



>From the Chief Health Officer, continued from page 1

## Canadian research strengthens the case for action

A major study in Canada, undertaken for the Ontario Government by the Canadian Institute for Advanced Research, has strengthened the case for action.<sup>5</sup> The Early Years Study, subtitled 'reversing the real brain drain', examined the relationships between early brain development, child development and learning, behaviour and health at different stages of life. The 200-page report, citing more than 150 references, drew from the neurosciences, developmental psychology, social sciences, anthropology, epidemiology, and other disciplines. It presents powerful new evidence that the early years of development from conception to 6 years of age—particularly the first three years—set the base for competence and coping skills that will affect learning, behaviour and health throughout life. Early experiences and stimulating, positive interactions with adults and other children are far more important for brain development than previously realised.

The report's conclusion was that 'the period of early childhood development is equal to or, in some cases, greater in importance for the quality of the next generation than the periods that children and youth spend in school or post secondary education'.<sup>5</sup> The recommendations for enhancing the potential in the early years included establishing or developing:

- Early child development and parenting centres in communities, involving the public and private sectors
- Improved maternity/paternity leave benefits for parents
- Family-friendly workplaces
- Tax incentives for developing new centres in communities
- An integrated, independent outcome measure of human development
- A network for community information sharing.

## British experience shows what can be done

The UK Government's White Paper<sup>6</sup>—importantly, signed by the entire Cabinet—also emphasises the central role of early childhood. A new cross-Government program, Sure Start, has been established to provide support to parents and local communities, addressing their needs and making available the support they require to give their children the best possible start in life. It is targeted to areas of disadvantage, binding together existing services to enhance their performance in meeting the particular needs of young families. More than £4.5 million will be spent on 250 local programs in England, focusing on children aged under 4 years and their families. Sure Start works across the boundaries of government departments and is both multidisciplinary and multi-agency at community levels.

Health visitors (community health nurses) are an intrinsic part of this process and have been clearly designated as local public health practitioners. Their role is being modernised to develop a family-centred approach, working with individuals, families and communities to improve health and reduce health inequalities. School health nurses and midwives, who have a strengthened public health role, also make important contributions.

## WHO is leading an international renaissance

At an international level, investment in early childhood has been further recognised by the World Health Organisation (WHO) Regional Office for Europe.<sup>7</sup> Health 21—the 'health for all' policy framework for the WHO European Region—sets an ambitious social policy agenda based on 21 aspirational health targets for the twenty-first century. These are not meant to be a prescriptive list, but they make up the essence of regional health policy. The targets provide a framework for action for the European region and an inspira-

tion for actions tailored to country and local levels.

The first two European targets concern reducing health inequalities between countries and within countries. The third target then focuses on a 'healthy start in life'. The framework recommends that genetic and dietary counselling, a smoke-free pregnancy, and evidence-based prenatal care help prevent low birth weight and congenital abnormalities. Governments need to implement policies that create a supportive family, with wanted children and good parenthood capacity. Parents need the means and skills to bring up and care for their children in a social environment that protects the rights of the child. Local communities need to support families by ensuring a safe nurturing environment and providing health-promoting childcare facilities.

The third target states that 'by the year 2020, all newborn babies, infants and pre-school children in the region should have better health, ensuring a healthy start in life'. Specific measurable health outcome targets are presented for infant mortality, congenital disease, accidents and violence, and low birth weight. This approach is consistent with previous WHO 'health for all' documents, and many industrialised countries have adopted it as a core component of their national health policies or strategies.

## Australian plans are now well underway

In Australia the Attorney-General's Department has undertaken an international review of early childhood programs as a means of preventing crime and other social problems.<sup>8</sup> A major conclusion of the review was that interventions, such as home visiting, family support and parenting education, can have a major impact on at-risk families and children to improve their quality of life and help prevent future offending. Such strategies were also found to be cost-effective compared with the long-term costs of crime and the criminal justice response.

There is now a growing commitment among States, Territories and the

Commonwealth to mount ambitious programs focusing on these early years, with support from the health, education, community and justice sectors. In Victoria, the Department of Human Services will lead a major initiative, Best Start, commencing 2001–02. This initiative will require the support and participation of a wide range of organisations, professional groups and the wider community.

As we begin to focus on early childhood more as a new area for public health investment, an opportunity exists to develop new measures of progress, in terms of both process and outcome. Tracking the progress and achievements of our strengthened child health strategies will be an important task for the next

decade. Future issues of *Health of Victorians* will chart the challenges, responses and lessons learned.

## References

1. Bible. Proverbs 22:6.
2. Catford J. Public health—past, present and future. 1993–94 NHS handbook. Eighth edition. Tunbridge Wells, Kent: JM Publishing, 1993.
3. Barker DJP. Mothers, babies and diseases in later life. London, BMJ Publishing, 1994.
4. Wilkinson R, Marmot M, eds. The solid facts—social determinants of health. Copenhagen: World Health Organisation Regional Office for Europe, 1998.
5. McCain MN, Mustard JF. Early years study—reversing the real brain drain. Final report. Toronto: Canadian Institute for Advanced Research, 1999.
6. Her Majesty's Government. Saving lives—our healthier nation. London: 1999. See [www.official-documents.co.uk](http://www.official-documents.co.uk)
7. World Health Organisation. Health 21, the 'health for all' policy framework for the WHO European Region. European 'health for all' series no 6. Copenhagen: World Health Organisation Regional Office for Europe, 1999.
8. National Crime Prevention. Pathways to prevention: developmental and early intervention approaches to crime in Australia. Canberra: Attorney-General's Department, 1999.

*Professor John Catford DM, FRCP, FAFPHM is the Chief Health Officer and Director, Public Health, Department of Human Services. He holds a number of State and National appointments including Board Member of the ANZFA, National Public Health Partnership and NHMRC.*

Contact: Tel. 03 9637 4200, Fax. 03 9637 4250, Email: [john.catford@dhs.vic.gov.au](mailto:john.catford@dhs.vic.gov.au)

## ANNOTATION

# Harmful Drug Use in Victoria: It Is Our Problem

Rob Moodie

## Levels of drug use and the impact on Victoria

Drug use in Victoria is increasing. The use of cannabis, hallucinogens, amphetamines, ecstasy, cocaine, heroin, and hazardous drinking has been on the rise since 1991. Reported cannabis use (in the previous 12 months) rose from 10 per cent in 1991 to 18.4 per cent in 1998. Similarly, heroin use rose from 0.3 per cent in 1991 to 1 per cent in 1998.<sup>1</sup>

The only exception to this rule is tobacco. Consumption and prevalence levels declined over the 1990s, with levels of 23 per cent and 18 per cent among men and women at the end of 1999<sup>2</sup> compared with 28 per cent and 24 per cent in 1992.<sup>3</sup> Despite this improvement smoking still remains the major preventable killer in Victoria and Australia.

But it has been the impacts of illicit drug use that have sparked successive waves of community concern. In Victoria deaths from overdose rose from 50 in 1991 to 359 in 1999. A heroin drought has led to a decrease of deaths from 126 during the first four months of 2000 to 17 in the same period in 2001.

During the past decade we also witnessed a rapid rise in the number of non-fatal overdoses, a decline in the age of initiation in heroin use, and the emergence of visible street markets associated with crime, street sex work, overdoses, and public nuisance.<sup>4</sup> Drug-related crimes are on the rise, despite the overall fall in the crime rate, and account for over 60 per cent of crimes against property.<sup>4</sup> Magistrates estimate that 80–90 per cent of the criminal cases appearing before them are related to illicit drugs.<sup>5</sup>

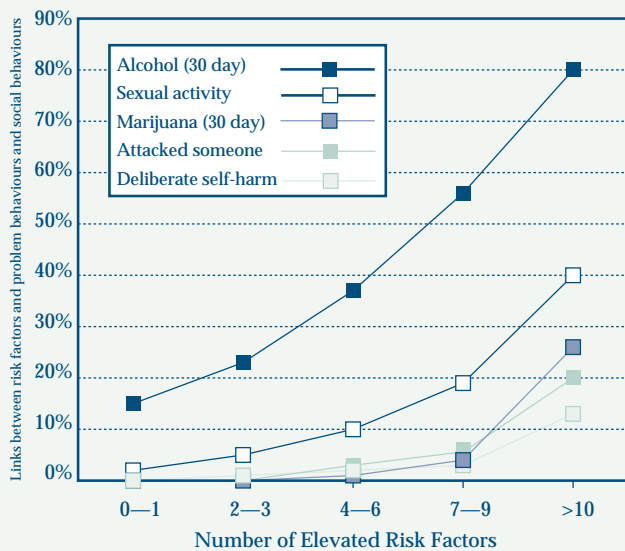
And what does the future hold for us? The Victorian Burden of Disease Study predicts that illicit drug use by 2016 will be the third largest cause of years of life lost among men.<sup>6</sup>

## What determines harmful drug use?

The availability of a drug—its cost, its purity and the accessibility and regularity of its supply—is one of the important determinants of its use. The more we have been able to regulate the availability of tobacco, for example, the more successful we have been in decreasing its use, despite it being legal. On the other hand we have virtually no control of the illicit drug market; price, purity, accessibility and regularity of supply are all deter-

### >Harmful Drug Use in Victoria, continued from page 3

Figure 1: How Risk Factors Are Linked with Problem Behaviours and Social Behaviours



Source: Department of Human Services. Improving lives of young Victorians in our community—summary report. Melbourne: 2000, p.7.

mined by unknown forces, many outside Australia, who participate in a hugely profitable global trade with an estimated annual turnover of US\$400 billion.<sup>7</sup>

Risk factors that determine the demand for drug use are manifold. They include poverty, low attachment to one's community and community disorganisation, detachment from one's school or workplace, parental alcohol and drug use, family conflict, inconsistent parenting, marital instability, and friends engaging in problem behaviours. As Figure 1 shows, the more of these risk factors that are present, the more individuals and communities are likely to use drugs such as marijuana, alcohol harmfully.

Factors that protect against drug use include: a culture of cooperation and tolerance among individuals and between institutions and diverse groups in society; a sense of belonging to family, to school, to one's workplace and to one's community; good relationships within and outside the family; positive achievements; and stability and security.<sup>8</sup>

The risk and protective factors are not easily addressed. They relate to the bigger picture about what level of investment we are prepared to make our social, educational and economic infrastructure. They fundamentally relate to what sort of society we want to be.

### What can we learn from other approaches? what is being done in Victoria?

The overarching strategies recommended by the Drug Policy Expert Committee and being implemented by the Victorian Government are prevention, criminal justice and law enforcement, user treatment and support, and reduction of drug-related harm. These are supported by workforce development and ongoing research and evaluation.

We have rightly become concerned about the death and

injury resulting from illicit drugs, but we also need to remember and draw from the lessons of our major public health successes. In the early 1950s, 75 per cent of Victorians smoked; now, less than 22 per cent smoke. In 1971, over 1000 Victorians died from road trauma and 10 times that number suffered serious physical injury; 30 years later, 600 fewer people die on our roads and 6000 fewer people suffer serious injury. We achieved these outcomes by agreeing on a collective strategy, by aligning our collective skills and capacities from different sections of our community.<sup>9</sup>

What we can also learn from successful approaches overseas is that different parts of the program can and have to work together. So, it is not policing or services for drug users. It is not abstinence-based education or education about avoiding harm from drugs. It is not drug-free treatment *against* methadone or heroin prescription. It is not even voluntary treatment *against* compulsory treatments.

From recent experience in Switzerland, Germany, Holland and Sweden it is clear that policing works better when there are easily accessible street-based services for drug users and when policy have somewhere to send users. It also appears the services for drug users work better when there is a good relationship with police and when users are free from the threat of dealers.

The Dutch experience reinforces the need for different approaches to work synergistically. The Netherlands is often demonised as the drug users' paradise because it has cannabis cafes. Yet, with a national population of 16 million it has approximately one third of the heroin users than Australia. Over 80 per cent of these smoke rather than inject heroin, and the average age of users is steadily rising as the number of young users decreases. The overdose rates in the Netherlands are less than one tenth of Australia's. The country's cannabis rates are even significantly lower than those in the United Kingdom.<sup>10</sup>

The Dutch have 70 per cent of their heroin users under treatment, with the majority on voluntary drug substitution programs. One quarter of those in treatment are in voluntary abstinence-oriented treatment or compulsory drug free prison programs or prison therapeutic community programs. At the same time others who are in opiate substitution programs such as methadone are there by order. The Netherlands is also conducting a trial of heroin substitution.

### What will determine the success of our programs in Victoria?

The success of the current program in Victoria will depend on the intensity and breadth of the interventions, on how well the different parts of the system can work together, and on how rigorously we evaluate every step of the process. A search for quality has to dominate our thinking. Success will also depend on how well we invest in the people working within the system—the youth and welfare workers, the alcohol and drug workers, the social workers, nurses, police, court officials and doctors.

## And what will we need to add to our current program?

As part of local drug strategies we have to expand street level health and support services for users, including primary health care services, treatment and referral, needle and syringe exchange, housing and employment support, as well as short-term accommodation.

We will need to complement the upcoming State drugs awareness campaign with a 10-year illicit drug communication strategy to ensure a long-term, consistent and coordinated approach.

Despite a level of concern from some quarters we will have to continue to consider the role of supervised injecting facilities and the role of expanding treatment opportunities, such as heroin substitution. Given the evidence of the effectiveness of the Swiss 'heroin trial' in greatly reducing harm to users and to the community (in terms of reduced crime and less public nuisance), it becomes unethical *not* to trial this approach in Australia.

We need to establish greater common ground to minimise the destructive effects of division and disagreement, as exemplified during the debate on a trial of supervised injecting rooms. We strongly agree on the need to decrease the numbers of young (and not so young) people who are injecting drugs or using other drugs harmfully. To do this we need to increase protective factors and minimise the risk factors mentioned earlier.

And if we can do this, then we will also be reducing the same risk factors and increasing the same protective factors of a whole range of issues such as alcohol abuse, smoking, depression, crime, early drop-out from school, suicide, road crashes, HIV infection, and so on. The more we can collectively focus all of our community's efforts on these risk and protective factors, the more successful we will be.

And for this we need an increasingly inclusive, tolerant and productive society—one in which we increasingly talk with each other, not at each other. Together we can do better.

## References

1. Department of Human Services. 1998 national drug household survey: Victoria results. Melbourne: in press.
2. Trotter L, Mullins R, Freeman J. Key findings of the 1998 and 1999 population surveys in Quit evaluation studies. Melbourne: Centre for Behavioural Research in Cancer, 2000.
3. Winstanley M, Woodward S, Walker N. Tobacco in Australia. Facts and issues. Carlton: Victorian Smoking and Health Program, 1995.
4. Drug Policy Expert Committee. Drugs: meeting the challenge, stage 2 report. Melbourne: Department of Human Services, 2000.
5. Porter L. Drugs now a factor in almost all crime, say magistrates. Sunday Age. Melbourne, 20 May 2001
6. Department of Human Services. Victorian Burden of Disease Study: Mortality. Melbourne: 1999.
7. United Nations International drug Control Program. World drug report 1999. Oxford: Oxford University Press, 1999.
8. Fuller A. Promoting resilience and preventing substance abuse as well as violence and suicide. Unpublished paper prepared for the Drug Policy Expert Committee, 2000.
9. Moodie R. The art and science of health promotion. Aus J Primary Health Interchange. Special issue: primary health care 2000;6 (3 and 4): 61–68.
10. Council of Europe. Social consequences of and responses to drug misuse in member States. Draft report. Strassborg: Parliamentary Assembly, Council of Europe, 2001.

**Professor Rob Moodie** MBBS, MPH, F(FPHM)RACP is the CEO of VicHealth, Chair of Ministerial Council on AIDS, Hepatitis and Related Diseases. He is also a member of the Premiers Drug Prevention Council.

Contact: Tel. 03 9667 1302, Fax 03 9667 1375 (for Professor Moodie at the Victorian Health Promotion Foundation)

## LEADING ARTICLES

# New Pharmacotherapies: Improving Treatment Choices for Heroin Users in Victoria

Alison Ritter

### Abstract

*A three-year program of research examining new options for the treatment of heroin dependence focused on the practical application of research for Victoria. Australia has lagged behind other countries in establishing new pharmacotherapy treatments. LAAM, buprenorphine, naltrexone and slow-release oral mor-*

*phine provide possibilities for improving the treatment service system by increasing the choice available to clients. A comprehensive feasibility analysis determined the research questions and trial designs for 14 studies of these new treatments. A summary of the studies is provided here, along with a selection of the results. Importantly, the program of research has demonstrated the ability to conduct sci-*

*entific work while maintaining a focus on the practical implications and contributing to direct enhancement of the treatment service system. Buprenorphine is now registered in Australia and the results of the research program directly contributed to Victorian and national clinical guidelines and training programs for buprenorphine.*

>New Pharmacotherapies, continued from page 5

## Introduction

When a three-year program of research into new pharmacotherapy treatment options for heroin dependence commenced in Victoria in 1997 there was only one pharmacotherapy treatment for heroin dependence—methadone. Controlled randomised trials and large-scale observational studies indicate that methadone treatment is effective in reducing heroin use, improving psycho-social functioning and reducing the risk of blood-borne virus transmission.<sup>1,2,3</sup>

However, there are limitations to methadone treatment. These limitations apply to some individuals currently receiving treatment and deter others from entering treatment. They include the requirement for daily dosing, side-effects and the length of the withdrawal from methadone. More importantly, heroin users have only one drug choice if they wish to enter substitution treatment—that is methadone. Choice is a significant determinant of the outcome of treatment, so greater choice will improve success rates for treatments.

The program of research was concerned with four new drugs: LAAM, buprenorphine, naltrexone and slow-release oral morphine. LAAM, an opioid agonist with a duration of action of 48–72 hours, is used as a maintenance treatment option. The long duration of action allows dosing to be reduced to three times per week and, where take-away doses are prohibited or eliminated, reduces the risk of diversion. LAAM has been shown to reduce heroin use, reduce user involvement in criminal activities, and increase the emotional and physical wellbeing of those individuals participating in treatment.<sup>4,5,6</sup> LAAM is registered in the United States for the treatment of heroin dependence.

Buprenorphine is a partial opioid agonist used in maintenance treatment. Its duration of action is 24–48 hours. There is contradictory information about its pleasurable effects, but it is known to block the effects of other opioids. Withdrawal from

buprenorphine is thought to be mild and overdose risk is low when compared with that of opioid agonists such as methadone and heroin. As with LAAM and methadone, buprenorphine has been shown to be an effective treatment for heroin dependence, reducing illicit drug use and improving individuals psycho-social functioning.<sup>7,8,9,10</sup>

Buprenorphine is registered in France and the United Kingdom, and pending registration for the treatment of heroin dependence in other European countries and the United States.

Buprenorphine also shows considerable promise as an effective drug for use in withdrawal treatment. While a number of withdrawal treatments are available, buprenorphine has the potential benefit of a faster and more cost-effective intervention.

Slow-release oral morphine is an opioid agonist with a 12–24 hour duration of action. It is indicated for use as a maintenance treatment. The slow-release form overcomes many of the disadvantages of the short-acting nature of morphine, so theoretically it should have the same treatment effects as those of methadone, without some of methadone's disadvantages. There has been no research that demonstrates slow-release oral morphine's safety and efficacy in the treatment of heroin dependence. While available in Australia, slow-release oral morphine it is not registered for the treatment of heroin dependence.

Naltrexone is an opioid antagonist that blocks the effects of heroin and other opioids. It has been used in relapse prevention to maintain a drug-free state and also as a pharmacotherapy in drug withdrawal. Research evidence supports its use as a relapse prevention treatment. Naltrexone's use within the context of relapse prevention has been demonstrated to reduce relapse rates and improve psycho-social functioning in individuals who continue to take naltrexone.<sup>11</sup> Naltrexone is registered in over 30 countries for the treatment of heroin dependence,

including the United States and European countries.

The objective of the research program was to conduct trials that would lead to the further development of these new treatments and contribute to their registration in Australia.

## Method

A comprehensive feasibility analysis was conducted in Victoria before the research trials began.<sup>12</sup> Feasibility analysis was concerned with determining the most important research questions and trial design issues. The principles used to inform the final determination of trial designs included practical utility, partnerships and cooperation, contribution to the ultimate goal of registration, and consumer involvement.

Trials were designed to ensure the outcomes were directly related to practice. The LAAM and buprenorphine implementation trials, for example, included a considerable focus on the development of validated clinical guidelines and training programs. Likewise, the research question for naltrexone concerned the role of counselling in addition to naltrexone prescribing.

Trials were designed to use expertise from a range of different sources. Interstate as well as Victorian cooperative efforts occurred. Contribution to registration was a guiding principle, so a significant focus on cost-effectiveness occurred across the main trials. Cost-effectiveness data are crucial to the Commonwealth's decision to subsidise a drug. For our population to have real access to treatment choice, the treatments must be affordable.

Throughout the feasibility phase, consumers were consulted on the trials and trial designs. A specific project was established to pilot a consumer advocacy and complaints mechanism, which was available for trial participants as well as other clients of maintenance treatment. In total 14 different trials were conducted (see Table 1).

## Key Findings

The program of research concluded in June 2001, with final reporting in September 2001. Some studies have been completed, while others are close to finalisation.

The buprenorphine implementation trial produced validated clinical guidelines for maintenance treatment with buprenorphine. These guidelines have been adopted nationally

and are already in use in Victoria. The buprenorphine training package has been developed, evaluated and disseminated. Findings from the randomised trial of buprenorphine for heroin withdrawal revealed the superiority of buprenorphine over clonidine for managing heroin withdrawal, as measured by the user's retention in treatment, heroin use and psycho-social outcomes.<sup>13</sup>

A survey of current methadone

maintenance patients indicated that approximately 70 per cent of current methadone clients were either 'very' or 'extremely' interested in methadone withdrawal; however, only 18–30 per cent of clients are likely to be suitable for withdrawal, based on criteria such as ongoing heroin use and psychosocial functioning. Although a large number of clients want to withdraw from methadone, only a smaller percentage may be suitable according to clinical criteria.

Data analysis is yet to conclude on the naltrexone studies, the cost-effectiveness components of the LAAM and buprenorphine implementation trials, and the neuropsychological, driving and pharmacokinetic studies.

## Conclusions

The new pharmacotherapies project demonstrated the capacity to design and conduct trials of new drug treatment options that have practical application for Victorians. Since the commencement of the research, naltrexone and buprenorphine have been registered in Australia (March 1999 and November 2000 respectively). The research work also directly contributed to the national clinical guidelines and training programs for buprenorphine.

There are a significant number of further research questions and practical issues associated with the delivery of these new treatments. Ongoing research is required.

## Acknowledgements

The Victorian Government's Community Support Fund funded this research. Reckitt Benckiser and Boehringer Ingelheim supplied the drugs free of charge. A large team of Turning Point researchers and clinicians ensured the success of the research program.

## References

1. Ball JC, Corty E. Basic issues pertaining to the effectiveness of methadone maintenance treatment. In: Leukefeld CG, Tims FM, eds. Compulsory treatment of

Table 1: Summary of the New Pharmacotherapies Project Trials

Trial	Objectives
LAAM implementation trial	Examine community-based LAAM maintenance treatment; develop and evaluate training programs; validate clinical guidelines for LAAM; and conduct a cost-effectiveness analysis (randomised trial)
Buprenorphine implementation trial	Examine community-based buprenorphine maintenance treatment; develop and evaluate training programs; establish validated clinical guidelines for buprenorphine; and conduct a cost-effectiveness analysis (randomised trial)
Investigating heroin withdrawal using buprenorphine	Trial the efficacy of buprenorphine for heroin withdrawal (two pilot dosing studies, followed by randomised controlled trial comparing buprenorphine with clonidine)
Investigating methadone withdrawal using buprenorphine	Survey the need for and suitability of buprenorphine for methadone withdrawal (randomised pilot dosing study, comparing two different buprenorphine withdrawal regimes)
Pilot study of slow-release oral morphine	Examine dosing regimes and heroin use detection methods (multiple case study)
Naltrexone side effects study	Determine rates of depression and dysthymia in heroin-free naltrexone maintenance patients
Naltrexone treatment outcome study	Investigate the role of a structured 12-week counselling program in enhancing naltrexone treatment outcomes (randomised trial)
Examining the safety of driving on methadone, LAAM and buprenorphine	Examine the relative effects of the three maintenance drugs on driving performance (using a driving simulator)
National pregnancy register	Monitor pregnancy outcomes for maintenance patients
Neuropsychological effects study	Examine the differential subjective and objective cognitive effects of LAAM, methadone and buprenorphine
Buprenorphine with Vietnamese clients	Examine the acceptability and effectiveness of buprenorphine for Vietnamese clients (pilot study)
Koori project	Examine the acceptability and effectiveness of maintenance treatments for Koori clients (pilot study)
LAAM and morphine pharmacokinetic studies	Examine the pharmacokinetics and pharmacodynamics of morphine and LAAM
Consumer Advocacy and Complaints Project	Test a consumer advocacy and complaints mechanism for clients in maintenance treatments

>New Pharmacotherapies, continued from page 7

- drug abuse: research and clinical practice. NIDA Research Monograph Series. Rockville, Maryland: US Department of Health and Human Services, 1988, pp. 178–91.
2. Dole V, Nyswander M. Methadone maintenance treatment: a 10-year perspective. *J Amer Med Assoc* 1976;235(19):2117–9.
  3. Ward J, Mattick RP, Hall W, eds. Methadone maintenance treatment and other opioid replacement therapies. Amsterdam: Harwood Academic Publishers, 1998.
  4. Fudala PJ, Montgomery A, Herbert J, et al. A multicenter labeling assessment study of levo-alpha-acetylmethadol (LAAM) for the treatment of opiate addicts. Paper presented at the 55th Annual Scientific Meeting, College on Problems of Drug Dependence, Rockville, Maryland, 1994.
  5. Ling W, Charuvastra VC, Kaim SC, Klett CJ. Summary of veterans administration phase II cooperative study for LAAM and methadone. *NIDA Res Monogr* 1976;(8):94–102.
  6. Ling W, Klett CJ, Gillis RD. A cooperative clinical study of methadyl acetate. I. Three-times-a-week regimen. *Arch Gen Psychiatry* 1978;35(3):345–53.
  7. Johnson RE, Eissenberg T, Stitzer ML, et al. A placebo controlled clinical trial of buprenorphine as a treatment for opioid dependence. *Drug Alcohol Depend* 1995;40(1):17–25.
  8. Kosten TR, Schottenfeld R, Ziedonis D, Falcioni J. Buprenorphine versus methadone maintenance for opioid dependence. *J Nerv Ment Dis* 1993;181(6):358–64.
  9. Ling W, Charuvastra C, Collins JF, et al. Buprenorphine maintenance treatment of opiate dependence: a multicenter, randomized clinical trial. *Addiction* 1998;93(4):475–86.
  10. Strain EC, Stitzer ML, Liebson IA, Bigelow GE. Buprenorphine versus methadone in the treatment of opioid-dependent cocaine users. *Psychopharmacology (Berl)* 1994;116(4):401–6.
  11. Tucker T, Ritter A. Naltrexone in the treatment of heroin dependence: a literature review. *Drug and Alcohol Rev* 2000;19(1):73–82.
  12. Ritter A, Kutin J, Lintzeris N, Bammer G, eds. Expanding treatment options for heroin dependence in Victoria: buprenorphine, LAAM, naltrexone and slow-release oral morphine. New pharmacotherapies project—feasibility phase. Melbourne: Turning Point Alcohol and Drug Centre, 1997.
  13. Lintzeris N, Bell J, Bammer G, et al. Unpublished data presented at IVth European Substitution Therapies Conference, Arrezo, Italy, 2000.

*Dr Alison Ritter PhD is the Head of Research at Turning Point Alcohol & Drug Centre. Contact: Tel. 03 8413 8413, Fax 03 8413 8444, Email alisonr@turningpoint.org.au*

## High-Voltage Power Lines: Are Victorians at Risk?

Peter D. Harty, Morrie Facci, Brad Cassels and Paul Van Bunyder

### Abstract

*The recent publication of a UK report on the risks of power frequency electromagnetic fields, particularly high-voltage power lines, led to significant media interest and some concern among the Victorian public. The report authors reviewed the results from cellular research, animal experiments and epidemiology to provide a comprehensive assessment of the current cancer risks associated with power frequency electromagnetic fields. This article reviews the report findings and those of other studies on high-voltage power lines, looking at the implications for the Victorian public. Current scientific evidence does not demonstrate a causal link between any health impact and typical exposures to electromagnetic fields. However, a precautionary approach suggests, while the high cost of reducing current exposure from overhead power lines*

*is not justifiable, that future unnecessary heavy exposures should be avoided if this is achievable without excessive costs or technical difficulties.*

### Introduction

The possibility that exposure to low-frequency electromagnetic fields, generated by electric currents, is associated with an increased risk of cancer has been debated since a link was first suggested in 1979.<sup>1</sup> However, this initial work, relying on distances from power lines and on wiring configurations, did not measure electromagnetic fields.

Since that initial report, confirmatory data (either experimental or epidemiological) have not been available and serious limitations have been identified in nearly all studies on power lines and cancer.<sup>2</sup> The lack of epi-

demiological support for the association even led a 1997 *New England Journal of Medicine* editorial to call for a cessation of studies on the topic because these were a 'waste of research resources'.<sup>3</sup>

Electromagnetic fields from power lines are of extremely low frequency. Physicists believe that low levels of environmental exposure are unable to produce biological effects, because the amount of energy in these fields is below that required to break molecular bonds such as those in DNA.<sup>3</sup>

Debate on the topic was rekindled in Victoria recently when the Advisory Group on Non-Ionising Radiation (AGNIR) to the UK National Radiological Protection Board (NRPB), chaired by Sir Richard Doll, published a report on power frequen-

cy electromagnetic fields and the risk of cancer.<sup>4</sup> The report updated previous AGNIR work on this topic<sup>5,6,7</sup> and reviewed experimental and epidemiological data to support its conclusions.

## Experimental studies

AGNIR found no clear evidence that exposure to power frequency electromagnetic fields at prevailing levels can affect biological processes.<sup>4</sup> Further, it found no evidence that exposure to such fields is directly genotoxic or can bring about the transformation of cells in culture. Its review of a large number of animal studies found no convincing evidence of power frequency electromagnetic fields increasing the risk of cancer.<sup>4</sup>

## Epidemiological Studies

The recent availability of instruments to assess magnetic fields over periods of time has improved the quality of epidemiological studies.<sup>8</sup> Combining the results from a number of large and well-conducted studies, the AGNIR report found some evidence that exposures of 0.4 microtesla ( $\mu\text{T}$ )—4 milligauss (mG)—or higher are associated with a doubling of the risk of leukaemia in children under 15 years of age. No effect was found at lower exposures.

The evidence for the effect remained 'not conclusive' because the key studies identified in the review might have suffered from selection bias or random variation. In addition, the review found no convincing evidence of an increased risk of other previously implicated cancers (such as brain tumours or leukaemia) in adults.

The threshold exposure level of 0.4  $\mu\text{T}$  is such that only 0.5 per cent of the UK population is estimated to face such exposures. Around 75 per cent of this share are a long way from overhead power lines, instead being exposed in the home via household appliances and household wiring.

With childhood leukaemia having an incidence rate of 4 out of 100 000 children per year,<sup>9</sup> this increased risk from magnetic fields would equate to four extra Victorian cancer cases every 20 years, with three of these cases being unrelated to power line exposure.

The report recommends that further studies in the United Kingdom would be of little value, because the number of individuals exposed above 0.4  $\mu\text{T}$  is too small to provide any useful information. Denmark and Sweden, on the other hand, are identified as countries where residential exposures over 0.4  $\mu\text{T}$  are more common and where better quantitative information may be obtained on the size of the leukaemia risk in relation to electromagnetic fields.

The NRPB's response to the report notes that if there is an increased risk of leukaemia in children living near high-voltage power lines, then it is such a small risk that 'it has already been demonstrated in the UK childhood cancer study that it has not been possible to detect this increase in the UK'.<sup>4</sup>

## Where to from here?

The Australian guidelines for limiting exposure to electromagnetic fields, established by the National Health and Medical Research Council,<sup>10</sup> are based on preventing established health effects. The maximum level under the guidelines for continuous exposure of the public to power frequency fields is 1000 mG, or 100  $\mu\text{T}$ . The NRPB view is that the AGNIR report provides no additional scientific evidence to require a change in exposure guidelines. The Victorian Department of Human Services supports the view that current guidelines are adequate to protect the public and that no action is required to reduce exposure levels that are already well below the specified maximum limits.

Scientific evidence does not demonstrate a causal link between any health impact and typical exposures to electromagnetic fields. However, a precautionary approach suggests that future unnecessary heavy exposures from overhead power lines should be avoided if this is achievable without excessive costs or technical difficulties.

## References

1. Wertheimer N, Leeper E. Electrical wiring configurations and childhood cancer, *Am J Epidemiol* 1979; 109:273–384.
2. Savitz DA, Pearce NE, Poole C. Methodology issues in the epidemiology of electromagnetic fields and cancer. *Epidemiol Rev* 1989;11:59–78.
3. Campion EW. Power lines, cancer and fear. *NEJM* (editorial) 1997;337 (1):44–6.
4. National Radiological Protection Board. ELF electromagnetic fields and the risk of cancer. *Doc NRPB* 2001;12(1): 1–179.
5. National Radiological Protection Board. Electromagnetic fields and the risk of cancer. *Doc NRPB* 1992;3(1): 1–138.
6. National Radiological Protection Board. Electromagnetic fields and the risk of cancer. *Radiol Prot Bull* 1993;142.
7. National Radiological Protection Board. Electromagnetic fields and the risk of cancer. *Doc NRPB* 1994;5(2): 77–81.
8. Ahlbom A, Feychting M. Current thinking about risks from currents. *Lancet* 2000;357:1143–4.
9. Australian Institute of Health and Welfare. *Cancer in Australia 1997: incidence and mortality data for 1997 and selected data for 1998 and 1999*. Canberra: 1997.
10. National Health and Medical Research Council. *Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields*. Canberra: 1998.

**Dr Peter D. Harty**, PhD, BSc (Hons), MARPS, **Morrie Facci** BSc (Hons), DipEd, MARPS, and **Dr Brad Cassels** PhD, MAppSc (Med Phys), BAppSc(Physics), are in the Radiation Safety Unit, Public Health Division, Department of Human Services  
**Paul Van Buynder** MBBS, MPH, FAFPHM is the Senior Medical Advisor in Social and Environmental Health Branch, Public Health Division, Department of Human Services  
 Contact: Dr Peter Harty: Tel. 03 9637 4178, Fax 03 9637 4508, Email peter.harty@dhs.vic.gov.au

# Mesothelioma as a Marker for Asbestos-Related Lung Disease in Victoria

Stephen Begg, Theo Vos and Christine Stone

## Abstract

*This study describes the geographic distribution of asbestos-related health outcomes in Victoria using mesothelioma as a marker. The study team calculated standardised incidence and mortality ratios for each local government area and examined State-wide secular trends. The results show that mesothelioma is a rare disease occurring predominantly in elderly men, with higher-than-expected rates occurring in localities with traditionally high levels of occupational exposure to asbestos. Trends continue to increase despite a dramatic reduction in levels of exposure since the 1980s, confirming what is known about the lag between exposure and disease onset. Confounding factors (such as smoking) and imprecise estimates of the ratio of asbestos-related lung cancers to mesotheliomas make it difficult to quantify the wider impact of asbestos.*

## Introduction

Asbestos is attractive for use in industry because it combines a number of attributes, including strength, fire resistance and insulation. However, exposure to this material is associated with significant health risks<sup>1</sup>—a fact well established in the 1950s. Lung cancer and mesothelioma are the most commonly attributed malignancies, but cancers of the gastrointestinal tract, kidney, pancreas and larynx have also been reported.<sup>2</sup> The Latrobe Valley is Victoria's industrial centre for coal-fired power generation in the south-east of the State. Asbestos was used extensively in the construction of power stations following the establishment of the State Electricity Commission in 1921.<sup>3</sup> High levels of occupational exposure occurred in this industry<sup>4</sup> and other industries<sup>5,6</sup> until the 1980s when tighter regulations were introduced.

Because the lag between exposure

and malignant disease is about 20–30 years,<sup>7,8</sup> the size of the population health impact of this material is only just becoming apparent<sup>5</sup> and is expected to peak in 10–20 years.<sup>9</sup> The most common asbestos-related malignancy is bronco-genic lung cancer,<sup>10</sup> with the case ratio of asbestos-related lung cancers to mesotheliomas being as high as 10:1.<sup>11</sup> However, the independent effect of smoking on lung cancer confounds this association.<sup>12,13</sup> The aetiology of mesothelioma, on the other hand, is almost entirely due to asbestos exposure and is unrelated to smoking.<sup>14–16</sup> Thus, mesothelioma is a suitable marker for identifying the geographic distribution of asbestos-related health outcomes.<sup>17</sup> The aim of this study was to describe the epidemiology of mesothelioma throughout Victoria over the period 1986–99.

## Methods

Mortality and population data for the period 1986–99 were obtained from the Australian Bureau of Statistics. Incidence data for the period were obtained from the Victorian Cancer Registry (1998 being the most recent year for which data could be provided). Mesothelioma malignancies were identified using the codes 163 (ICD-9) and C45 (ICD-10). All data, regardless of year, were analysed in terms of current local government boundaries. Local governments comprise two or more statistical local areas (SLAs), which are the most disaggregated geographic identifier for place of usual residence in the data. To achieve geographic consistency over the study period, SLA data that were fragmented as a result of the 1993 council amalgamations were re-apportioned using information from the 1996 census on the proportion of each old SLA population residing in each of the new SLAs after the boundaries were redrawn.

Standardised incidence and mortality ratios (SIRs and SMRs respectively) and 95 per cent confidence limits for each local government and sex combination were calculated using Victoria as the standard population. This method, known as indirect standardisation, is appropriate for comparisons across areas with small populations.<sup>18</sup> A ratio of 1 indicates no difference from the State average. Annual age-adjusted incidence and mortality rates and confidence limits were also calculated using 1986 as the baseline to indicate secular trends.

## Results

A total of 997 incident cases were coded to mesothelioma in Victoria over the period 1986–98 (836 males and 161 females), resulting in 469 deaths. The majority of these malignancies occurred in elderly males, with an exponential increase from the age of 40 years. The average annual incidence rate per year was 1.7 per 100 000 population, rising from 41 cases (or 1 per 100 000) in 1986 to 111 cases (or 2.4 per 100 000) in 1998. When adjusted for age, the latter figure was reduced to 2.1 but was still significantly higher than at baseline (95 per cent confidence interval of 0.7–1.3 compared with 1.7–2.5). Mortality rates were consistently lower but followed the same trend, rising from 0.4 per 100 000 at baseline (95 per cent confidence interval of 0.2–0.6) to an age-adjusted rate of 1.3 per 100 000 (95 per cent confidence interval of 1.0–1.6) in 1999.

Figure 1 shows two municipalities with significantly raised SIRs in males: Latrobe at 3.3 times the expected incidence (95 per cent confidence interval of 2.3–4.5) and Hobsons Bay at 2.0 times (95 per cent confidence interval of 1.3–2.9). Three other municipalities also had higher-

than-expected incidence (Melbourne, Maribyrnong and Brimbank), but for these municipalities the results were of marginal significance. The pattern in mortality for males was the same, with Latrobe at 4.6 times the expected mortality (95 per cent confidence interval of 3.1–6.5) and Hobsons Bay at 2.9 times (95 per cent confidence interval of 1.9–4.4). Greater Geelong also had higher than expected mortality, with an SMR of 1.5 (95 per cent confidence interval of 1.1–2.2).

The differences for females were less conclusive as a result of the smaller numbers, as indicated by the wider confidence intervals. Only Hobsons Bay had higher-than-expected incidence, with an SIR of 3.2 (95 per cent confidence interval of 1.4–6.2), and two municipalities had excess mortality—Golden Plains at 12.6 (95 per cent confidence interval of 1.4–45.6) and Greater Bendigo at 3.7 (95 per cent confidence interval of 1.3–8.0).

## Discussion

Our analysis shows mesothelioma is a rare disease occurring predominantly in elderly men, with higher-than-expected rates of occurrence limited to specific localities. Incidence is increasing across the State, despite a dramatic reduction in levels of exposure since the 1980s. This confirms what is known about the lag between exposure and disease onset. Given that five-year survival for this cancer is as low as 7 per cent,<sup>19</sup> the consistently lower mortality rates compared with incidence suggests that a proportion of mesothelioma deaths are coded to other diseases. It is worth noting also, for SLAs fragmented by boundary changes, that it is uncertain whether the local government area of residence was correctly reassigned in every instance. Moreover, the study team could not determine the extent to which people relocated to other municipalities before being recorded as having the disease. The combined effect of these factors is likely to reduce the observed differences between local government areas.

The higher morbidity and mortality

rates for Latrobe and Hobsons Bay are of particular interest. These results confirm the existence of asbestos-related problems in the Latrobe Valley among males. That females do not experience higher rates in this region is significant, suggesting industrial exposure as the most likely aetiology. This explanation equally applies to Hobsons Bay and surrounding suburbs, which are areas with strong links to the shipping industry in which the practice of handling asbestos without protection was once widespread.<sup>20</sup> The assumption that the majority of workers in these industries live near their place of work could not be proven, because this type of information was not available.

The confounding effects of smoking, together with imprecise estimates of the ratio of asbestos-related lung cancers to mesotheliomas, make it difficult to quantify the wider impact of asbestos. It is clear, however, that mesothelioma is a disease for which the median survival time is extremely short (regardless of the speed of diagnosis) and the prospects for therapy advances are poor.<sup>21</sup> While the prognosis for asbestos-related broncogenic lung cancer is slightly better, and is comparable to survival rates for other lung cancers, early detection through more frequent chest x-ray screening does not reduce mortality.<sup>22</sup> Further, the evidence for alternative technologies such as helical or low-dose CT scanning remains equivocal.<sup>23,24</sup> By far the greatest impact on the burden of lung cancer in 20 years will be achieved through programs directed at increasing smoking cessation rates and reducing the number of children taking up smoking.<sup>25</sup>

## References

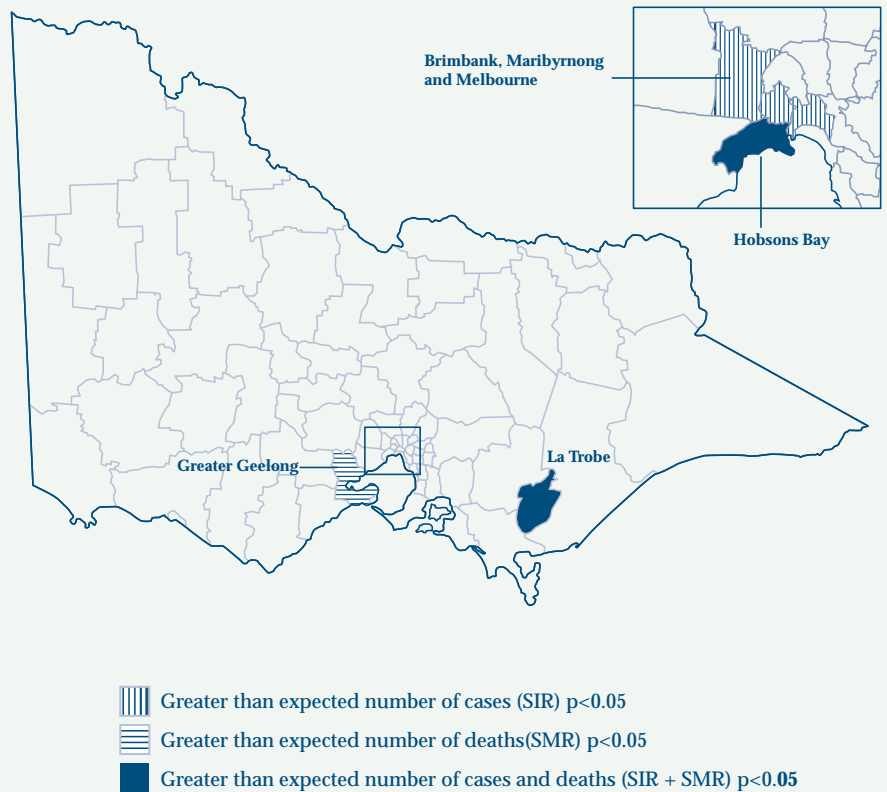
1. Boffetta P. Health effects of asbestos exposure in humans: a quantitative assessment. *Med Lav* 1998;89:471–80.
2. Selikoff I, Seidman H. In Landrigan P, Kazemi H, eds. *The third wave of asbestos disease: exposure to asbestos in place*. New York: The New York

- Academy of Sciences, 1991.
3. Wragg G. *The asbestos time bomb*. Melbourne: Catalyst Press, 1995.
4. Lazarus R. Lung-function reference values from Victorian power-industry workmen. *Med J Aust* 1982;2:121–4.
5. Yeung P, Rogers A, Johnson A. Distribution of mesothelioma cases in different occupational groups and industries in Australia, 1979–95. *Appl Occup Environ Hyg*. 1999;14:759–67
6. Yeung P, Rogers A. An occupation–industry matrix analysis of mesothelioma cases in Australia 1980–85. *Appl Occup Environ Hyg*. 2001;16:40–4.
7. Musk AW, Dolin PJ, Armstrong BK, et al. The incidence of malignant mesothelioma in Australia, 1947–80. *Med J Aust* 1989;150:242–3, 246.
8. Xu Z, Armstrong BK, Blundson BJ, et al. Trends in mortality from malignant mesothelioma of the pleura, and production and use of asbestos in Australia. *Med J Aust* 1985;143:185–7.
9. Anonymous. International expert meeting on new advances in the radiology and screening of asbestos-related diseases. *Scan J Work Environ Health* 2000;26:449–54.
10. Barroetavena MC, Teschke K, Bates, DV. Unrecognized asbestos-induced disease. *Am J Ind Med* 1996;29:183–5.
11. Albin M, Magnani C, Krstev S, et al. Asbestos and cancer: an overview of current trends in Europe. *Environ Health Perspect* 1999;107:289–98.
12. de Klerk NH, Musk AW, Armstrong BK, Hobbs MS. Smoking, exposure to crocidolite, and the incidence of lung cancer and asbestosis. *Br J Ind Med* 1991;48:412–7.
13. de Klerk NH, Musk AW, Eccles JL, et al. Exposure to crocidolite and the incidence of different histological types of lung cancer. *Occup Environ Med* 1996;53:157–9.
14. Gun RT. Mesothelioma: is asbestos exposure the only cause?

- Med J Aust 1995;162:429–31.
15. Hansen J, de Klerk NH, Musk AW, Hobbs MS. Environmental exposure to crocidolite and mesothelioma: exposure–response relationships. *Am J Respir Crit Care Med* 1998;157:69–75.
  16. Hammond E, Selikoff I, Seidman H. Asbestos exposure, cigarette smoking and death rates. *Ann NY Acad Sci* 1979;330:473–90.
  17. Elliott P, Westlake AJ, Hills M, et al. The Small Area Health Statistics Unit: a national facility for investigating health around point sources of environmental pollution in the United Kingdom. *J Epidem & Comm Health* 1992;46:345–9.
  18. Rothman K. *Modern epidemiology*. Boston: Little, Brown and Company, 1986.
  19. South Australian Cancer Registry. *Epidemiology of cancer in South Australia*. Adelaide; Department of Human Services, 2000.
  20. Mitchell, C., Emmerson, B. and Aroney, C. (1981) Prevalence of respiratory morbidity in Brisbane waterside workers. A study of possible asbestos-related disease, *Med J Aust*, 2, 139–41.
  21. Musk AW, Woodward SD. Conventional treatment and its effect on survival of malignant pleural mesothelioma in Western Australia. *Aust NZ J Med* 1982;12:229–32.
  22. Manser R, Irving L, Stone C. Lung cancer screening. *Cochrane Library*, in press.
  23. Patz EF, Jr, Goodman PC, Bepler G. Screening for lung cancer. *N Engl J Med* 2000;343:1627–33.
  24. Jett JR. Spiral computed tomography screening for lung cancer is ready for prime time. *Am J Respir Crit Care Med* 2001;163:812–3.
  25. Department of Human Services. *Victorian Burden of Disease Study: Morbidity*. Melbourne: 1999.

Figure 1: Victorian Municipalities with Higher-than-Expected SIRs and SMRs for Mesothelioma, 1986–99

### Males



### Females



**Stephen Begg** BA (Hons) MPH and **Dr Theo Vos** MD, MSc are in the Health Outcomes Section, Public Health Division, Department of Human Services, and Department of Epidemiology and Preventive Medicine, Monash University  
**Christine Stone** GradDipEpidBiostat, MPH, MHSc (PHP) Prevention and National Health Priorities Section, Public Health Division, Department of Human Services

Contact: Stephen Begg: Tel. 03 9637 4868, Fax 03 9637 4763, Email [stephen.begg@dhs.vic.gov.au](mailto:stephen.begg@dhs.vic.gov.au)

# Legionnaires Disease: the Victorian Picture

Paul G. Van Buynder, Graham Tallis, Noel Cleaves, David E. Leslie

## Abstract

*Notifications of legionnaires disease have increased markedly in Victoria in the past five years. This increase has been partly due to improved case detection and has been accompanied by a fall in case fatality ratios. Further improvements in outcomes require enhanced clinical suspicion in primary care settings and an understanding of the value and use of current tests. Cooling towers are an important source of Legionella infection, and recent legislative changes will improve the management of risk in these settings. Data from the accompanying registration process may also improve knowledge of critical factors contributing to Legionella overgrowth in cooling towers and subsequent illness. Clinicians should attempt to obtain positive cultures from all cases.*

## Introduction

*Legionella* is a gram-negative environmental organism naturally associated with water bodies and soil.

Compared with other water-borne bacterial pathogens, it is relatively tolerant of harsh environmental conditions, high temperatures and chlorine ion concentrations. This tolerance is partly due to the ability of the genus to live intracellularly; in the environment it is often associated with free-living amoebae and in humans it can reside within macrophages, offering protection from host immune responses.

Compared with the previous triennium (1995–97), *Legionella* notifications in Australia over the past three years (1998–000) increased from 171 cases per year (range of 160–192), on average, to 335 cases per year (range of 260–474). The increased notifications were almost wholly due to increases in South Australia, Queensland and Victoria.

The differential uptake of new diagnostic technology such as urinary antigen testing, along with the varied pub-

lic health response to individual cases, is likely to be responsible for the increased recognition, the variation in notification rates among States, and the increasing proportion of cases attributed to *L. pneumophila* serogroup 1.

Legionnaires disease was first reported in Victoria in 1979. The number of cases notified in Victoria each year has since gradually increased, with a more marked rise in recent times (Figure 1). Notification of cases is most frequent in summer and autumn. Table 1 shows notifications in Victoria during the period 1996–99. The increasing notification trend continued in 2000 with almost 250 cases. Even after removing the effect of the outbreak at Melbourne Aquarium, this represents a further doubling of incidence. *L. pneumophila* (particularly serogroup 1) continues to represent the bulk of Victorian cases, unlike the situation elsewhere in Australia where *L. longbeachae* accounts for up to one third of cases.

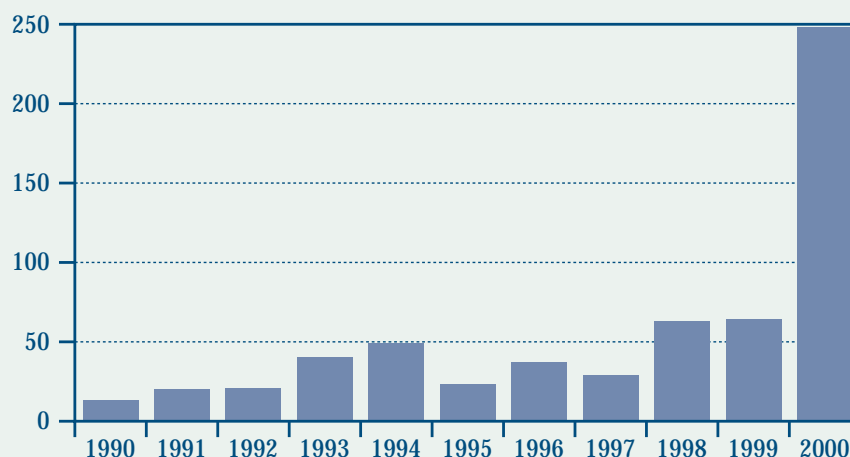
Some of the increase in notifications is attributable to improved diagnostic tools and may represent cases that previously would have gone unrecognised—the increase being associated with a fall in mortality and a fall in the culture positive rate. While the reduced mortality trends

and the presumed increased case detection are laudable, the immediate challenges in Victoria are to continue achieving improved rates of early diagnosis, to lessen the risk associated with cooling towers, and to use the opportunities afforded by recent legislative changes to enhance knowledge required for risk management. These challenges are considered in the following sections.

## Diagnosis of Legionnaires Disease

Achieving further improvements in case outcomes requires an enhanced clinical suspicion in primary care settings and an understanding of current test utility. Fatalities continue to occur where the diagnosis has not been made ante-mortem, with the coroner detecting two cases in 2001. The clinical and radiological findings alone cannot definitely identify cases of legionnaires disease, and no single laboratory test will identify all cases of the disease. Accurate diagnosis depends on a combination of high clinical suspicion, the culture of respiratory specimens, the detection of *Legionella* antigens in urine, and serology to detect immune responses to the bacterium.

Figure 1: Legionella Notifications in Victoria, 1990–2000



### >Legionnaires Disease, continued from page 13

Culture of respiratory specimens is still the gold-standard diagnostic test for legionellosis. Given that sputum production is not a prominent feature of legionellosis, bronchoscopic collection of specimens should be considered wherever appropriate. Culture will detect all *Legionella* species and serotypes, usually within two to five days. Culture will also allow more detailed examination of the isolates by subtyping for epidemiological purposes.

The *Legionella* urinary antigen test provides the most rapid method of laboratory diagnosis. Laboratories use both ELISA and immunochromatography methods. This test is specific for *L. pneumophila* serogroup 1, but may give weaker positive results for other *Legionella* species and serotypes. Urinary antigen is normally detectable around three days after the onset of symptoms and may be excreted for weeks (to months) following infection. Early treatment with appropriate antibiotics may reduce the level of antigen excretion; however, the test is highly sensitive and is usually positive in patients requiring hospitalisation. False positive results are rarely reported.

Serology is less useful for acute diagnosis, because *Legionella* antibodies may not appear until four to six weeks post infection and because there is a high level of individual variability in humoral immune responses to *Legionella*. Some patients do not mount any detectable antibody response, despite the presence of culture-proven respiratory infection. Also, any population has a small proportion of healthy subjects with low-level antibodies detectable, necessitating the demonstration of a rise in titre between acute and convalescent sera for an accurate serological diagnosis. A single high titre (greater than or equal to 512) may indicate recent infection, but for opti-

Table 1: Legionella Notifications in Victoria, 1996–99

	1996	1997	1998	1999
Total number of notifications	36	29	63	64
Male numbers (% of total)	26 (72%)	25 (86%)	15 (81%)	44 (69%)
Deaths (case fatality ratio)	7 (19%)	5 (17%)	8 (13%)	5 (8%)
Cases with positive culture (% of total)	22 (61%)	17 (59%)	33 (53%)	15 (23%)
<i>L. pneumophila</i> serogroup 1 (% of all cases)	27 (75%)	22 (76%)	60 (95%)	56 (88%)

mum use of serology testing, a convalescent serum specimen should be collected six to eight weeks following the onset of disease.

### Minimising the Risks of Cooling Tower Systems

Where sources of infection have been identifiable after notification, cases in Victoria appear to have been associated with cooling towers. Cooling tower systems are commonly used in industry either to cool fluids in industrial processes or as part of an air-conditioning system. The warm and moist environment inside a cooling tower provides an ideal setting for the growth of bacteria, including *Legionella*.

The Victorian Government has introduced a new strategy to reduce the risks associated with cooling towers. This strategy includes the compulsory registration of all cooling tower systems, the development of risk management plans to address the risks of cooling tower systems and independent auditing of the plans. The new regulations have been accompanied by increased industry support in the form of guides and information.

Risk management is regarded as the key theme of this new strategy. The critical risks associated with the management, design and use of the cooling tower system must be managed well to avoid *Legionella* bacteria multiplying in a system and potentially infecting susceptible people with

legionnaires disease.

Every risk management plan must set out a maintenance program to address the potential risks of a cooling tower system. Detailed in the new Building (*Legionella*) Regulations, these risks include stagnant water, poor water quality, nutrient growth, deficiencies in the cooling tower system, and the location of and access to towers.

To assist industry the Department of Human Services has produced a 'Guide to Developing Risk Management Plans for Cooling Tower Systems' which discusses these critical risks. It includes a risk classification table to assist cooling tower system owners understand the risks, and it recommends maintenance programs proportionate to the risk classification. The risk classification incorporates not only risks inherent in the system but also the susceptibility and number of persons potentially exposed. The maintenance programs include routine inspections, service, cleaning, and bacterial testing (including for *Legionella*).

The new Regulations do not mandate sampling for *Legionella* in cooling towers. Previous studies<sup>1</sup> of routine sampling of cooling towers have shown great variability in systems over time. Thus, health risks from cooling towers cannot be reliably assessed from *Legionella* testing alone. The Victorian approach, therefore, is to recommend the use of *Legionella* testing as a performance measure

and the use of other parameters relating to water quality (such as pH and biocide levels) as control measures. The guide for risk management plans outlines recommended frequencies for *Legionella* testing based on risk classification.

## Addressing the Knowledge Deficit

The required registration of all cooling towers in Victoria will enable the collection of data on the engineering factors predisposing to (1) colonisation of cooling towers and (2) transmission of *Legionella* to humans. It is plausible over time that data will be available to address the importance of issues such as tower type, maintenance programs, and the type and timing of biocide use. Smaller-sized cooling towers and operating conditions have been implicated in a review of the seasonal nature of legionnaires disease.<sup>2</sup>

The increasing reliance on urinary antigen testing has indirectly reduced the number of cultures available for comparison with environmental samples. While some doubt has been cast on the sensitivity of these comparisons,<sup>3</sup> there is a public health benefit from obtaining a positive culture in all clinical settings because clinical disease can then be matched to possible environmental sources. Over time then, more information may become available on those aspects of cooling towers that predispose to disease causation.

The symbiotic relationship between *Legionella* and amoeba in biofilms and the effect of this relationship on *Legionella* in cooling towers require further study. Some existing data show that *Legionella* can reproduce within amoebae,<sup>4</sup> that amoebae can expel vesicles of respirable size that contain infectious doses of *Legionella*<sup>5</sup> and that not only do these vesicles resist some biocides such as isothiazolol,<sup>6</sup> but the biocides may have a stimulant effect on the amoebae.<sup>7</sup> Previous studies have also highlighted the varying effectiveness of differing biocides against *Legionella*.<sup>8</sup> It is hoped that cooling tower register data will provide information about the role of biocide dosing in *Legionella* release.

Recent changes in testing regimes have altered the epidemiology of *Legionella* notifications. This change is likely to be magnified by altered public awareness produced by the legislative changes and associated enhanced inspections. Further research will be required to understand more clearly the 'true incidence'. An opportunity exists for Victoria to be at the forefront of global efforts to understand and control legionnaires disease.

## References

1. Bentham RH. Routine sampling and the control of *Legionella spp* in cooling tower water systems. *Curr Microbiol* 2000;41(4):271-55.
2. Bentham RH, Broadbent CR. A

model for autumn outbreaks of legionnaires' disease associated with cooling towers, linked to system operation and size. *Epidemiol Infect* 1993;111(2):287-95.

3. Drenning SD, Stout JE, Joly JR, Yu VL. Unexpected similarity of pulsed-field gel electrophoresis patterns of unrelated clinical isolates of *Legionella pneumophila*, serogroup 1. *J Infect Diseases* 2001;183:628-32.
4. Rowbotham TJ. Preliminary report on the pathogenicity of *Legionella pneumophila* for freshwater and soil amoebae. *J Clin Pathol* 1980;33:1179-83.
5. Rowbotham TJ. Current views on the relationships between amoebae, legionellae and man. *Israel J Med Sci* 1986;22:678-89.
6. Berk SG, Ting RS, Turner GW, Ashburn RJ. Production of respirable vesicles containing live *Legionella pneumophila* cells by two *Acanthamoeba spp*. *Appl Environ Microbiol* 1998;64(1):279-86.
7. Srikanth S, Berk SG. Stimulatory effect of cooling tower biocides on amoebae. *Appl Environ Microbiol* 1993;59:3245-9.
8. Bentham RH, Broadbent CR. Field trial of biocides for control of *Legionella* in cooling towers. *Curr Microbiol* 1995;30(3):167-72

**Dr Paul G. Van Buynder** MBBS, MPH, FAFPHM is the Senior Medical Advisor, Social and Environmental Health Section, Public Health Division, Department of Human Services

**Dr Graham Tallis** MBBS, MPH, FAFPHM is the Acting Manager, Communicable Diseases Section, Public Health Division, Department of Human Services

**Noel Cleaves** is the Project Officer - Legionella, Environmental Health Unit, Public Health Division, Department of Human Services

**David E. Leslie** MBBS, FRCPA is the Medical Microbiologist at the Victorian Infectious Diseases Reference Laboratory

Contact: Paul Van Buynder: Tel. 03 9637 4861, Fax 03 9637 4507, Email paul.vanbuynder@dhs.vic.gov.au

# Improvement in the Life Expectancy of Victorians

Anne Magnus, Theo Vos and Stephen Begg

## Abstract

*The latest trends in life expectancy at birth of Victorians show that the differences between males and females, socio-economic strata and Local Government Areas (LGAs) are becoming smaller:*

- Life expectancy at birth improved from 75.6 years to 76.5 years in males and from 81.4 years to 82.0 years in females across the periods 1992–96 and 1996–99.
- The gap in male life expectancy between the highest and the lowest 20% of Victorians in terms of socioeconomic status narrowed from 3.3 to 2.6 years between 1996 and 1999 while the gap in female life expectancy narrowed from 2.3 to 1.8 years.
- The gap between the LGAs with the highest and lowest male life expectancy reduced from 7 to 5.3 years across the periods 1992–96 and 1996–99, while this gap in female life expectancy widened from 4 to 5.2 years.

*The gap between metropolitan and rural areas of Victoria remained the same at 1–1.5 years. This means there should be renewed effort to tackle the determinants of ill-health in rural areas.*

## Introduction

Life expectancy is a summary measure of population health. It captures the mortality experience of a population in a single figure, determining the average life span of a child born today if currently observed age-and-sex specific mortality rates continue indefi-

nately into the future. Thus, it is an artificial measure, because we know that mortality rates have continued to decline for at least the last 150 years and are likely to continue to show improvement. However, it is an easily calculated, easily interpreted and commonly used summary measure.

Life expectancy at birth in Australia has increased steadily from 55.2 years for males and 58.8 years for females at the beginning of the twentieth century to 75.9 and 81.5 years respectively at the end of the century for males and females.<sup>1</sup> Australia ranks among the top five countries in the world in terms of life expectancy of both males and females,<sup>2</sup> despite the fact that life expectancy of indigenous Australians is estimated to be 20 years less than that of the general population.<sup>1</sup>

Life expectancy in Victoria is slightly higher than the Australian average. However, the Victorian Burden of Disease Study identified considerable differences in life expectancy across LGAs, across socioeconomic strata, between rural and metropolitan areas and between indigenous and non-indigenous Victorians.<sup>3</sup> The most recent analyses of life expectancy in Victoria refer to the years 1992–96. Three additional years of data are now available, so this paper presents an update of the trends in life expectancy and examines changes over time in the gap between sub-populations with low and high life expectancy.

## Methods

For the current analysis, the Australian Bureau of Statistics provided mortality data for Victorians who died anywhere in Australia for the period 1979–99. Population data by Statistical Local Area (SLA) were obtained from the Australian Bureau of Statistics and the Department of Infrastructure which made population projections from the 1996 census data for SLAs in Victoria. All data, regardless of year, were analysed in terms of current LGA boundaries.

All-cause mortality by age and sex was used to create abridged life tables according to the Chiang method.<sup>4</sup> Separate life tables for the whole of Victoria were created for each of the years between 1979 and 1999. For comparisons of life expectancy by socioeconomic status, SLAs were classified into 5 quintiles of equal population size according to the Index of Relative Socio-Economic Deprivation, one of the Socio-Economic Indices for Small Areas (SEIFA).<sup>5</sup> Urban and rural classifications of SLAs were derived from the rural/remote/metropolitan area (RRMA) classification of the Department of Primary Industries and Energy.<sup>6</sup> For comparisons between LGAs, life tables were created for the periods 1992–96 and 1996–99. To improve the accuracy of the calculations of life expectancy by LGA in 1996, several years of death data were examined and contiguous

Figure 1: Life Expectancy at Birth, by Sex, Victoria, 1979–99

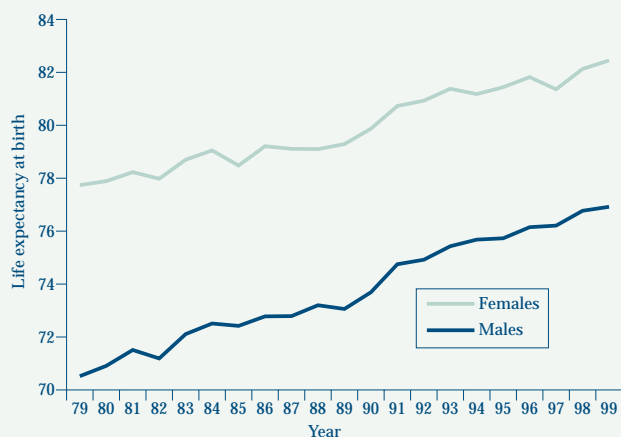
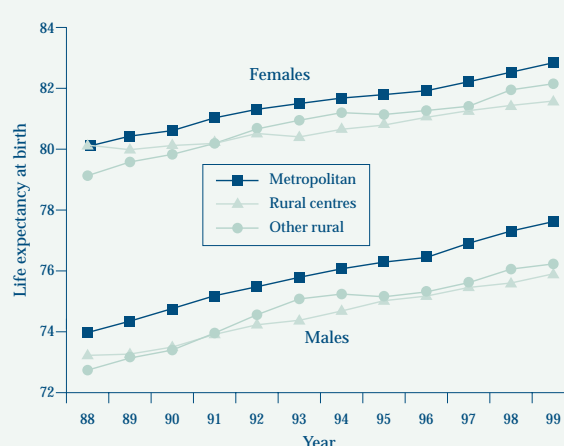


Figure 2: Life Expectancy at Birth, in Metropolitan Victoria, Rural centres and Other Remote Areas, 1988–99



LGAs with populations of less than 30,000 were aggregated. Thus, the 79 LGAs in Victoria were brought back to 56 small areas with an aggregate population size of at least 120 000 over the four-year period 1996–99.

The 95 per cent confidence intervals of life expectancy at birth estimates were derived by simulation methods, using the @RISK software program.<sup>7</sup> The software allows the entry of probability distributions in a spreadsheet and then recalculates the spreadsheet many times over to produce summary statistics of designated output variables. The age- and sex-specific numbers of deaths were entered as a Poisson distribution.

## Results

Average life expectancy at birth in Victoria has continued to increase since 1996. A regression analysis performed on the data from 1979 to 1996 predicted an annual increase in life expectancy of 0.33 years in males and 0.25 years in females.<sup>3</sup> The 1999 figures of 76.9 years in men and 82.4 years in women actually fall within a 0.1 year accuracy of these predictions (Figure 1).

Between 1996 and 1999, a 1 to 1.5 year gap in life expectancy between metropolitan Victoria and rural towns remained for both males and females. Male life expectancy in 1999 in 'other rural and remote' areas was similar to that of males in rural towns while females in 'other rural and remote' areas in 1999 had a life expectancy close to that of females in urban areas (Figure 2).

The gap in male life expectancy between the highest and lowest SEIFA quintiles reduced from 3.3 to 2.6 years between 1996 and 1999. Over the same period, the gap in female life expectancy between the highest and lowest SEIFA quintile narrowed from 2.3 years to 1.8 years.

The gap between the LGAs with the lowest and highest male life expectancy reduced from 7 years to 5.3 years across the period 1992–96 and 1996–99, while the gap in female life expectancy widened from 4 years to 5.2 years. The LGAs of Yarra, Port Phillip and Stonnington showed sig-

Figure 3: Male Life Expectancy at Birth, by LGA, Victoria, 1996–99

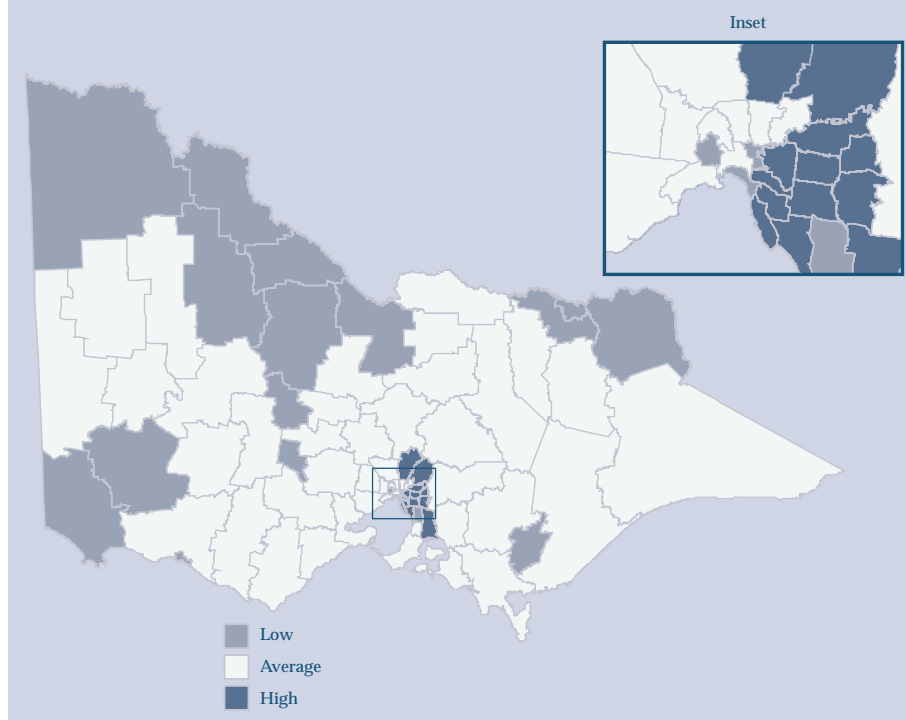
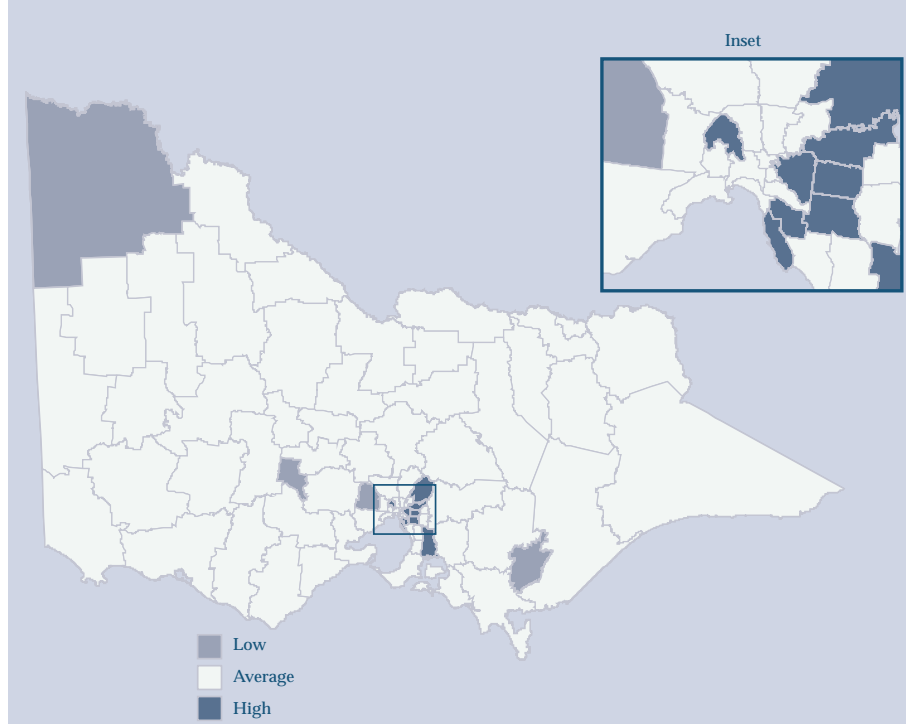


Figure 4: Female Life Expectancy at Birth, by LGA, Victoria, 1996–99



nificant improvements in male life expectancy greater than 3 per cent, between the periods of analysis. Other LGAs with significantly increased male life expectancy include Hobsons Bay, Casey, Latrobe, Whitehorse, Moreland, Greater Geelong, Queenscliff, Mornington Peninsula, Brimbank, Boroondara, Knox, Kingston and Darebin (Table 1). Female life expectancy improved significantly and by more than 3 per

cent in Nillumbik. The other LGAs with significantly improved life expectancy in females were Port Phillip, Whitehorse, Greater Dandenong, Moonee Valley, Hume, Darebin, Greater Geelong, Queenscliff and Mornington Peninsula (Table 2).

In the period 1996–99, 14 LGAs (all metropolitan) had significantly higher male life expectancy at birth while 19 (4 metropolitan, 15 rural) had sig-

## &gt;Improvement in the Life Expectancy of Victorians, continued from page 17

nificantly lower life expectancy. Ten LGAs (all metropolitan) had significantly higher female life expectancy at birth and 4 (1 metropolitan and 3 rural) had significantly lower life expectancy (Figure 3).

## Discussion

This analysis highlights several interesting trends. Male life expectancy continues to improve at a faster rate than that of females. In part, this can be explained by a decline in tobacco-related deaths in men while women are increasingly suffering the consequences of having started smoking in larger numbers two to four decades ago.

The reduction in the gap across LGAs might have reflected a trend towards gentrification (that is, an increase in the proportion of people of higher socioeconomic status in the area) of inner-city areas such as Yarra, Port Phillip and Stonnington. However, this does not explain the narrowing of the gap in life expectancy at birth for males but not females. The city of Latrobe was the only rural LGA to show significant improvement in life expectancy over this period. Rural LGAs typically have smaller population sizes and therefore are less likely to register statistically significant changes over time. However, the facts that metropolitan LGAs showed greater improvements than rural LGAs did, on average, and that the gap in life expectancy between rural and urban areas combined did not reduce, mean health issues of rural Victorians warrant a greater focus.

It is encouraging that the gap in life expectancy across socioeconomic strata narrowed but this seems largely to have reflected improved life expectancy in the more deprived metropolitan areas. The SEIFA index is based on 1996 census information, so it does not capture subsequent improvements in socioeconomic status as occurred in some of the inner-city suburbs.

Trends in life expectancy are an important indicator of the overall performance of the health system and broader public health approaches. However, these trends ignore

Table 1: Male Life Expectancy at Birth, Ranking Order and Proportional Change, by LGA, Victoria, 1992–96 and 1996–99

	1992-1996			1996-1999			% change 1.2%+
	Rank	LEB 75.61		Rank	LEB 76.50		
<b>VICTORIA Males</b>							
Manningham	1	78.58	H	1	79.26	H	0.9%
Whitehorse	4	77.54	H	2	79.18	H	2.1%+
Monash	2	77.96	H	3	78.94	H	1.3%
Bayside	3	77.56	H	4	78.75	H	1.5%
Boroondara	5	77.26	H	5	78.67	H	1.8%+
Casey	9	76.58	H	6	78.27	H	2.2%+
Nillumbik	10	76.58	H	7	78.26	H	2.2%
Stonnington	26	75.44		8	77.95	H	3.3%+
Whittlesea	7	76.77	H	9	77.90	H	1.5%
Glen Eira	6	76.80	H	10	77.75	H	1.2%
Maroondah	8	76.64	H	11	77.52	H	1.1%
Knox	14	76.13		12	77.34	H	1.6%+
Banyule	12	76.32	H	13	77.28	H	1.3%
Kingston	20	75.71		14	77.23	H	2.0%+
Yarra Ranges	13	76.30	H	15	77.18		1.2%
Mitchell/Murrindindi	18	75.80		16	77.10		1.7%
Cardinia	11	76.40		17	77.03		0.8%
Mornington Peninsula	21	75.66		18	77.03		1.8%+
Hume	25	75.45		19	76.91		1.9%
Moonee Valley	19	75.75		20	76.87		1.5%
Colac-Otway/Surf Coast	17	75.91		21	76.86		1.3%
Greater Shepparton	15	76.05		22	76.58		0.7%
Alpine/Delatite/Wangaratta	16	76.04		23	76.53		0.6%
Greater Geelong/Queenscliff	22	75.53		24	76.40		1.2%+
Hobsons Bay	42	74.64	L	25	76.39		2.3%+
Moreland	30	75.31		26	76.38		1.4%+
Brimbank	37	74.90	L	27	76.34		1.9%+
Bass Coast/South Gippsland/French Island	35	75.01		28	76.20		1.6%
Mount Alexander/Macedon Ranges	27	75.40		29	76.10		0.9%
East Gippsland	47	74.16	L	30	76.02		2.5%
Golden Plains/Hepburn/Moorabool	43	74.56	L	31	76.02		2.0%
Wyndham	28	75.38		32	75.94		0.7%
Moira/Strathbogie	36	74.92		33	75.88		1.3%
Darebin	41	74.66	L	34	75.87		1.6%+
Greater Bendigo	33	75.05		35	75.87		1.1%
Frankston	24	75.49		36	75.84		0.5%
Corangamite/Moyne	48	74.10	L	37	75.81		2.3%
Hindmarsh/Horsham/West Wimmera/Yarriambiack	29	75.37		38	75.72		0.5%
Wellington	38	74.90		39	75.62		1.0%
Melbourne	51	73.78	L	40	75.61		2.5%
Ararat/Northern Grampians/Pyrenees	52	73.74	L	41	75.59		2.5%
Greater Dandenong	31	75.29		42	75.51	L	0.3%
Glenelg/Southern Grampians	50	73.99	L	43	75.30	L	1.8%
Indigo/Towong/Wodonga	34	75.02		44	75.28	L	0.3%
Warrnambool	40	74.68		45	75.27	L	0.8%
Baw Baw	39	74.80		46	75.25		0.6%
Melton	23	75.50		47	75.16		-0.4%
Buloke/Loddon/Central Goldfields	44	74.56		48	74.98	L	0.6%
Ballarat	49	74.04	L	49	74.92	L	1.2%
Latrobe	53	73.25	L	50	74.81	L	2.1%+
Mildura	46	74.38	L	51	74.58	L	0.3%
Port Phillip	55	71.93	L	52	74.58	L	3.7%+
Campaspe	32	75.19		53	74.54	L	-0.9%
Gannawarra/Swan Hill	45	74.45	L	54	74.47	L	0.0%
Yarra	56	71.68	L	55	74.37	L	3.8%+
Maribyrnong	54	72.99	L	56	73.97	L	1.3%

H indicates a life expectancy at birth significantly higher than the Victorian average

L indicates a life expectancy at birth significantly lower than the Victorian average

+ indicates a statistically significant change in life expectancies between the two periods

Table 2: Female Life Expectancy at Birth, Ranking Order and Proportional Change, by LGA, Victoria, 1992–96 and 1996–99

VICTORIA Females	1992-1996		1996-1999		% change 0.8%+		
	Rank	LEB 81.37	Rank	LEB 81.99			
Nillumbik	25	81.27	1	83.98	H	3.3%+	
Manningham	3	82.88	H	2	83.63	H	0.9%
Monash	1	83.35	H	3	83.56	H	0.3%
Whitehorse	8	82.06	H	4	83.48	H	1.7%+
Yarra Ranges	7	82.19	H	5	83.32	H	1.4%
Bayside	5	82.49	H	6	83.27	H	0.9%
Baw Baw	29	81.23		7	83.26		2.5%
Moonee Valley	12	81.85		8	83.15	H	1.6%+
Melbourne	2	82.90	H	9	83.14		0.3%
Glen Eira	6	82.27	H	10	83.06	H	1.0%
Casey	15	81.65		11	82.99	H	1.6%
Boroondara	4	82.58	H	12	82.98	H	0.5%
Colac-Otway/Surf Coast	19	81.52		13	82.70		1.4%
Kingston	23	81.47		14	82.42		1.2%
Hume	51	80.25	L	15	82.40		2.7%+
Frankston	16	81.60		16	82.32		0.9%
Stonnington	13	81.73		17	82.29		0.7%
Banyule	9	82.02	H	18	82.24		0.3%
Campaspe	27	81.25		19	82.21		1.2%
Darebin	31	81.06		20	82.21		1.4%+
Warrnambool	32	81.06		21	82.20		1.4%
Greater Dandenong	43	80.79		22	82.14		1.7%+
Greater Geelong/Queenscliff	28	81.24		23	82.11		1.1%+
Hindmarsh/Horsham/West Wimmera/ Yarriambiack	14	81.70		24	82.09		0.5%
Knox	26	81.26		25	82.08		1.0%
Moira/Strathbogie	33	81.05		26	82.04		1.2%
Brimbank	30	81.15		27	82.01		1.1%
Mornington Peninsula	39	80.91		28	81.95		1.3%+
Whittlesea	21	81.50		29	81.85		0.4%
Yarra	53	80.17	L	30	81.77		2.0%
Alpine/Delatite/Wangaratta	46	80.62		31	81.77		1.4%
Indigo/Towong/Wodonga	40	80.86		32	81.74		1.1%
Mitchell/Murrindindi	44	80.65		33	81.69		1.3%
Moreland	17	81.55		34	81.68		0.2%
Mount Alexander/Macedon Ranges	49	80.46		35	81.66		1.5%
Buloke/Loddon/Central Goldfields	50	80.44		36	81.60		1.4%
Greater Shepparton	47	80.58		37	81.60		1.3%
Maroondah	24	81.35		38	81.59		0.3%
Hobsons Bay	20	81.52		39	81.58		0.1%
Glenelg/Southern Grampians	42	80.80		40	81.58		1.0%
Cardinia	11	82.01		41	81.51		-0.6%
Maribyrnong	45	80.63		42	81.51		1.1%
Corangamite/Moyne	36	81.01		43	81.50		0.6%
Golden Plains/Hepburn/Moorabool	10	82.02		44	81.47		-0.7%
Wyndham	18	81.53		45	81.46		-0.1%
Port Phillip	55	79.41	L	46	81.43		2.5%+
Greater Bendigo	22	81.48		47	81.43		-0.1%
Gannawarra/Swan Hill	38	80.95		48	81.34		0.5%
Ararat/Northern Grampians/Pyrenees	54	79.56	L	49	81.06		1.9%
East Gippsland	34	81.04		50	81.02		0.0%
Bass Coast/South Gippsland/French Island	37	80.97		51	81.02		0.1%
Wellington	48	80.55		52	81.02		0.6%
Ballarat	52	80.22	L	53	80.92	L	0.9%
Mildura	35	81.02		54	80.83	L	-0.2%
Latrobe	56	79.40	L	55	80.39	L	1.2%
Melton	41	80.83		56	78.79	L	-2.5%

H indicates a life expectancy at birth significantly higher than the Victorian average

L indicates a life expectancy at birth significantly lower than the Victorian average

+ indicates a statistically significant change in life expectancies between the two periods

changes that occur in non-fatal outcomes. To examine changes in health status fully, measures such as the disability-adjusted life expectancy (DALE) and disability-adjusted life year (DALY) are needed. These measures are not as easily updated as life expectancy because they are derived from a multitude of data sources. Updates of the burden of disease and DALE are planned over the next few years.

## References

1. Australian Institute of Health and Welfare. Australia's health 2000: the seventh biennial report of the Australian Institute of Health and Welfare. Canberra: 2000.
2. World Health Organisation. World Health Report 2000. Geneva: 2000.
3. Department of Human Services. The Victorian Burden of Disease Study: Mortality. Melbourne: 1999.
4. Chiang CL. The life table and its applications. Florida: Robert E Krieger Publishing Company, 1984.
5. Australian Bureau of Statistics. 1996 census of population and housing. Socio-economic indices for small areas. ABS catalogue no. 2039.0. Canberra: 1998.
6. Department of Primary Industries and Energy. Rural, remote and metropolitan areas classification, 1991 census edition. Canberra: 1994.
7. Palisade. @RISK: advanced risk analysis for spreadsheets. New York: 1996.

These life expectancy figures for Local Government Areas are also available on the burden of disease website at:

<http://hn01.dhs.vic.gov.au/bodw/>

*Anne Magnus BEc, BED is a member of the Health Outcomes Section, Department of Human Services  
Dr Theo Vos MD, MSc and Stephen Begg BA (Hons) MPH are with the Health Outcomes Section, Department of Human Services and Department of Epidemiology and Preventive Medicine, Monash University*

Contact: Anne Magnus

Tel. 03 9637 4241, Fax 03 9637 4763,

Email [anne.magnus@dhs.vic.gov.au](mailto:anne.magnus@dhs.vic.gov.au)

