

# January 2009 Heatwave in Victoria: an Assessment of Health Impacts



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## Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
<b>2</b>	<b>Background</b>	<b>2</b>
<b>3</b>	<b>Heatwave event in Victoria</b>	<b>4</b>
<b>4</b>	<b>Measuring the Impact—Data Sources</b>	<b>5</b>
4.1	Ambulance Victoria (AV)	5
4.2	Melbourne Medical Deputising Service (MMDS)	5
4.3	The Victorian Emergency Minimum Dataset (VEMD)	5
4.4	Deaths reported to the State Coroner’s Office	5
4.5	Victorian Registry of Births, Deaths and Marriages	5
<b>5</b>	<b>Results</b>	<b>6</b>
5.1	Ambulance Victoria	6
5.1.1	Metropolitan emergency cases	6
5.1.2	Attendances for heat related conditions	6
5.1.3	Cardiac arrest	7
5.2	Melbourne Medical Deputising Service (MMDS)	7
5.2.1	Total Attendances	7
5.2.2	Calls to attend a deceased person	7
5.2.3	Direct heat related illness	8
5.3	The Victorian Emergency Minimum dataset (VEMD)	9
5.3.1	Total Emergency Department (ED) Presentations	9
5.3.2	Direct heat related conditions	10
5.3.3	Deaths on arrival in Emergency Departments and deaths in Emergency Departments	10
5.4	State Coroner’s Office and reportable deaths	11
5.5	Total mortality from the Victorian Registry of Births, Deaths and Marriages and State Coroner’s Office	12
<b>6</b>	<b>Discussion</b>	<b>15</b>
<b>7</b>	<b>References</b>	<b>16</b>

## Executive Summary

The January 2009 heatwave in Victoria was of unprecedented intensity and duration with maximum temperatures 12–15°C above normal for much of Victoria, whilst Melbourne endured three consecutive days of temperatures above 43°C.

The population health impact of this extreme heat event has been assessed by collecting available data from five different sources: assessments by Ambulance Victoria (AV) metropolitan paramedics, locum doctor visits by the Melbourne Medical Deputising Service (MMDS), Public Hospital Emergency Department presentations as collected in the Victorian Emergency Minimum Dataset (VEMD); reportable deaths to the State Coroner's Office (SCO); and death registrations collated by the Victorian Registry of Births, Deaths and Marriages (BDM).

Data for the week of the heatwave, 26 January to 1 February 2009, was compared to the same period in previous year(s). The results of this analysis have shown that there was substantial morbidity and mortality related to the heatwave, with associated demands on health services.

The key findings were:

Ambulance Victoria metropolitan emergency case load:

- a 25% increase in total emergency cases and a 46% increase over the three hottest days
- a 34 fold increase in cases with direct heat-related conditions (61% in those 75 years or older);
- a 2.8 fold increase in cardiac arrest cases.

Locum GP attendances by MMDS:

- an almost 4 fold increase in attendances for direct heat-related conditions (65% in those 75 years or older);
- an almost 2 fold increase in calls to attend a deceased person.

Emergency Department presentations:

- a 12% overall increase in presentations, with a greater proportion of acutely ill patients and a 37% increase in those 75 years or older;
- an 8 fold increase in direct heat-related presentations (46% in those aged 75 years and over);
- an almost 3 fold increase in patients dead on arrival (69% being 75 years or older).

Total all-cause mortality:

- There were 374 excess deaths over what would be expected: a 62% increase in total all-cause mortality. The total number of deaths was 980, compared to a mean of 606 for the previous 5 years. The greatest number of deaths occurred in those 75 years or older, representing a 64% increase;
- Included in these total deaths were 179 deaths reported to the State Coroner's Office; a 77% increase from the 101 deaths reported for the same period in 2008. Reportable deaths in those 65 years and older more than doubled.

Mortality during heatwaves can be difficult to measure, as deaths tend to occur from exacerbations of chronic medical conditions as well as direct heat related illness, particularly in the frail and elderly. Excess mortality provides a measure of impact, but does not provide information specifically on underlying cause of death.

This report provides a snapshot of a significant impact on mortality, morbidity and health service utilisation, with the greater burden of illness and death falling on the elderly. The insights gained will inform strategies already being developed to improve the resilience of Victorian communities to the impacts of extreme heat events.

## 1 Introduction

This report provides an analysis of the health impacts of the January 2009 Victorian heatwave. This was a period during which Victoria experienced the most extreme temperatures, with many records set for high day and night time temperatures, as well as for the duration of extreme heat. Over the five days, 27–31 January 2009, maximum temperatures were 12–15°C above normal over much of Victoria. The temperature was above 43°C for three consecutive days from 28–30 January reaching a peak of 45.1°C on 30 January 2009.

Heatwaves have recently received significant attention and recognition as an issue of public health importance and concern. The surprisingly large effects of exposure to long periods of unaccustomed high temperatures was highlighted by the catastrophic European heatwave of 2003, where excess all-cause mortality across twelve countries has recently been revised up from 50,000 [1] to 70,000 [2].

As there is no specific surveillance system designed to examine the health impacts of heatwaves, data for this report has been collected from a variety of different sources based upon their relevance, quality, completeness and availability. Each on its own provides a particular view of the effects and taken together builds a picture of significant consequences.

## 2 Background

Heatwaves are brief periods of unusually high temperatures which can result in significant harm. They are considered an increasing public health issue driven by increasing numbers of vulnerable elderly and the increasing heat-island effect resulting from progressive urbanisation. The acceptance of climate change, with forecast increases in temperatures and extreme weather events, makes a response to this hazard a greater imperative. Communities have to re-evaluate their degree of adaptation to their local climate and consider if they remain suitably prepared, capable and resilient to meet this changing threat. The January 2009 heatwave has demonstrated that prolonged extremely high temperatures are a major hazard for Victorians that we must now expect and continue to prepare for in order to reduce harm.

Cooler countries naturally focus upon remaining warm and pay less attention to a few infrequent hot days, whilst those constantly exposed to high temperatures will have by necessity focused effort to meet this challenge and become somewhat accustomed and resilient to heat [3].

A community's capacity to respond and manage variations in temperature is reflected in the relationship between mortality and ambient temperatures. This classically forms a J-shaped curve and demonstrates that populations have an optimum temperature at which mortality rates are the lowest. Typically mortality rates increase rapidly as temperatures rise past a threshold. These relationships vary between differing cities, with differing optimal temperatures and differing temperature thresholds [4]. In the Netherlands the minimum mortality is around a mean temperature of 16.5°C, in London it is 19°C and Rome, 24° [3].

In the summer of 2003, France suffered from its worst ever heatwave since records began in 1873 [5] with two thirds of the 180 weather stations recording temperatures above 35°C and 15% above 40°C. Its onset was so abrupt that it has been described as a "heatquake" [6], and resulted in an unprecedented number of excess deaths, 14,802 for the period 1 to 20 August. Paris was particularly affected, sustaining a 190% increase in deaths. 74% of excess deaths occurred in those who lived at home [7]. Temperatures exceeded 35°C for 10 days, including 4 consecutive days from 8–11 August.

Attributed mortality across Europe during the August 2003 heatwave increased by 60% in France, 40% in Portugal, 8% in Spain, 17% in England and Wales (42% in the London region) and 15% in Italy. Even the Swiss suffered a 7% increase in excess mortality. The Netherlands have previously suffered a 24% increase during their 1994 heatwave and Greater London a 23% increase resulting from a 1995 heatwave [8].

In contrast, analysis of data from Adelaide during heatwaves between 1993 and 2006 [9] found total mortality and age-specific mortality did not increase, apart from a small increase in mental health-related mortality in people aged 65–74 years. It was suggested that these findings may reflect the benefits of adaptation to regular hot weather events.

Extreme heat is a generic health stressor and can affect all members of the community. The elderly and the very elderly have been found to be especially at risk. Their increased vulnerability relates to a combination of an impaired physiological response to heat (reduced thirst response and diminished ability to sweat) and the higher prevalence of chronic diseases involving the cardiovascular, respiratory, renal and endocrine systems [8].

As a group the elderly are likely to have lower cardiovascular fitness, which is essential for thermoregulation, and are frequently on a number of medications that may also impair this response. Chronic under-hydration may also be seen in the frail and the elderly increasing their vulnerability to environmental and physiological stressors.



Other common features of the elderly such as impaired mobility (musculoskeletal disorders, parkinsonism), visual impairment, varying degrees of cognitive decline and waning social connectedness and support, all add to reduce the capacity of the elderly to adequately protect themselves from the effects of extreme heat.

Impacts of heatwaves also depend on community and health/welfare system preparedness and the effective activation of preventative measures. In addition any disruption of critical infrastructure (electricity supply, transportation system) as well as associated adverse events such as fires, and increased air pollution, may play a role in exposing the vulnerabilities of individuals [8].

It also appears that heatwaves that occur earlier in the summer have a larger impact [10] which may be due to lack of short-term acclimatisation and forward mortality displacement. This latter phenomenon relates to the hastening of death (by days to weeks) in those already expected to die, as a result of the additional strain created by excessive heat exposure. In this way, increased temperatures (including heatwaves) early in summer reduce the pool of heat-vulnerable individuals later in that same summer [11].

The direct effect of extreme heat exposure includes heat cramps, heat syncope, heat exhaustion and heat stroke. The latter is a medical emergency manifest by an elevated core body temperature and varying degrees of neurological impairment which can progress to death.

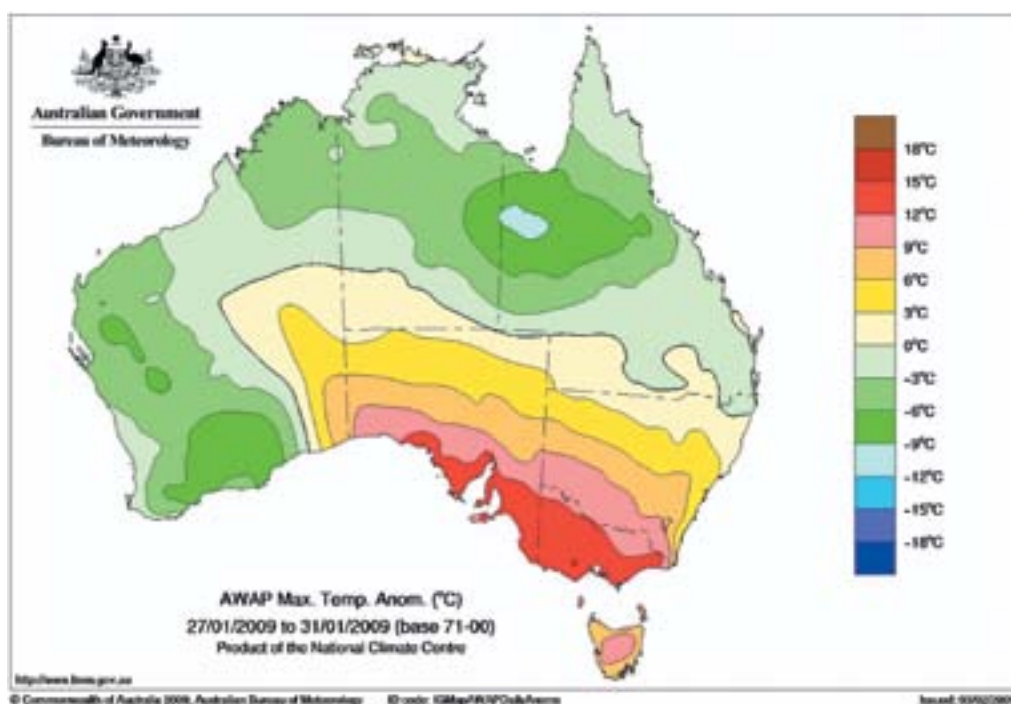
Differentiating heat stroke deaths from cardiovascular or cerebrovascular deaths can be difficult especially if subjects were not under medical care at the time. In addition, deaths from exacerbations of pre-existing conditions may not be identified or recorded (by medical staff in hospitals or General Practitioners in the community) as having been precipitated by a heatwave, thereby potentially obscuring its impact. This potentially hidden group make up the majority of deaths from heatwaves and have been identified in this analysis by taking account of 'all-cause-mortality' and not restricting it to deaths recorded as hyperthermia/heatstroke. Post-mortem examination cannot rely on any specific pathological features or test in order to identify those cases which were heat related.

Any otherwise healthy person who spends a long time outdoors during a heatwave is also at risk of detrimental health effects, especially if they are involved in physical exertion (workers, joggers), wearing inappropriate clothing, or are not consuming adequate amounts of fluids.

### 3 Heatwave event in Victoria

An exceptional heatwave affected south-eastern Australia in late January 2009. The majority of Victoria experienced the most extreme conditions with many records set at the time both for high day and night time temperatures as well as for the duration of extreme heat. Over the five days 27–31 January 2009, maximum temperatures were 12–15°C above normal over much of Victoria.

**Figure 1. Maximum temperature anomalies for the period 27–31 January 2009**



At the time, Melbourne's maximum temperature of 45.1°C on 30 January 2009 was the second-highest on record behind 45.6°C on 13 January 1939 (subsequently surpassed on Saturday 7 February 2009, which reached 46.4°C).

Overnight temperatures were also extremely high with Melbourne Airport's minimum of 30.5°C on the 29th January only 0.4°C short of the Victorian record. The extremely high day and night temperatures combined to make a record high daily mean temperature (average of maximum day and minimum night temperature) in Melbourne (35.4°C on 30 January), which was the first time Melbourne's daily mean temperature has exceeded 35°C (Table 1).

**Table 1. Temperatures in Victoria, 26 January– 1 February 2009**

	Max. day time temperature	Min. night time temperature	Mean temperature
Monday 26 Jan	25.5	14.4	19.9
Tuesday 27 Jan	36.4	16.6	26.5
Wednesday 28 Jan	43.4	18.8	31.1
Thursday 29 Jan	44.3	25.7	35.0
Friday 30 Jan	45.1	25.7	35.4
Saturday 31 Jan	30.5	22.5	26.5
Sunday 1 Feb	33.8	20.3	27.0

## 4 Measuring the Impact—Data Sources

This report incorporates data from five separate sources as follows:

### 4.1 Ambulance Victoria (AV)

Ambulance Victoria provided data relating to their case assessments conducted between 1 December and 1 February for the years 2007 to 2009. More detailed data was obtained in relation to final primary assessments recorded as heat related (defined as heat stress, heat stroke and dehydration) and those recorded as cardiac arrest. The final primary assessment is what the attending paramedic believes is the patient's main problem at the time and is selected using a predefined list. The data provided relates essentially to metropolitan Melbourne, however has infrequent inclusion of attendance at the border with rural regions.

### 4.2 Melbourne Medical Deputising Service (MMDS)

MMDS provides an after-hours deputising service for approximately 3000 general practitioners in metropolitan Melbourne and more recently, Geelong. Patients seeking care from their GP when the practice is closed would be directed to contact MMDS for a doctor to undertake a home visit. Staff at MMDS triage calls, with patients requiring emergency care being directed to Ambulance Victoria or an Emergency Department. After each consultation the locum doctor provides clinical notes which are entered into a database so as to communicate with the patient's usual doctor. De-identified data were extracted using keywords for heat-related diagnoses and records of deceased patients. MMDS provides a service to many elderly patients especially in aged care facilities.

### 4.3 The Victorian Emergency Minimum Dataset (VEMD)

The VEMD is a dataset that contains de-identified administrative and clinical data detailing presentations at Victorian public hospitals that have 24-hour Emergency Departments (EDs). This includes the majority of public hospital ED attendances.

### 4.4 Deaths reported to the State Coroner's Office

Certain deaths are required by law to be reported to the State Coroner. These include deaths which are unexpected or appear to have resulted directly or indirectly from accident or injury (which may include the effects of heat or cold), where the identity of the person is not known, or where a medical practitioner has been unable to provide a death certificate.

### 4.5 Victorian Registry of Births, Deaths and Marriages

Victorian mortality data are collated by the Registry of Births, Deaths and Marriages (BDM). Death certificates are required to be completed by a registered medical practitioner within 48 hours of the death and then forwarded to BDM. Confirmatory documentation is also provided by the funeral director using a Death Registration Statement, also forwarded to BDM.

## 5 Results

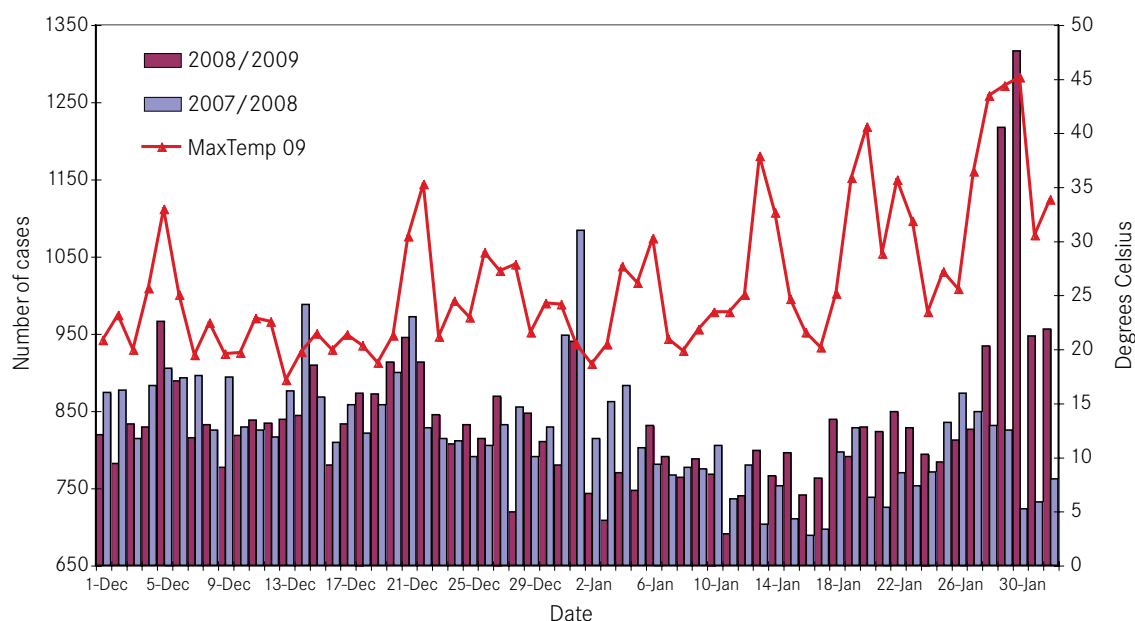
### 5.1 Ambulance Victoria

Analysis was undertaken of metropolitan Melbourne data for the week 26 January to 1 February 2009 and compared with the same calendar dates in 2008.

#### 5.1.1 Metropolitan emergency cases

Cases receiving an emergency ambulance dispatch in Melbourne between the period from 26 January to 1 February 2009 were 25% higher than for the same period in 2008 (7008 cases compared to 5595). This represents an additional 1413 cases. Taking the three hottest days, 28th to 30th January 2009, there were 3467 cases this year, as compared to 2379 in 2008, an excess of 1088 cases, which is a 46 per cent increase.

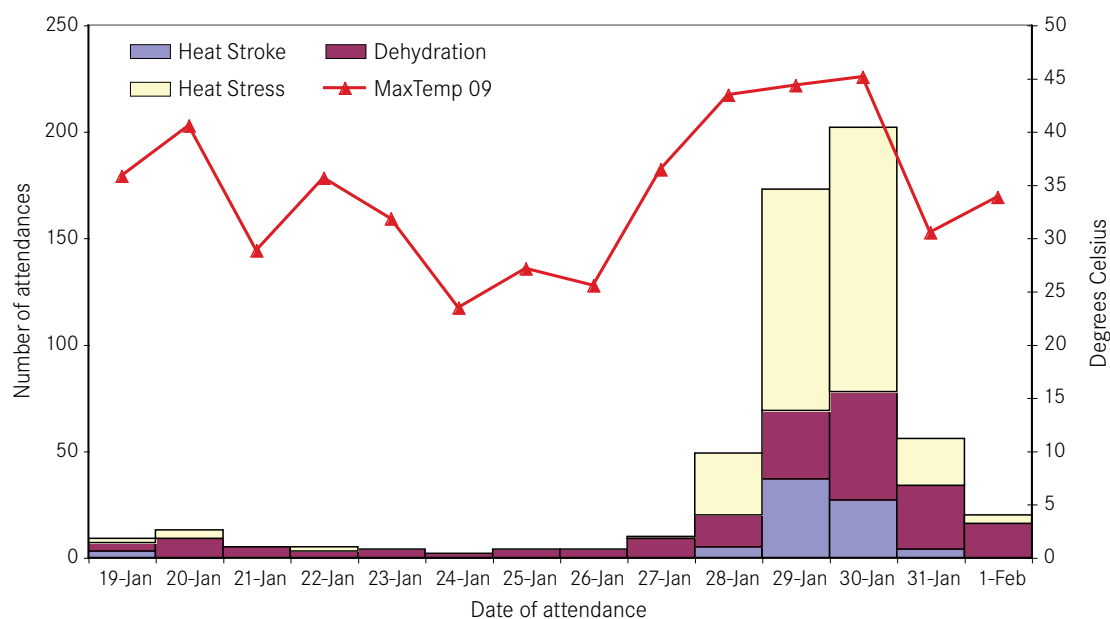
**Figure 2. Total emergency cases by Ambulance Victoria in Metropolitan Melbourne for the period 1 Dec–1 Feb 2007–2009**



#### 5.1.2 Attendances for heat related conditions

Attendances for heat related conditions (heat stress (n=284), heat stroke (n=73) and dehydration (n=157)) dramatically increased during this week to a total of 514 cases. This was 499 more than for the same period in 2008 representing over a 34 fold increase in 2009. It should be noted that 313 (61%) of the total heat related cases were in those 75 years or older and 80% of all cases were transported to hospital.

**Figure 3. Ambulance attendances of heat-related illnesses in Metropolitan Melbourne 19 Jan–1 Feb 2009**



### 5.1.3 Cardiac arrest

During the week 26 January to 1 February 2009, there were a total of 192 attendances for cardiac arrest (of all causes), compared to 69 for this period in 2008, an excess of 123 attendances, which constitutes a 2.8-fold increase.

## 5.2 Melbourne Medical Deputising Service (MMDS)

MMDS has provided de-identified data relating to consultations undertaken during the week of the heatwave (26 January to 1 February 2009) and for the same dates in 2008.

### 5.2.1 Total Attendances

Total attendances during the period 26 January to 1 February were 1955 in 2009, compared to 1914 in 2008, representing an excess of 41 attendances and a percentage increase of 2%.

Approximately half of the patients were seen in aged care facilities (53%) and there were more females (62%), and this is consistent with the same period in 2008.

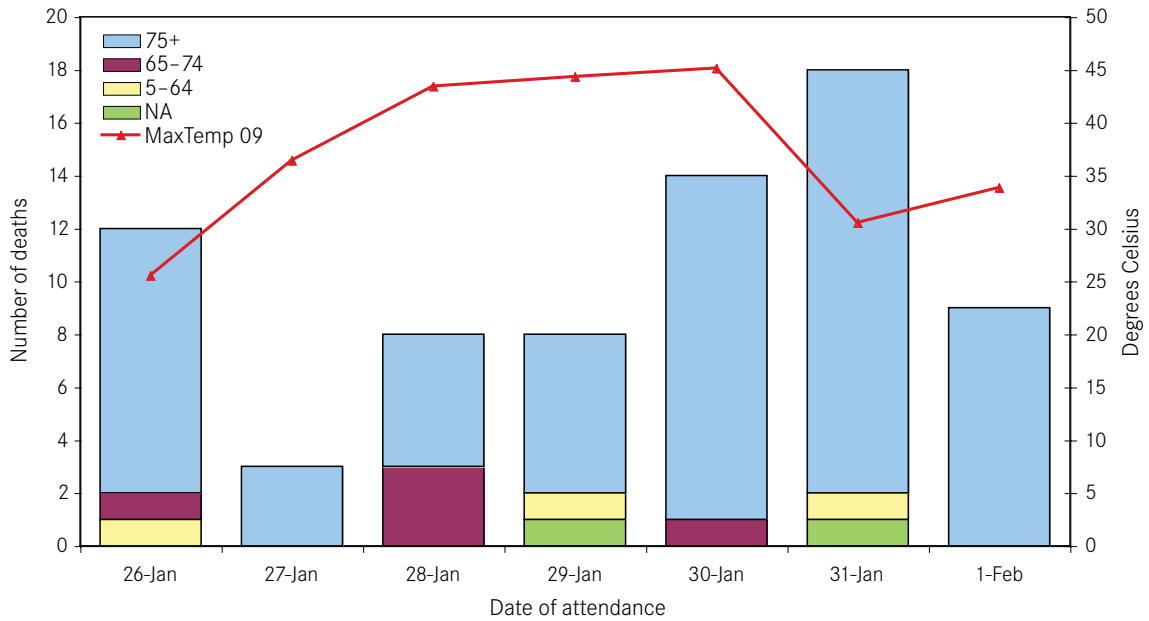
### 5.2.2 Calls to attend a deceased person

During the week of the heatwave the locum service attended a total of 77 patients who were deceased compared to 42 in 2008. This corresponds to an excess of 35 and close to a 2-fold increase.

Of those who were deceased:

- 65 (84%) were in those 75 years or older compared with 39 (93%) in 2008.
- 55 (71%) occurred in persons in aged care facilities in 2009 compared to 39 (93%) in 2008.

**Figure 4. MMDS locum attendances to deaths in metropolitan Melbourne 26 Jan–01 Feb 2009**



### 5.2.3 Direct heat related illness

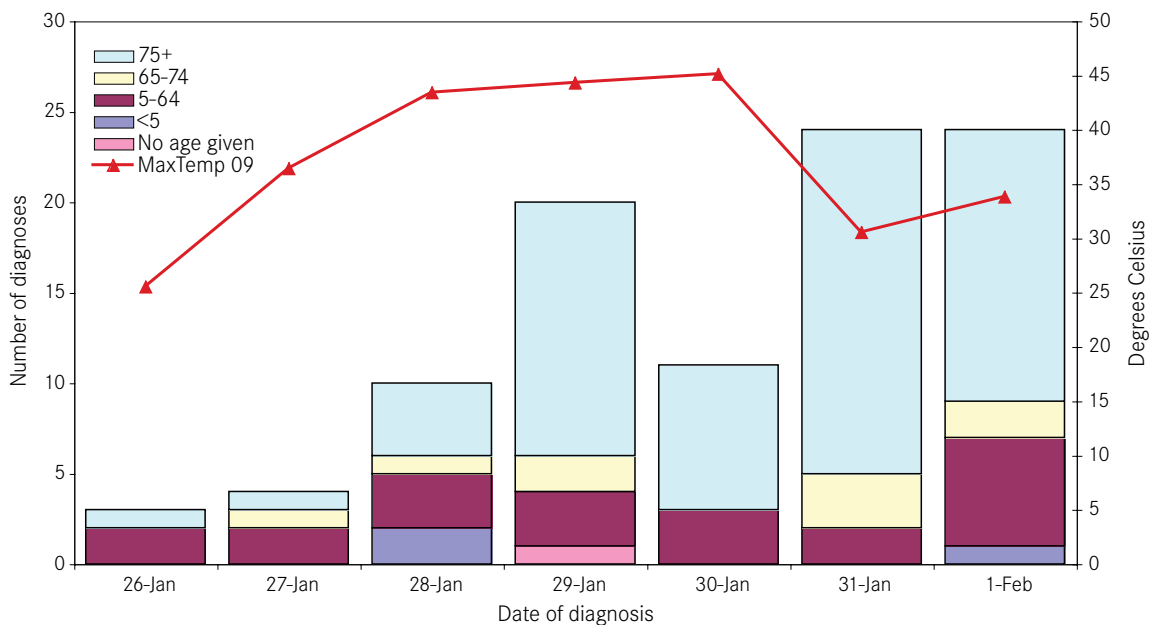
Patients diagnosed with direct heat-related illness included heat stroke, heat stress, heat exhaustion, heat syncope, heat rash and dehydration.

During the week 26 January–1 February 2009 the locum service attended a total of 96 patients for a direct heat related diagnosis compared to 25 in 2008 (close to a 4 fold increase).

Of those who attended for direct heat related conditions in 2009:

- 62 (65%) patients were 75 years or older compared with 12 in 2008.
- 42% of the cases were in aged care facilities and 68% were female.

**Figure 5. MMDS heat-related diagnoses by age group, 28 Jan–01 Feb 2009**



### 5.3 The Victorian Emergency Minimum dataset (VEMD)

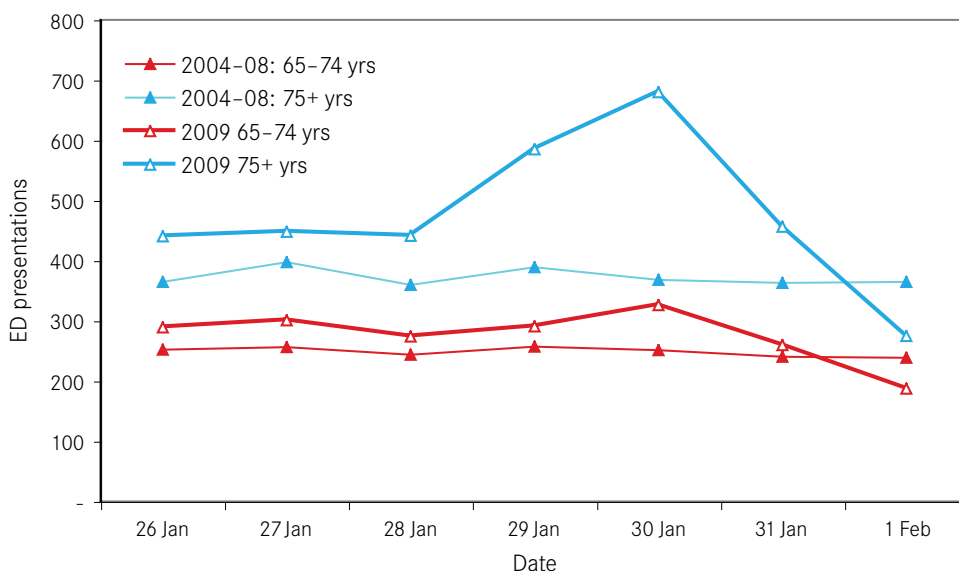
Data were provided for the week 26 January to 1 February 2009 and compared with the average presentations for the same week over the previous 5 years.

#### 5.3.1 Total Emergency Department (ED) Presentations

Over the week 26 January to 1 February 2009 there was a 12% overall increase in ED presentations with 26,366 observed presentations in 2009 and 23,546 expected presentations (average for the same calendar week for 2004–08).

There was a 37% increase in those 75 years and older (3568 presentations compared to an expected number of 2607).

**Figure 6. Emergency department presentations by age group: mean of 2004–2008 vs 2009**



The full impact of the heatwave upon EDs will not only depend upon the numbers of presentations but also their severity.

Presentations are triaged into 6 categories called: Resuscitation; Emergency; Urgent; Semi-Urgent; Non-Urgent; and Dead on Arrival.

Overall there was a 64% increase of patients requiring immediate resuscitation (excess of 92), a 26% increase in Emergency presentations (excess of 439), a 25% increase in Urgent presentations (excess of 1539) and a 7% increase in semi-urgent presentations (excess of 839).

Non-urgent presentations were reduced by 4% (reduction of 171 presentations, i.e. 4085 presentations compared to 4256 expected).

### 5.3.2 Direct heat related conditions

These included heat stroke, heat syncope and dehydration. In total there were 714 presentations to EDs with such heat related conditions (203 due to heat stroke, 123 with heat syncope and 388 with dehydration) compared to an expected number of 85 presentations giving an excess of 629 presentations, an 8.4 fold increase.

Of this number of total heat related conditions, 325 (i.e. 46%) were in people 75 years or older.

The type of usual accommodation of these patients is detailed in table 2 and shows the majority occurred in people who lived at home with others.

**Table 2. Usual accommodation of those presenting in EDs with heat related conditions**

Usual type of Accommodation	Frequency	Per cent
Private residence, living with others	562	79.5
Private residence, living alone	83	11.7
Residential ACF (high and low care)	20	2.8
Community based residential supported living facility or other supported accommodation	2	0.3
Boarding/Rooming House/Hostel	3	0.4
Unknown/unable to determine	24	3.4
Other	13	1.8
Total <sup>1</sup>	707	100.0

<sup>1</sup> Seven of the 714 presentations did not include data on the type of accommodation

### 5.3.3 Deaths on arrival in Emergency Departments and deaths in Emergency Departments

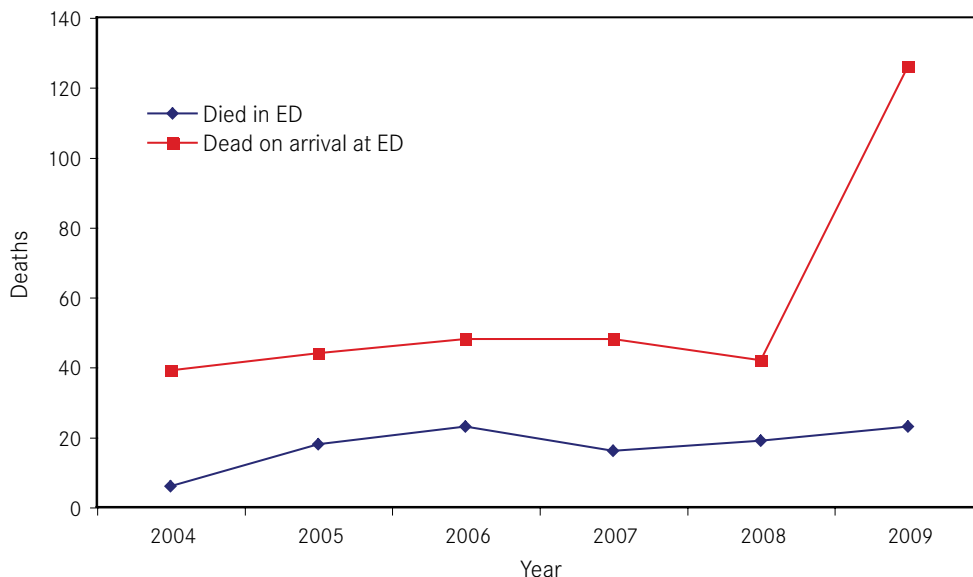
Emergency Department deaths are coded in VEMD data as 'dead on arrival' or 'death in ED'.

In the week 26 January to 1 February 2009, 126 people were taken to an ED already deceased (69% of whom were 75 years of age or older) compared to an expected number of 44 cases, almost a 3 fold increase.

The 23 deaths that occurred at an Emergency Department over this week were not statistically different to preceding years (average of 16 deaths for the same week in 2004–08).



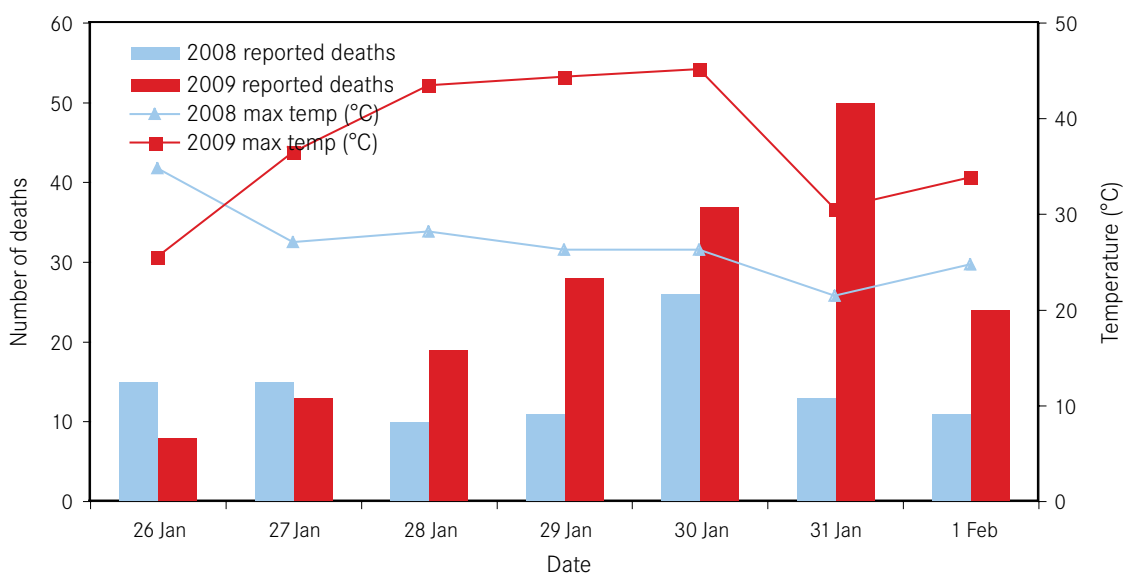
Figure 7. Deaths in and prior to arrival in emergency departments (26 January–1 February)



### 5.4 State Coroner’s Office and reportable deaths

The State Coroner’s office provided data in relation to number of reportable deaths during the week 26 January to 1 February 2009, and for the same dates in 2008. All of these reportable deaths undergo the usual process of careful investigation to ascertain the underlying cause of death, but these details were not available for this analysis.

Figure 8. All State Coroner Office reported deaths by temperature and day, Victoria, 2008 & 2009



The rise in reportable deaths increased with the rising temperature and peaked one day after the highest temperature was recorded in Melbourne and declined as the temperature fell.

For the week 26 January to 1 February 2009, there were 179 reportable deaths compared with 101 in 2008 representing an increase of 78, i.e. a 77% increase.

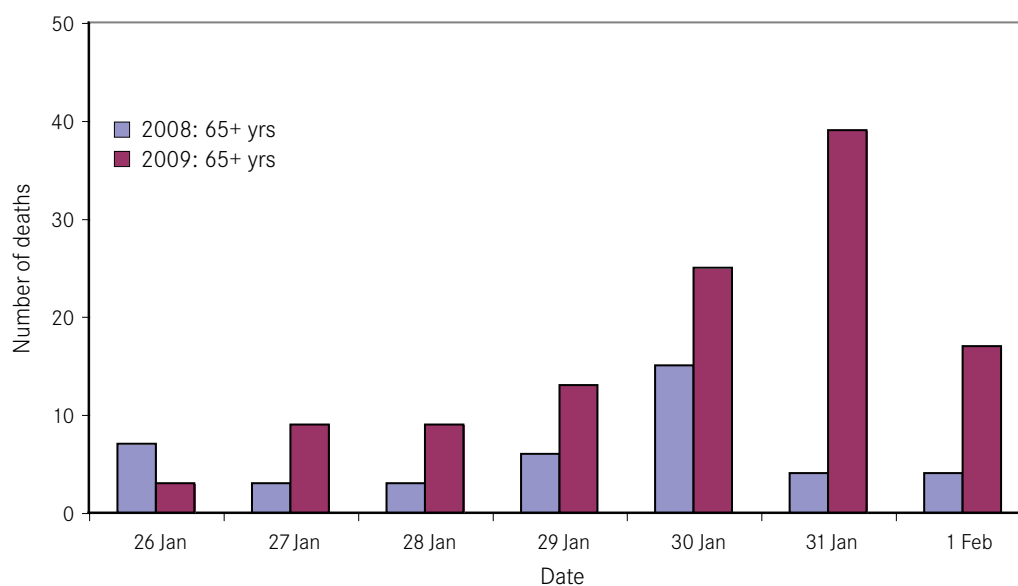
In those 75 years or older, there were 86 reported deaths in 2009 and 30 in 2008 making an excess of 56, almost a 3 fold increase.

In those 65–74 years or age, there were 29 reported deaths in 2009 and 12 in 2008 making an excess of 17, almost a 2.5 fold increase.

Taken together, in those over 65 years the ratio of deaths in 2009 to deaths in 2008 was 2.7.

There was no statistically significant difference in deaths observed in those under 65 years of age.

**Figure 9. 65+ years reported deaths by day, Victoria, 2008 & 2009**

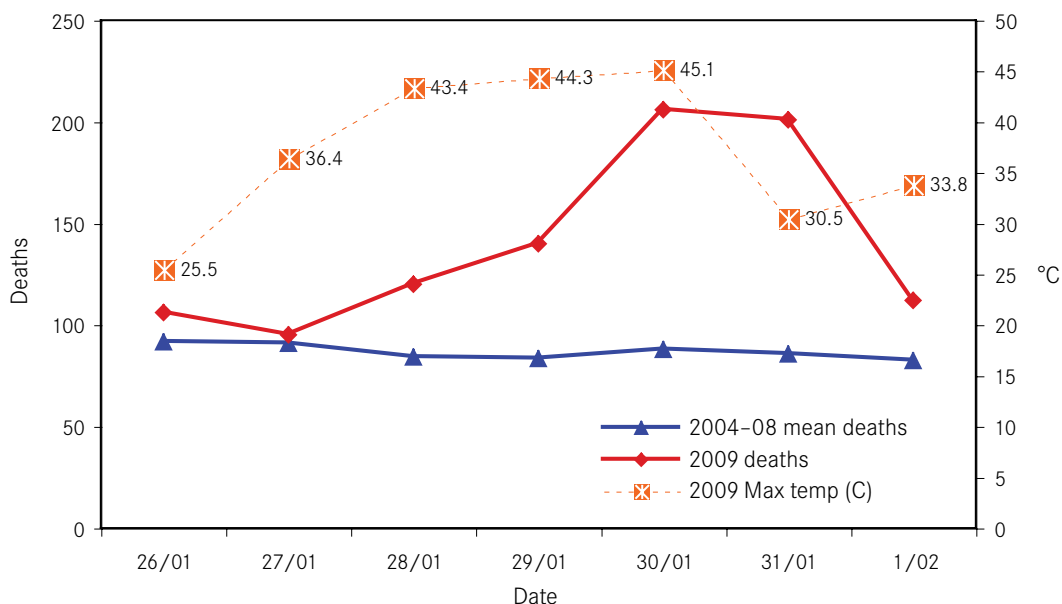


## 5.5 Total mortality from the Victorian Registry of Births, Deaths and Marriages and State Coroner's Office

This analysis examined total deaths for the week of 26 January to 1 February 2009 and compared these for the same period over the preceding five years. For the calculation of all-cause mortality, data from the Registry was combined with the data from the State Coroner's Office for the same period as the two data sources were mutually exclusive. No analysis could be done on cause of death as the Australian Bureau of Statistics provides official mortality figures with standardised codes of cause of death but this data will not be available for some time.

There was a clear increase in all cause mortality that followed the onset of the heatwave with a rapid decline as temperatures fell. Over the week of 26 January to 1 February 2009, total deaths were 980 and the expected deaths for the week was 606. This represents 374 excess deaths and corresponds to an Observed/Expected ratio of 1.62 (95% Confidence Interval 1.46, 1.79), representing a 62% increase in deaths for this week. (The expected deaths were calculated from the average number of deaths occurring in that week between 2004 and 2008).

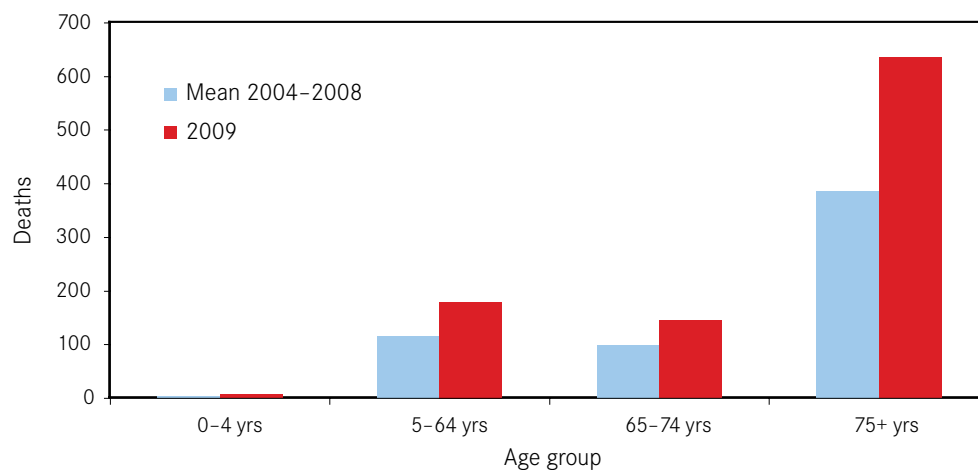
Figure 10. Deaths between 26 Jan and 1 Feb: Mean deaths in 2004–08 vs 2009



\* Deaths data from BDM and reports to SCO

The greatest number of deaths occurred in those 75 years of age or older ( $n=636$ ), however significant numbers also died in those 65–74 years ( $n=145$ ) and 5–64 years ( $n=180$ ). (NB. A small number of deaths were reported with unknown age).

- In those aged 75 years or older, there were 248 excess deaths (636 compared to 388) with an observed/expected ratio of 1.64 [95% confidence interval, 1.45, 1.86]. This represents a 64% increase over the average for the same period between 2004 and 2008.
- In those aged 65–74 years, there were 46 excess deaths (145 compared to 99) with an observed/expected ratio of 1.46 [95% confidence interval, 1.13, 1.89]. This represents a 46% increase over the average for the same period between 2004 and 2008.
- In those aged 5–64 years, there were 64 excess deaths (180 compared to 116) with an observed/expected ratio of 1.55 [95% confidence interval, 1.22, 1.95]. This represents a 55% increase over the average for the same period between 2004 and 2008.
- In those aged 0–4 years, there were 3 excess deaths (7 compared to 4) with an observed/expected ratio of 1.71, [95% confidence interval, 0.51, 5.81]. This was statistically not significantly different from the average for the same week between 2004 and 2008.

**Figure 11. Deaths in Victoria between 26 Jan and 1 Feb by age group: 2004–08 vs 2009**

The data from the Registrar and the State Coroner's Office are provisional and although these are expected to account for the vast majority of deaths, it may be revised over time. It is possible that deaths relating to the heatwave occurred or were reported outside this period of analysis thereby underestimating the impact. Certainly the vast majority of short-term mortality is expected to have been captured.

## 6 Discussion

The January 2009 heatwave has clearly had a substantial impact on the health of Victorians, particularly the elderly. This has been shown to be the case for heat related conditions such as heat stress and dehydration, whether measured by ambulance attendances, locum doctor visits or hospital emergency department attendances. Mortality during the week of the heatwave was also increased as measured by reportable deaths to the State Coroner and total deaths measured by reports to the Victorian Registry of Births, Deaths and Marriages.

In all the data sources examined, the health impact of the heatwave was measured by comparing the week of this year's heatwave with similar periods in previous years. This gives for example with total deaths, the concept of total excess mortality, which has been calculated to be 374 excess deaths in Victoria for the week of 26 January to 1 February 2009.

From the data examined, we cannot say who these people are, where they live, or what they died from. With the frail elderly for example one would expect that they would have a variety of chronic medical conditions such as cancer, heart and lung diseases, stroke and dementia. In such patients any additional stress, be it due to a viral gastroenteritis, influenza or a heatwave, may be sufficient to cause death.

In looking at heatwave mortality it is, however, not possible to say how many of the people who died would have otherwise died in the days or weeks following if we did not have the heatwave. We cannot determine if their deaths were brought forward by a short period, or in how many cases the death was totally unexpected and due principally to the effects of the heatwave. The data does however point to the substantial impact of the heatwave on the elderly.

Overseas experience has shown the magnitude of harm possible from heatwaves. This possibility was the driving force behind numerous warnings provided in the media to ensure that everyone, particularly the elderly, should make an effort to reduce physical activity, keep cool and well hydrated and the message to ensure that people checked on elderly friends, relatives and neighbours, especially those living alone.

The need to prepare for such heatwave events has resulted in the documentation of heatwave plans such as the heatwave plan for England, "Protecting Health and Reducing Harm from Extreme Heat and Heatwaves" [12], and the Californian "Contingency Plan for Excessive Heat Emergencies"[13].

Such plans have in common a series of activities that are put into effect in the time leading up to and during an extreme heat event and are designed to reduce morbidity and mortality among vulnerable members of the population.

The Victorian Government identified the need to respond to predicted heat events in the Sustainability Action Statement released in 2006 which committed to a Victorian Heatwave Plan involving communities and local government. As a part of this strategy the department has established a heat alert system for metropolitan Melbourne and is undertaking similar work for regional Victoria. A series of pilot projects have been undertaken engaging local government to develop heatwave plans that could be integrated with existing local government public health and/or emergency management plans. One of the outcomes of these pilot projects will be the production of a toolkit to assist local councils in the preparation of heatwave response plans over the period 2009/10.

As the predictions in relation to climate change are that extreme weather events are going to become more frequent and severe in the years to come, we have a duty to ensure that Victorians are well prepared to protect the most vulnerable members of our communities during such events.

## 7 References

1. Brucker, G., Vulnerable populations: lessons learnt from the summer 2003 heatwaves in Europe. *Euro Surveill*, 2005. **10**(7): p. 147.
2. Robine, J.M., Death toll exceeded 70,000 in Europe during the summer of 2003. In *Protecting health in Europe from climate change*. p 14 Edited by Bettina Menne, Franklin Apfel et al, World Health Organisation, 2008. <http://www.euro.who.int/Document/E91865.pdf> accessed 12 February 2009. *Comptes Rendus Biologies*, 2008. **331**(2): p. 171–178.
3. Wolf, T. and Menne, B., Environment and health risks from climate change and variability in Italy, World Health Organization Europe: <http://www.euro.who.int/document/E90707.pdf>, 2007.
4. Jol, A. and Šťastný, P., Impacts of Europe's changing climate—2008 indicator-based assessment Joint EEA-JRC-WHO report. [http://www.eea.europa.eu/publications/eea\\_report\\_2008\\_4](http://www.eea.europa.eu/publications/eea_report_2008_4), 2008.
5. Vandentorren, S., et al., August 2003 heatwave in France: risk factors for death of elderly people living at home. *Eur J Public Health*, 2006. **16**(6): p. 583–91. 2003.
6. National Institute of Public Health Surveillance, France, Annual Report 2003.
7. Cadot, E., Rodwin, V.G., and Spira, A., In the heat of the summer: lessons from the heat waves in Paris. *J Urban Health*, 2007. **84**(4): p. 466–8.
8. Kovats, R.S. and Hajat, S., Heat stress and public health: a critical review. *Annu Rev Public Health*, 2008. **29**: p. 41–55.
9. Nitschke, M., Tucker, G.R., and Bi, P., Morbidity and mortality during heatwaves in metropolitan Adelaide. *Med J Aust*, 2007. **187**(11–12): p. 662–5.
10. Hajat, S. et al., Impact of hot temperatures on death in London: a time series approach. *J Epidemiol Community Health*, 2002. **56**(5):p.3;67–72.
11. Baccini, M., Biggen, A., and Accetta, G., Heat effects on mortality in 15 European cities. *Epidemiology*, 2008. **19**(5): p. 711–9.
12. Heatwave Plan for England: Protecting Health and Reducing Harm from Extreme Heat and Heatwaves, Whitehall, London 2008.
13. Contingency Plan for Excessive Heat Emergencies, Governor's Office of Emergency Services California 2008

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