESA conducted a post incident analysis, followed by improvements to emergency response protocols, risk communication strategies, and HAZMAT classification	Decisions and actions that should have been documented include notification actions, evacuation/sheltering decisions, calls for inter disciplinary assistance	Exposed people, registered immediately after the incident, would have been followed up, and health effects would have been investigated, starting from the first day of the incident

Source: Compiled from HDWA, UWA Survey Research Centre & Curtin University of Technology 2001, Economics and Industry Standing Committee 2001a & 2002, OECD 2003

Table 5: Follow-up - Best Practice and the Situation at Bellevue

Best Practice	Bellevue Situation	Appropriate Actions	Environmental Health Benefits
Conduct EIA	A contaminated site assessment was undertaken by URS - the Detailed Site Investigation and the Further Site Investigation	Protocols should have been developed identifying the types of assessments and measurements	Early identification and subsequent clean-up of contaminated areas would have prevented avoidable human exposure to hazardous substances
Make (inter) national effort to improve understanding of the environmental consequences of the incident	Environmental impacts are documented and published in the Detailed Site Investigation and the Further Site Investigation HDWA investigated the public health risks from the smoke plume, and the environmental contamination	Relevant parties should document the adverse impacts on the environment, and publish the results The area affected by the incident should be monitored to determine long-term environmental consequences	Understanding the environmental consequences of the incident would have contributed to the identification of the public health impact
Monitor, observe and register exposed population, including those seemingly unaffected	Health impact assessments for the first responders, exposed people and the population were arranged and undertaken by local GPs and medical centres Identification and medical follow-up of exposed people were incomplete and not systematic The Community Survey of Bellevue Fire Health Effects was conducted to determine extent and nature, and duration of health effects of the fire The Bellevue Fire Health Surveillance Register was implemented to register individuals who were exposed to the effects of the fire	Public authorities should have ensured that exposed persons, whether they appeared affected or not, were systematically examined and properly registered to allow for short- and long-term follow-up	Early assessment, examination and subsequent observation will assist in later diagnosis and treatment of symptoms
Take biological samples after exposure and where appropriate, at regular intervals	Thirty volunteer fire fighters had blood samples taken after their possible exposure Blood tests were offered to concerned members of the community	There should have been a structured approach to monitoring and sampling to ensure quality of data collection and analysis, and provide a basis for comparison over time and between events	
Define and apply epidemiological protocols and sampling methods	Gaps and overlaps existed regarding the sampling protocols and methods, due to communication difficulties between the involved agencies Uncertainty existed over the lead responsibility regarding the medical follow-up of the exposed population	To improve the value of any monitoring/sampling, there should have been information available concerning the immediate environment and population before the incident, such as background levels of exposure and the nature of local ecosystems	Application of epidemiological protocols and sampling methods would have contributed to: • Characterise the incident • Limit the adverse consequences for health and environment • Learn from the incident experience
Share information concerning long- and short-term health effects, appropriate treatment, and epidemiological and health follow-up	Local GPs were inadequately informed by the public authorities, and not provided with a list of chemicals Experts were consulted to provide advice regarding the health effects of the exposure	Expert information sharing should have been undertaken to improve the understanding of the health effects	Thorough understanding of the health effects would have improved diagnosis, treatment and care of the exposed population
Investigate the incident to determine root and contributory causes	A Parliamentary Inquiry into the fire resulted in two reports, containing 46 findings and 21 recommendations The Inquiry relied on voluntary submissions, and has been criticised for not calling important witnesses, such as former employees of Waste Control	Incident investigation should be conducted by a group of experts, for example a specially designated commission All interested parties should have an opportunity to be involved in the investigation	The findings and recommendations of the investigation will assist policy makers in making informed decisions about planning, regulation, and management of hazardous materials, in order to prevent similar incidents in the future
Publish investigation reports	Both reports were subsequently published in 2001 and 2002	Investigations should be documented, and reports should be published, to inform relevant stakeholders of the lessons learned, in order to help reduce the likelihood of similar incidents occurring in the future	

Source: Compiled from HDWA, UWA Survey Research Centre & Curtin University of Technology 2001, Alliance for a Cleaner Environment 2001, Economics and Industry Standing Committee 2001a & 2002, URS Australia Pty Ltd 2002 & 2003, OECD 2003

- During and after the incident at Waste Control, criticism has been raised with regard to the attendance and involvement of volunteer fire fighters without appropriate Personal Protective Equipment (PPE). According to FESA investigations, this was the result of a combination of factors, including communication difficulties and the lack of an initial HAZMAT classification.

- Adequate toxicological data were not available, which resulted in substantial uncertainties about potential health risks from plume exposure, and consequently safe evacuation distances.

- Insufficient co-ordination existed between the HDWA and the Incident Controller in regard to the evacuation procedures. Before the HEAT assembled, the Police had already evacuated residents because of the proximity to the fire. It appeared that the evacuated people were not properly looked after, and wanted to return to their homes. Despite HDWA's recommendation to permit residents not to return to their homes, they were sent home by the Incident Controller at the site. In addition, the evacuees were not registered at the time of the incident.

- Communication gaps existed between the HDWA and the community. Despite various efforts to inform the local residents, anger and anxiety existed over the perceived lack of information.

Follow-up

Follow-up deals with the actions to be taken after an incident, following the immediate response activities. The focus should be on learning from the experience in order to avoid similar incidents in the future. Follow-up activities, therefore, include initial clean-up activities, the assessment of health and environmental consequences, incident reporting and investigations. Table 5 summarises the follow-up measures and activities undertaken by the public authorities after the Bellevue fire.

- Within the constraints of the inadequacies with regard to prevention, preparedness and emergency response, the follow-up phase at the Bellevue chemical fire was reasonably well organised, and in many aspects were close to international best practice.

- The public was concerned that exposed people were not adequately identified, that local GPs were inadequately informed, and that a lack of clarity existed in regard to the responsibility for the medical follow-up of the exposed. Each of these concerns is, however, largely rooted in inadequacy in preparedness and emergency response, thereby limiting effectiveness of the follow-up activities.

Discussion

This paper set out to review the environmental health assessment and management before, during and after the Bellevue fire in Western Australia from the perspective of current international best practice, as compiled by the OECD (2003). Environmental health procedures and practices were assessed within the framework of the four-step management framework to deal with potential chemical incidents (i.e. prevention, preparedness, emergency response, and follow-up).

The review demonstrated that the environmental health management system in Western Australia was not adequately prepared to deal with emergencies in

hazardous waste management on the scale of the fire in Bellevue. Most importantly, environmental health considerations were poorly handled with regard to the risks posed by Waste Control. Neither environmental nor health impact assessments were ever considered, let alone performed - the HDWA was never consulted - and the operation of the hazardous waste facility was considered to be appropriate for the Bellevue site. The desire to keep the site open, to avoid waste accumulation in the community and further uncontrolled dumping, prevailed over the need to enforce at least basic standards of environmental performance, emergency prevention and preparedness. In addition, insufficient interagency collaboration and information sharing, for example the HDWA not being a core member of the WESTPLAN-HAZMAT, undermined the overall preparedness for a chemical incident on the scale of the Bellevue fire. As a consequence, a structured approach to monitor the exposed community after the incident was never considered let alone in place at the time of the incident. The insufficient preparedness resulted in an emergency response, severely hampered by co-ordination and communication difficulties, leading for example to residents being unnecessarily exposed to the plume, as they were allowed to return to their homes, despite negative advice from the HDWA. As adequate toxicological data were not available, uncertainties existed over the health risks from exposure to the plume and safe evacuation distances. After the fire, the problems continued with the exposed population being inadequately identified, monitored and followed-up, resulting in avoidable anxiety and anger in the community.

The proper use of international best practice in the management of the environmental health impacts of the Bellevue fire would have had tremendous environmental health benefits. Proper environmental and environmental health risk assessment should have identified Waste Control as a hazardous facility, justifying more stringent regulations and strict enforcement, so that the chances of a fire incident would have been minimised. More vigorous commitment to emergency planning would have provided an emergency plan, proper list of chemicals, and clear procedures to deal with the incident, as it unfolded. The emergency response would then have been less dependent on uninformed, but skilled 'guesses' by emergency crews attending the incident. In sum, the risk of the incident would have been reduced, its scale likely minimised, and exposure of emergency staff and community minimised, with the added benefit of having avoided angst and frustration in the community.

Conclusion

In conclusion, international best practice in the prevention, preparedness, emergency response, and follow-up of chemical incidents, should be implemented to reduce the risk and severity of potential incidents and to improve the emergency response in case of an incident, with the ultimate aim to decrease the exposure and consequently the health impacts in the population.

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Endnotes

1. This section is largely based on the work of the Economics and Industry Standing Committee (2001a, 2002).

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Legislation

Explosives and Dangerous Goods Act 1961 (EDG Act) (WA)

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The Public Health Response to a Case of Hepatitis A in a Food Handler at a Large Sydney Community Club

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Key words: *Hepatitis A; Policy; Immunoglobulin; Prevention; Foodborne Disease*

Hepatitis A is a viral infection often transmitted via the faecal-oral route, the most common pathways being through eating contaminated food, touching contaminated articles, such as nappies or linen, and by direct contact with an infectious person. Outbreaks overseas have been linked to infected food handlers, resulting in a high degree of intervention by public health authorities in such cases in recent years. This article reports on a mass-vaccination clinic conducted in December 2003 to prevent hepatitis A following the notification to a public health unit in Sydney of a case of hepatitis A involving a food handler. The article outlines the issues faced by the public health unit, the characterisation of risk and the public health responses taken. The intervention was the first of this type and scale in Australia, and has influenced how responses will be conducted in the future.

Hepatitis A is a notifiable condition in New South Wales under the *NSW Public Health Act (1991)*. The condition is associated with substantial morbidity with 486 notifications of hepatitis A in NSW in the period of January 2000-June 2002, of which 123 were hospitalised (Neville & McAnulty 2004). In December 2003, the Unit was advised of a case of hepatitis A in a 31-year-old male food handler who worked in a café at a large metropolitan club. The case had a history of nausea, vomiting, mild diarrhoea, fever, and arthralgia with an onset four days prior to notification. When initially interviewed by telephone, the case displayed sound food hygiene skills and knowledge, but reported inconsistent use of gloves when handling 'ready-to-eat' foods. The case had a key role in food preparation and continued to work while symptomatic. At the time of notification The NSW Health notifiable disease response protocols required that cases who are food handlers be excluded from work for seven days from the onset of jaundice, and that Normal Immunoglobulin (NIGH) be offered to exposed close contacts only. NIGH can prevent clinical illness in contacts if given within 14 days of exposure. However, previous overseas outbreaks called into question whether the provision of NIGH should be more widely extended in this circumstance. Specifically, in the United States there had been two reported circumstances where foodborne transmission of hepatitis A had resulted in significant morbidity (Dato et al. 2003; La Porte et al. 2001). An outbreak of hepatitis A in Massachusetts US, implicated a restaurant worker as the source (La Porte et al. 2001). No action was taken to alert patrons or recommend NIGH and subsequently 46 additional cases resulted. In another outbreak in Pennsylvania, 555 cases including three deaths were identified in patrons of a restaurant (Dato et al. 2003).

The Unit used a risk management approach to identify, characterise and manage the risks associated with this case.

Initial Responses

The case was interviewed and provided with routine counselling about risk and minimising exposure to others, and was advised to stay home from work until non-infectious. The Unit also undertook an assessment at the club to ascertain the extent of potential risks to patrons and staff, which included a meeting with management, inspection of food preparation areas and a review of club records.

Risk characterisation and assessment

The club had approximately 36 000 members and employed 240 staff. The club had numerous facilities including several large function rooms, beverage outlets, and three restaurants. It was confirmed by the head chef that the index case had reported feeling unwell on 6th December. On that day he went home but returned to work until 8 December, as the club was very busy due to Christmas functions. Based on the onset of illness being 6 December 2003, the period where patrons and staff could have been exposed to infectious material was estimated to be from 22 November to 9 December.

From the inspections and information obtained during interviews with the index case, a number of factors were present involving the index case which enabled us to conclude that there was a potential public health risk. These factors included that the index case:

- had a key role in preparation of a variety of foodstuffs in a busy food service with a large number of patrons;
- did not always wear gloves when handling ready-to-eat food;
- might not have followed existing hand-washing protocols at all times;
- was likely to be infectious while working, including three days while symptomatic; and
- had vomited into a kitchen sink at work during the infectious period.

We considered there was potential for club patrons and employees to have been exposed, not only if they had consumed contaminated food, but also by coming into contact with potentially contaminated surfaces, such as taps at hand basins. From discussions with the club, it was estimated that over 1000 patrons could have dined in the cafeteria where the chef worked while infectious. Based on the above characterisation of risk, and the recent literature on foodborne transmission of hepatitis A (Dato et al. 2003; La Porte et al. 2001), we assessed the risks of a potential outbreak to be significant, if patrons were not given immunoglobulin.

The practical aspects of risk management

Following characterisation and assessment of the risk, several teleconferences were convened with local and international experts in order to determine further management in line with contemporary practice. It was decided to offer counselling and NIGH to the estimated 1000 patrons who attended the café between 22 November and 9 December 2003.

The decision to run the clinic at the club was made for a number of reasons including the suitability of its facilities, the club's desire to be involved and the familiarity of the venue to its clients. Patrons were alerted by several methods including using contact details provided in the café's booking register and through a media campaign involving both local and state print and radio media. A 24-hour hotline (with recorded information) was established and local Divisions of General Practice were alerted.

Logistic issues were considerable and included: availability and delivery of fifteen hundred vials of NIGH; staffing the clinic with nurses, doctors and counsellors; setting up the clinic in a commercial area; security

concerns; access for the elderly patrons; interpreters for patrons from culturally and linguistically diverse backgrounds; the need rapidly to devise information sheets and consent forms; and ways to maximise attendance. The local hospital, which was not suitable for conducting the clinic for logistic reasons, such as security and space, provided bedding and other supplies. The Public Health Unit formed an incident management team comprising the Immunisation Coordinator, Senior Communicable Diseases Manager and a Senior Food Inspector under the direction of the Acting Director, who managed the incident coordination, command and control. We were fortunate to have experienced staff that were able to address the various tasks and issues and bring the clinic together in such a short time.

One thousand one hundred and sixty six people presented over four days, and 768 patrons were given NIGH. The club estimated the cost of the clinic to their business to be around $44 700, including lost revenue.

Discussion

This is the first reported mass hepatitis A vaccination clinic held in Australia. There was considerable debate over whether mass prophylaxis with NIGH was indicated. Our decision to offer NIGH to patrons of the club was strengthened by the case's inconsistent use of gloves and the fact that he worked while symptomatic. While risk of transmission from vomitus is not documented in the literature, the case's vomiting in the kitchen sink while infectious raised additional concerns.

Arguments against conducting this clinic included the relatively inexact mechanism of establishing risk of transmission, the lack of literature on efficacy of NIGH in this situation, and the fact that efficacy of NIGH declines rapidly within days of exposure (Conaty et al. 2000). Creating unnecessary public concern, adverse publicity, logistics, and the cost of the clinic were other considerations. The cost to the Public Health Unit was estimated to be around $45 000, which included the cost of NIGH and approximately 12 staff working for various periods over the weekend. The decision to conduct this intervention was subject to considerable debate at the time, especially given the costs involved and the departure from established protocols.

However, the action might have averted a potentially large foodborne outbreak, as in January 2004, the Public Health Unit was notified of four cases, linked to the café, who had not attended the intervention clinic and/or had not received NIGH.

Conclusion

It is plausible to argue that our intervention averted further cases and possibly a widespread outbreak of hepatitis A. The clinic worked well in this setting and highlights the need to work collaboratively with the community in the event of other potentially large-scale outbreaks.

It has also set a precedent for future public health action in NSW. The NSW Health Department has altered its hepatitis A management protocols, specifying that NIGH is offered to patrons if an infected food handler is involved in the preparation of foods that are not heated (NSW Health Department 2004), if deficiencies in personal hygiene are noted, or if the food handler has been symptomatic with diarrhoea or vomiting

Acknowledgments

We would like to acknowledge Brett Campbell for his involvement in this project, all the NSW Health Department and Area Health Service staff who participated in the clinic and staff and management at the club for their co-operation.

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Communicable Disease Epidemiology and Control: A Global Perspective, 2nd Edition

Roger Webber

CABI Publishing, Oxfordshire, 2005, ISBN 0 85199 902 6, $79.00

With both new and reemerging communicable diseases being identified on an almost weekly basis and with the potential impacts of outbreaks of these diseases being a real consideration for public health practitioners, the release of the second edition of this text is both welcomed and timely.

From its title, it can be inferred that there are two dominant themes within the text: (i) communicable diseases are a global issue - they are as important as they ever have been for developed countries and they continue to be the main cause of death and infirmity in the developing world; and (ii) epidemiology forms the logical basis for studying and controlling these diseases - as they are a community problem and understanding the modes of transmission provides the key to implementing effective control measures.

Any text that attempts to provide a comprehensive review of communicable diseases is compelled to make some decisions on what to cover and what to leave out. To try and adequately address this balance, the text provides a comprehensive listing of 340 diseases and their key epidemiological characteristics in the last chapter (Chapter 19), and then covers the important diseases (from global perspective) in detail in the main part of the text.

The first five chapters provide an extremely good overview of communicable disease principles by covering the following topics: elements of communicable diseases, communicable disease theory, control principles and methods, control strategy and organisation, and notification and health regulations. The sections on control principles and methods and on outbreak investigation and management are of particular relevance to environmental health practitioners.

The remaining chapters describe the epidemiological features of a large range of diseases, using the means of transmission as the basis for classification. These groups include: water washed diseases, faecal-oral diseases, food-borne diseases, diseases of soil contact, and so on. The following detailed information is provided for each disease: organism responsible, clinical features, diagnosis, transmission, incubation period, period of communicability, occurrence and distribution, control and prevention, treatment, and surveillance. Despite the developing world focus of the diseases discussed, a large number of locally-relevant diseases are included. This section of the text then concludes with a short chapter on 'new and potential diseases'.

Overall, the second edition of *Communicable Disease Epidemiology and Control: A Global Perspective* provides a comprehensive and easy to read review of the principles of communicable disease control and the epidemiological features of the world's most important diseases. On its own it is an impressive text, but it also makes an invaluable companion to the latest edition of the *Control of Communicable Diseases Manual* (now edited by David L. Heymann). I would therefore highly recommend this text to all environmental health practitioners.

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A Small Dose of Toxicology: The Health Effects of Common Chemicals

Steven G. Gilbert

CRC Press, Boca Raton, ISBN 0-415-31168-3, $68.00 RRP

All environmental health practitioners have some level of knowledge of toxicological principles, but it is a subject area that many people struggle to understand and fully appreciate. This is because as students, we can get overwhelmed by the detail and lose sight of the basic principles.

The text *A Small Dose of Toxicology* provides some welcome relief from the usually dense toxicology textbooks, and presents a concise but useful introduction to the topic. The author maintains that we all have some intuitive understanding of what toxicology is, but we generally have trouble applying this knowledge to real-life situations. The author states that "this book is a tool that will help people learn about toxicology so they can form their own opinions about the potential harm from any exposure and develop ways to reduce exposure". He goes on to say that "knowing the underlying principles of toxicology allows for far more effective analysis of a problem or situation and thus more effective decision-making".

Given this perspective, the text is structured in the following manner: chapters 1 and 2 provide an overview of the concepts of toxicology; chapters 3 to 14 illustrate these concepts through discussing a range of commonly encountered toxic agents; chapters 15 to 17 discuss targets of toxic agents; and then chapters 18 and 19 discuss how toxicology is used in risk assessment and how it can be applied in the home.

The chapters on toxic agents provide a concise overview of key issues that relate to each of the toxic agents chosen. Each of these chapters generally has the following format: a dossier on the agent, case studies, introduction and history, biological properties, health effects, reducing exposure, regulatory standards, recommendations and conclusions, more information and references. The introductory chapters provide an excellent summary of toxicological principles and the chapters on targets of toxic agents provide concise and compelling information on topics that the general public are most concerned about: neurotoxicology, cancer and genetic toxicology, and pregnancy and developmental toxicology. The final chapters then pull it all together by explaining how toxicology can be used as the basis for better decision-making.

To assist further with making the principles of toxicology more accessible, a companion website (www.asmalldoseof.org) contains additional references and PowerPoint presentations for each chapter that reinforce key points.

Overall, this text provides an excellent introduction to toxicological principles and illustrates these in an effective and easy to understand way. The chapters on 'the principles of toxicology' and 'risk assessment and risk management' should be required reading for all environmental health practitioners, and I would recommend this text as an antidote for those who have been 'over-dosed' by the standard toxicology texts.

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