Fire, Contact Burn and Scald Injury Fatalities among Children (0-9 years) and Seniors (70+ years) in Victoria, 2000-2003

this study is a joint initiative of the

State Coroner’s Office
&
Department of Human Services

Compiled by Lyndal Bugeja
Injury Prevention Research Officer
October 2004
# TABLE OF CONTENTS

List of Tables and Figures ........................................................................................................... iii
    Tables ........................................................................................................................................ iii
    Figures ...................................................................................................................................... iii

Abbreviations ............................................................................................................................... iv

Acknowledgements ...................................................................................................................... v
    Steering Committee ................................................................................................................... v
    General Acknowledgements .................................................................................................... v

Executive Summary ...................................................................................................................... vi

Introduction ................................................................................................................................... 1
    Previous Research .................................................................................................................... 1
    Victorian Fire Safety Organisations ....................................................................................... 8
        Metropolitan Fire Brigade .................................................................................................... 8
        Country Fire Authority ....................................................................................................... 8
    Prevention Measures and Programs implemented in Victoria ............................................... 9
        Prevention Measures .......................................................................................................... 9
        Prevention Programs ......................................................................................................... 11
        Programs for Children ....................................................................................................... 12
        Programs for the Elderly .................................................................................................... 13
    Aims ......................................................................................................................................... 13
    Case Inclusion and Definitions .............................................................................................. 13

Method ......................................................................................................................................... 14
    Case Identification .................................................................................................................. 14
    Data Synthesis ....................................................................................................................... 15
    Data Analysis .......................................................................................................................... 17
    Limitations .............................................................................................................................. 17
    Data Source ............................................................................................................................ 17

Results ......................................................................................................................................... 19
    Fire-Related Deaths (from burns and / or smoke inhalation) ................................................ 20
        Personal Characteristics ..................................................................................................... 20
        Contributory Factors ......................................................................................................... 20
        Fire Characteristics ........................................................................................................... 22
        Environmental Characteristics .......................................................................................... 25
    Contact Burns ........................................................................................................................ 26
    Scald Deaths .......................................................................................................................... 26

Discussion ................................................................................................................................... 29
    Fire-Related (burn and / or smoke inhalation) burn prevention ............................................ 29
    Contact Burn Prevention ........................................................................................................ 32
    Scald Prevention ...................................................................................................................... 32

References .................................................................................................................................... 34
LIST OF TABLES AND FIGURES

Tables

TABLE 1
Hospital treated fire, burns and scald cases in children (0-4 years) and seniors (aged 70+ years) reported by Cassell et al. (2004) ................................................................. 2

TABLE 2
Circumstances surrounding fire, burn and scald injuries as reported by Cassell et al. (2004). 2

TABLE 3
Summary of results - fire incident fatalities of 0-15 and 65+ year olds in New Zealand as reported by Duncanson et al. (2001) ................................................................. 4

TABLE 4
MFB and CFA prevention programs and initiatives ......................................................... 11

TABLE 5
Pattern of fire-related behaviour in children ................................................................. 12

TABLE 6
NCIS Query Design Items ............................................................................................ 15

TABLE 7
List of Data Items ........................................................................................................ 16

TABLE 8
Frequency of deaths from fires, contact burns and scalds by age, 2000-2003: Victoria (n=40) ................................................................................................................. 19

TABLE 9
Frequency of deaths from fires by age and gender, 2000-2003: Victoria (n=27) ............. 20

TABLE 10
Frequency of fires incidents by age and room of origin, 2000-2003: Victoria (n=25) .... 22

TABLE 11
Frequency of scald deaths by age and substance, 2000-2003: Victoria (n=11) ............ 27

Figures

FIGURE 1
Frequency of burns and scalds deaths per year, 2000-2003: Victoria (n=40) ................. 19
## ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
</tr>
<tr>
<td>BC</td>
<td>Building Commission</td>
</tr>
<tr>
<td>CFA</td>
<td>Country Fire Authority</td>
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<tr>
<td>CPR</td>
<td>Cardio Pulmonary Resuscitation</td>
</tr>
<tr>
<td>CSC</td>
<td>Coronal Services Centre</td>
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<tr>
<td>DHS</td>
<td>Department of Human Services</td>
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<td>ED</td>
<td>Emergency Department</td>
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<tr>
<td>ICD</td>
<td>International Classification of Diseases</td>
</tr>
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<td>JFAIP</td>
<td>Juvenile Fire Awareness and Intervention Program</td>
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<tr>
<td>LCMS</td>
<td>Local Case Management System</td>
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<tr>
<td>MFB</td>
<td>Metropolitan Fire Brigade</td>
</tr>
<tr>
<td>MUARC</td>
<td>Monash University Accident Research Centre</td>
</tr>
<tr>
<td>NCIS</td>
<td>National Coroners Information System</td>
</tr>
<tr>
<td>RCH</td>
<td>Royal Children's Hospital</td>
</tr>
<tr>
<td>SCO</td>
<td>State Coroner’s Office</td>
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<tr>
<td>SQL</td>
<td>Structured Query Language</td>
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<tr>
<td>VAED</td>
<td>Victorian Admitted Episodes Database</td>
</tr>
<tr>
<td>VCFS</td>
<td>Victorian Coronial Facilitation System</td>
</tr>
<tr>
<td>VEMD</td>
<td>Victorian Emergency Minimum Dataset</td>
</tr>
<tr>
<td>VFSC</td>
<td>Victorian Forensic Science Centre</td>
</tr>
<tr>
<td>VIFM</td>
<td>Victorian Institute of Forensic Medicine</td>
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# ACKNOWLEDGEMENTS

## Steering Committee

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<thead>
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<th>Position</th>
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## General Acknowledgements

<table>
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EXECUTIVE SUMMARY

An Injury Prevention Research Officer position, funded by the Public Health Group of the Department of Human Services (DHS), was established at the State Coroner's Office (SCO) in October 2001 for a period of three years. The role of the Research Officer was to undertake a number of projects investigating unintentional injury deaths for patterns and contributory factors.

This report presents the findings of an investigation into fatal injury resulting from fire (burns and smoke inhalation), contact burns or scalds in children (aged 0-9 years) and the older seniors (aged 70 years and over) that occurred in Victoria between 2000 and 2003. Of particular interest was the identification of contributory factors related to safety practices and behaviours, such as:

- the presence and use of smoke alarms;
- barriers to escape from fire;
- the contribution of consumer products; and
- the role of the temperature of hot tap water at bathroom outlets in domestic dwellings in scald-related fatalities.

Forty deaths of children (aged 0-9 years) and seniors (aged 70 years and older) due to fire, burn and scald injury were identified on the National Coroners Information System (NCIS) and the State Coroner's Office Local Case Management System over the four-year study period 2000-2003. Coronial case files were retrieved and examined for issues of interest using a combination of quantitative and qualitative methods.

The main findings of the study were:

- **Fire-related fatalities**: (n=27 deaths (68%) from 25 incidents)
  - 70% of fatalities were seniors aged 70 years and over
    - alcohol intoxication contributed to only a small number of deaths among seniors (n=4)
    - 74% of 70+ year olds were described as being in poor health, which may have impacted on their ability to escape the fire
    - ~60% of seniors lived alone;
  - 36% of fatal fires involving children and seniors originated in the bedroom, 28% fires originated in the lounge room;
  - 40% of fatal fires were ignited from an electrical appliance, a further 28% were ignited from a lit or improperly discarded cigarette
  - 56% of fatal fire incidents occurred at night between 8:00 pm and 8:00 am, and 72% incidents occurred on a weekday
  - 44% incidents occurred in the winter months (June-August).

- **Contact burn fatalities**: (n=2 deaths, 5%)
  - both fatal incidents involved women aged 70+ years
  - in both cases the burn injuries causing death were sustained from portable heaters following a fall.

- **Scald fatalities**: (n=11 deaths, 27%)
  - ten of the 11 scald deaths (91%) were seniors (aged 70 years and over)
  - ten of the 11 scald fatalities (91%) occurred in the bathroom, eight of which occurred when the deceased was bathing or showering
the major contributing factor to scald-related deaths was difficulty controlling or adjusting the hot tap water flow or water temperature.

Based on these findings it is recommended that:

Recommendation 1
The CFA and MFB promote the use of wall mounted heaters as an alternative to upright / portable heaters through programs the fire services deliver to older people.

Recommendation 2
Cigarette-related fire and fire fatality data should be collated by the MFB and CFA using FIRS and the NCIS to provide up to date evidence to inform a campaign for the development of regulations for fire-safe cigarettes in Australia. In the interim, in view of the number of fatalities, the tobacco industry may consider developing an industry based Code of Practice or Standard for fire-safe cigarettes with the assistance of Standards Australia.

Recommendation 3
The CFA and MFB continue to raise awareness amongst older adults of the risks of smoking in bed through programs the fire services deliver to older people.

Recommendation 4
10-year single purpose lithium battery smoke alarms should be promoted and there should be an outreach give-away and installation program for low income households with young children and house bound older people.

Recommendation 5
Renewed effort should be made to convince all householders to lower the maximum temperature of hot water delivered to bathroom outlets to 50° Celsius.
**INTRODUCTION**

This report presents the findings of an examination of fatal injury resulting from a fire, contact burns and scalds in children (aged 0-9 years) and seniors (aged 70+ years) in Victoria over the four-year period 2000 to 2003. This research is part of a joint project of the Department of Human Services (DHS) and the State Coroner's Office (SCO) to investigate the causes of unintentional injury to Victorians in an effort to contribute to injury and death prevention.

**Previous Research**

A considerable amount of research has been undertaken in Australia and overseas describing the nature and extent of fatal and non-fatal injury resulting from fires and burns. This research has reported that fire and burn injuries contribute significantly to mortality and morbidity, that the costs associated with treatment are extremely high and that scarring and disfigurement of survivors causes considerable ongoing psychologically distress (Cassell, Clapperton & Ashby, 2004). Previous research on scald injury has been limited to studies addressing non-fatal injury or fatal injury in children.

The review to follow will cover:

- findings from previous studies of non-fatal fire, burn and scald injury conducted in Australia and New Zealand
- findings from a New Zealand study of fatal fire, burn and scald injury among 0-15 year olds and seniors aged 65+ years
- Australian and U.S. research identifying factors contributing to fatal burn and scald injury including the role of:
  - alcohol intoxication;
  - cigarettes;
  - fire play;
  - poor life circumstances;
  - absence of smoke alarms; and
  - unsafe products.
- results of a systematic review of the effectiveness of community based fire prevention interventions.

Cassell, Clapperton and Ashby (2004) recently investigated Victorian emergency department (ED) presentations and hospital admissions data on unintentional fire, burn and scald injury in young children (0-4 years) and seniors (aged 70 years and older) covering the period July 2001 to June 2003. The study also included an examination of fatal injury cases extracted from the Coroners' database over this period. To avoid repetition, the results of their investigation of fatal incidents will not be reported in this review.
The findings reported from the study in relation to non-fatal fire, burn and scald injury are summarised in Table 1.

**TABLE 1**
Hospital treated fire, burns and scald cases in children (0-4 years) and seniors (aged 70+ years) reported by Cassell et al. (2004)

<table>
<thead>
<tr>
<th>Child cases</th>
<th>Seniors’ cases</th>
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</table>
| ▪ 1,780 children (aged 0-4 years) were treated for burns and scalds in Victorian hospitals between July 2001 and June 2003:  
  ○ 495 hospital admissions; and  
  ○ 1,285 ED presentations.  
  ▪ Trend data indicate a 17% reduction in the all-causes hospital admissions rate for burns and scalds in this age group since 1992, mainly due to a 20% decrease in the rate of admission for scalds  
  ▪ Scalds still accounted for 75% of admissions and 50% of presentations for burns and scalds in 2001/3  
  ▪ Major causes of burn and scald injury were:  
    ○ hot drinks spills (tea and coffee);  
    ○ heated hot water;  
    ○ contact with hot household appliances; and  
    ○ contact with heaters. | ▪ 434 seniors aged 70 years and older were treated for burn and scald injuries in Victoria between July 2001 and June 2003 (including 290 hospital admissions).  
  ▪ Trend data indicate a 19% reduction in the all-causes admission rate for burns and scalds in seniors aged 70 years and older since 1992 mainly a result of a decrease in the scalds admission rate.  
  ▪ Scalds still accounted for 50% of admissions and 60% of presentations for burns and scalds  
  ▪ Major causes of burn and scald injury were:  
    ○ contact with hot fluids (heated hot water);  
    ○ hot drinks;  
    ○ contact with running hot water;  
    ○ exposure to smoke, fire and flames; and  
    ○ contact with hot heating appliances. |

Cassell et al. (2004) also reported common circumstances in which fire, burn and scald injury occurred, summarised in Table 2.

**TABLE 2**
Circumstances surrounding fire, burn and scald injuries as reported by Cassell et al. (2004)

<table>
<thead>
<tr>
<th>Scald</th>
<th>Contact Burn</th>
<th>Fire and Flame</th>
</tr>
</thead>
</table>
| ▪ Hot tea and coffee spills  
  ▪ Children pulling down pots and pans from the stove  
  ▪ Parents accidentally spilling hot substances on children during food preparation  
  ▪ Children pulling kettles, jugs, urns and saucepans of boiling water over themselves | ▪ Contact with hot household appliances such as ovens, stoves, irons and barbecues  
  ▪ Contact with hot heating appliances. | ▪ Faulty electrical appliance/fuse box  
  ▪ Using accelerants to ignite fires or near open flames  
  ▪ Drying clothing near heaters  
  ▪ Smoking in bed and  
  ▪ Accumulation of clutter, which acted as an accelerant. |
Based on their study Cassell et al. (2004) made a number of recommendations in relation to prevention and control initiatives and surveillance, research and investigations. These recommendations included:

- develop a case for a standard for spill-resistant (commuter) mugs, to present to Standards Australia;
- conduct a multifaceted burn and scald prevention, education and media campaign aimed at parents of young children and older people;
- implement an active inspection and enforcement system in relation to smoke alarms;
- encourage cigarette manufacturers to produce self-extinguishing cigarettes;
- promote 10-year single purpose lithium battery smoke alarms and institute outreach give-away and installation programs for low income households with young children and seniors;
- investigate reasons for under-reporting of burns and scalds in older people in relation to emergency department presentations data;
- conduct a survey to determine the proportion of Victorian households that have functioning smoke alarms;
- implement measures to improve data quality on injury surveillance systems; and
- improve quality and accessibility of data collection systems on fire-related injuries and institute systematic monitoring and routine sharing of information among agencies with responsibility for fire prevention and control.

Duncanson, Reid, Langley and Woodward (2002) conducted a study on non-fatal injury resulting from fire incidents in Aotearoa, New Zealand. The study consisted of an examination of 862 hospital admissions from burn injury or smoke inhalation resulting from residential fires between 1996 and 2000. It was found that the highest injury rates were amongst children under five years, males and Maoris. Information on the presence or absence of smoke alarms was not available.

Commonly reported circumstances in which burn injury occurred included:

- stovetop / oven igniting cooking materials;
- heater causing burn;
- naked flame igniting bedding, furniture or other combustibles;
- outdoor fires for rubbish, warmth or cooking causing burns; and
- means of heating igniting bedding, furniture or other combustibles.
The researchers concluded that future prevention of non-fatal fire and flame injury required intersectoral and cross-cultural collaboration and partnership to raise awareness of fire risks and of effective intervention strategies.

Two earlier studies by Duncanson, Ormsby, Reid, Langley and Woodward (2001a and 2001b) investigated fatal fire injury amongst 0-15 year olds and 65+ years olds in Aotearoa, New Zealand between 1991 and 1997. Both studies used Fire Investigation Reports and coronial records to examine deaths identified from Fire Incident and Health Service records.

Over the study period there were 53 deaths (39 incidents) of children less than 15 years of age and 39 deaths (38 incidents) of individuals aged 65 years and over. The major findings from these studies are summarised in Table 3.

**TABLE 3**
Summary of results - fire incident fatalities of 0-15 and 65+ year olds in New Zealand as reported by Duncanson et al. (2001)

<table>
<thead>
<tr>
<th>0-15 Years</th>
<th>65+ Years</th>
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<tr>
<td>66% of child burn fatalities were aged under five years;</td>
<td>Fatality rate increased with age:</td>
</tr>
<tr>
<td>79% were males;</td>
<td>o 0.6 fatalities / 100,000 for 65-74 year olds;</td>
</tr>
<tr>
<td>70% were Maoris / Pacific Islanders;</td>
<td>o 1.8 / 100,000 for 75-84 year olds;</td>
</tr>
<tr>
<td>In 70% of cases, smoke alarms were absent;</td>
<td>o 4.4 / 100,000 for 85+ year olds.</td>
</tr>
<tr>
<td>Sources of fire:</td>
<td>No difference between male and female fatality rate;</td>
</tr>
<tr>
<td>o 36% matches / lighters; and</td>
<td>Fatality rate higher for Maori population;</td>
</tr>
<tr>
<td>o 26% heaters / fireplaces;</td>
<td>Little evidence of alcohol consumption;</td>
</tr>
<tr>
<td>Common scenarios:</td>
<td>50% of deceased lived alone;</td>
</tr>
<tr>
<td>o matches / lighter igniting bedding;</td>
<td>Origin of fire:</td>
</tr>
<tr>
<td>o matcher / lighter igniting motor vehicle interior;</td>
<td>o 42% bedroom;</td>
</tr>
<tr>
<td>o heater too close and igniting bedding;</td>
<td>o 25% lounge room; and</td>
</tr>
<tr>
<td>o candle igniting bedding;</td>
<td>o 25% kitchen.</td>
</tr>
<tr>
<td>o stove top igniting cooking materials;</td>
<td>Source of fire:</td>
</tr>
<tr>
<td>o unsafe discarding of cigarettes;</td>
<td>o heating appliances (41%);</td>
</tr>
<tr>
<td>o unsafe fireplace;</td>
<td>o smoking materials;</td>
</tr>
<tr>
<td>o misuse of flammable liquid; and</td>
<td>o cooking appliances and</td>
</tr>
<tr>
<td>o overloading of electrical outlets.</td>
<td>o electric blankets.</td>
</tr>
</tbody>
</table>

Based on these findings, Duncanson et al. (2001) concluded that prevention of fire incident fatalities relied on:

- raising awareness of fire safety issues across sectors concerned with health;
- addressing ethnic and socio-economic disparity; and
- promotion of fire safety strategies.
Numerous factors have been identified and examined as contributing to fire, burn and scald injury deaths. Of particular interest to the current study was the role of alcohol intoxication and cigarettes, fire play, poor life circumstances, absence of smoke alarms and the role of faulty consumer products.

One small Australian study and two large studies of fire-related fatalities in the US provide detailed information on contributory factors to fatal fires.

The Australian Bureau of Statistics (ABS) (2000) reported statistics relating to house fires in Australia, compiled from:
- the Population Survey Monitor for May 1998 and 2000;
- the ABS Causes of Death file (1968, 1978, 1988 and 1998); and
- 'Fires in the home 1987-1995', prepared by the NSW Fire Brigades.

In 1998, 123 deaths nationally were reported from flame and fire injuries, 70 (57%) in a private dwelling (ABS, 2000). The authors argued that although house fires represent a small minority of all accidental deaths (in 1998 house fires accounted for 1.5% of accidental deaths and 0.06% of all deaths of Australians), all recorded fire-related deaths were preventable.

ABS (2000) reported that males were at greater risk of fire-related death than their female counterparts and that the prevalence of house fire deaths varied according to the season of the year, where it was found that a higher rate was evident between June and August. An analysis of NSW fire fatalities data for the period 1987-1998 found that the leading cause of home fires in NSW in both 1987 and 1998 was an unattended heat source, representing 23% of accidental house fires in 1998. Other causes included failure or malfunction in an appliance or a piece of equipment.

The ABS (2000) report also analysed the reported use of fire prevention measures utilising Population Survey Monitor data for 1998 and 2000. The PSM survey data collected information from households on the use of:
- smoke detectors;
- electrical safety switches;
- fire extinguishers;
- sprinkler systems;
- fire evacuation plan; and
- removal of fire hazards.

The authors concluded that, in general, Australian households have taken at least some action to protect their homes against fire. It was found that in the period 1998-2000 the presence of at least one safety measure in the home had increased to 88%, (71% of reported fire protection action taken was the installation of at least one smoke detector). However, the report revealed that 90% of separate houses contained at least one smoke detector, whereas only 68% of flats and units had a smoke detector installed (ABS, 2000).

Barillo and Goode (1996) examined 727 fatalities that occurred between 1985 and 1991 in New Jersey. Cases were identified and collected from the New Jersey State Medical Examiners Office and fire department records. The researchers found that child and elderly populations were over-represented in house fire fatalities. It was also
found that a proportion of children contributed to their own demise, with approximately 10% of fatal house fires attributed to children playing with fire. Barillo and Goode (1996) argued that the elderly have a greater recovery time for even minor burn injuries due to increased frailty, rather than just an inability to detect and escape from fire.

It was contended that the high incidence of fatal house fires could be mostly attributed to:

- a failure to install and maintain smoke detectors,
- the consumption of alcohol, and
- a range of implications that impact on escape.

Barillo and Goode (1996) found carelessness involving tobacco products was the greatest contributing factor to house fire fatalities. The authors estimated that 1,500-2,300 fatalities and 7,000 serious injuries each year in the US could be attributed to fires caused through smoking material, not including fatal fires caused by people smoking in bed or smoking while intoxicated (Barillo & Goode, 1996).

Barillo and Goode (1996) argued in favour of the deployment of 'fire-safe' cigarettes that extinguish automatically once discarded and suggested that there be greater education to those members of the community at higher risk of fire injury and fatality, particularly on the dangers associated with smoking in bed and smoking whilst intoxicated.

An earlier study by Brigham and McGuire (1994) examined the issue of cigarette ignited fire injury and death in the United States, and the feasibility and barriers to the development and implementation of fire-safe cigarettes in the United States, including opposition from the tobacco industry. The paper also addressed legislative progress for the previous 15 years in regards to this issue.

A recent editorial by Chapman and Balmain (2004) outlined the current status and recent action in relation to the fire-safe cigarette (referred to as "reduced ignition propensity cigarette") in Australia, the United States and Canada. Chapman and Balmain (2004) reported that in Australia:

- approximately 14 people die each year in cigarette caused fires;
- at least 4,574 fires are caused directly by cigarettes and smoker's materials;
- in the year 1998-1999 smoking related fires cost 52.1 million dollars in tangible costs (i.e. health, private property damage and fire service costs);
- 7% of bushfires are caused by discarded cigarettes; and
- the tobacco industry is self-regulated which means that:
  - ingredients and quality are not controlled by legislation;
  - companies can avoid disclosing ingredients by declaring commercial-in-confidence; and
  - companies are not required to comply with any standards.

Chapman and Balmain (2004) also reported that tobacco companies add burn accelerants (sodium and potassium) to cigarette paper and that market research indicated that reduced ignition propensity cigarettes were acceptable to smokers. According to Chapman and Balmain (2004) as of July 2004, all cigarettes sold in New
York must pass a performance standard requiring that no more than 25% of cigarettes tested exhibit full length burns on a bed of filter paper specified in the test method. Similar legislation was passed in Canada in March 2004 to take effect from October 2005. The apparent major concern by the tobacco industry is litigation relating to people burnt in fires caused by cigarettes (Chapman & Balmain, 2004).

The authors concluded that although fire investigators support the introduction of the fire-safe cigarette in Australia, the unregulated nature of the tobacco industry makes it difficult to develop a standard. Chapman and Balmain (2004) recommend that there should be a national tobacco Act in Australia and that in the interim cigarette reduced ignition propensity regulations should be introduced in Australia in line with Canada and New York.

In relation to interventions, Turner, Spinks, McClure and Nixon (2004) conducted a Cochrane Review to assess the effectiveness of community-based, coordinated and multi-strategy interventions for reducing burns and scalds injury in 0-14 year old children. The aim of the review was to examine the published literature on the effectiveness of prevention measures in order to inform practitioners attempting to reach fire injury prevention targets included in government injury prevention policies.

Thirty-two community trials were reviewed, only three of which met the study quality criteria for inclusion in the review. Only one of the three included studies (Ytterstad, 1995), demonstrated a significant decrease in childhood burn and scald injury in the intervention group compared with a control group (Turner et al., 2004). The Ytterstad (1995) study was conducted in Harstad in Norway and consisted of educational advice for both the prevention of burn and scald injuries and immediate first aid treatment. The method of this advice consisted of one-on-one counselling sessions by public health nurses and at health fairs, shopping malls and through the media (Turner et al., 2004). 1995 results from the Harstad study demonstrated a 52.9% decrease for burn injury rates in the intervention community compared to a 14.1% decreased in the six surrounding municipalities and a 9.9% increase in the control community. 1998 results demonstrated a further decrease to 57.5% in burn injury rates in the intervention community, a 40.1% decrease in the six surrounding municipalities and a 18.1% increase in the control community (Turner et al., 2004).

On the basis of their systematic review, Turner et al (2004) reached the following conclusions:

- limited evidence-based research exists that reports effective community-based programs to prevent burns and scalds in children; and
- rigorous evaluations that include a measure of injury outcome and a contemporary community control as part of the study, should be built into all future community-based burns prevention programs.
Victorian Fire Safety Organisations

Metropolitan Fire Brigade

The Metropolitan Fire Brigade (MFB) covers the metropolitan areas of Melbourne. The MFB has 1,511 professional fire fighters staffing 47 strategically located fire stations and specialist departments around the Melbourne metropolitan area. MFB fire fighters provide rapid and effective emergency response to the community. Strategic, expert advice is also provided by the MFB to the State Government on major events and anti-terrorist activities. The MFB also has a mandate to respond with the Metropolitan Ambulance Services to all life threatening medical emergencies with a particular focus on cardiac arrest incidents.

A large role of the brigade is the development and implementation of prevention strategies and community education programs in identified risk areas in order to reduce fire-related injury and death. Data is gathered by fire fighters and investigators who attend fire incidents.

Some of the other non-emergency services provided by the MFB include:
- input into the development of Australian Standards, Codes of Practice and Regulations affecting community safety;
- conduct building regulation related inspections of fire and life safety systems and maintenance compliance; and
- development of fire safety and emergency plans for major events.

Country Fire Authority

The Country Fire Authority is a community service organisation and one of the world’s largest volunteer-based emergency services. There are approximately 59,000 volunteer members supported by over 425 career fire fighters and officers and more than 750 career support and administrative staff. There are 2.5 million people and 150,182 square kilometres of land in the CFA area. This area includes more than 980,000 homes, and covers all of rural Victoria, and the provincial cities and towns (except State forests and National Parks). The area also includes more than a million residents in outer Melbourne suburbs such as Frankston and Dandenong, and key growth suburbs such as Cranbourne, Melton and Werribee.

CFA divide the land covered into nine CFA Areas and 20 Regions. There are over 1,200 CFA brigades across the State and they carry out a wide range of duties. The brigades respond to a range of different incidents and also undertake broader activities including community education and fire investigation.

Most of CFA's overall activity involves responding to incidents and suppressing fires. CFA respond to a variety of fire and emergency incidents as well as a range of other activities including:
- fire safety building inspections;
- delivering community awareness, education and safety programs;
- post incident analysis and fire investigation; and
- fire prevention planning and land use planning at a municipal level.

Prevention Measures and Programs implemented in Victoria

Prevention Measures

Smoke Alarms

In 1991 the Victoria's Building Code was amended to make the installation of hard-wired smoke alarms mandatory in all new houses and those under renovation. In 1996, further amendments made the installation of hard-wired alarms in all public housing compulsory. In 1997 all houses sold required a fitted hard-wired smoke alarm, and in 1999 it was made compulsory that all homes in Victoria be fitted with hard-wired or battery-powered smoke alarms.

The changes to the Building Code meant that by 1997, 78% of households in Melbourne had smoke alarms fitted, compared with less 15% prior to 1991. Comparison of Victorian and NSW data showed that the amended Victorian Building Codes greatly influenced the number of smoke alarms fitted. A 1992 survey found that approximately half of all households with children under five years of age in Melbourne had smoke alarms fitted, whereas only one tenth of Sydney households had a fitted smoke alarm.

The Building Regulations 1994 introduced by the Building Commission (BC) mandated the installation of self-contained smoke alarm complying to Australian Standard 3786-1993 near the ceiling of each floor or appropriate locations in each occupied dwelling or sole occupancy residence. It is estimated that since 1992, 312 people have survived residential fires in Victoria due to smoke alarms (Building Commission, 1998). There is no up-to-date information on the current coverage of Victorian households by working smoke alarms.

The continual maintenance of battery powered smoke alarms is paramount for effectiveness as a preventative strategy. Fire Authorities recommend that batteries be replaced each year. Cleaning of the alarm with a vacuum prevents the build up of dust particles that potentially can effect the operation of the alarm. It is also recommended that the manufacturers' guidelines be followed to ensure effective operation. Ten-year lithium powered battery smoke alarms are the best alternative to hard-wired alarms and should be promoted.

Change Your Clock Change Your Smoke Alarm Battery Campaign

A slogan that is repeatedly campaigned by the MFB is 'only working Smoking Alarms save lives'. MFB and CFA also run an annual campaign coinciding with daylight savings to 'Change Your Clock Change Your Smoke Alarm Battery'. The end of daylight savings is an important time because it marks the beginning of the colder months when house-fire risk is greater. The campaign is strongly enforced due to the general non-compliant action by the community. It was found by MFB research that almost 20% of households in Victoria had not changed their smoke alarm batteries in the last 12 months (www.mfbb.vic.gov.au). The working order of smoke alarms is a continued concern for the MFB and CFA. Research has shown that although the installation of smoke alarms is compulsory in Victoria, many are poorly maintained and not in working order. In addition, it was found that many people over the age of 65 years require assistance from members of their family or community to change the battery because it requires a ladder (www.mfbb.vic.gov.au). This issue is also a
continued concern for fire-fighting agencies because this age group is at greater risk of fire.

**Sprinklers**

The current Australian Standard for sprinkler systems are:

- **AS 2118.4**, for Residential Sprinkler Systems, suitable for building classified by the Building Regulations as Class 2 and 3, may be up to four storeys in height.
- **AS 2118.5**, for Domestic Sprinkler Systems, suitable for Class 1 dwellings, as classified by the Building Regulations, suitable for typical suburban home.

It has been found that the presence of a smoke alarm and sprinkler system can increase house fire survival to between 74% and 90% (www.mfbb.vic.gov.au).

**Hot Tap Water Temperature Regulation**

In 1994 the Australian Building Code was amended to require that in Victoria new hot water installations deliver hot water to outlets of fixtures for personal hygiene purposes at a temperature not exceeding 50°Celsius for residential buildings (The National Plumbing and Drainage Code AS3500.4-1994). Kidsafe ran a number of promotion campaigns in the 1990s to encourage householders with children to lower the temperature of water delivered at bathroom outlet using the thermostat on existing hot water systems and services or other available devices. Although there is no recent data on the proportion of Victorian households with hot water delivery at bathroom outlets at less than 50°Celsius, recently published data strongly suggests that there has been substantial reduction in the rate of hot water scald hospital admissions in young children and older people between 1996/7 and 2002/3 (Cassell, Clapperton & Ashby, 2004).

**Child-Resistant Cigarette Lighter**

In 1997, the importation of non-child resistant cigarette lighters into Australia was banned and their sale was made illegal under the Trade Practices Act. These legislative changes, implemented across Australia, were influenced by the Victorian Coroner’s recommendation for the ban following an investigation into the death of two young children in a house fire which was caused by a child playing with a cigarette lighter and Victorian injury surveillance data that found cigarette lighters were implicated in a number of severe fire-related burn injuries in children aged less than five years (Valuri, 1994).
Prevention Programs

The MFB and CFA administer a number of prevention programs they have jointly developed. These are outlined in Table 4. More detail about some of the programs relevant to the current study are outlined below.

**TABLE 4**

**MFB and CFA prevention programs and initiatives**

<table>
<thead>
<tr>
<th>Program</th>
<th>Program Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fired up English (CFA)</td>
<td>Fire safety education resources targeting adults of a non-English speaking background in classes studying English as a second language.</td>
</tr>
<tr>
<td>FLAMES, Better English Through Fire Safety (MFB)</td>
<td>Fire safety education program for teenage new arrivals to Australia who are studying at English Language Schools and Centres in an intensified English learning program. Discussions are underway to develop additional materials for primary aged students based on the MFB's FIRE ED Program.</td>
</tr>
<tr>
<td>FLAMES for English Language Schools and Centres</td>
<td>The Isolated Elderly program is conducted in partnership with elderly carer organizations. It highlights factors that make the elderly vulnerable to fire related deaths and injury and encourages carers to provide advice and develop strategies suitable for individual clients.</td>
</tr>
<tr>
<td>Isolated Elderly</td>
<td>The Multicultural Program provides advice on ways to reach multicultural communities. It works to ensure that culture, language and ethnic background do not present barriers to people from diverse linguistic and cultural backgrounds requiring services. Initiatives are created to raise the fire service's profile in ethnic communities and see that communities have input into the development of services.</td>
</tr>
<tr>
<td>Multicultural Program</td>
<td>The Winter and Summer programs are statewide programs intended to promote home fire safety at the community level based on seasonal fire risks. The program is intended to raise awareness of key messages. It generally consists of: media; key program delivery; partnership with other key organizations; promotions; and community presentations.</td>
</tr>
<tr>
<td>Winter/Summer Program</td>
<td>Early Fire Safe is an education program that aims to reduce the incidence of burns and scalds in very young children by promoting the awareness of the risks of burns and scalds to the people responsible for their care.</td>
</tr>
<tr>
<td>Early Fire Safe</td>
<td>Brigades in Schools is a fire safety education program for children on a range of topics including fire safety, outdoor fire safety, personal safety and the fire fighting service in the community. Lessons and worksheets have been written for children from prep to grade 6 in primary school.</td>
</tr>
<tr>
<td>Brigades in Schools (CFA)</td>
<td>FIRE ED is a fire safety education program for students in Grade Prep and Grade 6. It is delivered annually by MFB firefighters to all schools in the MFB district. FIRE ED has been developed in conjunction with the Curriculum and Standards Framework and delivers lessons on smoke alarms, the role of the firefighter, contacting 000 and home fire escape plans.</td>
</tr>
<tr>
<td>JFAIP</td>
<td>The Juvenile Fire Awareness and Intervention Program (JFAIP) is a statewide program aimed at children who have engaged in fire lighting behaviour or are considered to be at risk of this behaviour. See below.</td>
</tr>
<tr>
<td>Mobile Education Unit</td>
<td>The Unit provides fire safety education in primary schools. The equipped semi trailer is set up to resemble a kitchen, laundry, lounge and bedroom. The unit visits schools to demonstrate strategies that deal with unsafe or emergency situations.</td>
</tr>
<tr>
<td>SmokeBUSter</td>
<td>The MFB's SmokeBUSter is a mobile unit fitted with educational displays and mock ups of high risk areas of the home. It is suitable for attendance at school fetes, celebrations and shows.</td>
</tr>
<tr>
<td>Curriculum Materials</td>
<td>The fire services have provided a range of curriculum materials to assist teachers in the development and delivery of fire safety education for children.</td>
</tr>
</tbody>
</table>
Programs for Children

Juvenile Fire Awareness and Intervention Program

The Juvenile Fire Awareness and Intervention Program (JFAIP) is a co-operative initiative of the MFB, the CFA and the Royal Children's Hospital. The program was developed in 1987 after it became apparent that a trend had developed of house-fire incidents involving children. The aim of the program is to reduce injury, property damage and death that result from these types of fires. An examination of these fires revealed the following patterns, outline in Table 5.

**TABLE 5**
Pattern of fire-related behaviour in children

<table>
<thead>
<tr>
<th>Reasons</th>
<th>Approx. Age</th>
<th>Association</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curiosity/Fascination</td>
<td>3-16 years</td>
<td>Attraction to the colour, light and energy release by flames.</td>
</tr>
<tr>
<td>Attention seeking</td>
<td>6-12 years</td>
<td>A change in the family situation, e.g., parental separation, new baby, learning or social difficulties.</td>
</tr>
<tr>
<td>Peer Pressure</td>
<td>10-14 years</td>
<td>Learning difficulties or has low self-esteem.</td>
</tr>
<tr>
<td>Anger/Revenge</td>
<td>8-14 years</td>
<td>Difficulty relating to peers, or experiencing family problems.</td>
</tr>
<tr>
<td>Malicious Mischief</td>
<td>13-16 years</td>
<td>Family and social difficulties.</td>
</tr>
</tbody>
</table>


The program is available for Victorian children between four and seventeen years of age and is undertaken by experienced fire fighters that have received specialist training in the area. The program is also supported by psychologists and psychiatrists from the RCH. Participants are referred to the program from concerned parents, fire personnel, doctors, child welfare agencies, juvenile justice, community policing, Children’s Hospital Accident Prevention Centre and other family welfare sources. The Children’s Court has made participation in the program mandatory for juvenile fire lighters.

The program varies according to the age and maturity of the participant. Over a number of weeks the child is visited at home by the practitioner to establish trust within the child. The practitioner, child and parents then develop an awareness of fire safety issues in the home and use strategies such as role plays, discussions and enjoyable activities, to develop a greater respect for fire and awareness of its consequences. At the same time, the benefits of fire are outlined and the child is taught that fire is a tool and not a toy.

It is reported that since the program began in 1986, approximately 2,500 children have participated in the program. A profile of the program participants revealed that:

- 84% of participants are male;
- 78% are from single parent families;
- 59% have a smoker in the family;
- 21% are believed to have Attention Deficit Disorder or some level of hyperactivity;
- 20% of parents accept additional support for general behavioural problems;
the average age of fire lighters - 8.4 years old; and
the average age when the child first showed interest in fire - 2-3 years old.

There is no charge for the service and confidentiality is assured. It is expected that in the long term the program will help to reduce the number of fires that are lit throughout the state by children each year.

**Programs for the Elderly**

The Retire Ed campaign was developed to educate older members in the community that are statistically at greater risk of fire, fire-related injury and death. The reasons identified include:

- medication can sometimes impact on elderly persons capacity to hear and move properly, thus limiting their ability to detect and escape fire;
- impairments may make it difficult for the elderly to respond sufficiently in a fire; and
- living alone is identified as a vulnerability to fire.

The campaign has been in operation since 1993, and involves the use of a number of retired Fire-fighters who volunteer their time to speak to groups of elderly citizens throughout metropolitan Melbourne.

The program surrounds the enforcement of key issues, such as:

- the importance of smoke alarm installation and maintenance;
- security and fire safety;
- safe cooking practices;
- safe use of electrical appliances; and
- importance of regular home hazard checks.

**Aims**

The aim of the current study was to identify and examine contributory factors to fatal injury from fires, contact burns and scalds that occurred in Victoria over the 4-year period 2000 to 2003. Two specific age groups were selected for examination, children aged 0-9 years and seniors aged 70 years and over because these age groups accounted for a considerable number of fire, burn and scald fatalities over the study period.

Of particular interest was identifying potential contributory factors including:

- the presence and use of smoke alarms;
- barriers to escape from fire;
- the contribution of faulty consumer products to causality; and
- the role of hot tap water temperature in scald fatalities.

**Case Inclusion and Definitions**

Cases were included in the current study if the death was caused by a thermal injury resulting from contact with a flame or involvement with fire (including inhalations), hot objects (contact burns) or fluids, steam and vapours (scalds). Deaths resulting from chemical and electrical burns, burns sustained in motor vehicle collisions, intentional self-harm and interpersonal violence (homicide) were excluded from the study.
METHOD

Case Identification

Cases were identified and verified by searching electronic data and reports collected and stored by the Coronial Services Centre (CSC), the National Coroners Information System (NCIS) and the Country Fire Authority (CFA).

Multiple data sources were utilised to ensure that all fatalities were captured. These case identification methods were used:

1) Keyword search conducted on the TOPIC\(^3\) database, which contains electronically stored police report summaries and Coroner's findings.

2) Incident code search of the State Coroner's Office (SCO) Local Case Management System (LCMS) where incident code equalled “FID” (fire with death) for period 2000 – 2003 (inclusive).

3) Query design and key word search of the National Coroners Information System (NCIS), which stores all deaths reported to the Coroner in Australia.

4) The CFA conducted a search of its Fire and Incident Reporting System (FIRS), Casualty Module System and Fire Investigation Reports for fatal fires attended during 2000 and 2003 to validate the cases identified using methods 1-3.

Searches were conducted on the following databases:

1. TOPIC

Electronic versions of police report summaries, post-mortem reports and Coroner's findings were searched using keywords such as "burn"; "fire"; and "scald". These documents are stored on a database called “TOPIC”, which allows for multiple term searching. TOPIC contains data from 1989 onwards. The reports are not available for all cases, particularly post-mortem reports from deaths that occurred in rural jurisdictions.

2. State Coroner's Office Local Case Management System

Every death reported to the Victorian Coroner is entered onto the SCO LCMS, which dates back to 1989. At the time of entry, a code is assigned to the case that relates to the reported circumstances surrounding the death. One such incident code is “FID” (fire with death). All cases coded as fire with death from 2000-2003 were selected and the police report was obtained for each case. These were reviewed to identify cases where the deceased was aged between 0 and 9 years or 70 years and over.

3. National Coroner's Information System

A number of Query Design searches were conducted on the NCIS according to the criteria outlined in Table 6.

---

\(^3\) TOPIC is maintained by the Victorian Institute of Forensic Medicine (VIFM) for use by Coronial Services Centre staff.
**TABLE 6**  
**NCIS Query Design Items**

<table>
<thead>
<tr>
<th>Data Item</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>State / Territory</td>
<td>Victoria</td>
</tr>
<tr>
<td>Age</td>
<td>0-9 and 70+ years</td>
</tr>
<tr>
<td>Mechanism</td>
<td>G. Heat, cold, electricity radiation and sound</td>
</tr>
<tr>
<td></td>
<td>- G1. Heat, cold</td>
</tr>
<tr>
<td></td>
<td>- G1.1. Contact with hot liquid, steam, other gas</td>
</tr>
<tr>
<td></td>
<td>- G1.2. Contact with hot object or solid substance</td>
</tr>
<tr>
<td></td>
<td>- G1.3. Contact with fire or flame</td>
</tr>
<tr>
<td>Object</td>
<td>N. Food, Drink</td>
</tr>
<tr>
<td></td>
<td>- N01. Hot cooking oil or fat</td>
</tr>
<tr>
<td></td>
<td>- N03. Food, hot</td>
</tr>
<tr>
<td></td>
<td>- N04. Hot drinks</td>
</tr>
<tr>
<td></td>
<td>V. Fire, Flame, Smoke</td>
</tr>
<tr>
<td></td>
<td>- V09. Uncontrolled fire in building or structure</td>
</tr>
<tr>
<td></td>
<td>- V29. Controlled fire in building or structure</td>
</tr>
<tr>
<td></td>
<td>- V51. Ignition or melting of nightwear</td>
</tr>
<tr>
<td></td>
<td>- V59. Ignition or melting of other clothing and apparel</td>
</tr>
<tr>
<td></td>
<td>- V98 Other specified smoke, fire and flames</td>
</tr>
<tr>
<td></td>
<td>- V99. Unspecified smoke, fire and flames</td>
</tr>
</tbody>
</table>

4. CFA Fire and Incident Reporting System

The CFA's Fire and Incident Reporting System (FIRS) is a database that stores information and data on all fires and incidents attended and investigated by the CFA. The Casualty Module is linked to FIRS and it contains data such as civilian casualties (surname and given name, age and gender), incident address, type of call, ignition information, and whether smoke alarms were fitted. This module also includes summary details of the Fire Investigation Findings along with the details of the Coroner’s Findings once they have been handed down by the Coroner and received from the Coroner’s Office.

The State Fire Investigation Co-ordinator of the CFA reviewed the cases identified from the Coronial Services Centre for the purposes of data validation.

**Data Synthesis**

In all cases the Coroner had completed the investigation and made a finding. This meant that all the information collected by the police during the death investigation was available in the file. Each file generally contained the following information:

- Initial police report of death to the Coroner (Victoria Police Form 83)
- Post-mortem examination reports
  - autopsy report; and
  - toxicology report.
- Inquest brief
  - investigating police officer's summary of events from statements
  - witness statements
- photographs
- fire / forensic investigation report
- Coroner's finding.

A list of data items for collection from each case was compiled from previous research, and from a review of the cases. These data items were entered into a Microsoft Excel Spreadsheet (Table 7).

**TABLE 7**
List of Data Items

<table>
<thead>
<tr>
<th>Fire &amp; Contact Burns</th>
<th>Scalds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case Number</td>
<td></td>
</tr>
<tr>
<td>Case Status (open / closed)</td>
<td>Case Status (open / closed)</td>
</tr>
<tr>
<td>Inquest Number</td>
<td>Inquest Number</td>
</tr>
<tr>
<td>Deceased's name</td>
<td>Deceased's name</td>
</tr>
<tr>
<td>Age</td>
<td>Age</td>
</tr>
<tr>
<td>Adult/Child</td>
<td>Adult/Child</td>
</tr>
<tr>
<td>Gender</td>
<td>Gender</td>
</tr>
<tr>
<td>Day</td>
<td>Day</td>
</tr>
<tr>
<td>Date</td>
<td>Date</td>
</tr>
<tr>
<td>Time</td>
<td>Time</td>
</tr>
<tr>
<td>Location of Fire</td>
<td>Resident of Aged Care Facility</td>
</tr>
<tr>
<td>Origin of Fire</td>
<td>Presence of Carer</td>
</tr>
<tr>
<td>Burn Injuries</td>
<td>Informal Carer</td>
</tr>
<tr>
<td>Inhalation</td>
<td>Supervision / Carer Activity</td>
</tr>
<tr>
<td>Burn Injury and Inhalation</td>
<td>Immediate Treatment of Scald</td>
</tr>
<tr>
<td>Cause of Death</td>
<td>Location of Incident</td>
</tr>
<tr>
<td>Pre-Existing Illnesses</td>
<td>If Home, Own Residence</td>
</tr>
<tr>
<td>Alcohol/ drug remains in blood</td>
<td>Suburb of Incident</td>
</tr>
<tr>
<td>Level of Alcohol and drugs detected</td>
<td>Cause of Death</td>
</tr>
<tr>
<td>Presence of Smoke Detectors</td>
<td>Injuries</td>
</tr>
<tr>
<td>Cause of Fire</td>
<td>Body Region Scalded</td>
</tr>
<tr>
<td>Consumer Product Involvement</td>
<td>Percentage of Body Region Scalded</td>
</tr>
<tr>
<td>Barriers to Escape</td>
<td>Severity of Scald</td>
</tr>
<tr>
<td>House Construction</td>
<td>Pre-Existing Illnesses</td>
</tr>
<tr>
<td>Expert Fire Safety Recommendations</td>
<td>Alcohol/ drug remains in blood</td>
</tr>
<tr>
<td>Coroner's Comments and / or Recommendations</td>
<td>Level of Alcohol and drugs detected</td>
</tr>
<tr>
<td></td>
<td>Object Involved</td>
</tr>
<tr>
<td></td>
<td>Coroner's Comments and / or Recommendations</td>
</tr>
</tbody>
</table>

A second review of the cases was undertaken for the purposes of data entry. Some data items could not be completed for all cases, either because the information was not contained in the coronial file, denoted as "unknown" or the data item was not relevant to the particular case, denoted as "not applicable".
Data Analysis

Each case was allocated to one of three categories based on the substance causing the burn (fire-related, contact burn and scald). The Auto Filter function on Microsoft Excel™ was utilised to calculate the frequencies of the following data items:

- All deaths from fire, burns and scalds
  - frequency of deaths by category per year (2000 – 2003)
  - frequency of deaths by category by age
- Fire-related deaths
  - age group and gender
  - presence of alcohol and drugs
  - presence of pre-existing illness and injury
  - frequency of deceased who lived alone
  - room of origin of fire by age
  - source of fire
  - items ignited
  - presence and operation of smoke alarms
- Contact burn deaths
  - age group and gender
  - type of residence
  - object producing burn injury
- Scald deaths
  - location of incident
  - whether or not deceased lived alone
  - body region of scald injury
  - substance producing scald injury
  - presence of alcohol and drugs
  - presence of pre-existing illness and injury
  - water temperature

Themes and patterns were identified by conducting a content analysis on witness statements.

Limitations

Data Source

The data source utilised in the current study consisted of information submitted to the State Coroner's Office (SCO) for the purposes of death investigation. As the electronic system of data storage and retrieval is based on case management needs, it has limitations for research purposes.

Electronic Case Coding and Identification

There are a number of limitations in relation to case identification using the electronic coronial databases. Deaths that occur in rural Victoria are often investigated by local police members and completed by the local Magistrate/s, who act as Coroners. Once the case is completed, that is the Coroner has made a finding, the documents are sent
to Melbourne and stored at the Coronal Services Centre (CSC). The electronic textual information (police summary of circumstances and Coroner's findings) for cases completed in rural Victoria are not all stored on the SCO LCMS. As a result the keyword search using TOPIC does not identify all relevant cases.

The accuracy of textual information is also problematic, particularly in terms of the police Form 83 circumstances text. The Form 83 is required to be submitted to the Coroner within 24 hours of the death occurring in order to inform the forensic procedures and further investigation. Often information is scarce in the first 24 hours after the death and it is not until the investigation is almost complete that the events leading to the death are documented with any accuracy. This process can take days or even months. From a research perspective this information should be interpreted with care.

Coding of the deaths on the SCO LCMS is also not designed with research in mind. Each death is classified using one of 45 incident type codes, for example a death that occurred in the context of a residential fire would be coded as "FID". There is no specific code for a scald or contact burn and therefore the death would most likely be given a generic coded such as "reportable" or "REP". "Reportable" is the code applied when the circumstances of the death are unknown or there is no other code applicable. As a result there are a large number of cases with the code REP, for example in 2001 2,120 of the 4,003 deaths reported to the Coroner (53%) were coded as reportable. Due to time constraints, it was not feasible to examine every one of these deaths in order to identify the deaths resulting from a fire, burn or scald. Therefore, there may be some degree of under-reporting. Furthermore, the codes are allocated to deaths when they are first reported to the SCO, and are not updated as more details are known about the case.
RESULTS

Between 2000 and 2003 there were 40 deaths in Victoria of children aged 0-9 years and seniors aged 70 years and older that occurred as a result of fire, contact burn or scald injury. Twenty-seven deaths occurred in the context of a fire (burn from flame and / or smoke inhalation), 19 of which were seniors aged 70 years and over and eight of which were children aged between 0 and 9 years. Two deaths resulted from contact burns, both in seniors aged 70 years and over. The remaining 11 deaths resulted from scald injuries, ten fatalities were seniors aged 70 years and over and one was a child.

The frequency of these fatal incidents per year shows considerable variability as illustrated in Figure 1.

![Figure 1: Frequency of burns and scalds deaths per year, 2000-2003: Victoria (n=40)](image)

The frequency of fire, burn and scald fatalities by broad age group is shown in Table 8. The most common cause of injury for both children and seniors was a combination of burns from flame and smoke inhalation in the context of a house or room fire (n=18, 62%).

<table>
<thead>
<tr>
<th>TABLE 8</th>
<th>Frequency of deaths from fires, contact burns and scalds by age, 2000-2003: Victoria (n=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-9 Years</td>
</tr>
<tr>
<td>Scald</td>
<td>1</td>
</tr>
<tr>
<td>Contact Burn</td>
<td>0</td>
</tr>
<tr>
<td>Fire</td>
<td>-</td>
</tr>
<tr>
<td>- Fire / Flame Burn</td>
<td>0</td>
</tr>
<tr>
<td>- Smoke Inhalation</td>
<td>3</td>
</tr>
<tr>
<td>- Fire / Flame Burn &amp; Smoke Inhalation</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
</tr>
</tbody>
</table>
Fire-Related Deaths (from burns and / or smoke inhalation)

During the four-year study period there were 27 deaths of children (0-9 years) and seniors (aged 70+ years) as a result of a fire-related injury in Victoria. These deaths represented 68% of all fire, burn and scald injury deaths and resulted from 25 separate incidents. An examination of these incidents illustrated that:

- 56% (n=14 of 25) occurred at night, between 8:00 pm and 8:00 am;
- 72% (n=18 of 25) occurred on a weekday; and
- 44% (n=11 of 25) occurred in the winter months (June-August).

Personal Characteristics

Gender

Among both seniors and children, there was an even distribution of males and females (n=14 and n=13 respectively).

TABLE 9
Frequency of deaths from fires by age and gender, 2000-2003: Victoria (n=27)

<table>
<thead>
<tr>
<th>Age</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>5-9</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>70-74</td>
<td>4</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>75-79</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>80-84</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>85-89</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>90-94</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>13</td>
<td>27</td>
</tr>
</tbody>
</table>

Contributory Factors

Alcohol and Drugs

In 16 of the 19 deaths of seniors there was information about the presence and detected level of alcohol in the toxicology report contained in the coronial file. In 12 of these 16 cases, alcohol was not detected. In the remaining four cases alcohol was detected at the following levels:

- 0.23 g/100 mL – (72 year-old female);
- 0.13 g/100 mL – (89 year-old male);
- 0.19 g/100 mL – (70 year-old female); and
- 0.15 g/100 mL – (77 year-old female).

Evidence from the investigation into these four deaths revealed that a combination of alcohol intoxication, smoking and poor health contributing to the fire igniting and prevented escape. This is illustrated in the following excerpts.

The deceased suffered from ischaemic heart disease and was intoxicated at the time of the fire. The Forensic Physician stated that at a blood level of 0.23% it would be expected that the deceased would appear uncoordinated and be unsteady on her feet. Her level of consciousness or awareness would have been reduced. This would have affected her ability to appreciate her situation in the fire and take action to protect herself. The deceased's daughter reported that at the time of her passing she was on a 50 pack of cigarettes per day and that she lived alone. [1473/2000 - Inquest Brief]
The deceased was of poor health and had natural disease in the form of mild hypertensive cardiomegaly. The alcohol level (0.19 g/100 mL) may have impeded the deceased's conscious state and sensibility to a smoky environment. The deceased's daughter stated that the deceased was a very heavy drinker who had fallen on a few occasions due to drinking. She described a time when at the address the deceased, who also smoked, got out of her chair and dropped a lighted cigarette onto the chair and walked off. Daughter also stated that the deceased would become agitated and would drink very heavily prior to attending a doctor or specialist. She stated that the deceased was to go for chemotherapy on the morning of her death. Deceased lived alone. [2694/2000 - Inquest Brief]

The deceased was a heavy smoker, in the range of 40-50 cigarettes per day and succumbed to bouts of binge drinking. A combination of these habits would regularly see her smoking in bed whilst intoxicated. The post mortem results revealed ingestion of alcohol at a level which can cause considerable depression of the Central Nervous System and the presence of four prescription medications that may have affected escape. The deceased's daughter had previously expressed concerns that a fire may result. The deceased also lived alone. [2037/2002 - Inquest Brief]

In 21 of the 27 deaths of children and seniors there was information available in the toxicology report about the presence and detected levels of prescription drugs. In 17 of the 21 cases prescription drugs were not detected. In two of the five cases where prescription drugs were detected there was also evidence of alcohol consumption immediately prior to the fire. In four of the five cases the deceased was being treated for both a physical and mental illness, such as Alzheimer's disease, depression, arthritis, diabetes, cancer and cardio-vascular disease. There was no evidence in the toxicology reports to suggest that illicit drugs had been consumed in any of the cases.

Pre-existing Illness / Injury

An examination of post-mortem reports indicated that in 14 of the 19 fatalities of seniors, the deceased was considered to be in poor health. In all of these cases it was reported that illness and injury may have prevented the deceased from escaping the fire. Their health problems were both physical and mental, and included: (note more than one was reported in most cases):

- cardiovascular disease (e.g. ischaemic heart disease) - n=10
- respiratory disease (e.g. severe chronic obstructive lung disease and emphysema) - n=6
- cancer (n=5)
- physical injury (e.g. sciatica, injuries to legs) - n=5
- mental illness (e.g. anxiety) - n=5
- other (e.g. deaf) - n=3

Note that information on illness and injury was not systematically collected unless it was judged to be directed related to the cause of the death.

Living Alone

Eleven of the 19 seniors who died from fire, burn and scald injury lived alone (58%) and seven others lived with one or more other people. There was no information on living arrangements for one case.
Fire Characteristics

In 25 of the 27 fire-related deaths, the incident occurred at the deceased place of residence. The remaining two incidents occurred at a hospital and in a caravan.

Room of Origin of Fire

The majority of fires began inside the house (n=22, 88%). The two most common rooms of the house where the fire started were the bedroom and lounge room (n=9 and n=7 respectively). In most cases (n=19) the deceased was found in the room in which the fire started.

{| Room of Fire Origin | 0-9 Years Children | 70+ Years Seniors | Total |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Backyard / Balcony</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Bathroom / Laundry</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Bedroom</td>
<td>3</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Caravan</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Kitchen</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Lounge room</td>
<td>1</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Roof</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Not specified</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6</strong></td>
<td><strong>19</strong></td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>

Table 10: Frequency of fires incidents by age and room of origin, 2000-2003: Victoria (n=25)

Source of Fire

In ten of the 25 incidents (40%) the fire was ignited from an appliance. The appliances involved were as follows:

- baby monitor or power plug (n=1)
- circular saw (n=1)
- electric blanket (n=2)
- heater (gas and electric) (n=3)
- stove (n=2)
- television (n=1).

In five of the seven cases for which information was available, the fire resulted from misuse of the appliance.

_The fire was caused by the deceased drying his clothing and linen in front of the lounge room gas heater. [1358/2000 - Coroner's finding]_

_The fire appeared to have originated from a folded electric blanket. The cause of the fire was the ignition of available combustible materials such as the material of the electric blanket, other bedding on the bed and the floorboards. The probable source of ignition was from the misuse of the electric blanket, which was probably still switched on when folded and placed on the floor causing a malfunction and over-heating. [1456/2001 - Inquest Brief]_

_Probable ignition source was a twin bar electric radiator lying face down on compacted paper. (2433/2002 - Coroner's finding)
...the fire is likely to have been lit by the radiant heat from the radiator directed onto the armchair and fabric material (the towel, papers, clothing or sheet), or from this material falling onto the appliance whilst in operation. [2434 & 2435/2003 - Forensic Officer's Report]

In the three remaining cases, the appliance was found to be defective.

The most significant probabilities of ignition source were a faulty power plug or plugs or an adapter in the eastern wall, or overheating of a baby monitor transmitter. (3273/2000 - Coroner's finding).

A further nine cases involved smoking material, cigarettes, lighters or matches. Seven of the 25 fires (28%) were ignited from a lit or improperly discarded cigarette. All these incidents involved seniors. The most common scenario was that the deceased was either smoking in bed or fell asleep while smoking. In two of these seven cases the deceased was also intoxicated.

It was known that the deceased was a heavy smoker and that he smoked in bed. Police established that the deceased had been smoking in bed and had fallen asleep. [1989/2000 - Inquest Brief]

...deceased's daughter indicated that the deceased was a heavy smoker, in the range of 40-50 cigarettes per day ... succumbed to bouts of binge drinking ... combination of these habits would regularly see her smoking in bed whilst intoxicated... daughter had previously expressed concerns that a fire may result. [2037/2002 - Inquest brief page 6]

During my investigation of this incident and with consultation with the criminal investigation unit and the CFA, it is my opinion that the deceased, had fallen to sleep in the lounge room chair while smoking a cigarette which subsequently started the fire. [2849/2003 - Investigating Officer]

It was noted from the fire investigators into one of these incidents that:

The community needs to be made aware of the dangers of smoking in bed. The community also needs to be made aware of the importance of having a properly located, operating and maintained smoke alarms. Batteries must be replaced regularly. (2456/2000 - Fire Investigation & Analysis Unit)

Two fires were ignited by cigarette lighters/matches in the context of child fire play.

...the children apparently had a cigarette lighter and a candle under the bed. The bed has caught fire and then fire has engulfed the whole room. [0229/2000]

The deceased had a fascination with fire. It appears that he would become transfixed when in the presence of fire and would play with matches if given the opportunity to do so. ... A Detective from the arson squad conducted a thorough examination of the scene as part of the overall police investigation into the matter. He concluded that the deceased had lit a fire in his bedroom in the early hours of the morning and had then climbed into the wardrobe where his body was later found. ... The deceased attended a Juvenile Fire Awareness and Intervention Program conducted as a joint initiative of the following agencies: Metropolitan Fire and Emergency Service, Country Fire Authority and the Royal Children's Hospital. The title of the program attended by the deceased was 'Helping families solve the problem of child fire lighting'. The deceased attended this program over a period of some six months in 1998. The deceased would have been approximately 4 years old when he attended this program. With the benefit of hindsight, it is clear that the deceased and his
family would have benefited from additional counselling and assistance of the type that this program is designed to provide. [3033/2000]

The six remaining fatal fires were ignited by faulty wiring, unattended candles, or a combination of highly flammable substances in the vicinity of a lit flame.

The evidence satisfies me that the seat of the fire was in the roof cavity above the lounge room, with logic dictating that here was a wiring fault in this area. I am further satisfied that the restoration of the service following repair of the substation fault and the fire, were causally, related. The fact that no other reports of damage were received by the service provider does not deter me from this conclusion, as I am satisfied it was a combination of the fault at the substation and a pre-existing fault in the ceiling wire, that caused the tragic outcome. [1103 & 1104/2000 Coroner's finding]

- ...

... the origin of the fire was a small religious altar, made of cane, in the bedroom of the deceased. Each night she would burn oil and incense whilst praying. It appears that the altar ignited and the deceased was unable to exit her bedroom due to a faulty door lock. [0279/2000 - Coroner's finding]

- 

The deceased's mother was using Shellite Petroleum soap liquid to remove stains from clothing. It was stated by the deceased's father "...she used 4 or 5, 250ml bottles of Shellite in a bucket and proceeded to agitate in the bucket with her hands". It is apparent that whilst the mother was using Shellite in the laundry with the door closed the naked flame from the heater pilot ignited the Shellite and fire rapidly spread. A San Safety Advisor stated that the flue system for the heater was not efficient saying, "It was one of the poorest flue systems I have seen in a domestic situation". The flue kit was installed by the deceased's father. [1611/2001 - Coroner's finding]

**Items Ignited**

The most common item ignited in the fatal fires was beds and bedding (n=7). Other furniture such as wardrobes and lounge chairs were also ignited (n=4) as well as the deceased's clothing (n=3). Other items ignited included: flammable substances (n=3); appliances (n=3); roof space (n=2); grass (n=1); and paper (n=1).

The area of origin was the centre of the lounge room. The point of origin was non specific but in the immediate vicinity of the heater. The heater was the source of the ignition. The first fuels ignited were either material or paper, residue of which was found immediately next to the heater. The central lounge chair provided the next source of fuel aiding fire development. As to the circumstances of who turned the heater on...I do not have the information to make comment [2435 & 2435/2003 - Fire Investigator]

- 

Fire investigations revealed that a cigarette had fallen between the arm of the chair and a cushion which ignited the fire. Deceased awoke and tried to extinguish the fire before being overcome by smoke and suffering burns. She was conveyed to hospital but died some days later. [2849/2003 - Coroner's finding]
Environmental Characteristics

Smoke Alarms

In seven of the 25 fire incidents (causing 27 deaths) it was not specified in the coronial file whether a smoke alarm was fitted at the dwelling in which the fire occurred and in two further cases the presence of a smoke alarm was not applicable as the deceased was located outside the residence or on a balcony at the time of the fire.

In ten of the remaining 16 incidents a smoke alarm was fitted at the residence, seven of which were operational at the time of the fire. In three of these cases the smoke alarm was not operational because the battery was removed or disconnected.

*The detector was removed earlier due to a low battery. The deceased's son was to buy a replacement the following Monday.* [1473/2000 - Coroner's finding]

*The battery had been removed by the occupants when it went flat, and started it's audible warning tone.* [2456/2000 - Fire Investigation & Analysis Unit report]

*There are two smoke alarms that are located in the hallway adjacent to the kitchen. Both had a battery, which had been disconnected from the terminal.* [4100/2003 - Inquest Brief]

Of the seven cases where a smoke alarm was fitted and was operational at the time of the fire, there were two incidents where the smoke alarm did not sound. In both cases the deceased was in the bedroom where the fire ignited.

*There was a smoke detector fitted in the hallway, between the two front bedrooms. The performance of the detector may have been reduced as a result of the nearby front door being open (although with the screen door closed). The back door was also open, with the screen door closed, and there may have been some draught along the hallway.* [0229/2000 - VFSC Scientist findings]

*Two doors were shut and that minimised the ability of the smoke detector to emit an early warning sign.* [3273/2000 - VFSC, Scientist finding]

In the remaining five cases the alarm apparently did sound, however the deceased was unable to escape because they were either trapped inside the room or house where the fire was, were intoxicated or were overcome by smoke while trying to extinguish the fire, for example:

*The door to the bedroom was closed at the time of the fire, and the door handle had been removed. It was found on the floor approximately two metres from the door. This would have made the door difficult to open, particularly for an older person, even without the presence of a fire close by.* [0279/2000 - Fire Investigation Report]

*The deceased was suffering smoke inhalation and when he tried to exit the premises was unable as the security door was locked. This fatality again highlights the need for the public, especially the aged and handicapped to have some form of emergency procedures in place. The Brigade recommends that doors fitted with deadlocks be provided with a key in the lock when the premises is occupied. Also when grates and shutters are fitted to the windows that they can be swung open from the inside to effect an escape.* [1358/2000 - Fire investigator's report]
Contact Burns

Two of the forty deaths resulting from burns and scalds during the four-year study period resulted from contact burns. Both deaths were of females aged over 70 years. In one case the incident occurred at the deceased person’s home where she lived alone and in the other case the deceased was a resident of a hostel. Both women were in poor health, suffering from illnesses such as cardio-vascular disease and were described as frail. The circumstances leading up to these incidents involved a fall where the deceased made contact with a portable electric heater that was operating. The impact of the fall rendered both women unconscious and they subsequently sustained serious burn injury that resulted in death.

The conclusion which can be drawn from the evidence is that the heater and its use was safe; what created the danger was the occupants fall in a position which placed her in near contact with the still operating heater. [2257/2000 - Coroner's findings]

Scald Deaths

Personal Characteristics of Deceased

Eleven of the forty fire, burn and scald deaths resulted from a scald injury (27.5%). Seniors accounted for 10 of the 11 scald fatalities. There was an even distribution of males and females (n=5 and n=6 respectively) among scald fatalities.

Body Region Injured

The main regions of the body where a scald injury was sustained were:
- buttocks and legs (n=5);
- trunk (n=4); and
- chest (n=2).

Time of Fatal Scald Incidents

For cases where information was available in the coronial file (n=6), all of the incidents occurred during the day.

Location of Incident

In 10 of the 11 scald cases information was available on the location of the injury event. Eight occurred in the deceased's own home, one incident occurred at a residential aged care facility and the remaining incident occurred in a hospital. Nine of the ten incidents occurred in the bathroom. In the majority of cases it was unclear whether the deceased was living alone at the time of the incident.

Contributory Factors

Temperature of Hot Water at Bathroom Outlets

The mechanism of all but two scald deaths was too-hot bath or shower water from bathroom outlets (Table 11).
TABLE 11
Frequency of scald deaths by age and substance, 2000-2003: Victoria (n=11)

<table>
<thead>
<tr>
<th>Mechanism of scald</th>
<th>0-9 Years Children</th>
<th>70+ Years Seniors</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cup of Tea</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Bath Water</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Shower Water</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>10</td>
<td>11</td>
</tr>
</tbody>
</table>

The most common scenario resulting in scald injury was that the deceased experienced difficulty controlling or adjusting the water flow or water temperature. This is illustrated in the following excerpts.

*The DECEASED had been living alone for three weeks after his wife had left the family home because of the DECEASED'S alcoholism. The DECEASED had recently discharged himself from an alcohol rehabilitation centre. It appears that the DECEASED in an intoxicated state had soiled his trousers in the kitchen. He has removed his trouser and gone to the shower to try and clean them and himself. Leaving the trousers in the shower base he ran a bath to clean himself. He has run a bath of scalding hot water and climbed in. This appears to be the cause of the scalding burns to the buttocks, lower left leg, feet and elbows. The DECEASED had got out of the bath and walked to the lounge room and collapsed into an unconscious state. It appears that his Alcoholism and poor state of health has contributed to his death.* [1789/2002]

-*The DECEASED'S family doctor attended the home after the DECEASED'S husband telephoned his surgery and asked him to come and assess burns his wife had just received after accidentally turning the hot water tap fully on herself whilst in the shower. On attending the premises, the family doctor called an ambulance and the DECEASED was admitted to the Intensive Care Unit of the hospital. On admission to the hospital she was assessed as having 30% full and partial thickness cutaneous burns.* [2251/2002]

- Deceased male admitted to hospital after burning himself at home in the shower. Appears he turned hot water on instead of off, causing burns to 30% of his body. Condition deteriorated after admission, his care was complicated by pneumonia. [3209/2003]

In eight of the nine cases where the scald occurred while bathing, the deceased was suffering a number of physical and / or mental illnesses such as dementia, cardiovascular disease and arthritis. It was not stated in the coronial file whether these illnesses contributed to the incident, however in a number of cases the deceased was described as "frail" which may explain why they had difficulty controlling or adjusting the water flow and water temperature.

In the two remaining cases, one child and one senior, the scald injury, which become infected, was sustained from a spilt cup of tea.

*DECEASED, my step-dad, my friend and myself were watching television, and DECEASED climbed up the kitchen drawer handles and dragged a cup of tea that I had made for my step-father. I had just made a couple of milo and a cup of tea for myself and my friend. I was walking back in the kitchen when I saw Jeremy fall on the floor from the kitchen bench. The cup was still on the bench but the hot tea was on the kitchen floor and on DECEASED.* (3646/2000 - Brother's statement)
Whilst an inpatient at the hospital, the DECEASED spilt a hot cup of tea on her thighs. This resulted in burns, which were treated with cold water. A number of small blisters developed which were not considered serious. (0086/2003 - Coroner's findings)

Water Temperature

There was only one case where the investigation included a temperature test of the water temperature being delivered to the bath or shower.

I tested the bath taps hot water for approximately 30 seconds and I am of the belief that the water was scalding hot. The water running for that short period of time produced a vast amount of steam within the bathroom. The hot water was too hot to touch. A test of water using a thermometer within the flat indicated a water temperature in the area of 60 degrees Celsius. I located the hot water service within a cupboard inside the premises. I noted it to be a Rheem hot water service 101 series. Model number 101080. The heat setting was on the highest level. (3070/2000 - Investigating Police Officer Statement)

Alcohol and Drugs

The presence of alcohol and drugs was only specified in the coronial file in five of the 11 scald cases. Elevated blood alcohol concentration, (0.14 g/100mL) was detected in one case and prescription drugs (within therapeutic dosage limits) were detected in two other cases.
DISCUSSION

The current study examined 40 deaths of children aged 0-9 years and seniors aged 70 years and over from injuries sustained from fire, burns and scalds over the 4-year period 2000 to 2003 in Victoria.

Our analysis indicated that the main factors that contributed to fire, burns and scald deaths in children and seniors over the study period were faulty or improperly used electrical appliances, smoking in bed, improperly discarded cigarettes, fireplay (by children), excessive alcohol consumption, the temperature of hot tap water at bathroom outlets and frailty and pre-morbid conditions in seniors that may have affected their ability to withstand the effects of fire and flames, escape fire and use bathroom tap controls.

In a recent study, Cassell et al. (2004) reported on non-fatal hospital-treated fire, burn and scald injury over the period 2001-2003 in Victoria. In total, 1,780 children aged 0-4 and 434 seniors aged 70 years and older were treated in Victorian hospitals for burns and scalds over the three-year period. The findings on contributory factors to hospital-treated burns and scalds were similar to those found in our study of fatalities.

Fire-Related (burn and / or smoke inhalation) burn prevention

Fire-related injury accounted for the highest number of deaths in the current study for both children (n=8, 89%) and the elderly (n=19, 61%) in comparison to contact burns and scalds. By contrast, non-fatal injury from fire (smoke, fire and flames) accounted for the lowest number and percentage of hospital admissions and emergency department presentations for 0-4 year old children (n=50, 10% - admissions and n=98, 8% - presentations) compared with scalds and contact burns (Cassell et al., 2004). In the elderly, fire accounted for the second highest number and percent of non-fatal injury after scalds (n=92, 32% - admissions and n=14, 10% - presentations). Information on the circumstances and causes of non-fatal fire-related injury was limited due to the quality of case narrative data on emergency department presentations, however commonly reported factors included:

- using accelerants for igniting fires or near open flames;
- drying clothing near heaters;
- smoking in bed; and
- accumulation of clutter.

These findings are consistent with the results of the current study. The two most common items contributing to the ignition of fatal fire injury were appliances (both electric and gas) and cigarettes. Appliances primarily involved in the ignition of fatal fires were heating devices, including electric blankets. In most circumstances the deceased operated these appliances in a dangerous manner, such as drying clothes in front of a heater. A warm environment is an obvious necessity for both children and the elderly, however the use of heating devices should not increase the risk of burn injury. Both the current study and previous research identified electric bar type heaters as devices involved in fatal fire incidents (Duncanson et al., 2001b). Duncanson et al. (2001b) recommended that the New Zealand Fire Service Commission determine characteristics of safe home heating systems and develop fire safety programs to promote heating safety. Wall mounted heaters has also been
identified by a New Zealand Coroner as a safer alternative to upright portable heaters (Duncanson et al., 2001b).

**Recommendation 1 -** The CFA and MFB promote the use of wall mounted heaters as an alternative to upright / portable heaters through programs the fire services deliver to older people.

The other common scenario amongst the fire-related burns cases, primarily relevant to seniors was the ignition of fire from a lit or improperly discarded cigarette. Smoking in bed and falling asleep while smoking were found by fire investigators to have contributed to a number of deaths in the current study. The findings of the current study that 37% (n=7 of 19) of fatal fires in the 70 years and over age group were ignited from a cigarette supports previous research by Duncanson et al. (2001) who reported that cigarettes accounted for 18% of fatal fires in the 65 years and over age group in New Zealand.

Barillo and Goode (1996) reported that in the United States marketing of fire-safe cigarettes has been strongly advocated for years by burns prevention organizations and medical organizations such as the American Burn Association and the American Medical Association, however the US federal government was not convinced of the cost-effectiveness of this prevention measure. In addition there has been considerable opposition from cigarette manufacturers (Duncanson et al., 2001).

Duncanson et al. (2001) reported that in New Zealand in 2000 a Private Members Bill (the Cigarette (Fire Safety) Bill) was passed in New Zealand Parliament requiring that cigarettes sold be manufactured to reduce their propensity to ignite combustible materials if left unattended. Chapman and Balmain (2004) recently reported that as of July 2004, all cigarettes sold in New York must pass a performance standard requiring that no more than 25% of cigarettes tested exhibit full length burns on a bed of filter paper specified in the test method. Similar legislation was passed in Canada in March 2004 to take effect from October 2005.

In Australia, the tobacco industry in largely unregulated (with the exception of a ban on sale to minors and tax) and it is therefore difficult to develop a standard. In Victoria, it has been recently recommended by Cassell et al. (2004) that governments, consumer and injury prevention organisations put pressure on cigarette manufactures to produce self-extinguishing cigarettes. This recommendation is supported by the findings of this study. The Australasian Fire Authority Council is meeting in November 2004, where the issue of fire-safe cigarettes is on the agenda for discussion.

**Recommendation 2 -** Cigarette-related fire and fire fatality data should be collated by the MFB and CFA using FIRS and the NCIS to provide up to date evidence to inform a campaign for the development of regulations for fire-safe cigarettes in Australia. In the interim, in view of the number of fatalities, the tobacco industry may consider developing an industry based Code of Practice or Standard for fire-safe cigarettes with the assistance of Standards Australia.

The ability of the NCIS to assist in identification and monitoring of cigarette related fire deaths can be evidenced in that a national search of the NCIS conducted in 2003 identified 33 fire fatalities reported to a coroner between July 2000 and 2003 (excluding Queensland), which were suspected to have been caused by cigarettes (reported in Jordens & Tresidder, 2003). The search was conducted using coded
variables to initially identify all fire fatalities, and then refined further using keyword searching of text reports to identify only those fires fatalities involving cigarettes.

While debate on this issue continues, it is also recommended that there be greater education of smokers on the dangers associated with smoking in bed (Barillo & Goode, 1996; Cassell et al., 2004). It has also been recommended that given that ignition of fires commonly involve bedding and other furnishings (in the current study 44%, n=11), consideration should be given to the development of stringent flammability standards for materials used in bedding and lounges/chairs (Duncanson et al., 2001).

Recommendation 3 - The CFA and MFB continue to raise awareness amongst older adults of the risks of smoking in bed through programs the fire services deliver to older people.

The other common issue amongst the fatal fire incidents in the current study was the reduced ability of the youngest and oldest members of our community to escape in the event of fire. In the majority of fatal incidents involving seniors in our study (76%), the deceased was believed to have been located in the same room as the seat of the fire. Poor physical health, including cardio-vascular and respiratory diseases, mobility problems and the presence of a mental illness such as anxiety was thought by fire investigators to have hampered the ability of older people to escape the fire. In relation to children, in seven of the eight fire-related deaths the child was aged six years and under and was thought to have been too young to escape the fire.

In the current study, of the 16 cases where information on smoke alarms was specified and applicable, only 40% (n=7) were found to be fitted and operational at the time of the fire. Investigations into these fires revealed that in five cases the smoke alarm went off but the deceased was unable to escape the fire due to factors such as dead locked doors, poor mobility, poor health or intoxication. In two cases the alarm did not sound because the fire started in a room with the door closed that was too far away from the alarm.

In just under 40% (n=6) of cases, smoke alarms were not fitted at the dwelling where the fire occurred, although smoke alarm installation has been mandatory in all Victorian homes since 1999. Cassell et al. (2004) reported that the last household survey conducted by the Australian Bureau of Statistics (ABS) that covered smoke alarm ownership in Victoria was conducted in 1998, which reported 84% coverage. This was self-report data and there was no information on whether installed alarms were in working order at the time of the survey.

In our study, there were several reports of non-functioning smoke alarms due to removal of batteries or disconnection of wiring. These findings support the need for regular community education campaigns and assistance programs (as currently run by the MFB and CFA) to remind householders to undertake regular smoke alarm maintenance, and assist vulnerable community members, particularly the elderly, to perform maintenance tasks. Serious consideration should be given to the recent recommendation made by researchers from the Victorian Injury Surveillance and Applied Research Unit (VISAR) about the active promotion, by Fire Authorities, of the 10-year lithium battery smoke alarms:

> there should be promotion of 10-year single purpose lithium smoke alarms and an outreach give-away and installation program for low income households with young children and house bound older people. (Cassell et al., 2004).
The findings of the current study support this recommendation. The reported advantages of the 10-year lithium battery smoke alarm are that they do not require batteries to be changed annually and the batteries are single purpose and cannot be used in toys and games (Cassell et al., 2004).

**Recommendation 4 - 10-year single purpose lithium battery smoke alarms should be promoted and there should be an outreach give-away and installation program for low income households with young children and house bound older people.**

It was also clear from the review of prevention initiatives of the CFA and MFB that there is already a strong evidence based community safety focus in the areas of public awareness, education and regulation for fire-related deaths and injuries in Victoria. The MFB and CFA programs that involve direct contact with the community, particularly children and the elderly, make them ideal advocates for prevention initiatives such as lithium smoke alarms. The recently published Cochrane Review assessing the effectiveness of community-based, coordinated and multi-strategy interventions for reducing burns and scalds injury in 0-14 year old children may also be of benefit to the community safety area of the CFA and MFB to inform the design and evaluation of future prevention programs.

**Contact Burn Prevention**

Fatal injury from contact burns accounted for the lowest number and proportion of deaths in the current study. Only two occurred over the study period, both in seniors. By contrast, serious non-fatal injury from contact burns accounted for 12% and 14% of hospital admissions for burns and scalds among young children (0-4 years) and seniors (aged 70 years and older), respectively, over the period 2001 to 2003 in Victoria (Cassell et al., 2004).

The main reported cause of non-fatal injury from a contact burn among older adults was contact with a hot heating appliance (Cassell et al., 2004). This finding was consistent with the circumstances surrounding the two contact burn deaths in the current study. It was noted by Cassell et al. (2004) that heater guards should be promoted to older people, particularly given their high risk of falls. In the current study the heating appliances involved were upright portable heaters and it was noted in one of the coronial investigations that a more appropriate arrangement for heaters for the elderly would be for them to be wall mounted. Not only would wall mounted heaters reduce the risk of a contact burn, it would also reduce the risk of fire (as previously noted) and the risk of a fall from tripping over the device.

**Scald Prevention**

Fatal injury from a scald accounted for the second highest number of deaths from fire, burns and scalds in the current study (n=11, 27%), after fires. These deaths primarily occurred in the 70 years and over age group. Non-fatal injury from scalds accounted for the highest number and percentage of hospital admissions and emergency department presentations for 0-4 year old children (n=369, 75% - admissions and n=636, 49% - presentations) between July 2001 and June 2003 (Cassell et al., 2004). In the elderly, scalds also accounted for the highest number and percent of non-fatal injury (n=139, 40% - admissions and n=87, 60% - presentations).
Hot drink scalds rarely cause fatal injuries, although there were two cases reported in our current study. However, hot drinks spills are a major cause of hospital–treated scalds in both young children and seniors (Cassell et al., 2004). The spill-resistant mug promoted by the Monash University Accident Research Centre (MUARC) is a prevention measure that has the potential to reduce incidents of scalds from hot drinks.

The other common cause of both fatal and non-fatal scald injury was hot tap water. Cassell et al. (2004) reported that between July 2001 and June 2003 17% of hospital admissions for scalds in the 0-4 year age group and 18% of hospital admissions for scalds in the 70 years and over age group resulted from contact with hot tap water. In this study this scenario accounted for 82% of scald deaths and 23% of all deaths from fires, burns and scalds. These injuries mostly occurred in the context of bathing and showering and resulted from the deceased experiencing difficulty controlling or adjusting the water flow or water temperature. There was limited information in the coronial file in relation to water temperature at the locations where these incidents occurred. Despite this, awareness should be raised amongst the elderly community and parents of children that the temperature of hot water delivered from bathroom outlets should not exceed 50°C.

Recommendation 5 – Renewed effort should be made to convince all householders to lower the maximum temperature of hot water delivered to bathroom outlets to 50°C Celsius.
REFERENCES


