



Government of **Western Australia**  
Department of **Health**

# Bellevue Health Surveillance Register: Follow-up study

Epidemiology Branch  
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**Disclaimer:**

This report details the results of an epidemiological analysis of health service utilisation and possible effects of fire exposure of registrants on the Bellevue Health Surveillance Register. While every effort has been made to accurately describe the health service utilisation and possible effects of fire exposure, there is known variability in the accuracy of the data provided to us and this variability must be taken into account in the interpretation of the results in this report.

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## Acronyms

ABS	Australian Bureau of Statistics
ASR	Age standardised rate
CI	Confidence intervals
DoH	Department of Health, Western Australia
ED	Emergency department
FESA	Fire and Emergency Services Authority
OCS	Occasions of service
OR	Odds ratio
POBW	Proportion of optimal birth weight
SAS	Statistical Analysis System Institute Incorporated
SIR	Standardised incidence ratio
SRR	Standardised rate ratio
WA	Western Australia
WACR	Western Australian Cancer Registry
WADLS	Western Australian Data Linkage System
WAHMDS	Western Australian Hospital Morbidity Data System
WAHWSS	Western Australian Health and Wellbeing Surveillance System



## Executive summary

Following the investigation of the fire at the Waste Control Pty Ltd hazardous waste and solvent recycling facility in Bellevue on 15 February 2001, a parliamentary inquiry recommended the establishment of the Bellevue Health Surveillance Register to monitor the health of those exposed to the fire and detect any long-term health effects which might arise from the fire. While the First Report from the Bellevue Health Surveillance Register described the short-term health effects of the fire on registrants, it recommended that the registry be linked to databases held by the WA Department of Health with the view of checking for any longer-term health effects or prolonged short-term effects among registrants.

This report updates the description of the registrants, as 24 additional people registered since the analysis was previously reported. Details from the registry were used to link the hospitalisations, emergency department presentations and mental health outpatient attendances as well as birth, death and cancer registrations for those registrants granting permission to link to their health records.

The overall health status and comparisons with other relevant surveys for pre-existing and fire-related symptoms and physical emotional health and wellbeing were similar to those previously reported. Measures of lifestyle risk factors indicated that registrants were more likely to be physically active and drink, on average, a lower number of drinks per day, but had a lower proportion of non-drinkers than the State population. The prevalence of other lifestyle health risk factors, such as obesity and smoking, was similar to those previously reported.

The pattern and rate of hospitalisation of registrants over the study period was similar to that of the general population and there was no evidence of an increase in hospitalisation rates due to the effects of the toxins released in the fire.

While the rate of presentations to emergency departments (ED) among women after the fire was higher than that of the general population, it seems unlikely that the effects of the fire were a factor, as there was no such increase observed among male registrants.

There was a low number of registrants who made a large number of contacts with mental health outpatient services. The rate of attendance at mental health outpatient services among registrants decreased after the fire and was lower than that of the general population.

Few cancers were identified among the registrants, with the types among those commonly found in the general population. The incidence of all cancers was similar to that found in the general population.

Only three of the 237 registrants followed up had died during the seven years after the fire. Also, assessment of indicators of infant health – fetal deaths, low birth weight and proportion of optimal birth weight – showed no evidence of a change after the fire.

Although exposure to toxins – measured by location at fire and hours spent in Bellevue during the fire – were indirect, there was no evidence of a relationship between exposure and contact with health services, hospitalisation and presentation to EDs.

In conclusion, after identifying the health records of registrants by linking to an extensive range of health data sources, at the time of the study, there was no evidence of long-term adverse health outcomes or prolonged duration of short-term effects among registrants from the toxins released in the fire.

Based on the expert opinion canvassed in the parliamentary inquiry and the results of this study, further investigation into the long-term adverse health outcomes of registrants would not be warranted.

## Chapter 1 Introduction

On 15 February, 2001, at approximately 11pm, a fire occurred at the Waste Control Pty Ltd hazardous waste and solvent recycling facility in Bellevue. It was estimated that the facility had up to 500,000 litres of chemicals and toxic solvents in storage.<sup>1</sup> Fire and emergency services responded to the fire and over 50 local residents were evacuated.<sup>1</sup> The fire, which included the combustion of a range of chemicals stored at the site, was contained by the next morning.

The Bellevue fire generated considerable concern within the local community and Government. In particular, there was concern for those exposed to the fire and/or plume and the potential health effects of that exposure. Subsequently, several investigations into the short-term health effects of the Bellevue fire have been conducted.<sup>1-3</sup> These investigations have found that those exposed to the fire, including fire and emergency services and nearby residents, suffered short-term health problems associated with exposure to chemicals.<sup>1,3</sup> The most common issues were headaches, sore throat and breathing problems, and those with higher exposure or pre-existing health conditions were most likely to be affected.<sup>1,3</sup> A parliamentary inquiry into the Bellevue Fire concluded “that there is little likelihood of long-term risk to the health of firefighters and residents living near the site of the fire”.<sup>1</sup> However, the Inquiry recommended that the Department of Health establish a register to monitor the health of those exposed to detect any long-term health effects which might arise from the fire.<sup>1</sup>

The Bellevue Health Surveillance Register was established by the Department of Health (DoH) in July 2002 with a steering committee guiding the design, development and implementation of the register.<sup>2</sup> Campaigns were conducted to promote registration and by January 2003, 218 people had registered. A preliminary report of the health profile of registrants was prepared in May 2003 as a baseline for interpreting any subsequent change in health conditions.<sup>2</sup> A summary of the report was released in June 2003.<sup>3</sup> Of the six recommendations made in the report, two required the Department of Health to conduct a follow-up study in five years (2008) involving linking the register to the WA Hospital Morbidity Data System and Emergency Department Database, as well consider linkages to other databases held by the Department.

The Bellevue Health Surveillance Register Five Year Follow-up Working Group was established to oversee the linkage of the register to other datasets and conduct the analysis. Final linkages were completed to enable the analysis of the Bellevue Health Surveillance Register with key Department of Health datasets. This includes data from the WA Hospital Morbidity Data System (WAHMDS), Emergency Department (ED) Data Collection, Mental Health Information System, Western Australian Cancer Registry, Midwives Notification System, Australian Bureau of Statistics Mortality Data and the Western Australian Electoral Roll. All datasets include data up to the end of 2008. This report summarises the results of the follow-up of the Bellevue Health Surveillance Register.

The purpose of the follow-up study was to continue the surveillance of registrants and assess the impact of the fire on the health of registrants. To achieve this, the study updates the profile of registrants, describes the health service utilisation of registrants and determines whether fire exposure was related to increased ill health or death.

## Chapter 2 Previous Bellevue fire health investigations

The findings of previous Bellevue fire health investigations provide the background for the establishment of this follow-up study, implications for the study design and interpretation of the findings. The Parliamentary Inquiry<sup>1</sup> provides the best available inventory of the chemicals present at the site before the fire with a toxicology assessment of each as well as reports of short-term health effects and expert opinions on exposure levels and the likelihood of health effects. A detailed analysis of the baseline health of registrants on the Bellevue Fire Health Surveillance Register was reported in the First Report from the Bellevue Fire Surveillance Register.<sup>2</sup>

### Bellevue Hazardous Waste Fire Inquiry

The site of the fire was a chemical recycling and waste treatment facility, with a licence to store dangerous goods including flammable liquids, toxic solid wastes, solvents, corrosive substances and heavily contaminated water. While a comprehensive list of chemicals and their specific volumes at the site on the day of the fire was unable to be provided to the Parliamentary Inquiry, an inventory of the materials that were stored at the site, but not necessarily present at the time of the fire, was obtained from various regulatory sources. Classes of substances held at the site included flammable liquids, toxic, oxidising, corrosive and combustible substances.

A brief toxicological assessment of some of the chemicals known to be at the site was included in Volume 1 of the Bellevue Hazardous Waste Fire Inquiry.<sup>1</sup> Of the chemicals, perchloroethylene has been associated with an increase in cancer risks and xylene has been associated with respiratory, central nervous system and a number of other conditions with long-term exposure. Short-term exposure to high levels of the other chemicals listed has been associated with irritation of eyes, nose and throat, headaches, nausea, dizziness and vomiting.

The Inquiry found that while the chemicals present at the site on the day of the fire have significant health effects when there is an occupational exposure over long periods of time or through ingestion or inhalation, most exposures at the Bellevue fire were of a relatively short duration. Firefighters would have been exposed to the highest levels of substances, but only for short durations. They displayed symptoms commonly associated with short-term exposure to a range of chemicals including sore eyes, coughs, colds, chest complaints, dizziness, nausea and headache.

The short time of acute exposure means significant permanent health effects are unlikely, as there was no long-term small dose exposure which is a typical cause of chronic respiratory conditions or cancer. In addition, no person presented with symptoms that indicated any person was exposed to a highly toxic chemical or a significant dose to cause real concern.

While the Inquiry reported that perchloroethylene had been identified as a cancer-causing agent in animals at high levels of exposure, the evidence among humans is uncertain and it seemed unlikely that acute exposure would lead to cancer. It was also reported that other flammable liquids would have been subject to complete combustion and it is unlikely long-term health effects would have resulted from that exposure.

Based on the evidence provided by toxicology experts, the Inquiry concluded that there exists a low probability of medium to long-term serious or chronic health effects to the firefighters and residents exposed to the fire. However, due to the uncertainty about the types and concentrations of chemicals present at the site at the time of the fire, the Inquiry recommended that the Department of Health establish a medical register of individuals who were exposed to the effects of the fire.

### Bellevue Fire Health Surveillance Register

The First Report of the Bellevue Health Surveillance Register<sup>2</sup> described the health status of the initial 218 registrants and reported the first analysis of any associations between their health and exposure to the environmental contamination produced by the fire.

The prevalence of pre-existing health conditions among registrants was found to be similar to that of other West Australians, except for an increased prevalence of respiratory conditions other than asthma, and skin conditions.<sup>2</sup>

The symptoms reported by those who could recall at least one symptom which they thought was related to the fire were localised irritation of the respiratory tract, eyes and skin, together with headaches and lethargy. Most symptoms did not last long and few people took any action other than self-medication. A large proportion of registrants (40%) reported multiple symptoms, with 10% reporting four or more symptoms. Seventeen per cent of registrants reported symptoms which lasted more than one week.<sup>2</sup>

Seventeen per cent of registrants were classified as 'at risk' of psychological problems, with their self-reported emotional wellbeing poorer than the rest of the State.<sup>2</sup>

Compared with the rest of WA, registrants were more likely to be classified as physically inactive and overweight or obese. While registrants were more likely to drink alcohol, their overall alcohol consumption patterns were similar to the State. They were less likely to smoke tobacco.<sup>2</sup>

Registrants' rating of their physical and emotional health status was low and they reported that both had deteriorated during the past year.<sup>2</sup>

For emergency workers, there was a significant association between the risk of multiple symptoms and the time that was spent in Bellevue at the time of the fire and soon afterwards. The symptoms which were reported were predominantly related to irritation, but some reports suggested systemic effects. Those with multiple symptoms were more likely to have experienced symptoms of a longer duration, with emergency workers also at risk of longer duration of symptoms.<sup>2</sup>

The low level of emotional wellbeing reported by registrants was associated with both the number of symptoms at the time of the fire and the time spent in Bellevue at the time of the fire and immediately afterwards. The report concluded that it was not possible to determine whether this was evidence of a longstanding toxic effect or a consequence of the high level of anxiety and concern which followed the fire.<sup>2</sup>

One recommendation of the First Report of the Bellevue Health Surveillance Register,<sup>2</sup> called for the register to be linked to the WAHMDS and WA ED database and another recommended linking the register to other databases held by the DoH. The remainder of the report addresses these recommendations.

## Chapter 3 Methodology

A follow-up study was conducted to continue the surveillance of registrants on the Bellevue Health Surveillance Register. An additional 24 people had registered since the release of the First Report of the Bellevue Health Surveillance Register.<sup>2</sup> Therefore, an analysis was conducted on the registry as at January 2009 to update the information released in the First Report of the Bellevue Health Surveillance Register.<sup>2</sup> The register records were then linked to a range of administrative datasets to analyse the pattern of health service utilisation of registrants up to five years after the establishment of the register.

The aim of the follow-up study was to investigate the effects of the fire on registrants over the longer term.

Key objectives of the study were to:

- Update the health status of registrants to include those registered since the release of the first report
- Compare the health service utilisation of registrants before and after the fire to determine whether there was a change in health service utilisation among registrants since the fire
- Compare the health service utilisation among the registrants to the general population
- Compare the health conditions present among registrants before and after the fire to determine whether there was a change in health conditions among registrants since the fire
- Compare health conditions present among registrants with the general population.
- Determine whether health service utilisation was related to exposure to the fire and if it was different among registrant sub-groups, in particular between residents and firefighters.

### Data sources

#### Bellevue Health Surveillance Register

The Bellevue Health Surveillance Register was maintained by the WA DoH and the data were released to the Epidemiology Branch to conduct the follow-up study. The register contains data on personal details and demographic information, fire exposure information, pre-existing health conditions, fire-related health symptoms, emotional wellbeing, lifestyle factors, employment status and self-ratings of physical and emotional health.

Each registrant was required to complete a questionnaire designed specifically to collect information relating to the health status and fire exposure of the respondent. The questionnaire was designed to be consistent with the Western Australian Health and Wellbeing Surveillance System (WAHWSS) so that responses could be compared with the general population.<sup>4</sup>



## Linkage to health records

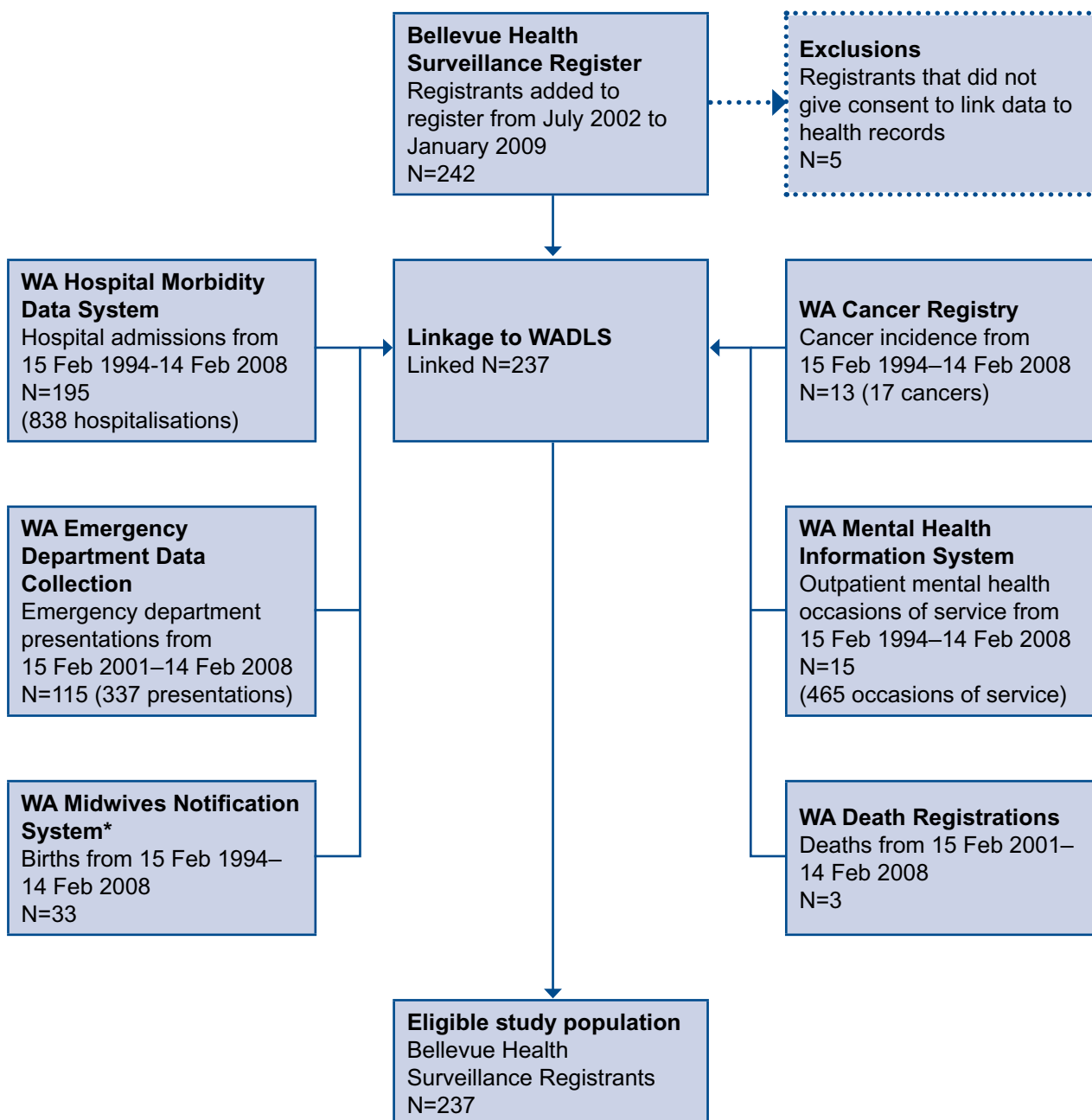
Registrants were asked if they gave consent for their details to be linked to health records. The details of those who gave consent were linked to the Western Australian Data Linkage System (WADLS)<sup>5</sup> to allow the extraction of health information on the registrants from various datasets held by the DoH. The linkage to these datasets allows the “tracking” of each contact the registrant has had with health services in WA and provides a measure of ill health among the registrants. Data relating to these registrants was then extracted from the following data collections from the earliest year available up to 2008:

- WA Hospital Morbidity Data System (WAHMDS)
- Emergency Department Data Collection
- Mental Health Information System
- Midwives Notification System
- WA Cancer Registry (WACR)
- WA Electoral Roll
- WA Mortality Register.

The WADLS links health records of the same individual using rigorous, internationally accepted privacy-preserving protocols, probabilistic matching and extensive clerical review.<sup>5</sup>

Comparisons were made across datasets to ensure consistency and integrity of the linked data. Each record was coded as dated before or after the Bellevue fire. Key variables from the Bellevue Health Surveillance Register Data were then added to each dataset using the individual identifiers provided by the WADLS.

Figure 1 Flow chart of data linkage and registrants included in the study



N = Total cases in the group (number of people unless otherwise specified)

\*Includes births of registrants and births to registrant mothers within study period

Inpatient admissions for Mental Health conditions were included in the WA Hospital Morbidity Data System

The data linkage process is reflected in Figure 1, which summarises the records matched from the various data collections for the 237 registrants included in the study. For example, a match to 838 hospitalisations was found for 195 of the 237 registrants in the WAHMDS.

Although not shown in Figure 1 the registrants were also matched to the WA Electoral Roll to assess the level of registrants lost to follow up. For those matched to the electoral roll none had moved out of the State and all deaths recorded on the roll were identified in the WA Mortality Register. Of the 12 adults who did not match to the electoral roll, all were identified in the other data collections linked in the study. There were 31 children not covered by the matching process to the electoral roll. While most were matched to other data collections linked in the study, five were matched only to their birth record and one child had no links.

### Hospital separations

Records of hospital separations of registrants from 14 February 1994 until 15 February 2008 were extracted from the WAHMDS. Each separation was coded as before or after the fire and the principal diagnosis was coded to the chapter in the International Classification of Diseases Version 10, Australian Modification (ICD10-AM). Analysis was conducted on the total separations and on a person basis.

### Emergency department presentations

Presentations to emergency departments (EDs) for individuals on the register were only available from 2001 from the Emergency Department Data Collection, therefore only the post-fire impact on ED presentations was analysed (from 15 February 2001 until 14 February 2008). Data from this period were not available for all hospitals. Data from the Joondalup Health Campus were available from 1 July 2004 and data from the Peel Health Campus from 1 January 2006. The discharge diagnosis was coded to the chapter of the ICD10-AM for records with this information available. Analysis was conducted on all presentations and on a person basis.

### Mental health outpatient and community occasions of service

An occasion of service (OCS) is a contact between mental health professionals and mental health clients individually or in a group. One client may have multiple contacts during a year. The statistics on occasions of service reflect the mental health outpatient and community service utilisation and OCS were analysed annually from 1994 until 2007.

### Cancer incidence

Cancer is defined as a varied group of diseases where cells in the body mutate and multiply out of control. They form local tumours, can invade and damage the tissue around them, and can spread to other parts of the body to cause further damage.<sup>6</sup>

In this study, eligible cancers were confirmed cases of primary neoplasms of types subject to a statutory notification requirement, diagnosed from 1994 to 2007 and registered with the WACR by April 2010. This incorporated malignant, invasive neoplasms (“cancers”) included in standard cancer incidence reporting, as well as in-situ carcinomas and benign central nervous system tumours and uncertain behaviour tumours. All primary neoplasms were included; therefore, an individual could have second and subsequent primary occurrences of the same or different types of neoplasm.

## Death registrations

Deaths among registrants that occurred between 15 February 2001 and 14 February 2008, and were registered with WA Registrar of Births Deaths and Marriages were included in the study.

## Birth records

Birth records for child registrants and children born to registrants who became mothers after the fire were obtained from 14 February 1994 until 15 February 2008 from the Midwives Notification System. The information retrieved contained the year of birth, condition at birth and information on birth weight, including the proportion of optimal birth weight. Proportion of optimal birth weight measures the appropriateness of intrauterine growth as the ratio of the observed birth weight to the estimated optimal birth weight for a newborn with the same non-modifiable determinants of fetal growth.<sup>7</sup>

## Electoral roll

Records were extracted from the WA Electoral Roll for registrants to determine their residential status in WA at the time of the study. While the roll covers only people 18 years and older, it assists in assessing the proportion of cases lost to follow-up.

## Methods

Any contact with health services for ill health after the fire was used to assess the health risk associated with exposure to the fire. Contact with health services was defined in the study as having a record in any of the datasets accessed by the study, excluding births and pregnancy-related hospitalisations. All pregnancy-related hospitalisations were excluded because during the study period it was difficult to determine from the coding, the degree of a complication in delivery. Consequently, it was difficult to classify a hospitalisation due to a complication in pregnancy as ill health.

Data from each of the datasets mentioned previously were also extracted for residents of the Perth metropolitan area to use as a comparison with the health service utilisation of registrants. Hospital separations and ED presentation data for Perth metropolitan residents were extracted for the same period as the registrants and coded into annual groups from 15 February to 14 February of the following year. Data relating to cancer incidence, mental health outpatient occasions of service and births of Perth metropolitan residents were also extracted for the same period as registrants and were analysed on a calendar year basis. Death data were not extracted for Perth metropolitan residents as the number of deaths among registrants was too low for further statistical analysis.

## Statistical Analysis

The statistical analysis of the health status and health utilisation of registrants involved updating the descriptive analysis initially reported,<sup>2</sup> analysing linked data to identify any changes in health service utilisation of registrants and comparing health utilisation of registrants with that of Perth metropolitan residents. The relationship between exposure to the fire and health service utilisation was also investigated by applying logistic regression analysis to the linked register and health utilisation data.

## Update of health status of registrants

The First Report from the Bellevue Health Surveillance Register<sup>2</sup> presented the preliminary analysis of 218 registrants. In the follow-up study, the register was analysed again using the information from all consenting individuals now included on the register to determine the impact of the addition of new registrants. The descriptive analyses conducted in the first report included standard demographic information, details about the registrants' location and actions during the fire, pre-existing health conditions, fire-related health symptoms, emotional wellbeing, lifestyle and other factors. Results from all current registrants were compared with those reported for registrants in the initial report and comparisons with Bellevue residents and the State were updated.

State and Bellevue survey results published in the initial report were used for comparison with current registrants where possible. Where the results from the current registrants required a different comparison to that reported in the initial report the unweighted sample means and confidence intervals were compared to results prepared from the State results weighted to adjust for oversampling in rural and remote areas.

## Analysis of linked datasets

The rate of contact with health services was determined for each year of data available from the individual data collections. Where possible the study period was from 1994 to 2007. In the case of death registrations and ED presentations, data from 15 February 2001 were analysed.

The utilisation of health services was described in terms of hospitalisation rates, rates of presentation to EDs, cancer incidence, birth outcomes (fetal deaths and low birth weight) and rates of contacts with mental health services.

Rates were calculated by dividing the number of events by the number of person-years contributed by the registrants. The person years of follow-up were from the commencement of the study period or birth until death or the end of the study period. The person-years of follow-up for each registrant by age, sex and year were calculated using the Lexis macro in SAS,<sup>8</sup> both before and after the fire.

For the analysis of cancer incidence, follow-up did not cease at the date of cancer diagnosis as each registrant was still at risk of being diagnosed with another cancer as multiple primaries were included in the analysis.<sup>9,10</sup>

Rates for the Perth metropolitan area were derived by dividing the number of events recorded for Perth metropolitan area residents by the Perth metropolitan area population for each period studied. Rates were calculated using a three-year moving average, with age-standardised rates and 95% confidence intervals (CI) calculated using the 2001 Australian population as the reference population.<sup>11</sup> Trends in age-standardised rates were estimated using Poisson regression based on the rolling three-year averages.

Standardised rate ratios (or standardised incidence ratios for cancer incidence analysis) were calculated as the ratio of the total number of observed events to the number of expected events to determine whether there was an excess of events among registrants compared with the Perth metropolitan area population.

The observed events (hospital separations, ED presentations, deaths, cancer incidence and mental health occasions of service) were identified through the data linkage process.

Expected events were calculated by multiplying the sex, 5 year age group, and period specific rates in the Perth metropolitan area population by the corresponding number of person-years of follow-up of registrants and summing across all stratifying variables.

The calculation of 95% confidence intervals were based on a Poisson distribution using the methods recommended for analysis of small numbers.<sup>12</sup>

### Exposure and health service utilisation

Logistic regression analysis was conducted to determine whether the risk of contact with health services was related to an individual's exposure to the fire and fire plume, while also considering the impact of other potential risk factors (such as age, sex and pre-existing conditions). Contact with health services was defined as a link to any record in the data collections analysed, with births and pregnancy-related hospital separations excluded as the reason for hospitalisation was not classified as ill health. If a child was unwell at birth then a separate hospital separation would be recorded for that event. Events seven years after the fire (15 February 2001–14 February 2008) were included in the analysis.

Two measures were used to quantify exposure. Firstly, the circumstances of the individual at the time of the fire were used as a measure of exposure and defined as whether the individual identified on the registry as a member of the public or an emergency services worker. Secondly, exposure was measured by the number of hours spent in the Bellevue area from 15 February 2001 to 23 February 2001.

Logistic regression analyses were also conducted on hospital separations and emergency department presentations separately to assess whether exposure and personal characteristics explained an increased use of these health services, specifically.

All analyses were completed in SAS Enterprise Guide Version 4.2.

## Chapter 4 Analysis of the Bellevue Health Surveillance Register

The Bellevue Health Surveillance Register was established in July 2002 by the DoH. The Register contains a range of personal, health and fire-related information collected from the registrants using a questionnaire. A report on the health profile of the initial 218 registrants was published in 2003.<sup>2</sup> This chapter provides an overview of the health profile of all registrants now included on the Register and comparisons with the previous report.

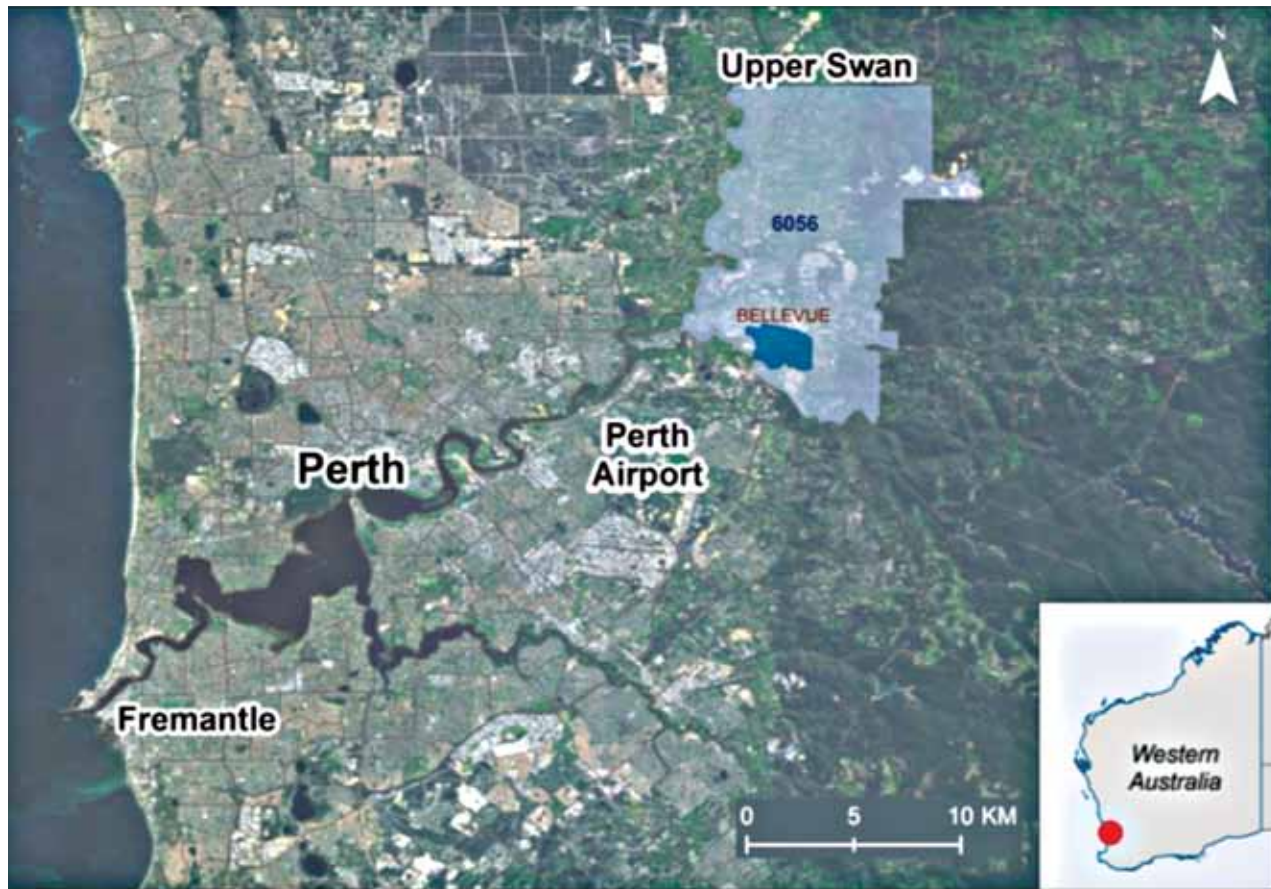
### Registrants and the Bellevue fire

A total of 242 people were registered on the Bellevue Health Surveillance Register between July 2002 and January 2009, with the last questionnaire received in November 2004. All registrants were given the opportunity to update their records upon seeking further medical advice in the future. However, few records were updated after registration and up to January 2009.

Of the registrants, 200 were adults (aged 16 years and older at the time of the fire) and 42 were children (aged less than 16 years at the time of the fire). The registrants were from 175 families, comprising between two and six registrants.

A summary of the characteristics of the registrants is shown in Table 1. Of the registrants, 162 (67.2%) were male and 79 (32.8%) were female. At the time of the fire, the average age was 44 years for adult registrants and 8 years for child registrants.

Figure 2 Location of Bellevue and postcode 6056 in Western Australia



During February 2001 (the month of the fire), 32.0% of adults and 70.7% of children listed their place of residence as the suburb of Bellevue (dark blue area in Figure 2). An additional 12.5% of adults and 24.4% of children listed their residence as other suburbs in the 6056 postcode (light blue area in Figure 2). The remaining registrants (55.5% of adults and 4.9% of children) listed their residence as somewhere other than Bellevue and postcode 6056.

Of the adult registrants, 151 (75.5%) were currently employed. There was a wide range of occupations however; 34 (17.0% of adult registrants) listed their occupation as fire-fighter and six (3.0% of adult registrants) as another emergency services profession (e.g. police officer).

There were 24 additional registrants included in this analysis whose questionnaires were received after the completion of the first report.<sup>2</sup> Of the additional registrants, 16 were adults and 8 were children. The inclusion of these registrants resulted in a similar proportion of males and females, a slightly younger average age and a higher percentage of Bellevue residents.<sup>2</sup>



Table 1 Characteristics of the registrants at the time of the fire

Registrants	Adult		Child		Total	
	N	%	N	%	N	%
	200	100.0	41	100.0	241	100.0
<b>Sex</b>						
Male	138	69.0	24	58.5	162	67.2
Female	62	31.0	17	41.5	79	32.8
<b>Country of birth</b>						
Australia	142	71.0	38	92.7	180	74.7
Other	58	29.0	3	7.3	61	25.3
<b>Area of residence</b>						
Bellevue	64	32.0	29	70.7	93	38.6
Other suburb in PC 6056	25	12.5	10	24.4	35	14.5
Other	111	55.5	2	4.9	113	46.9
<b>Area of residence (ever)</b>						
Bellevue	67	33.5	29	70.7	96	39.8
Other suburb in PC 6056	39	19.5	19	46.3	58	24.1
<b>Ever employed for wages</b>	184	92.0	–	–	184	92.0
<b>Currently employed</b>	151	75.5	–	–	151	75.5
<b>Current occupation</b>						
Firefighter	34	17.0	–	–	34	17.0
Other emergency services	6	3.0	–	–	6	3.0
Other	111	55.5	–	–	111	55.5

**Notes:**

Table excludes one child registrant who was not born at the time of the fire.

Missing information not shown but is included in the total when calculating percentages.

Total percentage is for adults and children combined unless adult-only question, where total is for adults.

Area of residence refers to home address during month of February 2001.

Area of residence (ever) refers to home address in 10 years prior to fire (Jan 1991–Feb 2001).

Current occupation refers to occupation in 2001.

The location and actions of the registrants on the night and week following the fire are shown in Table 2.

Table 2 Fire exposure of registrants

Registrants	Adult		Child		Total	
	N	%	N	%	N	%
	200	100.0	41	100.0	241	100.0
<b>Location at time of fire</b>						
At home	111	55.5	41	100.0	152	63.1
At work	14	7.0	–	–	14	5.8
Visiting Bellevue	12	6.0	–	–	12	5.0
Fighting the Bellevue fire as a FESA member	26	13.0	–	–	26	10.8
Helping with Bellevue fire as a volunteer or in some other capacity	23	11.5	–	–	23	9.5
Fighting bush fires close to Bellevue	7	3.5	–	–	7	2.9
Away	4	2.0	–	–	4	1.7
Other	3	1.5	0	0.0	4	1.7
<b>Address on night of fire</b>						
Bellevue	64	32.0	29	70.7	93	38.6
Other suburb in PC 6056	23	11.5	10	24.4	33	13.7
Other	87	43.5	2	4.9	89	36.9
<b>Evacuated on night of fire</b>	7	3.5	1	2.4	8	3.3
<b>Watched fire</b>	28	14.0	3	7.3	31	12.9
<b>Time spent in Bellevue from 15–23 February 2001</b>						
0 hour	17	8.5	0	0.0	17	7.1
1–12 hours	72	36.0	2	4.9	74	30.7
13–24 hours	10	5.0	1	2.4	11	4.6
2 days	20	10.0	7	17.1	27	11.2
3–4 days	16	8.0	1	2.4	17	7.1
5–9 days	69	32.5	30	73.2	95	39.4

**Notes:**

Table excludes one child registrant who was not born at the time of the fire.

Missing information not shown but is included in the total when calculating percentages.

On the night of the fire, 55.5% of adult registrants and 100.0% of child registrants were at home. A further 24.5% of adult registrants were part of the emergency response team, either fighting the fire or acting in some other capacity. An additional 3.5% were fighting bush fires close to Bellevue.

Eight registrants were evacuated from their home on the night of the fire, and 31 registrants watched the fire.

Of the registrants, 93 (38.6%) stayed at an address in Bellevue on the night of the fire, 33 (13.7%) in another suburb of postcode 6056, and 89 (36.9%) somewhere other than Bellevue and postcode 6056.

The total number of hours registrants spent in Bellevue from 11pm 15 February to 23 February 2001 ranged from 0 to 193 hours. On average, adult registrants spent 67.4 hours in Bellevue compared with 123.3 hours among child registrants.

However, the average number of hours varied substantially between those who went to Bellevue in response to the fire and those who were residents of Bellevue. Of registrants who were part of the emergency response team, the majority spent 12 hours or less in Bellevue during the week of the fire. This compared with an average of more than 50 and 100 hours in Bellevue for those who worked or were at home respectively, on the night of the fire.

The fire exposures of registrants presented in Table 2 are very similar to those presented in the First Register Report.<sup>2</sup> A similar breakdown of most locations at the time of the fire was also recorded, however, there was a slight increase in the proportion of individuals helping with the fire in some capacity (8.7% vs. 11.5%).<sup>2</sup> The average hours spent in Bellevue during and after the fire were similar for adults and children, and the relationship between location on the night of the fire and the numbers of hours spent in Bellevue remained the same.<sup>2</sup>

## Pre-existing health conditions

Registrants were asked whether they had any conditions that had ever been diagnosed by a doctor and the impact of the fire on these conditions. Table 3 shows a summary of the pre-existing health conditions diagnosed among the registrants.

Over half of all registrants (66.4%) had at least one pre-existing health condition diagnosed by a doctor. As found in the previous report, asthma, respiratory conditions, skin conditions and allergies were the most commonly diagnosed pre-existing conditions among registrants. The number and type of other pre-existing conditions diagnosed in registrants were also similar to those shown in the first report.<sup>2</sup>

With the addition of the new registrants, the prevalence of current conditions and whether these are worse since the fire, presented in Table 3, have only changed slightly from the previous report.<sup>2</sup> For example, the addition of the new registrants increased the number of adults with asthma and other respiratory conditions by two and one respectively. As shown in the previous report, a higher proportion of registrants reported having a respiratory condition other than asthma or a skin condition compared with the Bellevue community survey and the State.<sup>2</sup>

Table 3 Pre-existing health conditions of the registrants

Registrants	Adult			Child			Total		
	N	%	% with condition	N	%	% with condition	N	%	% with condition
	200	100.0		41	100.0		241	100.0	
<b>Any pre-existing conditions</b>	140	70.0		20	48.8		160	66.4	
<b>Number of pre-existing conditions</b>									
0	60	30.0		21	51.2		81	33.6	
1	59	29.5		9	22.0		68	28.2	
2	23	11.5		6	14.6		29	12.0	
3	32	16.0		2	4.9		34	14.1	
4	9	4.5		3	7.3		12	5.0	
5+	17	8.5		0	0.0		17	7.1	
<b>Asthma</b>									
Ever diagnosed	39	19.5		10	24.4		49	20.3	
Currently have	20	10.0	51.3	7	17.1	70.0	27	11.2	55.1
Worse since fire	14	7.0	35.9	4	9.8	40.0	18	7.5	36.7
<b>Other respiratory condition</b>									
Ever diagnosed	46	23.0		7	17.1		53	22.0	
Currently have	36	18.0	78.3	5	12.2	71.4	41	17.0	77.4
Worse since fire	17	8.5	37.0	2	4.9	28.6	19	7.9	35.8
<b>Eye condition</b>									
Ever diagnosed	18	9.0		0	0.0		18	7.5	
Currently have	10	5.0	55.6	0	0.0	0.0	10	4.1	55.6
Worse since fire	4	2.0	22.2	0	0.0	0.0	4	1.7	22.2
<b>Migraine</b>									
Ever diagnosed	40	20.0		3	7.3		43	17.8	
Currently have	27	13.5	67.5	2	4.9	66.7	29	12.0	67.4
Worse since fire	18	9.0	45.0	1	2.4	33.3	19	7.9	44.2
<b>High blood pressure</b>									
Ever diagnosed	26	13.0		–	–		26	26.0	
Currently have	23	11.5	88.5	–	–	–	23	23.0	88.5
Worse since fire	4	2.0	15.4	–	–	–	4	4.0	15.4
<b>Allergies</b>									
Ever diagnosed	42	21.0		6	14.6		48	19.9	
Currently have	35	17.5	83.3	6	14.6	100.0	41	17.0	85.4
Worse since fire	13	6.5	31.0	0	0.0	0.0	13	5.4	27.1
<b>Skin condition</b>									
Ever diagnosed	46	23.0		7	17.1		53	22.0	
Currently have	39	19.5	84.8	6	14.6	85.7	45	18.7	84.9
Worse since fire	18	9.0	39.1	1	2.4	14.3	19	7.9	35.8
<b>Neurological condition</b>									
Ever diagnosed	21	10.5		0	0.0		21	8.7	
Currently have	14	7.0	66.7	0	0.0	0.0	14	5.8	66.7
Worse since fire	10	5.0	47.6	0	0.0	0.0	10	4.1	47.6
<b>Other pre-existing conditions</b>	42	21.0		6	14.6		48	19.9	

**Notes:**

Table excludes one child registrant who was not born at the time of the fire.

Missing information not shown but is included in the total when calculating percentages.

Percentage for total is for adults and children combined unless adult-only question where total is for adults.

## Fire-related health symptoms

Registrants were asked to report any health-related problems they had as a result of the fire (Table 4).

Over half of all registrants (56.8%) reported at least one fire-related health symptom. Headaches were reported by 39.4% of registrants, sore throat by 30.7%, breathing problems by 24.9% and 22.8% had at least one other symptom.

Table 4 **Fire-related health symptoms in the registrants**

Registrants	Adult		Child		Total	
	N	%	N	%	N	%
	200	100.0	41	100.0	241	100.0
<b>Any fire-related symptoms</b>	119	59.5	18	43.9	137	56.8
<b>Number of fire-related symptoms</b>						
0	81	40.5	23	56.1	104	43.2
1	41	20.5	10	24.4	51	21.2
2	29	14.5	4	9.8	33	13.7
3	28	14.0	4	9.8	32	13.3
4	13	6.5	0	0.0	13	5.4
5+	8	4.0	0	0.0	8	3.3
<b>Headache</b>	86	43.0	9	22.0	95	39.4
<b>Breathing problems</b>	54	27.0	6	14.6	60	24.9
<b>Sore throat</b>	65	32.5	9	22.0	74	30.7
<b>Other symptoms</b>	51	25.5	4	9.8	55	22.8

### Notes:

Table excludes one child registrant who was not born at the time of the fire.

Missing information not shown but is included in the total when calculating percentages.

As in the previous report, comparisons with the Bellevue Community Survey and State found a higher prevalence of headaches, breathing and sore throat among registrants.<sup>2,3,13</sup>

## Physical and emotional health and wellbeing

In addition to pre-existing health conditions and fire-related health symptoms, registrants were asked about their physical and emotional wellbeing.

Of the adult registrants, 21.5% reported a high or very high level of psychological distress in the four weeks prior to completing their questionnaire (Table 5). This was similar to the 20.7% of registrants who reported a high or very high level of psychological distress in the previous report and was significantly higher than the prevalence of 8.8% seen in the State.<sup>2,3</sup>

Table 5 **Psychological distress among registrants in four weeks prior to completing the questionnaire**

	Adult	
	N	%
<b>Registrants</b>	200	100.0
<b>Psychological distress</b>		
Low	109	54.5
Moderate	42	21.0
High	21	10.5
Vey High	22	11.0

**Note:**

Missing information not shown but is included in the total when calculating percentages.

Registrants were asked to rate their physical and emotional wellbeing at the time of completing the questionnaire, with a comparison with the previous year (Table 6). The majority of registrants rated their physical health and wellbeing (79.3%) and emotional health and wellbeing (77.3%) as being good or better. Most registrants reported their physical and emotional health and wellbeing as similar or better when compared with the previous year. However, 56 registrants (23.1%) considered their physical health and wellbeing and 28 (11.6%) considered their emotional health and wellbeing to be worse.

Table 6 Self-rated physical and emotional health and wellbeing in registrants

Registrants	Adult		Child		Total	
	N	%	N	%	N	%
	200	100.0	42	100.0	242	100.0
<b>Physical health and wellbeing rating</b>						
Excellent	16	8.0	5	11.9	21	8.7
Very good	62	31.0	17	40.5	79	32.6
Good	79	39.5	13	31.0	92	38.0
Fair	31	15.5	5	11.9	36	14.9
Poor	7	3.5	0	0.0	7	2.9
Very poor	1	0.5	0	0.0	1	0.4
<b>Physical health and wellbeing rating compared to 1 year ago</b>						
Much better now	6	3.0	0	0.0	6	2.5
Somewhat better now	13	6.5	2	4.8	15	6.2
About the same	128	64.0	31	73.8	159	65.7
Somewhat worse now	43	21.5	6	14.3	49	20.2
Much worse now	6	3.0	1	2.4	7	2.9
<b>Emotional health and wellbeing rating</b>						
Excellent	26	13.0	4	9.5	30	12.4
Very good	65	32.5	8	19.0	73	30.2
Good	65	32.5	19	45.2	84	34.7
Fair	31	15.5	6	14.3	37	15.3
Poor	7	3.5	3	7.1	10	4.1
Very poor	2	1.0	0	0.0	2	0.8
<b>Emotional health and wellbeing rating compared to 1 year ago</b>						
Much better now	6	3.0	0	0.0	6	2.5
Somewhat better now	14	7.0	4	9.5	18	7.4
About the same	150	75.0	32	76.2	182	75.2
Somewhat worse now	21	10.5	3	7.1	24	9.9
Much worse now	3	1.5	1	2.4	4	1.7

**Notes:**

All figures include a child who was born in 2003 for whom the mother completed a questionnaire.

Missing information has been included in the total when calculating percentages.

The addition of the 24 new registrants resulted in similar percentages (Table 6) to those presented in the previous report.<sup>2</sup> As found previously, registrants rated their physical health as lower compared with the State as a whole and were also more likely to report that their physical health had deteriorated in the past year.<sup>2,3</sup>

## Lifestyle factors

Registrants were asked about lifestyle factors, such as physical activity, weight classification, alcohol consumption and smoking habits, which can impact on an individual's health status (Table 7).

For physical activity, national guidelines recommend at least 150 minutes of moderate activity per week over five or more sessions.<sup>14,15</sup> There were 128 (64.0%) adult registrants that met the guidelines for physical activity. Compared with the State, Bellevue registrants were significantly more likely to meet the guidelines for sufficient physical activity (64.0% compared with 48.9%), and were significantly less likely to do no physical activity (2.5% compared with 12.9%). The previous report used older physical activity guidelines therefore comparison between reports is not possible.<sup>2</sup>

The body mass index for each registrant was calculated based on their height and weight and then classified as not overweight, overweight or obese according to international guidelines.<sup>16</sup> In adults, 18.0% of registrants were not overweight or obese, 45.0% were overweight and 23.5% were obese. In children, 47.6% were not overweight or obese, 19.0% were overweight and 16.7% were obese. These proportions are similar to those presented in the previous report, and show that there were significantly more overweight and obese adult registrants when compared with the State.<sup>3</sup>

The number of days adult registrants usually drink, and the average number of drinks per drinking session, are presented in Table 7. These numbers and percentages have changed little with the inclusion of the 16 new adult registrants.<sup>2</sup> Compared with the State, Bellevue registrants recorded a significantly lower average number of drinks on a drinking day (2.4 compared with 3.4), significantly fewer registrants reported being a non-drinker (11.5% compared with 24.7%), and no difference was found in the proportion who drink every day of the week (9.5% compared with 12.5%). The previous report used older alcohol guidelines, therefore comparison between reports is not possible.<sup>2</sup>

Of adult registrants, 100 had never smoked or never smoked regularly (50.0%), 31 (15.5%) were daily or occasional smokers and 61 (30.5%) used to smoke. The majority of registrants lived in smoke-free homes (88.5%). These numbers and percentages for smoking were very similar to the previous report, and show that a higher percentage of registrants live in smoke-free homes compared with the State, and there was a lower percentage of daily or occasional smokers compared with the State.<sup>2,3</sup>



Table 7 Lifestyle factors of registrants

Registrants	Adult		Child		Total	
	N	%	N	%	N	%
	200	100.0	42	100.0	242	100.0
<b>Physical activity</b>						
Does no leisure time physical activity	5	2.5	–	–	5	2.5
Does less than 150 mins moderate physical activity per week	52	26.0	–	–	52	26.0
Does 150 or more mins of moderate physical activity per week but not over 5 sessions	2	1.0	–	–	2	1.0
Does 150 or more mins of moderate physical activity per week over 5 or more sessions	128	64.0	–	–	128	64.0
<b>Body mass index</b>						
Not overweight or obese	36	18.0	20	47.6	56	23.1
Overweight	90	45.0	8	19.0	98	40.5
Obese	47	23.5	7	16.7	54	22.3
<b>Number of days consume alcohol</b>						
Do not drink	23	11.5	–	–	23	11.5
Less than once a week	51	25.5	–	–	51	25.5
One day a week	24	12.0	–	–	24	12.0
Two days a week	20	10.0	–	–	20	10.0
Three days a week	27	13.5	–	–	27	13.5
Four days a week	13	6.5	–	–	13	6.5
Five days a week	14	7.0	–	–	14	7.0
Six days a week	6	3.0	–	–	6	3.0
Every day	19	9.5	–	–	19	9.5
<b>Average number of standard drinks consumed per drinking session</b>						
0	30	15.0	–	–	30	12.4
0.5	2	1.0	–	–	2	0.8
1	35	17.5	–	–	35	14.5
2	74	37.0	–	–	74	30.6
3	20	10.0	–	–	20	8.3
4	23	11.5	–	–	23	9.5
5	4	2.0	–	–	4	1.7
6	4	2.0	–	–	4	1.7
8	1	0.5	–	–	1	0.4
<b>Smoking at home</b>						
Smoke-free home	177	88.5	–	–	177	88.5
People occasionally smoke	8	4.0	–	–	8	4.0
People frequently smoke	9	4.5	–	–	9	4.5
<b>Smoking status</b>						
Smoke daily	26	13.0	–	–	26	13.0
Smoke occasionally	5	2.5	–	–	5	2.5
Used to smoke	61	30.5	–	–	61	30.5
Never smoked regularly	15	7.5	–	–	15	7.5
Never smoked	85	42.5	–	–	85	42.5

**Notes:**

All figures include 1 child who was born in 2003 for whom the mother completed a questionnaire.

Missing information has been included in the total when calculating percentages.

Percentage for total is for adults and children combined unless adult-only question where total is for adults.

## Summary

An update of the health status of the registrants was necessary as a further 24 people had registered since the previous report.

The addition of 24 registrants resulted in a slightly younger overall age and an increase in the proportion of Bellevue residents. The overall health status of the registrants remained similar to that previously reported.

While there was an increase in the proportion of registrants helping with the fire, the exposure measures were similar to those previously reported.

The findings and comparisons with other relevant surveys for pre-existing and fire-related symptoms and physical emotional health and wellbeing were also similar to the previous report.

A new measure of sufficient physical activity level was introduced in this analysis which indicated that registrants were more likely to meet the physical activity guidelines than the State population and less likely not to do physical activity. Also, newer measures of alcohol consumption levels used indicated that registrants drank a lower mean number of drinks per day, but had a lower proportion of non-drinkers than the State. The prevalence of other lifestyle health risk factors, such as obesity and smoking, were similar to those previously reported.

## Chapter 5 Health service utilisation of registrants

Of the 242 registrants on the Bellevue Health Surveillance Register, 237 (97.9%) gave consent for their details to be linked to health records. Their details were then linked to the WADLS to determine whether they had been admitted to hospital, presented to EDs, been treated for a mental health condition, been diagnosed with cancer, given birth, or died.

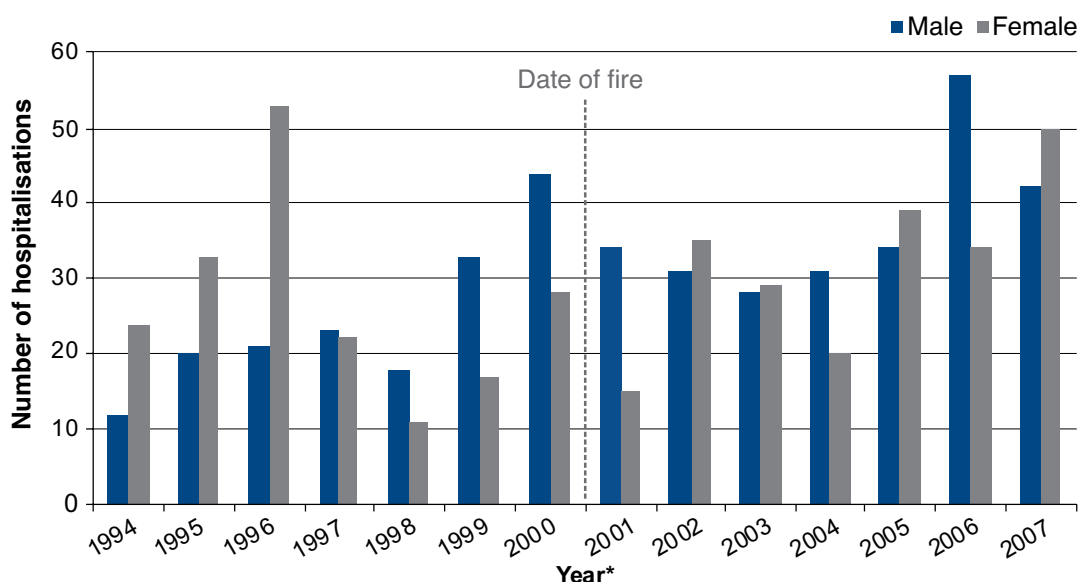
Where possible, links to health service utilisation were used to measure the ill health of registrants before and after the fire to detect any changes in ill health among registrants. To demonstrate whether any changes in ill health were peculiar to registrants, further analysis was conducted to determine whether any changes in the measures of ill health among registrants were different from those of the general population.

### Hospitalisations

#### Number and type of hospital separations

There were 195 registrants with a total of 838 hospital separation records during the 14-year study period from 1994 to 2008. There were 359 separations in the seven years prior to the fire, and 479 separations in the seven years after the fire. Figure 3 shows the number of admissions for each year, by sex, from 15 February 1994 to 14 February 2008.

Figure 3 **Number of hospitalisations of registrants, by sex, 15 February 1994–14 February 2008**



\*Year refers to calendar period of 15 February of year referenced to 14 February of next year

Males accounted for 51.1% of separations, and females 48.9% of separations. The majority of separations (54.1%) were same-day admissions and the average age on separation was 44 years.

The cause for each hospital separation is shown in Table 8.

Table 8 Number of hospitalisations of registrants, by ICD10 chapter, 15 February 1994–14 February 2008

Principal diagnosis of hospitalisation	Combined	
	N	%
Neoplasms (C00-D48)	63	7.52
Mental and behavioural disorders (F00-F99)	47	5.61
Diseases of the circulatory system (I00-I99)	64	7.64
Diseases of the digestive system (K00-K93)	146	17.42
Diseases of the musculoskeletal system and connective tissue (M00-M99)	97	11.58
Diseases of the genitourinary system (N00-N99)	60	7.16
Pregnancy, childbirth and the puerperium (O00-O99)	63	7.52
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00-R99)	49	5.85
Injury, poisoning and certain other consequences of external causes (S00-S98)	52	6.21
Factors influencing health status and contact with health services (Z00-Z99)	74	8.83
Other*	123	14.68
<b>Total</b>	<b>838</b>	<b>100.0</b>

**Notes:**

Principal diagnosis of hospitalisation is presented by chapter of the ICD10-AM.

\*No single ICD10 chapter in the “other” category was greater than 3.82% of hospitalisations.

The leading causes of hospital separation were diseases of the digestive system (17.4%), followed by diseases of the musculoskeletal system (11.6%), factors influencing health status (8.8%), and diseases of the circulatory system (7.6%). These conditions were among the leading causes reported for the State.<sup>17</sup>

## Risk of hospital separation

Age standardised rates (ASR) were calculated to determine the risk of hospital separation among registrants and the Perth metropolitan population from 15 February, 1995 until 14 February 2008. Table 9 and Figure 4 show a summary of the results.

**Table 9 Age-standardised rate of hospitalisations among registrants and Perth metropolitan population, by year, 15 February 1994–14 February 2008**

Year	N cases observed	Bellevue registrants			Perth metropolitan population		
		Crude rate	ASR	95% CI	Crude rate	ASR	95% CI
1995	54	241.11	272.84	220.48–325.19	266.90	280.86	280.32–281.40
1996	57	252.06	260.48	210.84–310.12	272.24	286.25	285.71–286.79
1997	49	214.77	211.68	173.63–249.73	279.13	292.78	292.24–293.32
1998	41	178.71	180.49	143.82–217.15	290.29	303.06	302.51–303.60
1999	50	216.03	228.21	183.02–273.39	302.00	313.56	313.02–314.11
2000	57	243.17	254.62	206.74–302.51	312.96	322.77	322.23–323.32
2001	62	264.29	271.38	223.31–319.46	320.15	328.11	327.57–328.66
2002	57	242.60	259.85	212.98–306.73	323.42	329.54	329.00–330.08
2003	58	245.76	284.34	231.67–337.02	327.68	331.95	331.42–332.49
2004	60	256.35	308.31	252.24–364.38	333.96	336.17	335.63–336.70
2005	72	305.13	310.52	257.91–363.12	341.92	342.18	341.65–342.71
2006	85	363.83	339.09	289.67–388.50	349.12	347.56	347.03–348.09

### Notes:

Crude rate = The number of hospitalisations per 1,000 population

ASR = Age and sex standardised rate per 1,000 person-years

CI = Confidence interval

Data presented are three-year moving averages with year referenced being the middle of the three-year period.

All years refer to calendar period of 15 February of year referenced to 14 February of the following year

Number of cases observed is the average of the three-year time period.

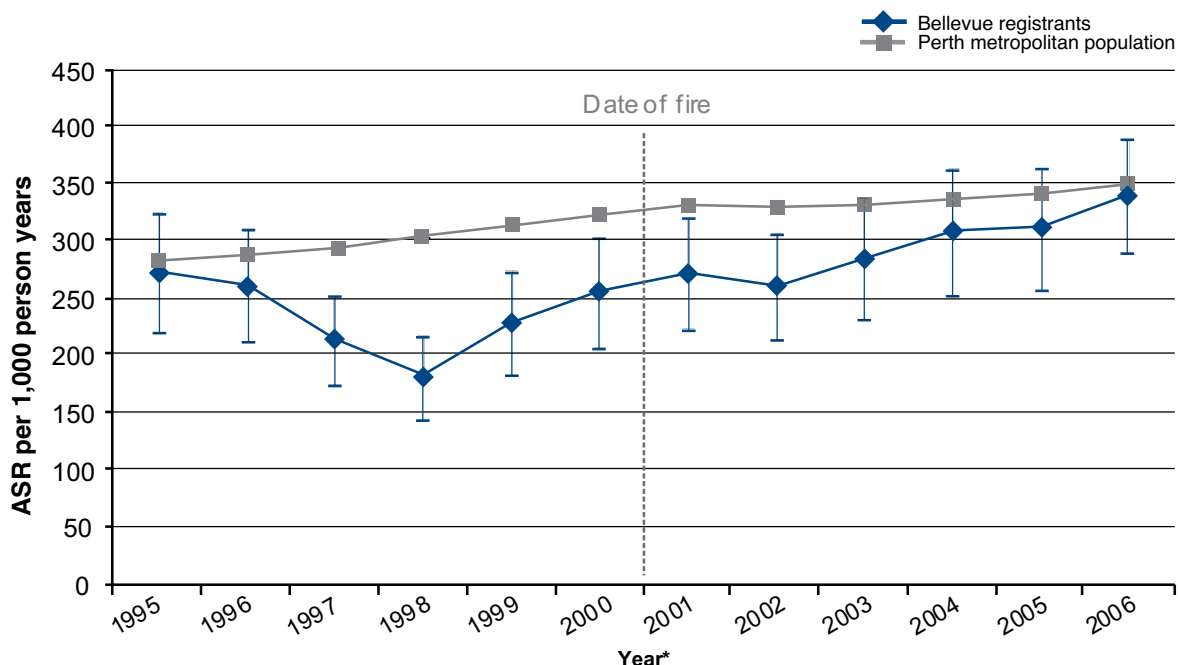
The ASR of hospital separations among Bellevue registrants fluctuated over the study period, ranging from 272.8 per 1,000 person years in 1995 to 339.<sup>1</sup> per 1,000 person years in 2006. For each ASR, the 95% Confidence Intervals (CIs) show the degree of statistical uncertainty around the actual value. Therefore, in 1995 (15 February, 1994 to 14 February, 1997), the ASR could actually range from 220.5 to 325.2 per 1,000 person years.

During this study period, the risk of hospital separation among the Perth metropolitan population also steadily increased from 280.9 per 1,000 person years (1995) to 347.6 per 1,000 person years (2006).

On average, the rate of hospital separations among registrants increased by 2.4% per year ( $p$ -value = 0.0003). In the Perth metropolitan population, the rate of hospital separation also increased, by 2.9% per year ( $p$ -value < 0.0001).

The risk of hospital separation among Bellevue registrants for each year was statistically similar or lower than the Perth metropolitan population.

Figure 4 **Age-standardised rate of hospitalisations among registrants and Perth metropolitan population, by year, 15 February 1994–14 February 2008**



\* Data presented are three-year moving averages with year referenced being the middle of the three-year period.

Year refers to calendar period of 15 February of year referenced to 14 February of the following year.

When hospital separations are combined for the seven years before the fire (15 February 1994 to 14 February 2000) and the seven years after the fire (15 February 2001 to 14 February 2008), the ASR for Bellevue registrants significantly increased from 236.7 per 1,000 person years (95% CI: 208.3-265.0) to 321.4 per 1,000 person years (95% CI: 286.1-356.8). The ASR for Perth metropolitan population also increased significantly during this time period, from 297.3 per 1,000 person years (95% CI: 297.0-297.7) prior to the fire to 338.6 per 1,000 person years (95% CI: 338.2-338.9) after the fire.

To determine whether the increase in hospital separations among Bellevue registrants was greater than the increase in the Perth metropolitan population Standardised Rate Ratios (SRR) were calculated. Table 10 shows a summary of the results.

Table 10 **Standardised rate ratio of hospitalisations among registrants, compared with Perth metropolitan population, by year and sex, 15 February 1994–14 February 2008**

Year	Sex	N cases observed	N cases expected	SRR	95% CI
1994–2000	Combined	359	390.88	0.92	0.83–1.02
2001–2007	Combined	479	546.58	0.88	0.80–0.96
1994–2000	Male	171	232.26	0.74	0.63–0.86
2001–2007	Male	257	348.50	0.74	0.65–0.83
1994–2000	Female	188	158.62	1.19	1.02–1.37
2001–2007	Female	222	198.08	1.12	0.98–1.28

**Notes:**

SRR = Standardised rate ratio

CI = Confidence interval

Year refers to calendar period of 15 February of year referenced to 14 February of the following year.

The SRR for hospital separations for the seven years before the fire was 0.92 with a 95% confidence interval (CI) of 0.83 to 1.02. This indicates that the observed number of hospital separations ( $n = 359$ ) was similar to that expected ( $n = 390.9$ ) based on the rates in the Perth metropolitan population. In each case, the 95% CIs show the degree of statistical uncertainty around the actual value of the SRR. That is, for men and women together, the lower bound of the confidence interval of 0.83 suggests that the rate of hospital separations could be as much as 17% less among registrants than in the Perth metropolitan population; the upper bound of 1.02 suggests it could be as much as 2% more.

SRRs were also calculated by sex for the seven years prior to the fire (Table 10). The number of hospital separations ( $n = 188$ ) were significantly higher than expected ( $n = 158.6$ ) among females in the seven years prior to the fire. The 95% confidence interval indicates the rate of hospitalisations was at least 2% higher than the Perth metropolitan population during this time period prior to the fire. For males in the time period prior to the fire, the number of hospital separations ( $n = 171$ ) was at least 14% lower than expected ( $n = 232.3$ ) compared to the Perth metropolitan population.

The SRR for the seven years after the fire for males and females combined was 0.88 with a 95% CI of 0.80-0.96. This indicates that the observed number of hospital separations ( $n = 479$ ) was significantly lower than expected ( $n = 546.6$ ). The 95% confidence interval indicates that the rate of hospital separations for Bellevue registrants during this time was between 20% and 4% lower than in the Perth metropolitan population.

The results by sex after the fire were similar, with the numbers of hospital separations among female registrants similar, and those among male registrants lower than expected based on the rates among the Perth metropolitan male and female population, respectively.

Considered together, Tables 9 and 10 indicate that the rate of hospitalisations in registrants has increased in the 7 years after the fire. However, the increase was not greater than that expected based on a similar increase in the Perth metropolitan area over the same time period. Statistical uncertainty means that the possibility of a small increase (or small decrease) cannot be completely ruled out.

While the rate of all-cause hospital separation among registrants may not be different from the Perth metropolitan population there may be differences in hospital separations for specific conditions. To investigate whether registrants were at a greater risk of being hospitalised for specific conditions compared with the Perth metropolitan population, SRRs were also calculated by condition (Table 11).



**Table 11 Standardised rate ratio of hospitalisations among registrants, compared with Perth metropolitan population, by ICD10 chapter and year, 15 February 1994–14 February 2008**

Principal diagnosis of hospitalisation	Year	N cases observed	N cases expected	SRR	95% CI
Certain infectious and parasitic diseases (A00-B99)	1994–2000	8	5.43	1.47	0.64–2.90
	2001–2007	–	–	–	–
Neoplasms (C00-D48)	1994–2000	20	23.37	0.86	0.52–1.32
	2001–2007	43	40.60	1.06	0.77–1.43
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50-D89)	1994–2000	–	–	–	–
	2001–2007	–	–	–	–
Endocrine, nutritional and metabolic diseases (E00-E89)	1994–2000	–	–	–	–
	2001–2007	9	9.76	0.92	0.42–1.75
Mental and behavioural disorders (F00-F99)	1994–2000	45	21.56	2.09	1.52–2.79
	2001–2007	–	–	–	–
Diseases of the nervous system (G00-G99)	1994–2000	–	–	–	–
	2001–2007	10	11.22	0.89	0.43–1.64
Diseases of the eye and adnexa (H00-H59)	1994–2000	14	6.98	2.01	1.10–3.36
	2001–2007	13	13.39	0.97	0.52–1.66
Diseases of the ear and mastoid process (H60-H95)	1994–2000	7	4.49	1.56	0.63–3.21
	2001–2007	–	–	–	–
Diseases of the circulatory system (I00-I99)	1994–2000	21	22.70	0.93	0.57–1.41
	2001–2007	43	32.76	1.31	0.95–1.77
Diseases of the respiratory system (J00-J99)	1994–2000	15	18.16	0.83	0.46–1.36
	2001–2007	17	17.94	0.95	0.55–1.52
Diseases of the digestive system (K00-K93)	1994–2000	57	51.32	1.11	0.84–1.44
	2001–2007	89	67.85	1.31	1.05–1.61
Diseases of the skin and subcutaneous tissue (L00-L99)	1994–2000	–	–	–	–
	2001–2007	7	8.48	0.83	0.33–1.70
Diseases of the musculoskeletal system and connective tissue (M00-M99)	1994–2000	40	33.06	1.21	0.86–1.65
	2001–2007	57	43.65	1.31	0.99–1.69
Diseases of the genitourinary system (N00-N99)	1994–2000	32	25.10	1.27	0.87–1.80
	2001–2007	28	26.40	1.06	0.70–1.53
Pregnancy, childbirth and the puerperium (O00-O99)	1994–2000	24	25.67	0.93	0.60–1.39
	2001–2007	39	18.91	2.06	1.47–2.82
Certain conditions originating in the perinatal period (P00-P96)	1994–2000	–	–	–	–
	2001–2007	–	–	–	–

Table 11 **Standardised rate ratio of hospitalisations among registrants, compared with Perth metropolitan population, by ICD10 chapter and year, 15 February 1994–14 February 2008 (cont.)**

Principal diagnosis of hospitalisation	Year	N cases observed	N cases expected	SRR	95% CI
Congenital malformations, deformations and chromosomal abnormalities (Q00-Q99)	1994–2000	–	–	–	–
	2001–2007	–	–	–	–
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00-R99)	1994–2000	22	18.14	1.21	0.76–1.84
	2001–2007	27	29.48	0.92	0.60–1.33
Injury, poisoning and certain other consequences of external causes (S00-T98)	1994–2000	24	27.56	0.87	0.56–1.30
	2001–2007	28	29.64	0.94	0.63–1.37
Factors influencing health status and contact with health services (Z00-Z99)	1994–2000	17	79.60	0.21	0.12–0.34
	2001–2007	57	156.45	0.36	0.28–0.47

#### Notes:

SRR = Standardised rate ratio. SRRs were only calculated where  $n > 5$ .

Statistics are not shown for categories with less than 5 hospitalisations.

CI = Confidence interval

Year refers to calendar period of 15 February of year referenced to 14 February of the following year.

Results for pregnancy, childbirth and the puerperium (O00-O99) are for female registrants only.

In the seven years before the fire, the number of hospital separations among Bellevue registrants were significantly higher than expected for mental health conditions (SRR = 2.1, 95%CI: 1.5-2.8) and eye diseases (SRR = 2.0, 95% CI: 1.1-3.4). For other conditions during this time period, the numbers of hospital separations were similar or lower than expected based on the Perth metropolitan population or the number was too small to calculate the SRR.

For the seven years after the fire, the number of hospital separations was significantly higher than expected for digestive system disorders (SRR = 1.3, 95%CI: 1.1-1.6) and pregnancy-related admissions (SRR = 2.1, 95%CI 1.5-2.8). For other conditions after the fire, the numbers of hospital separations were similar or lower than expected based on the Perth metropolitan population or the number was too small to calculate the SRR.

Additional analysis of those registrants reporting a respiratory condition other than asthma as a pre-existing diagnosis indicated that while only five registrants required hospitalisation for a respiratory condition before the fire, only two required hospitalisation for a respiratory illness after the fire.

#### Risk of people being hospitalised

In addition to examining the number of hospital separations among registrants, the number of registrants hospitalised was also investigated to determine if the number of registrants hospitalised each year, and in the years before and after fire, was higher than expected.

ASRs were calculated for the rate of people hospitalised among registrants and the Perth metropolitan population from 15 February, 1994 until 14 February 2008. Table 12 and Figure 5 show a summary of the results.

**Table 12 Age-standardised rate of people hospitalised per year among registrants and Perth metropolitan population, by year, 15 February 1994–14 February 2008**

Year	N cases observed	Bellevue registrants			Perth metropolitan population		
		Crude rate	ASR	95% CI	Crude rate	ASR	95% CI
1995	33	146.44	173.04	128.74–217.34	159.88	165.18	164.77–165.59
1996	36	159.74	175.85	131.56–220.13	157.17	162.41	162.01–162.82
1997	32	137.86	141.90	109.74–174.07	155.55	160.48	160.09–160.88
1998	31	134.03	138.50	106.10–170.89	158.12	162.65	162.26–163.05
1999	34	145.93	158.64	120.95–196.34	161.61	165.67	165.26–166.07
2000	40	170.65	185.19	143.89–226.49	165.34	168.80	168.41–169.19
2001	41	175.25	183.51	143.49–223.53	167.71	170.45	170.06–170.85
2002	42	176.30	182.10	142.83–221.36	167.84	170.05	169.66–170.43
2003	41	172.32	195.41	151.02–239.80	168.47	170.07	169.69–170.46
2004	41	174.20	186.90	144.34–229.46	169.43	170.36	169.98–170.74
2005	45	193.01	188.20	147.51–228.88	172.28	172.59	172.21–172.97
2006	50	214.60	191.69	155.50–227.88	175.45	175.15	174.77–175.52

#### Notes:

Crude rate = The number of people hospitalised per 1,000 population

ASR = Age and sex standardised rate per 1,000 person-years

CI = Confidence interval

Data presented are three-year moving averages with year referenced being middle of three-year period.

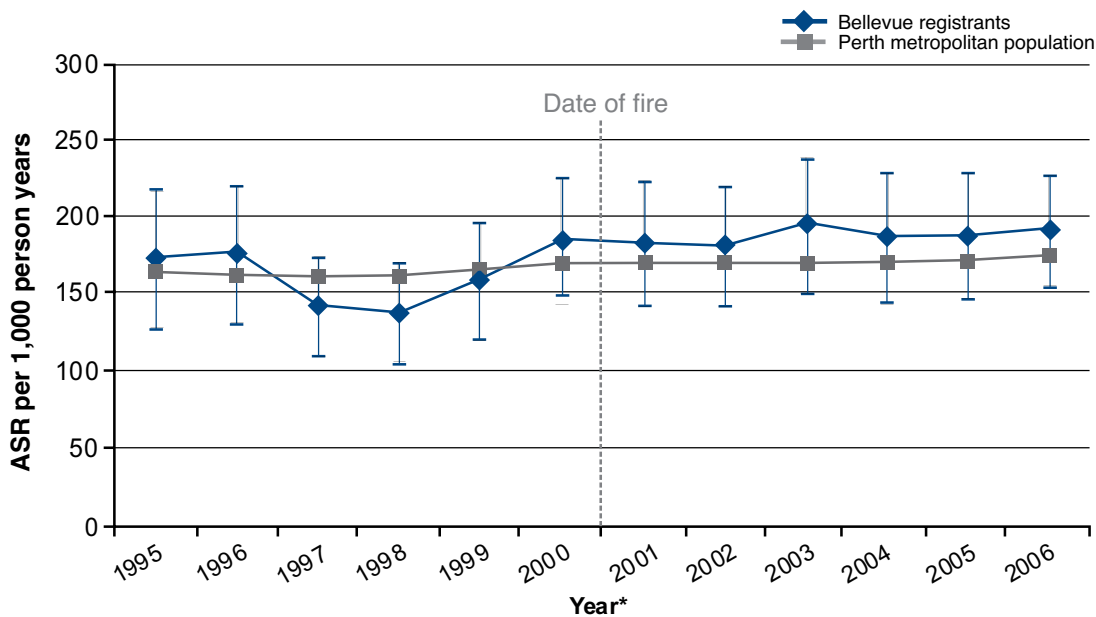
All years refer to calendar period of 15 February of year referenced to 14 February of the following year.

Results refer to number of people hospitalised during time period rather than the number of hospitalisations.

Number of cases observed is the average of the three-year time period.

The risk of registrants being hospitalised each year fluctuated over the study period, ranging from 173.0 per 1,000 person years in 1995 to 191.7 per 1,000 person years in 2006. On average, the rate of registrants being hospitalised increased by 2.0% per year ( $p$ -value = 0.0144). During this same time period, the risk of people being hospitalised among the Perth metropolitan population steadily increased from 165.2 per 1,000 person years (1995) to 175.2 per 1,000 person years (2006). The rate of hospitalisations in the Perth metropolitan population increased on average by 0.65 % per year ( $p$ -value < 0.0001).

Figure 5 **Age-standardised rate of people hospitalised per year among registrants and Perth metropolitan population, by year, 15 February 1994–14 February 2008**



\* Data presented are three-year moving averages with year referenced being the middle of the three-year period.  
 Year refers to calendar period of 15 February of year referenced to 14 February of the following year.  
 Results refer to number of people hospitalised during time period rather than the number of hospitalisations.

The risk of hospitalisation among Bellevue registrants for each year of the study period was similar to the Perth metropolitan population (Table 12). The average number of hospital separations per person per year for Bellevue registrants was 1.5 compared with 1.9 for the Perth metropolitan population.

The number of registrants hospitalised in the seven years before and after the fire was compared with that expected based on the Perth metropolitan population (Table 13).

Table 13 **Standardised rate ratio of registrants hospitalised before and after fire, compared with Perth metropolitan population, by sex and year, 15 February 1994–14 February 2008**

Year	Sex	N cases observed	N cases expected	SRR	95% CI
1994–2000	Combined	127	128.84	0.99	0.82–1.17
2001–2007	Combined	156	141.66	1.10	0.94–1.29
1994–2000	Male	78	78.08	1.00	0.79–1.25
2001–2007	Male	97	90.41	1.07	0.87–1.31
1994–2000	Female	49	50.75	0.97	0.71–1.28
2001–2007	Female	59	51.25	1.15	0.88–1.49

**Notes:**

SRR = Standardised rate ratio

CI = Confidence interval

Year refers to calendar period of 15 February of year referenced to 14 February of the following year.

Results refer to number of people hospitalised during time period rather than the number of hospitalisations.

The SRR for the seven years before the fire for males and females combined was 0.99 with a 95% CI of 0.82-1.17. This indicates that the observed number of people hospitalised ( $n = 127$ ) is not statistically different from that expected ( $n = 128.8$ ) based on the Perth metropolitan population. The 95% CI indicates that the rate of people hospitalised during this time could have ranged from 18% lower to 17% higher. Similar results were found when disaggregating by sex.

The observed number of registrants hospitalised for the seven years after the fire for both sexes combined, and for males and females separately, was also similar to the number expected based on the Perth metropolitan population.

Considered together, Tables 12 and 13 indicate that the risk of Bellevue registrants being hospitalised at least once each year was similar or slightly increased in the 7 years after the fire. This risk was not greater than that expected based on a similar increase in the Perth metropolitan area over the same time period. Statistical uncertainty means that the possibility of a small increase (or small decrease) cannot be completely ruled out.

## Emergency department (ED) presentations

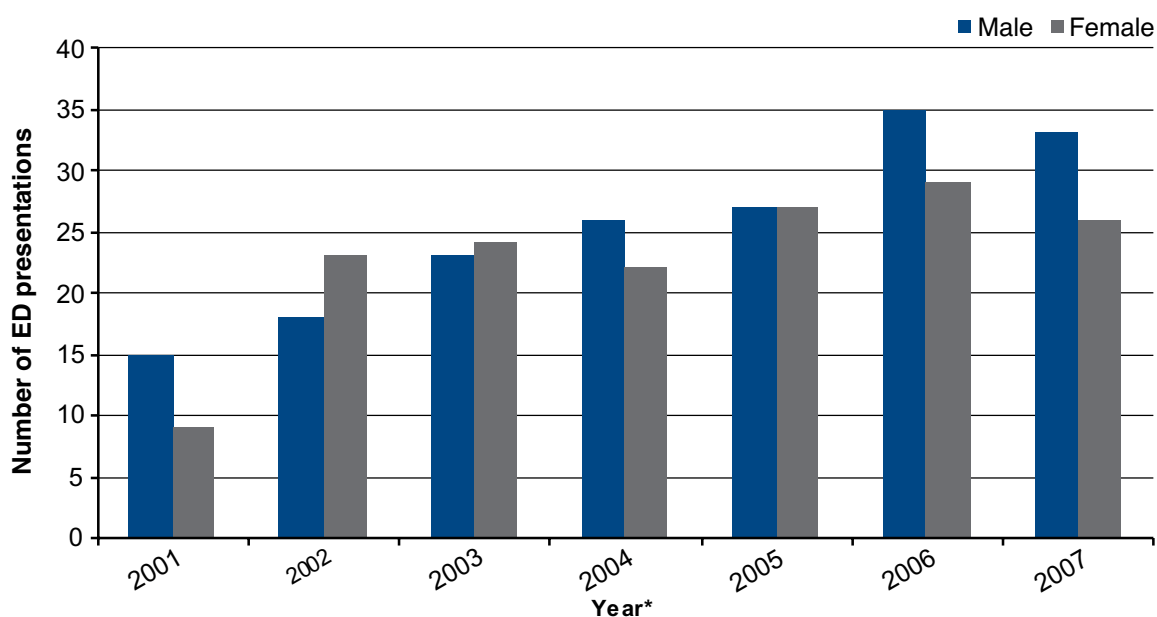
### Number and type of ED presentations

There were 115 registrants that presented to EDs 337 times in the seven years after the fire. Records of presentations before the fire were not available. Of the 337 presentations, 52.0% were male and 48.0% were female. The average age on presentation was 42.3 years for males and 39.9 years for females. The number of presentations for each year by sex is shown in Figure 6.

Of all ED attendances, the majority were emergency presentations (86.4%) rather than return visits, referrals or transfers. The triage category for the presentations were non-urgent for 41 (12.2%), semi-urgent for 159 (47.2%), urgent for 88 (26.1%), emergency for 45 (13.4%), and 4 (1.2%) required resuscitation. Of all presentations, 27.3% were required to be admitted to hospital or transferred to another care facility.

Information was available on the diagnosis for 77.2% of all ED presentations for registrants. Of those with a diagnosis, the leading causes were injury (32.3%), followed by symptoms, signs and abnormal clinical and laboratory findings (15.8%) and diseases of the respiratory system (9.6%), digestive system (8.5%), and circulatory system (7.3%).

Figure 6 **Number of emergency department presentations of registrants, by sex, 15 February 2001–14 February 2008**



\*Year refers to calendar period of 15 February of year referenced to 14 February of the following year

### Risk of ED presentation

Age-standardised rates were calculated for presentations among registrants and the Perth metropolitan population from 15 February 2001 until 14 February 2008. Table 14 and Figure 7 show a summary of the results.

Table 14 **Age-standardised rate of emergency department presentations among registrants and the Perth metropolitan population, by year, 15 February 2001–14 February 2008**

Year	N cases observed	Bellevue registrants			Perth metropolitan population		
		Crude rate	ASR	95% CI	Crude rate	ASR	95% CI
2002	37	157.97	229.89	116.63–343.14	154.55	156.69	156.05–157.34
2003	45	192.09	269.02	166.92–371.11	186.26	188.91	188.21–189.61
2004	50	211.03	356.31	215.73–496.88	200.40	202.95	202.23–203.67
2005	55	235.59	372.75	232.18–513.32	221.95	224.33	223.58–225.08
2006	59	251.55	374.53	218.93–530.12	240.15	242.25	241.48–243.02

**Notes:**

Crude rate = The number of emergency department presentations per 1,000 population

ASR = Age and sex standardised rate per 1,000 person-years

CI = Confidence interval

Data presented are three-year moving averages with year referenced being the middle of the three-year period.

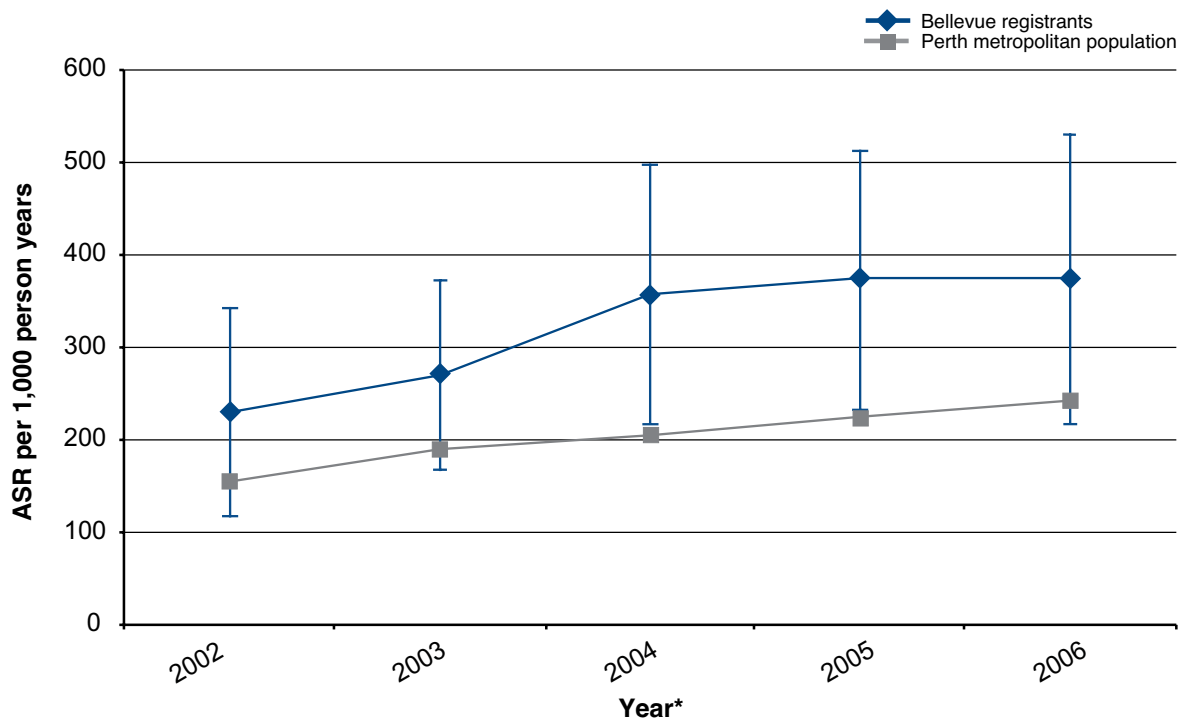
Years refer to calendar period of 15 February of year referenced to 14 February of the following year.

Number of cases observed is the average of the three-year time period.

The rate of ED presentations among registrants increased over the study period, ranging from 229.9 per 1,000 person years in 2002 to 374.5 per 1,000 person years in 2006. During this same time period, the rate of hospitalisation among the Perth metropolitan population also increased from 156.7 per 1,000 person years to 242.3 per 1,000 person years.

On average, the rate of ED presentations among the registrants increased by 10.03% per year ( $p$ -value = 0.0005). In the Perth metropolitan population, the rate of presentation also increased, by 10.79 % per year ( $p$ -value < 0.0001). The increase, in both registrants and the Perth metropolitan population, is partly due to improvements in data collection during this time (see Chapter 3).

Figure 7 **Age-standardised rate of emergency department presentations among registrants and Perth metropolitan population, by year, 15 February 2001–14 February 2008**



\*Data presented are three-year moving averages with year referenced being middle of three-year period. All years refer to calendar period of 15 February of year referenced to 14 February of the following year.

When the seven years after the fire are combined, the ASR for Bellevue registrants was 301.9 per 1,000 person years (95% CI: 258.1-345.6) compared with 201.4 per 1,000 person years (201.1-201.6) in the Perth metropolitan population. This indicates that on average, for this time period, the rate of ED admissions for registrants was higher than for the Perth metropolitan population.

The numbers of ED presentations among registrants in the seven years after the fire were compared with those expected based on the Perth metropolitan population (Table 15).



Table 15 **Standardised rate ratio of emergency department presentations among registrants, compared with the Perth metropolitan population, by year and sex, 15 February 2001–14 February 2008**

Year	Sex	N cases observed	N cases expected	SRR	95% CI
2001–2007	Combined	337	279.90	1.20	1.08–1.34
2001–2007	Male	177	187.75	0.94	0.81–1.09
2001–2007	Female	160	92.15	1.74	1.48–2.03

**Notes:**

SRR = Standardised rate ratio

CI = Confidence interval

Year refers to calendar period of 15 February of year referenced to 14 February of the following year.

The SRR for ED presentations for the seven years after the fire was 1.20 with a 95% confidence interval (CI) of 1.08 to 1.34. This indicates that the observed number of ED presentations ( $n = 337$ ) was greater than that expected ( $n = 279.9$ ) based on the rates in the Perth metropolitan population. The confidence interval indicates that the increase is at least 8% higher than expected.

By sex, the SRRs for ED presentations for the seven years after the fire were 0.94 (95%CI 0.81-1.09) for males and 1.74 (95%CI 1.48-2.03) for females. For males, this indicates the expected number of ED presentations ( $n = 177$ ) was similar to that expected ( $n = 187.8$ ). For females, this indicates the expected number of ED presentations ( $n = 160$ ) was greater than that expected ( $n = 92.2$ ). The CI indicates the excess among females was at least 48% higher than expected.

Considered together, Tables 14 and 15 indicate that while the overall rate of registrants presenting to the ED in the seven years after the fire was higher than expected based on the Perth metropolitan population, this was due to a higher presentation rate in female registrants. It was not possible to determine whether the rate of ED presentations was higher than the Perth metropolitan population in the seven years before the fire as complete ED presentation data were not available for this period.

## Mental health occasions of service

### Number and type of mental health occasions of service

There were 15 registrants that accessed outpatient and community mental health care facilities during the study period (15 February 1994–14 February 2008) of which four were male and 11 were female. In total, these 15 registrants had 465 occasions of service, 397 were prior to the fire and 68 were after the fire. The average age at each occasion of service was 44.8 years overall; 48.8 years for males and 23.2 years for females.

The average number of occasions of service per person during the study period was 31; however, the median was six as there was one patient with over 350 occasions of service. The number of registrants who accessed services each year ranged from 0 to 12.

### Risk of mental health outpatient and community occasions of service

Age-standardised rates were calculated for mental health occasions of service among registrants and the Perth metropolitan population from 15 February, 1994 until 14 February 2008. Table 16 shows a summary of the results.

The rate of mental health occasions of service among Bellevue registrants increased from 53.0 per 1,000 person years in 1996 to 226.9 per 1,000 person years in 1999, before declining to 79.9 per 1,000 in 2006. During this same time period, the risk of mental health occasions of service among the Perth metropolitan population ranged from 222.5 per 1,000 person years (1996) to 245.8 per 1,000 person years (2006).

While on average the rate of mental health occasions of service in the Perth metropolitan population increased by 0.36% per year (p-value <0.0001), there was no linear trend identified for Bellevue registrants, with the highest rates occurring before the fire.

The risk of mental health occasions of service for Bellevue registrants for each year of the study period was similar or lower when compared with the Perth metropolitan population.

**Table 16 Age-standardised rate of mental health occasions of service among registrants and Perth metropolitan population, by year, 15 February 1994–14 February 2008**

Year	N cases observed	Bellevue registrants			Perth metropolitan population		
		Crude rate	ASR	95% CI	Crude rate	ASR	95% CI
1995	–	–	–	–	212.52	222.56	222.08–223.04
1996	12	51.29	53.01	33.50–72.51	222.03	230.07	229.56–230.55
1997	24	104.48	77.01	55.26–98.75	231.01	237.17	236.69–237.65
1998	79	343.01	206.89	176.02–237.76	228.12	232.69	232.22–233.16
1999	119	512.18	226.92	202.96–250.88	227.03	229.85	229.39–230.31
2000	109	463.59	193.24	171.95–214.53	221.03	222.28	221.84–222.73
2001	55	234.61	97.00	81.07–112.93	220.37	220.43	219.99–220.88
2002	9	38.08	48.23	28.45–68.02	217.78	217.18	216.75–217.61
2003	6	26.84	39.89	19.86–59.92	219.85	219.00	218.57–219.43
2004	9	39.66	64.44	37.36–91.53	223.94	222.87	222.44–223.30
2005	12	49.67	69.71	45.88–93.54	235.20	233.85	233.42–234.29
2006	13	56.85	79.93	53.29–106.57	247.39	245.78	245.33–246.22

#### Notes:

Crude rate = The number of mental health occasions of service per 1,000 population

ASR = Age and sex standardised rate per 1,000 person-years. ASRs were only calculated where  $n > 5$ .

CI = Confidence interval

Data presented are three-year moving averages with year referenced being the middle of the three-year period.

Years refer to calendar period of 15 February of year referenced to 14 February of the following year.

Number of cases observed is the average of the three-year time period.

Comparison of the ASR for mental health occasions of service seven years before and after the fire, found the ASR for registrants significantly decreased from 147.6 per 1,000 person years (95% CI 132.0-163.3) before the fire, to 65.8 per 1,000 person years (95% CI 226.6-227.2) after the fire. The ASR for the Perth metropolitan population significantly increased during this time period, from 226.9 per 1,000 person years (95% CI 226.6-227.2) before the fire to 230.9 per 1,000 person years (95% CI 230.7-231.2) after the fire.

The number of mental health occasions of service in the seven years before and after the fire was compared to that expected based on the Perth metropolitan population (Table 17).

Table 17 **Standardised rate ratio of mental health occasions of service among registrants, compared to the Perth metropolitan population, by year and sex, 15 February 1994–14 February 2008**

Year	Sex	N cases observed	N cases expected	SRR	95% CI
1994–2000	Combined	397	375.41	1.06	0.96–1.17
2001–2007	Combined	68	402.60	0.17	0.13–0.21
1994–2000	Male	370	264.98	1.40	1.26–1.55
2001–2007	Male	21	261.67	0.08	0.05–0.12
1994–2000	Female	27	110.43	0.24	0.16–0.36
2001–2007	Female	47	140.93	0.33	0.25–0.44

**Notes:**

SRR = Standardised rate ratio

CI = Confidence interval

Year refers to calendar period of 15 February of year referenced to 14 February of the following year.

The SRR for the seven years before the fire for males and females combined was 1.06 with a 95% CI of 0.96-1.17. This indicates that the observed number of mental health occasions of service ( $n = 397$ ) was not statistically different to that expected ( $n = 375.4$ ) based on the Perth metropolitan population. The 95% CI indicates that the rate of registrants hospitalised for mental health conditions during this time could have ranged from 4% lower to 17% higher than the Perth metropolitan population.

In the same time period, the number of observed mental health occasions of service ( $n = 370$ ) among males was higher than expected ( $n = 265.0$ ) based on the Perth Metropolitan population. For females, the number of observed mental health occasions of service ( $n = 27$ ) was lower than expected ( $n = 110.4$ ) based on the Perth metropolitan population.

The SRR for the seven years after the fire for males and females combined was 0.17 with a 95% CI of 0.13-0.21. This indicates that the observed number of mental health occasions of service ( $n = 68$ ) was significantly lower than expected ( $n = 402.6$ ) based on the Perth metropolitan population. The 95% CI indicates that the rate of mental health occasions of service among registrants during this time was at most 79% lower. Results for males and females during this time period were similar.

Considered together, Tables 16 and 17 indicate that the rate of mental health occasions of service among male Bellevue registrants decreased in the seven years after the fire, and remained stable among female Bellevue registrants. Furthermore, the rate of mental health occasions of service in registrants was not greater than that expected based on the rates in the Perth metropolitan population over the period after the fire, among males or females.

### Risk of people attending an outpatient and community mental health service

An individual might have attended a mental health outpatient service multiple times within the study period. So, in addition to examining the overall number of mental health occasions of service among registrants, the number of registrants contacting a mental health outpatient service was also investigated to determine whether the number of registrants attending mental health outpatient facilities was higher than expected.

Although the number of mental health occasions of service for males during the period before the fire was high (Table 17), the number of individuals attending a mental health outpatient service before and after the fire was low (Table 18). As a result of the small numbers it was not possible to compare the rate of attendance at mental health outpatient services before and after the fire among registrants.

SRRs were calculated to determine whether the number of registrants attending a mental health outpatient service in the seven years before and after the fire were different from that expected based on the Perth metropolitan population (Table 18).

**Table 18 Standardised rate ratio of mental health occasions of service before and after fire, compared with Perth metropolitan population, 15 February 1994–14 February 2008**

Year	Sex	N cases observed	N cases expected	SRR	95% CI
1994–2000	Combined	5	7.08	0.71	0.23–1.65
2001–2007	Combined	11	10.36	1.06	0.53–1.90

#### Notes:

SRR = Standardised rate ratio

CI = Confidence interval

Year refers to calendar period of 15 February of year referenced to 14 February of the following year.

Results refer to the number of people with mental health occasions of service during time period rather than the number of occasions of service.

The SRR for the seven years before the fire for males and females combined was 0.71 with a 95% CI of 0.23-1.65. This indicates that the rate of registrants with at least one mental health outpatient attendance before the fire could be 77% lower or up to 65% higher than the rate for the Perth metropolitan population.

The SRR for the seven years after the fire for males and females combined was 1.06 with a 95% CI of 0.53-1.90. This indicates that the rate of registrants with at least one mental health occasion of service after the fire could be 47% lower or up to 90% higher than the rate of the Perth metropolitan population.

The rate of registrants with at least one mental health occasion of service was statistically similar to the rate in the Perth metropolitan population before and after the fire, indicating that the rate among registrants remained the same relative to the Perth metropolitan population. Statistical uncertainty means that the possibility of a small increase (or small decrease) cannot be completely ruled out.

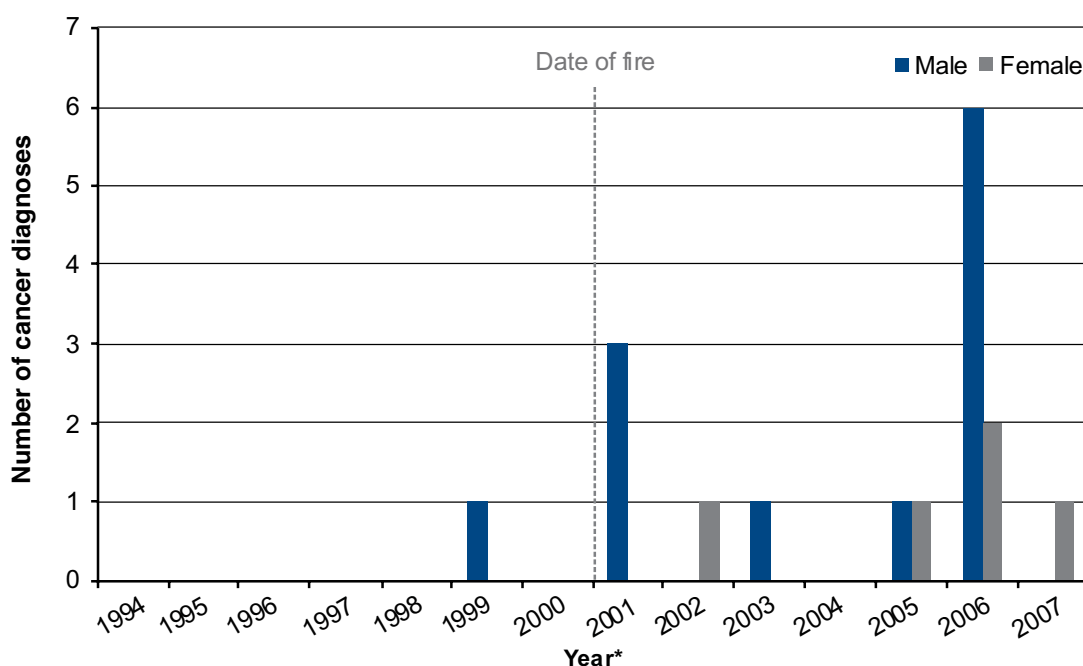
## Cancer

### Number and type of cancers

There were 17 cancers diagnosed in 13 registrants during the 14-year study period. Four registrants were diagnosed with multiple cancers.

Of the 17 cancers, one was diagnosed before the fire and the remaining 16 were diagnosed after the fire (Figure 8). Diagnoses in males accounted for 70.6% compared with 29.4% in females. The average age at diagnosis was 55 years overall, 53 years for males and 60 years for females.

Figure 8 **Number of cancers diagnosed in registrants, by sex, 15 February 1994–14 February 2008**



\*Year refers to calendar period of 15 February of year referenced to 14 February of the following year.

The types of cancers diagnosed in the registrants are shown in Table 19. The most common types were skin melanoma ( $n = 4$ ), in situ skin melanoma ( $n = 3$ ), prostate cancer ( $n = 2$ ) and uncertain behaviour colorectal carcinoma ( $n = 2$ ). Prostate cancer, colorectal cancer and melanoma were also among the leading types of cancer incidence in the State during this period.<sup>18</sup>

Table 19 **Number and type of cancers diagnosed in registrants, February 15 1994-February 14 2008**

Cancer type	N
Melanoma (skin)	4
In situ skin melanoma	3
Prostate	2
Uncertain behaviour colorectal carcinoma	2
Breast	1
Colorectal cancer	1
Eye and lacrimal gland	1
Hodgkin lymphoma	1
Lip, gum and mouth	1
Lung, bronchus and trachea	1

The standardised incidence ratios (SIRs) were calculated for the registrants, by sex and year, based on the rate of cancer in the Perth metropolitan population (Table 20).

Table 20 **Standardised rate ratio of cancer among registrants, compared with the Perth metropolitan population, by sex and year, 15 February 1994–14 February 2008**

Year	Sex	N cases observed	N cases expected	SIR	95% CI
1994–2000	Combined	1	5.86	0.17	0.01–0.95
2001–2007	Combined	16	10.79	1.48	0.85–2.41
1994–2000	Male	1	3.60	0.28	0.01–1.55
2001–2007	Male	11	7.20	1.53	0.76–2.73
1994–2000	Female	–	–	–	–
2001–2007	Female	5	3.59	1.39	0.45–3.25

**Notes:**

SIR = Standardised incidence ratio. SIRs were not calculated where the observed cases was <5

CI = Confidence interval

Year refers to calendar period of 15 February of year referenced to 14 February of the following year.

The SIRs for cancer from 15 February 1994 to 14 February 2000 could not be calculated due to the small number of cancer diagnoses in this time period. The SIR for cancer from 15 February 2001 to 14 February 2007 was 1.48 with a 95% CI of 0.85 to 2.41. This indicates that the rate of cancer incidence after the fire could be 15% lower or up to 141% higher than the rate among Perth metropolitan population. Similar results were also found by sex. Statistical uncertainty means that the possibility of a small increase (or small decrease) cannot be completely ruled out.

## Deaths

Of the 237 registrants, three were deceased seven years after the fire (up to 14 February, 2008). Due to the small number of deaths among registrants, further details are suppressed in this report to protect confidentiality, but they varied in age, sex and cause, and thus were highly unlikely to be related to the fire.

No further analysis could be conducted due to the small number of deaths among registrants.

## Births

During the study period, there were 33 births registered to or for registrants. This includes the registrations of births for children who were registrants and also births to mothers who were registrants (where the child was not a registrant). There were 14 births in the seven years before the fire and 19 births in the seven years after the fire. All were single births except for one set of twins.

The number of births each year fluctuated from one to six. The crude birth rate was on average lower than the Perth metropolitan birth rate, but varied by year. The fetal death rate was lower than in the Perth metropolitan population, as there were no births resulting in fetal deaths among female registrants confined during the study period. Although the number of babies born to mothers on the register with a low birth weight (less than 2500 grams) was low, the percentage of low birth weight babies born to mothers on the register was approximately twice that in the Perth metropolitan population. The percentage of low birth weight babies was similar before and after the fire. All five low birth weight babies weighed more than 1500 grams and thus were not in the very low or extremely low birth weight categories.

An alternative measure of assessing the appropriateness of fetal growth, the POBW, was analysed for all births in the study during the study period. The POBW was estimated for 14 births in the seven years before the fire and 13 births in the seven years after the fire. Estimation of the POBW in the period after the fire was not possible for 4 births because of missing values for variables used in the estimation of optimal birth weight and for a further two births which were a set of twins. Statistically there was no difference in the mean POBW for births in the study before and after the fire and in comparison with the metropolitan area. However, statistical uncertainty means that the possibility of a small difference cannot be completely ruled out (Table 21).

Table 21 Mean of proportion of optimal birth weight for births before and after fire, compared with Perth metropolitan population, 15 February 1994–14 February 2008

Period	Bellevue			Perth metropolitan		
	Births	Mean	95% CI	Births	Mean	95% CI
1994–2000	14	97.0	89.2–104.8	108461	98.1	98.0–98.1
2001–2007	13	92.8	86.1–99.4	82998	99.0	98.9–99.1

**Note:**

Calculation of the proportion of the optimal birth weight was not possible for four births in the period after the fire due to missing values and for one set of twins.

## Summary

The data presented in this chapter described the pattern of health service utilisation of registrants in terms of hospitalisation, emergency department presentations and mental health occasions of service. Birth, cancer and death registrations among registrants were also reported as an indication of changes in health status.

While the comparison of hospitalisation rates among registrants before and after the fire indicated an increase after the fire, this pattern was reflected in a similar trend in hospitalisation of the Perth metropolitan population. In addition there was no indication of a higher rate of hospitalisation among registrants compared with the Perth metropolitan population after the fire. Only the rate of hospitalisation for treatment of diseases of the digestive system was higher among registrants than the Perth metropolitan population after the fire.

The reasons for ED presentations after the fire were dominated by injuries. The improvements in the data collection of ED presentations and gradual inclusion of presentations from all EDs in WA in the data collection partly accounted for the observed increase in presentation rate among registrants and the Perth metropolitan population. While the rate of ED presentation among registrants was higher than the Perth metropolitan population, when comparing between genders, the rate among female registrants was higher than males in the Perth metropolitan population.

There was a low number of registrants who made a large number of contacts with mental health outpatient services, particularly in the period before the fire. The higher rate of hospitalisations for mental health disorders than the Perth metropolitan population in this period is consistent with this finding. However, the rate of attendance at mental health outpatient services among registrants decreased after the fire and was lower than that of the Perth metropolitan population.

The types of cancers identified among registrants were amongst those commonly found in the general population. The incidence of all cancers among registrants was similar to that found in the Perth metropolitan population.



The very small number of deaths among registrants during the study period meant that statistical analysis of death records was not possible.

Further investigation of low birth weight births registered to or for registrants indicated that there was no statistical difference in the mean POBW before and after the fire or compared with Perth metropolitan births.

## Chapter 6 Exposure and ill health

The previous chapter described the contacts with the health system of the registrants as a group compared with the general population. This chapter will focus on determining whether there was any association between contacting health services for ill health and exposure to the fire. While controlling for other factors that might influence contacting health services for ill health, the analysis will also determine whether the risk of contacting health services for ill health was different among groups of registrants, and in particular whether there was a difference between residents and emergency service workers.

To determine any association between contacting health services for ill health and exposure to the fire, information from the Bellevue Register and health services records were linked for those registrants who gave consent for their data to be linked ( $n = 237$ ).

### Contact with health services

Logistic regression analysis was conducted using any contact with health services (yes/no) as the outcome variable. Any contact with health services after the fire was chosen to increase the numbers within the analysis and was defined as any admission to hospital (excluding pregnancy, childbirth and the puerperium), emergency department presentation, mental health occasion of service, cancer diagnosis or death.

Only adults were included in the analysis as there was no variation among children, including variables used to measure exposure.

Table 22 shows the results from the logistic regression for the independent effect of each variable that may influence contact with health services. Not every variable captured in the register was included in the regression and only those with sufficient numbers, of greatest relevance or considered the best measures for exposure are shown. Exposure was measured by fire location, area of residence and hours spent in Bellevue. Fire location was categorised into emergency services and the general public.

Only age was associated with the risk of contact with health services ( $OR = 1.03$ ;  $CI = 1.01-1.06$ ). The risk was lower for middle-aged adults than younger adults but highest for the oldest adults. The odds ratios (ORs) for emergency services, males, high psychological distress and excess body mass were low, but not different from reference categories. High ORs were found for other employment and any contact with health services before the fire, but were also not different from the reference categories.

Of the pre-existing and fire-related symptoms, none was related to contact with health services for ill health after the fire.

Table 22 Crude odds ratios (OR) for risk of contact with health services, adult registrants only, for selected variables

	No contact with health system (N=50)		Contact with health system (N=146)		Risk of contact with health system		
	N	%	N	%	OR	95% CI	P-value
<b>Fire location</b>							
Member of public (ref)	32	64.00	110	75.34	–		
Emergency services	18	36.00	36	24.66	0.58	0.29–1.16	0.123
<b>Sex</b>							
Female (ref)	11	22.00	51	34.93	–		
Male	39	78.00	95	65.07	0.53	0.25–1.11	0.093
<b>Age</b>							
16 to 34 years	12	24.00	34	23.29	–		
35 to 44 years	23	46.00	34	23.29	0.52	0.22–1.21	
45 to 54 years	11	22.00	44	30.13	1.41	0.56–3.59	
55 years and older	4	8.00	34	23.29	3.00	0.88–10.23	0.011*
<b>Area of residence (Feb 2001)</b>							
Other (ref)	26	52.00	82	56.16	–		
Bellevue	17	34.00	46	31.51	0.86	0.42–1.75	0.672
Other suburbs in postcode 6056	7	14.00	18	12.33	0.82	0.31–2.17	0.682
<b>Current occupation</b>							
Not currently employed (ref)	15	30.00	34	23.29	–		
Firefighter/Emergency services	11	22.00	28	19.18	1.12	0.45–2.83	0.806
Other employment	24	48.00	84	57.53	1.54	0.72–3.30	0.261
<b>Any pre-existing conditions</b>							
No (ref)	16	32.00	43	29.45	–		
Yes	34	68.00	103	70.55	1.13	0.56–2.25	0.735
<b>Any fire-related symptoms</b>							
No (ref)	21	42.00	58	39.73	–		
Yes	29	58.00	88	60.27	1.10	0.57–2.11	0.777
<b>Psychological distress</b>							
Low (ref)	24	48.00	82	56.16	–		
Moderate	12	24.00	30	20.55	0.73	0.33–1.64	0.449
High	9	18.00	12	8.22	0.39	0.15–1.04	0.059
Very high	5	10.00	17	11.64	1.00	0.33–2.98	0.993
<b>BMI categories</b>							
Not overweight or obese (ref)	6	12.00	30	20.55	–		
Overweight	24	48.00	64	43.84	0.53	0.20–1.44	0.215
Obese	12	24.00	33	22.60	0.55	0.18–1.65	0.286
<b>Current smoker</b>							
No (ref)	41	82.00	117	80.14	–		
Yes	8	16.00	22	15.07	0.96	0.40–2.33	0.934

Table 22 Crude odds ratios (OR) for risk of contact with health services, adult registrants only, for selected variables (cont.)

	No contact with health system (N=50)		Contact with health system (N=146)		Risk of contact with health system		
	N	%	N	%	OR	95% CI	P-value
<b>Any previous contact with health system</b>							
No (ref)	28	56.00	65	44.52	–	–	–
Yes	22	44.00	81	55.48	1.59	0.83–3.03	0.162
	N	Mean	N	Mean	OR	95% CI	P-value
<b>Hours spent in Bellevue</b>							
Feb 15-23	50	69.64	146	67.11	1.00	1.00–1.00	0.837
Feb 15-17	50	19.53	146	18.26	1.00	0.98–1.01	0.679
Feb 18-23	50	50.11	146	48.85	1.00	0.99–1.01	0.893
Years resident in Bellevue	50	2.45	146	1.92	0.96	0.89–1.05	0.383
Years resident in other suburbs in postcode 6056	50	1.69	146	1.01	0.93	0.84–1.03	0.153
Number of pre-existing conditions	50	1.78	146	1.73	0.99	0.84–1.16	0.865
Number of fire-related conditions	50	1.26	146	1.46	1.09	0.88–1.34	0.447
Hours spent doing physical activity per week	62	5.16	163	5.46	1.00	0.95–1.05	0.916
Number of alcohol drinks per week	48	5.02	141	6.51	1.03	0.98–1.08	0.233
Number of previous contacts with health system	50	8.60	146	1.75	0.99	0.97–1.01	0.317

**Notes:**

For location at the time of fire, 'member of public' includes those at home, work, visiting Bellevue, away or other. 'Emergency services' refers to those involved in the emergency response to the fire.

Area of residence refers to home address during the month of February 2001.

Current occupation refers to occupation in 2001.

\* p-value for trend across age categories.

Years resident in Bellevue or other suburbs in postcode 6056 refers to home address in 10 years prior to fire (Jan 1991-Feb 2001).

An analysis of each of the exposure variables was conducted to control for the impact of age. Adjusting for age had little impact on the results. For fire location, the OR for emergency services increased marginally from 0.58 to 0.64, while the OR for hours in Bellevue during 15 to 23 February 2001 remained 1.00. There was no association found between exposure and contact with health services.

A separate analysis, including age and sex, of the impact of other variables on the relationship between exposure and contact with health services after the fire was conducted for those variables that changed the OR for the emergency services category of fire location by more than 10% when modelled individually. The number of years resident in Bellevue was used in the model rather than ever lived in Bellevue as this improved the fit of the model.

The results of the multivariate analysis show that males (OR = 0.31) were less likely to contact health services than females and the 95% CIs indicate that males were at least 9% less likely to contact health services than females. As age increases (OR = 1.05) the likelihood of contacting health services increased, with the 95% CI indicating an increase in one year of age resulting in at least a 2% increase in likelihood of contacting health services (Table 23). The relationship between emergency services category of fire location (OR = 0.69) and contacting health services remained the same as in the univariate analysis. There appeared to be no relationship between any of the other variables included in the model and contacts with health services. Results of the analysis indicate that emergency services registrants who responded to the fire are similar in their risk of having contact with health services as registrants who were members of the general public on the night of the fire.

Modelling of hours in Bellevue from 15 to 23 February as an alternative exposure variable indicated that none of the other variables that may influence the effect of exposure and contact with health services changed the OR by any degree. Therefore, hours in Bellevue was not related to contact with health services after the fire.

Modelling the number of contacts with the health system was attempted, but a model that accounted for a sufficient amount of the variation was unable to be derived using either Poisson or Negative Binomial regression.

Table 23 **Adjusted odds ratio (OR) for risk of contact with health services with fire location as the measure of exposure, adults only, selected variables**

	Risk of contact with health system		
	OR	95% CI	P-value
<b>Fire location</b>			
Member of public (ref)	–		
Emergency services	0.69	0.25–1.96	0.487
<b>Sex</b>			
Female (ref)	–		
Male	0.31	0.11–0.91	0.034
<b>Current occupation</b>			
Not currently employed (ref)	–		
Firefighter / Emergency services	1.56	0.38–6.38	0.539
Other employment	2.33	0.77–7.05	0.135
<b>BMI categories</b>			
Not overweight or obese (ref)	–		
Overweight	0.63	0.19–2.04	0.440
Obese	0.66	0.19–2.31	0.512
<b>Age (in years)</b>	1.05	1.02–1.09	0.002
<b>Years resident in Bellevue</b>	0.89	0.79–1.01	0.076
<b>Years resident in other suburbs in postcode 6056</b>	0.88	0.77–1.01	0.076
<b>Number of alcohol drinks per week</b>	1.03	0.97–1.09	0.402

**Notes:**

For location at the time of fire, “member of public” includes those at home, work, visiting Bellevue, away or other. “Emergency services” refers to those involved in the emergency response to the fire.

Current occupation refers to occupation in 2001.

Years resident in Bellevue or other suburbs in postcode 6056 refers to home address in 10 years prior to fire (Jan 1991-Feb 2001).

Variables included in the model if the change to the OR of fire location was greater than 10%

## Hospitalisation since fire

While the relationship between any contact with health services and exposure to the fire provided an overall measure of the differing use of health services associated with different types of exposure, it was also important to assess whether there was a change in hospitalisation, alone, with different exposure types. The increased need for hospitalisation may indicate the development of more serious levels of disease not evident in an overall health service contact analysis.

Hospitalisation for pregnancy-related conditions was removed from the analysis, as it was the intention to assess the influence of exposure on ill health.

The analysis of the independent effect of variables on a registrant being hospitalised after the fire indicated that there was an increased risk with increasing age and any fire-related symptoms, while a high level of psychological distress was associated with a decreased risk. Exposure as measured by location at the fire or hours (per 10 hours) in Bellevue, showed no relationship with the risk of hospitalisation after the fire.

While adjusting for variables that had the greatest influence on the OR for the category of emergency services for fire location and hours spent in Bellevue variables and excluding those that measure the same effect, no relationship was found between the types of exposure and the risk of hospitalisation after the fire (Table 24 and 25).

Adjusting for either exposure variable (fire location and hours spent in Bellevue), BMI category, sex, age, years resident in Bellevue and nearby suburbs and alcohol consumption, the risk of being hospitalised after the fire was increased for registrants reporting a fire-related health symptom (Table 24 and 25).

The majority of the hospitalisations for registrants reporting fire-related symptoms were more than six months after the fire. A detailed examination of the reasons for hospitalisation in the seven years after the fire for registrants reporting fire-related symptoms indicated a broad range of reasons for hospitalisation with the proportions in major disease categories similar to that of the Perth metropolitan population.

**Table 24 Adjusted odds ratio (OR) for risk of hospitalisation with fire location as exposure measure, adults only, selected variables**

	Risk of hospitalisation		
	OR	95% CI	P-value
<b>Fire location</b>			
Member of public (ref)	–		
Emergency services	0.59	0.16–1.04	0.226
<b>Any fire-related health symptom</b>			
No (ref)	–		
Yes	2.24	1.06–4.72	0.034
<b>BMI categories</b>			
Not overweight or obese (ref)	–		
Overweight	0.87	0.32–2.40	0.792
Obese	0.90	0.30–2.73	0.852
<b>Sex</b>			
Female (ref)	–		
Male	0.41	0.16–1.04	0.059
<b>Age (in years)</b>	1.06	1.02–1.09	0.001
<b>Years resident in Bellevue</b>	0.90	0.81–1.01	0.074
<b>Years resident in other suburbs in postcode 6056</b>	0.90	0.79–1.02	0.111
<b>Number of alcohol drinks per week</b>	1.01	0.96–1.06	0.678

**Notes:**

For location at the time of fire, “member of public” includes those at home, work, visiting Bellevue, away or other. “Emergency services” refers to those involved in the emergency response to the fire.

Current occupation refers to occupation in 2001.

Years resident in Bellevue or other suburbs in postcode 6056 refers to home address in 10 years prior to fire (Jan 1991-Feb 2001).

Variables included in the model if the change to the OR of fire location was greater than 10%.

Table 25 **Adjusted odds ratio (OR) for risk of hospitalisation with hours spent in Bellevue as exposure measure, adults only, selected variables**

	Risk of hospitalisation		
	OR	95% CI	P-value
<b>Hours spent in Bellevue 15-23 Feb 2001 (per 10 hours)</b>	1.00	0.94–1.08	0.828
<b>Any fire-related health symptom</b>			
No (ref)	–		
Yes	2.12	1.02–4.41	0.046
<b>BMI categories</b>			
Not overweight or obese (ref)	–		
Overweight	0.86	0.32–2.36	0.776
Obese	0.85	0.28–2.55	0.772
<b>Sex</b>			
Female (ref)	–		
Male	0.38	0.15–0.98	0.044
<b>Age (in years)</b>	1.06	1.02–1.09	0.001
<b>Years resident in Bellevue</b>	0.91	0.79–1.06	0.231
<b>Years resident in other suburbs in postcode 6056</b>	0.90	0.79–1.03	0.277
<b>Number of alcohol drinks per week</b>	1.01	0.96–1.06	0.747

**Notes:**

For location at the time of fire, “member of public” includes those at home, work, visiting Bellevue, away or other. “Emergency services” refers to those involved in the emergency response to the fire.

Current occupation refers to occupation in 2001.

Years resident in Bellevue or other suburbs in postcode 6056 refers to home address in 10 years prior to fire (Jan 1991-Feb 2001).

**Presentation to emergency departments since fire**

The risk of presentation to EDs after the fire is also an important indicator of the need to contact health services for ongoing acute episodes of ill health that could be related to fire exposure.

The analysis of the independent effect of variables on the risk of presenting to an ED after the fire indicated a decreased risk for presenting to an ED for emergency services workers and overweight registrants, but there was no association between reporting a fire-related symptom and risk of ED presentation as was found for hospitalisation. After adjusting for variables with the greatest influence on the OR for emergency service workers, the strength of the relationship between emergency service workers and risk of presentation to EDs was reduced to a marginal effect (Table 26).

Table 27 indicates that there was no relationship between hours spent in Bellevue from 15 February 2001 and 23 February 2001 and the risk of presentation to EDs, but there was a decreased risk of presentation to EDs in relation to years lived in Bellevue.



The risk of presentation to EDs for emergency services workers was half that of the general public, while the risk of presenting to EDs was marginally higher for every 10 hours spent in Bellevue from 15 February 2001 to 23 February 2001. In contrast, the risk of presenting to EDs was marginally lower the longer a registrant had lived in Bellevue.

Table 26 **Adjusted odds ratio (OR) for risk of presentation to emergency departments with fire location as type of exposure, adults only, selected variables**

	Risk of ED presentation		
	OR	95% CI	P-value
<b>Fire location</b>			
Member of public (ref)	–		
Emergency services	0.50	0.24–1.02	0.057
<b>Sex</b>			
Female (ref)	–		
Male	0.62	0.32–1.18	0.146
<b>Age (years)</b>	1.00	0.98–1.02	0.798
<b>Years resident in Bellevue</b>	0.94	0.86–1.02	0.138
<b>Years resident in other suburbs in postcode 6056</b>	1.01	0.91–1.12	0.861

**Notes:**

For location at the time of fire, “member of public” includes those at home, work, visiting Bellevue, away or other. “Emergency services” refers to those involved in the emergency response to the fire.

Current occupation refers to occupation in 2001.

Years resident in Bellevue or other suburbs in postcode 6056 refers to home address in 10 years prior to fire (Jan 1991-Feb 2001).

Table 27 **Adjusted odds ratio (OR) for risk of presentation to emergency departments with hours spent in Bellevue as type of exposure, adults only, selected variables**

	Risk of hospitalisation		
	OR	95% CI	P-value
<b>Hours spent in Bellevue 15-23 Feb 2001 (per 10 hours)</b>	1.06	1.00–1.12	0.063
<b>Sex</b>			
Female (ref)	–		
Male	0.60	0.31–1.14	1.118
<b>Age (years)</b>	1.00	0.98–1.02	0.819
<b>Years resident in Bellevue</b>	0.89	0.79–1.00	0.047
<b>Years resident in other suburbs in PC 6056</b>	1.01	0.92–1.12	0.787

**Notes:**

For location at the time of fire, “member of public” includes those at home, work, visiting Bellevue, away or other. “Emergency services” refers to those involved in the emergency response to the fire.

Current occupation refers to occupation in 2001.

Years resident in Bellevue or other suburbs in postcode 6056 refers to home address in 10 years prior to fire (Jan 1991–Feb 2001).

## Summary

While the risk of contact with health services among emergency services workers was lower than the general public, the analysis was unable to identify a relationship between fire exposure and contact with health services for ill health. There was no relationship found between hours spent in Bellevue from 15 February 2001 to 23 February 2001 and contact with health services for ill health.

No relationship between exposure (fire location or hours spent in Bellevue) and hospitalisation for ill health or presentation to EDs was found.

## Chapter 7 Discussion

The purpose of the register was to monitor the health of its members. Accordingly, members of the public were encouraged to continue to register or update their records on the register to reflect their current health status. Since the first report, few additional registrations were recorded, with the last registration reported in November 2004. Since then there were few updates reported to the register indicating a decline in the health concerns among registrants.

Not surprisingly, the updated information on the health status of the registrants was similar to that reported in the first report finding that a significantly higher percentage of registrants had respiratory conditions other than asthma, skin conditions and health symptoms than the general population at the time of the fire.

While this report gave an update of the health status of registrants compared with the general population, its focus was on the health service utilisation of registrants since the fire as a means of monitoring their health over the longer term in response to recommendations made in the first report.

Data linkage made it possible to track registrants' use of health services, such as hospitals, EDs, mental health services and entries on the cancer, birth and death registries.

While the number and rate of hospitalisations increased throughout the study period, the increase was similar to that expected based on the Perth metropolitan population. The reasons for hospitalisations accounting for the majority of cases were similar to those observed among the Perth metropolitan population. Considering the overall pattern of hospitalisation described for registrants there is no evidence of an excess of hospitalisations among registrants that was related to exposure to toxins in the fire.

The excess of hospitalisations for digestive system conditions among registrants compared with the general population after the fire is difficult to explain, but from the toxicology report presented in the parliamentary inquiry, there is no reason to suspect this is related to exposure to toxins released in the fire.

There were few registrants requiring hospitalisation for respiratory conditions, despite the concerns raised in the first report. Of those registrants with a pre-existing respiratory condition, other than asthma, only two required hospitalisation after the fire compared with five before the fire.

The rate of presentations to EDs among registrants increased after the fire at a similar rate to the Perth metropolitan population. Part of the increase was due to improved data collection over the study period. When the rate of presentation for both genders was compared with their Perth metropolitan population counterparts, the rate among female registrants was higher than that among Perth metropolitan females. While the explanation for the excess ED presentations among female registrants is not clear, it seems unlikely that the effects of the fire may be a factor, without a similar increase being observed among male registrants. Additionally, the majority of ED presentations among registrants were for treatment of injuries which are not likely to be related

to the longer-term toxic effects of the fire. Also, the reasons accounting for the majority of ED presentations were similar to those observed among the Perth metropolitan population.<sup>19</sup>

Although there were few registrants contacting mental health services for treatment over the study period, there were a high number of attendances by these registrants at mental health outpatient services before the fire. An increase in mental health service utilisation before the fire was consistent with the higher rate of hospitalisation for mental health disorders among registrants compared with the Perth metropolitan population. After the fire the rate of hospitalisation for mental disorders was lower than the Perth Metropolitan population and the rate of attendances at mental health outpatient services decreased. Despite registrants reporting a high level of psychological distress at the time of the fire these data provide no evidence to suggest that the fire was associated with an increase in mental health disorders among registrants.

Given the types of cancers diagnosed among registrants since the fire were among the most common in the Perth metropolitan population and the incidence was similar to that of the Perth metropolitan population, there was no current evidence to suggest that exposure to toxins of the fire has increased the risk of cancer of registrants, although the lead time from exposure may still be too short for diagnosis of fire-related cancers.

There are many determinants of intrauterine growth including medical risks before and during pregnancy, socioeconomic factors and lifestyle behaviours.<sup>20</sup> While no statistically significant difference in POBW was detected, it seems likely that any possible difference in birth weight between births in the study and births in the Metropolitan area would have been due to factors other than the toxic effects of the fire. Any toxic effects on intrauterine growth would have been expected to be greatest for pregnancies at the time of the fire. There was only one pregnancy recorded in the study in this period and the POBW was in the expected range.

While no consistent relationship was found between the fire-exposure measures and indicators of ill health, registrants reporting a fire-related symptom (headache, sore throat, breathing problems and others) had a higher risk of hospitalisation in the seven years after the fire, compared with those with no reported fire-related symptoms. However, without an association between fire-exposure and ill health it is unlikely that symptoms reported in the aftermath of the fire are related to an increased risk of hospitalisation among registrants reporting fire-related symptoms.

Among registrants reporting fire-related symptoms, there were few hospitalisations in the six months immediately after the fire suggesting that the increased risk of hospitalisation was not due to acute episodes related to the fire. Furthermore, the long-term pattern of hospitalisation among registrants reporting fire-related symptoms in the seven years after the fire reflected that expected among the general population, rather than one depicting specific fire-related conditions.

In addition, according to the first report,<sup>2</sup> emergency services workers most likely had the highest exposure to the toxins of the fire, as demonstrated by an increased risk of fire-related and multiple symptoms with longer duration. Yet, this study consistently found that the risk of ill health (including hospitalisation risk) in the seven years since

the fire was lower (but not statistically) among emergency workers compared with registrants who were members of the general public.

Also, the risk of any contact with health services or ED presentation was not significantly elevated among registrants reporting fire-related symptoms compared with those not reporting fire-related symptoms. Therefore, the finding of an increased risk of hospitalisation among registrants reporting fire-related symptoms after the fire was not consistent with other analyses conducted in this study.

Considering the results of all the fire-exposure regression analyses together, it seems unlikely that exposure to the toxins of the fire caused long-term health effects.

This finding reflects the expert opinions expressed in the parliamentary inquiry that long-term health effects were unlikely following exposure to the toxins of the fire.

There are several important considerations to be taken into account to assess whether the results for health service utilisation of registrants, as presented, reflect the true position with respect to health outcomes of registrants compared with the Perth metropolitan population.

The recruitment for the register sought a wide representation of the public affected by the Bellevue fire, but the register reflected a self-selected group of people who were either emergency service workers or people suffering from pre-existing conditions, with both groups concerned for their future health. Comparisons with other surveys found that while registrants had a higher prevalence of fire-related symptoms and more were overweight and obese than the general population, they had a higher level of physical activity, drank alcohol less and had a lower prevalence of current smokers. These findings are not surprising when the make up of the register is considered. Firefighters are more likely to have a healthy lifestyle while those suffering from pre-existing conditions may be inclined to reduce alcohol consumption and smoke less.

The lack of detail in the inventory of chemicals involved in the fire has hampered the analytical approach and interpretation. It was difficult to determine which conditions to focus on in the analysis. Consequently, the analysis was broad, consisting of an extensive range of data sources with the aim of covering all possible conditions.

The Perth metropolitan population was selected as a suitable comparison due to the location of Bellevue and the likelihood that most emergency workers were residents of the Perth metropolitan population. The definition of the Perth metropolitan area remained consistent when extracting data from all data sources accessed in the study.

When considering long-term health outcomes from an exposure to a health risk, an adequate follow-up period is required to ensure all cases caused by the exposure are identified. In the case of cancer this can be 10 years or more. Therefore this study could not make a true assessment of the risk of cancer or any other disease with long latency among registrants.

Interpretation of the results of the regression analysis of levels of exposure and risk of ill health as measured by contacts with health services must take into account limitations in the data.

The small numbers of registrants in each category restricted the power of the calculations to detect small but significant differences in risk. However, apart from a possible increase in ED presentations associated with hours spent in Bellevue over the period immediately after the fire, there were no other situations where exposure was associated with an increase in ill health.

Measuring of exposure for use in the regression analysis had its own limitations. The measure of 'location at the fire' may have been confounded by the better health status of emergency workers over registrants who were members of the general public, while hours spent in Bellevue during the period of the fire was based on self-reporting, which is highly vulnerable to recall bias.

However, the analysis of the registrants' health records through linked data had significant strengths. An extensive range of health data sources were interrogated to track registrants' health records. Linkage to the WA Electoral Roll and follow-up of those not on the roll confirmed that all registrants were still likely to be resident in WA during the period of the study and few, if any, were lost to follow-up. With respect to hospitalisation and ED presentations, the sample size was sufficiently large to provide reliable and accurate estimates, and had the statistical power to detect effects in the situations being investigated. For this reason, the conclusions of the study became more reliant on the linked data analysis of registrants' health records.

Overall, there was no increase in the rate of hospitalisation, ED presentations, and mental health occasions of service after the fire which could not be accounted for by a consistent trend in the general population during the same period. There was no evidence to suggest that there was an increase in deaths, cancer incidence or adverse birth outcomes or an excess number compared with the general population after the fire. At the time of the study, there was no evidence of long-term adverse health outcomes or prolonged duration of short-term effects from the toxins released in the fire.

## Chapter 8 Conclusion

This report presents the results of a follow-up study of registrants on the Bellevue Health Surveillance Register to determine whether there were any adverse long-term health outcomes or prolonged short-term health effects among the registrants. The study included an updated analysis of the Register, extensive health data linkage to allow a comparison of health service utilisation and registration on birth, death and cancer records between registrants and the general population, and an analysis of the relationship between fire exposure levels and ill health.

At the time of the study, no evidence was found of long-term adverse health outcomes or prolonged duration of short-term effects from the toxins released in the fire.

Based on the expert opinion canvassed in the parliamentary inquiry<sup>1</sup> and the results of this study, further investigation into the long-term adverse health effects of registrants would not be warranted.

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## Glossary

### **Age-standardised rate**

Each ASR indicates the number of hospital separations, per 1,000 persons, that would occur in the selected population, in this case Bellevue registrants, if they had the same age and sex structure as the standard population. Standardising the number of hospitalisations allows for comparison across years and population subgroups.

### **Birth weight**

The first weight, measured to the nearest five grams, of the newborn, which is usually obtained within the first hour of birth. A newborn with a birth weight less than 2500 grams is classified as low birth weight.

### **Confidence interval (95%)**

A confidence interval shows the range in to which the true value of an estimated measure is likely to fall. The 95% per cent confidence interval is the range of estimates within which the true value would fall into 95% of the time.

### **Crude rate**

The number of events within a population divided by the total number of people in the population.

### **Fetal death**

The complete expulsion or extraction from its mother of a product of conception of at least 20 weeks gestation or 400 grams birth weight, which after separation did not show any signs of life.

### **Hospital separation**

An episode of care for an admitted patient, which can be a total hospital stay (from admission to discharge, transfer or death) or a portion of a hospital stay beginning or ending in a change of type of care (for example, from acute to rehabilitation). Separation also means the process by which an admitted patient completes an episode of care either by being discharged, dying, transferring to another hospital or changing type of care.

### **Mean**

Mean is commonly called the “average”. The mean is the sum of all scores divided by the number of scores.

### **Occasion of service**

An episode of care that occurs in non-admitted patient setting.

### **Odds ratio**

In the context of this study the odds ratio given for categories of variables in the logistic regression analysis can be interpreted as the increase/decrease in the odds of contacting health services compared with the reference category.

**Person-years**

The total amount of time calculated by the product of the number of years and the population size that members have been exposed to a health risk or affected by a health condition.

**Proportion of optimal birth weight**

The proportion of optimal birth weight is a measure of appropriateness of intrauterine growth. It is calculated as the ratio of the value of the observed birth weight to that of the optimal birth weight of a baby with the same non-modifiable risk factors for birth weight (gestational duration, fetal gender, and maternal height, age and parity).

**p-value**

The p-value is the probability of rejecting the null hypothesis of a study question when the hypothesis is true. The null hypothesis is usually a hypothesis of “no difference”. For example, there is no difference in a particular characteristic between two populations. A p-value of 0.05 indicates that there is only a 5% chance of rejecting the null hypothesis when it is actually true; that is, of deciding, on the basis of an observed difference, that there really is a difference when many repetitions of the study would show that was no difference.

**Standardised Incidence Ratio**

A SIR is the ratio of the observed number of new events (cases of cancer in this study) in a specific population or geographic region relative to what it would be if the population had the same rate of these new events and characteristics as a larger comparison population. In this study the Perth metropolitan population was chosen as the comparison population.

**Standardised Rate Ratio**

A SRR is the ratio of the observed number of events (cases of cancer in this study) in a specific population or geographic region relative to what it would be if the population had the same rate of these events and characteristics as a larger comparison population. In this study the Perth metropolitan population was chosen as the comparison population.

**Triage category**

Used in the emergency departments of hospitals to indicate the urgency of a patient's need for medical and nursing care. Patients are triaged into one of five categories on the Australasian Triage Scale. The triage category is allocated by an experienced registered nurse or medical practitioner.

# Notes



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