

**REDUCING RESIDENTIAL FIRE FATALITIES**

**STRATEGIC MANAGEMENT OF CHANGE UNIT**

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An applied research project submitted to the United States National Fire Academy  
as part of the Executive Fire Officer Program

April 1999

## Abstract

A primary role of fire departments is to protect people against the threat of fires in their homes. Rising fire fatality rates in Tasmania, particularly when limited to well-defined sectors of the community, are a sign that existing fire safety strategies are not addressing the needs of at-risk groups.

This paper has evaluated literature on the causes of residential fire fatalities and has analysed historical fire fatality records to identify sectors of the community most at risk from fires. Fire prevention and safety strategies designed to reduce residential fires and fire deaths have also been evaluated. Finally, in order to increase the effectiveness of smoke alarms when fire *does* occur, smoke alarm maintenance habits of a high-risk sector of the community have been analysed.

This paper has addressed the following specific questions:

1. What behavioural and environmental factors contribute to fire fatalities in dwellings?
2. What sectors of the Tasmanian community are most at risk from fire?
3. What strategies should be adopted by Tasmania Fire Service to improve fire safety in dwellings for communities most at risk?

To ensure objectivity, fire investigators, senior public health officials, the Chief Coroner, and marketing and education specialists have been consulted.

People unable to look after themselves properly, including the elderly and the very young, disabled persons and those affected by medication, non-prescribed drugs or alcohol are particularly at risk from fire. Risk increases for those who smoke, particularly if smoke alarms are

not maintained in the home. Low-income households are disproportionately represented in fire fatality statistics.

To ensure limited resources are directed where they will be most effective, strategies to reduce fire fatalities should target high-risk groups. Television promotions distinguishing between safe and unsafe fire behaviour and promoting the benefits of properly maintained smoke alarms should be used. Schemes to increase use of alarms in low-income households and those occupied by the aged should be implemented.

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## Introduction

Fire departments have a mandate, and an obligation, to protect people from fire. High or rising fire fatality rates are a sign that a fresh approach to improving fire safety may be needed to ensure that service delivery is aligned with the needs of the community.

Traditional service delivery methods may no longer be, or may never have been, appropriate to the needs of hard-to-reach sectors of the community. When faced with dwindling financial resources, fire departments must ensure that appropriate fire safety programs are delivered where they will achieve the most good; that is, to those most at risk from fire.

For the seven years to June 1998, Tasmania Fire Service experienced an average fire fatality rate of 1.1 deaths per 100,000 population, nearly twice the national average of 0.6 for the same period. In the first six months of the 1998/99 fiscal year, the Tasmanian fire fatality rate jumped to 1.9, a clear signal that it was time to review existing fire prevention and fire safety programs to ensure that those most at risk from fire were heeding the fire safety message. Significantly, all preventable fire fatalities in Tasmania since July 1991 have occurred in residential dwellings.

The purpose of this research paper is to identify the factors that contribute to fire fatalities in Tasmanian dwellings and propose strategies to reduce these fatalities for those most at risk.

In order to address the residential fire fatality problem in Tasmania, this paper will answer the following questions:

1. What behavioural and environmental factors contribute to fire fatalities in dwellings?
2. What sectors of the Tasmanian community are most at risk from fire?

3. What strategies should be adopted by Tasmania Fire Service to improve fire safety in dwellings for communities most at risk?

Evaluative research of literature on fire-risk behaviours will identify behavioural and environmental factors that contribute to residential fire fatalities. Analysis of historical incident data including fire investigation reports and coronial records will identify additional socio-economic and other circumstances that have contributed to fire fatalities in Tasmanian dwellings. Evaluative research of literature on strategies to improve fire safety in the home will serve to identify the most appropriate strategies for Tasmania Fire Service to implement in the community. Finally, a survey of Tasmanian homes will identify the smoke alarm maintenance habits of the community, and any steps necessary to improve these habits.

### **Background and Significance**

Tasmania is Australia's smallest and least populous State, with a land area of 25,000 square miles and a population of some 470 000 people. Lying between the latitudes of 41 and 44 degrees south, Tasmania is also the coldest State with a temperate climate strongly influenced by prevailing westerly winds. The average maximum temperature in populated areas varies from 76°F in summer to 56°F in winter.

Principally as a result of poor economic growth compared to all other Australian States, Tasmania is the only State experiencing a declining population. It has the highest unemployment rate and the second highest proportion of the population aged over 65 years. Household disposable income per capita is lower than any other State (Australian Bureau of Statistics [ABS], 1998)

In the 7 years to June 30 1998, the Australian fire fatality rate remained steady at 0.6 fire deaths per 100,00 population. For the same period, Tasmania experienced an average of 5 preventable fire deaths per annum, or 1.1 deaths per 100,000 population, approximately double the national average. For comparative purposes, the fatality rate for the United States in 1991 was 1.5, with a year 2000 target of 1.2 fire deaths per 100,000 population (National Center for Injury Prevention and Control, 1998).

All preventable fire fatalities in Tasmania in the last five years have occurred in single occupancy residential accommodation. This situation differs from other jurisdictions; nearly 25% of fire deaths in Britain and the United States in 1995 occurred outside the residential sector (Pigot, 1997) and 23% of fatalities in New South Wales between 1987 and 1995 occurred outside the residential sector (Nicholopoulos, 1996).

Tasmania Fire Service is the State's only fire department and is responsible for protecting life, property and the environment from the impact of fire.

In order to address the high fire fatality rate in residential property, Tasmania Fire Service has implemented a number of home fire safety programs. At 77%, voluntary installation of smoke alarms is higher than in any other State, and since 1994 builders of all new residential accommodation have been required by law to install hard-wired smoke alarms. However, due to the limited home-building program, this measure has not significantly increased the proportion of households with alarms. Only in Victoria where smoke alarms are mandatory does the rate, at 81%, exceed Tasmania's.

In addition to widely promoting the benefits of correctly installed and maintained smoke alarms, education programs for school children and the elderly are delivered on a broad scale.

In the first three months of the 1998/99 fiscal year, nine people died in house fires in Tasmania, lifting the fire fatality rate to 1.9, more than three times the national average. These deaths have prompted a fresh look at the causes of residential fire fatalities in Tasmania to ensure programs are targeted at the needs of the most vulnerable sectors of the community.

The aim of this research paper is to identify those in the community most at risk from a fire fatality in the home, and to propose strategies that will reduce the risk.

This paper has been written to satisfy the requirements of the Strategic Management of Change (SMOC) Unit of the United States National Fire Academy's Executive Fire Officer Program. Developing a preparedness to adopt new and more effective approaches to reduce residential fire fatalities will require significant strategic and cultural change in many fire departments. The SMOC unit equips fire department executives with the skills needed to effect the necessary changes in an environment increasingly marked by competition, accountability and uncertainty.

## **Literature Review**

Many researchers have studied the physical, behavioural and socio-economic circumstances that have existed at the time a fatal fire has started. Collectively, these circumstances produce a picture of who is most at risk from fire, and the activities victims are likely to be engaged in when fire occurs. Having identified the at-risk groups and risky behaviour, appropriate fire prevention and safety programs targeting these groups can be implemented to ensure that scarce resources are allocated to fire safety programs in a cost-effective way.

### **Situational and behavioural factors contributing to the risk of fatality**

Rhodes and Reinholdt (1996) report that many fire victims have been smoking in bed or have inappropriately discarded smoking material. Several victims have been engaged in other habitual and risky behaviour such as leaving radiators on, or abusing alcohol and non-prescribed drugs. Others suffered physical disability such as frailty or restricted mobility, or intellectual or psychological illness and were on medication. Fewer than half the victims sought to escape, and most victims were either asleep and/or intoxicated at the time of the fire.

A 1998 study by Rhodes and Reinholdt found that the following events brought together the ignition source and fuel in the majority of fatal residential fires:

- unsafe use or disposal of smoking materials,
- inappropriate use of a heat source for heating, cooking or lighting,
- flame accessible to people unaware of the potential danger of fire,
- faulty electrical appliances or wiring, and
- a disabling event causing direct contact with a heat source.

According to Hall (1998), nearly 25% of all fire fatalities in the United States in 1995 were caused by inappropriate use or disposal of smoking materials; 95.2% of these deaths occurred in residential property. In 63% of cases, inappropriate disposal of material caused the fatality, and in 20% of cases, a fatality occurred after the smoker fell asleep.

A study of fires in homes in Columbia from 1991 to 1997, indicates that as many as 52% of fatalities were linked to smoking (“Fire in Columbia”, 1998). This report also highlighted that 24% of fatal fires were due to poorly maintained or improperly used heaters, and 12% were attributed to children playing with fire.

Warning people of the dangers of smoking in bed, the need to dispose of smoking materials carefully, and the need to maintain and use heating appliances appropriately is likely to have a positive effect on reducing residential fire fatalities.

Cropp (1991) found that carelessness of the victim was often the cause of a fire, citing the following common causes:

- falling asleep with the ignition source on,
- ignition source left unattended,
- ignition source accidentally turned on,
- children playing with the ignition source,
- combustible material too close to the ignition source,
- mental impairment or unconsciousness due to alcohol or drugs, and
- careless disposal of smoking materials.

In addition to alerting householder to the causes of fires, effective fire prevention strategies need to make people aware both of appropriate fire safe behaviour, and inappropriate behaviour likely to increase the risk of fire in the home.

Rhodes and Reinholdt (1998) also found that the following key factors affect the victim's capacity to escape effectively:

- an inappropriate response, either remaining in the building or returning to it,
- no appropriate escape route due to barred windows or locked door,
- no effective warning system,
- lack of suitable fire fighting equipment, or
- the victim is directly involved with or in close proximity to the fire.

Clearly, providing people with advice about fire alarm devices and what to do when fire breaks out is also likely to reduce residential fire fatalities.

### **Identifying groups most at risk from fire in the home**

According to the Queensland Fire & Rescue Authority [QF&RA], 1998) those at greatest risk of death in a house fire include people aged 65 years and older, children aged up to 4 years, adults affected by alcohol, and adults not in the workforce This is largely backed up by Rhodes and Reinholdt (1998) who found that the elderly and the very young, persons with physical or mental disabilities, and people under the influence of alcohol or other drugs comprise the high risk groups. A report by Nicholopoulos (1998) indicates that many victims over a 5-year period had been drinking alcohol, were on medication or were affected by non-prescribed drugs. 14% of victims were physically or mentally disabled at the time of their death.

This research suggests that those most at risk from a fire fatality in the home are those less able to look after themselves properly, both in a general sense and at the time fire occurs. These include the aged, the very young, the physically or mentally disabled and those affected by drugs or alcohol.

In a study carried out in Baltimore, fire deaths rates were highest in census areas where property rental values were low. The death rate from fires ignited by heating or electrical equipment was nine times as high in low rent areas as in high rent areas (Mierley and Baker, 1983). The writer concurs with the findings of the National Fire Data Center (1997, p. 25) that:

Socio-economic factors are among the best predictors of fire rates at the neighbourhood level. If the data were available, it would likely be found that the relationship between socioeconomic status and fire rates are even stronger at the household level.

Clearly, fire safety behaviour exhibited by low-income households is not as good as that practiced in higher income households.

In a study conducted in North Carolina, high vulnerability groups were identified as younger than 5 years or older than 64, those with a physical or cognitive disability, or those impaired by alcohol or other drugs. 53% of adults whose blood alcohol was measured were intoxicated (Marshall et al. 1998). The presence of an adult unimpaired by disability, alcohol or drugs significantly reduces the risk of death for the high vulnerability group should fire break out. The presence of a working smoke alarm significantly reduces the risk of death in the event of fire for both high and low vulnerability groups.

Ballard, Koepsell, and Rivara (1992) conducted a 2-year study in Washington's King County in 1984 to measure the effects of alcohol and smoking on residential fire injuries. The study revealed that households experiencing fires had lower household incomes and were less educated. Smoking emerged as a more important behavioural risk factor in fire ignition than drinking. However, intoxication significantly increased the risk of injury or death in the event of a fire.

Smoking was also cited as a major contributor to fire fatalities in a study conducted in Copenhagen Denmark from 1991 to 1996. That report by Leth, Gregersen and Sabroe (1998) supports the view that the risk of a fire fatality in the home increases if smoking is combined with alcoholic intoxication or a physical or mental handicap.

Almond (1997) suggests that fire is a social problem, influenced by people, their age, mobility, mental health, and behaviour in the home, their fire awareness and the care they take to prevent fire. Almond identifies the elderly, young children, disabled people, people who use or

abuse drugs and alcohol, and low-income households as the sectors most at risk. “The risk of death is greatest in mobile homes, in those involving alcohol impaired persons, and in those in houses without smoke detectors” (Runyan, Shrikant, Linzer, Sacks, and Butts, 1992, p. 859).

In Tasmania where the occupation of fire victims was known, 69% were unemployed persons (including pensioners and other retirees, 12% were unskilled workers, and 19% were skilled tradespersons. None of the fire victims were professionals or other white-collar workers. (QF&RA, 1998). This suggests that the level of household income, and the lifestyle that accompanies it, may impact on the risk of death in a residential fire.

This view is supported by the Chief Fire Officer of the New South Wales Fire Brigades who indicated that low-income households put themselves at greater risk during cold winters in an effort to save money. Repairs are deferred and preventative maintenance is not carried out on electrical appliances (Gintowt, 1993). In 1991 in the United States, 48% of deaths in residential fires occurred in the four coldest months of December to March (National Center for Injury Prevention and Control, 1998). This supports the view that the higher fire fatality rate in Tasmania may be due in part to the colder winters compared to other Australian States. It also reinforces the view that fire prevention and safety strategies need to target vulnerable low-income groups in their homes, particularly immediately before and during winter.

Seeking to separate risky behaviours from socio-economic characteristics based on the literature is not easy. It appears that people from low-income households exhibit risky behaviour more often than wealthier households do. The behaviour which increases the risk of fire is well documented (particularly inappropriate discarding of smoking materials, and inappropriate use of heating appliances), as is the behaviour exhibited when fire occurs that increases the risk of

fatality. The common physical characteristics of fire victims (age, infirmity, disability, and intoxication) are also well identified in the literature.

### **Strategies to improve fire safety in the home for at-risk groups**

“Fire prevention strategies need to target those populations at highest risk” (Rhodes and Reinholdt, 1998, p. 318). Given the competition amongst public safety agencies for limited resources, it is becoming increasingly important to focus fire prevention and safety programs where they will have the greatest impact.

Almond (1997) points out that early broad-based campaigns in Britain were readily taken up by those who probably needed them least. Smoke alarms campaigns saw an increase in usage from 9% in 1987 to 75% by 1994, but surveys revealed that the elderly and low-income households, the very groups most likely to suffer a fire in their homes, were the least likely to adopt this safety device. Like other social problems, fire disproportionately affects the weak, and fire safety advice is most often ignored by those who need it most.

Clearly, new ways need to be developed to ensure messages get through to those who most need to hear them, as traditional methods of broadcasting to the whole community appear not to be heeded by those most at risk.

Rhodes and Reinholdt (1998, p. 325) believe that:

Fatalities occur among the ‘hard to reach’ sector of the community: those who are less likely to be exposed to traditional fire intervention and safety measures. It is therefore unlikely that any single intervention will provide a solution. An integrated approach, using a variety of strategies targeted to address the needs of particular groups, is more likely to be effective.

Reliance on a particular strategy may be ineffective, while multiple strategies are more likely to reach the target audience and reinforce other, complementary fire safety messages and strategies.

Rhodes and Reinholdt (1998) also point out that many in the high risk groups are unable to take full responsibility for their own safety, and therefore the involvement of others is necessary to ensure appropriate fire safety measures are adopted.

Rhodes and Reinholdt (1996) report that in a study of fire fatalities in Victoria Australia over a four year period, smoke alarms were most likely to have prevented a fatality in 44% of cases, and were unlikely to have prevented a fatality in 31% of cases. Building materials and furnishings designed to reduce fire risk would have been likely to prevent a fire in 27% of cases, and interactive fire safety education in 26% of cases. Other intervention measures likely to have been successful included fire safety publicity (13%), on-site firefighting (10%) and fire department intervention (3%). It is clear that a range of strategies should be implemented in order to ensure risk is reduced in as many circumstances as possible. It is interesting to note that fire department intervention was the least likely to have been effective in saving a victim. The Queensland Fire and Rescue Authority estimates that most victims in residential fires die prior to or coinciding with alarm time(QF&RA, 1998). This reinforces the view that householders need to accept responsibility for their own safety if they are to survive a fire in their homes.

Research suggests that education programs should not only target the elderly, but also their carers and those who regularly come into contact with them (QF&RA, 1998).

Public education is recommended in "Fire in Columbia" (1998) as the best way to get the message across about increasing fire safety in the home, and reducing the number of fire fatalities.

However, if public education programs are going to make a difference, they need to be targeted at low-income communities and aged people, and contain messages that make sense to the target market, rather than being delivered using a broad-brush approach.

Pigot (1997) suggests that the time has come to install active measures in the form of residential fire sprinklers in order to combat an unacceptable fatality rate. Pigot points out that legislation mandating the installation of domestic sprinklers in new homes in parts of the United States has had a dramatic effect within a few short years. The use of domestic fire sprinkler systems and other installed devices such as smoke alarms is favoured by Baker (1992, p. 887):

The heavy drinker not only is likely to be a smoker but also easily forgets a cigarette and often sleeps soundly. The difficulty of influencing the smoking behaviour of an intoxicated person means that preventative efforts must automatically protect everyone at risk.

However, while smoke alarms may be inexpensive, sprinkler systems are likely to be beyond the reach of those who need them most.

### **Gaining a better understanding of the risk**

The British Home Office (1998) advises that many required details of fatal fires are not included on standard fire reports. The Home Office report recommends that fire investigation reports be extended to include details of victims, be standardised, and that the information be collected and analysed centrally. This strategy will clearly improve the information available on fire victims and facilitate the development of more effective strategies.

### **Increasing the effectiveness of smoke alarms**

Nicholopoulos (1996) cites the 1995 UK Audit Commission Report, which indicates that residential fires that take more than 30 minutes to be detected are 15 times more likely to result in

a fatality than fires detected within 15 minutes. The report also found that smoke alarms are likely to reduce deaths from 9 per 1,000 fires to 3 per 1,000 fires.

Despite that "...a considerable number of householders believe that early warning of smoke and fire is the most critical factor affecting their safety in the event of fire" (QF&RA, 1998, p. 28), Nicholopoulos (1998) reveals that during a five year period in New South Wales, no homes where fire fatalities occurred were fitted with smoke alarms.

Where the presence or absence of smoke alarms was recorded in fatal fire cases in Australia, only 7 out of 202 fatalities had smoke alarms present. In only one fatal fire in Tasmania during a five year period was a smoke alarm reported present. It operated, but failed to alert the occupant, as it was located in another room (QF&RA, 1998).

Other reports indicate that the risk of death in a house fire is reduced by 40% (Hall, 1994) to 60% (Ozzane-Smith and Watson, 1991) if a working smoke alarm is installed.

Recognising the value of smoke alarms, many researchers and regulators now recommend or require several inter-connected hard-wired smoke alarms in homes, located in each bedroom, on each level of the house, and in living areas adjacent to kitchen areas. Hall (1994) reports that hard-wired smoke alarms do not require periodic power source replacement, do not permit the removal of the power source for use elsewhere, and are statistically much less susceptible to power source interruption.

The West Midlands Fire Service reports (Payne, 1995) that the elderly and disabled are most at risk from death in residential fires, but are least likely to have a smoke alarm. Almond (1997) identifies the main reasons for the low level of effectiveness of smoke alarms as flat batteries or removed batteries, and confirms that the homes of those at highest risk are least likely

to have smoke alarms. According to Pigot (1997), 44% of smoke alarms failed in 1995 in Britain because batteries were missing, 11% because batteries were flat, and 8% because alarms were incorrectly sited or installed.

Evidently, having identified the groups most at risk from residential fires and fire fatalities, there is a need to ensure that their homes are equipped with smoke alarms that are maintained in working condition. This will help ensure that notwithstanding inappropriate fire safety behaviour, householders will in many instances receive sufficient warning of fire to escape, provided they also adopt appropriate escape strategies.

Payne (1995) reports that the West Midlands Fire Service arranged the free distribution of 35,000 smoke alarms to at-risk households in their jurisdiction in an effort to reduce residential fire fatalities. So far results have been very encouraging.

## **Procedures**

### **Definition of terms**

**Battery-operated smoke alarm** – a smoke alarm typically powered by a 9-volt DC power supply.

**Dwelling/residential accommodation** – a permanent or temporary structure in which a person or persons may be expected to sleep on a regular basis, including houses, flats, hotels, motels, mobile homes, boats and tents.

**Fire fatality** – a fatality where fire either directly or indirectly causes death. Direct causes may include but are not limited to smoke inhalation, asphyxiation or burns. Indirect causes may include but are not limited to cardiac arrest or stroke suffered as a consequence of fire.

**Fire fatality rate** – the number of preventable fire fatalities per 100,000 population.

**Hard-wired smoke alarm** – a smoke alarm connected to a dwelling's 240-volt AC power supply. Alarms of this type have a back-up battery in case of power failures.

**Preventable fire fatality** – a fire fatality which does not include death by murder or suicide, or where fire has been used to conceal a murder or suicide.

**Smoke alarm** – a device that detects smoke particles produced in the combustion process and sounds an alarm, typically a piercing beep of 85 decibels.

## **Research methodology**

### **Literature research**

In order to identify the human and environmental factors contributing to fire fatalities in dwellings, evaluative analysis of recent research on the subject was carried out by the writer in October and November of 1998. This research revealed information on the physical environment and human factors contributing to fire fatalities as well as social and economic factors that may contribute to fire fatalities.

Evaluative research of literature addressing strategies to improve fire safety in the home was carried out in January and February 1999.

### **Interviews**

To identify factors contributing to fire fatalities in dwellings in Tasmania, interviews were conducted with Tasmania Fire Service's two full-time fire investigators in December 1998 (S. Walkley, personal interview, December 8&9, 1998, and M. Graham, personal interview, December 10, 1998). These interviews revealed a number of factors that in the opinion of these experienced officers needed further analysis to identify what contribution they make to the risk of fatality in homes.

Interviews were also held in December 1998 with the Chief Medical Officer of the Department of Health and Human Services (Dr J. Sparrow, personal interview, December 17, 1998) and the Chief Coroner from the Department of Justice (Coroner A. Schott, personal interview, December 17, 1998) to discuss the utility of a new data collection form (refer Appendix A) developed following interviews with the fire investigators. This form was then used to gather historical fire fatality data and has since been adopted by Tasmania Fire Service and the Coroners Office to collect data on future fire fatality cases.

Finally, discussions were held with representatives of Tasmania Fire Service's advertising agency (V. Fergusson and L. Gannell, personal interview, March 9, 1999) to discuss the most appropriate ways to deliver fire safety publicity and education to those households identified as most at risk.

### **Data analysis**

In December 1998, the writer gained access to data on fire fatalities in Tasmania for the period 1994-1998 from coronial records from the Department of Justice, and fire investigation reports from Tasmania Fire Service. This data was analysed to identify any social or economic circumstances that may have contributed to residential fire fatalities in Tasmania. Data from 23 fires involving 30 victims over the last five years was collected using the data collection tool referred to above, and was then analysed.

### **Survey**

Much of the literature dealing with fire safety strategies in the home identifies working smoke alarms as a factor that significantly decreases the risk of death by fire. Despite the high adoption rate of smoke alarms in Tasmania (77%), fire fatality rates are the highest in the nation.

In order to establish the proportion of smoke alarms maintained in working condition within 12 months of a major maintenance program, a survey was conducted of public housing tenants in the 3 months to March 31 1999 during Tasmania Fire Service's annual maintenance program. Government policy requires that all public housing be equipped with at least one battery-operated smoke alarm. Twelve percent of the 12,297 occupied dwellings in public ownership were surveyed during the 3-month period. Survey data was gathered by Tasmania Fire Service's Fire Equipment Officers using the survey form included at Appendix B.

### **Assumptions and Limitations**

The primary purpose of this paper is to identify the human and environmental factors contributing to fire fatalities in dwellings, and strategies, based on strategies introduced in other Australian States and elsewhere, which will improve fire safety and reduce fire fatalities. Given different political, economic, social, climatic and geographical factors existing within and between different jurisdictions, strategies that are appropriate for some communities may not meet the needs of others.

The sample size of 30 fire fatalities in Tasmania over the five years to December 1998 is small, and minor changes in the number of fatalities per annum has a significant impact on the fire fatality rate. Given the poor quality of existing data on socio-economic characteristics of the 30 fire victims, few trends were able to be identified. These are addressed in the 'results' section.

The survey of smoke alarms in Tasmania was restricted to households occupying public housing classified as elderly persons units (EPUs). These households are not representative of the whole community, as they are comprised in most cases of aged low-income households

dependent to a large degree on welfare. Their smoke alarm maintenance practices may not represent those of the community as a whole.

Households surveyed were those scheduled for maintenance; that is, households were not selected at random. The households had all been serviced approximately 12 months before the survey. Other public housing households that are not part of the servicing program may not have given any attention to their alarms for considerably longer than 12 months. It is likely therefore that the results reported are more favourable than would be the case had all public housing been surveyed. The smoke alarm maintenance practices of people in private dwellings was not established.

In considering strategies involving smoke alarms, the special needs of the hearing impaired have not been addressed in detail.

## **Results**

### **Research Question 1 - What behavioural and environmental factors contribute to fire fatalities in dwellings?**

A review of the literature reveals that there are a number of situational, behavioural and socio-economic factors that increase the risk of a fatal fire occurring. Research supports the view of Runyan, Shrikant, Linzer, Sacks, and Butts (1992) that residential fires are most likely to be caused by heating and cooking equipment or inappropriately discarded smoking materials. Heating and cooking equipment is most often responsible for fires when it is used inappropriately or left unattended. Other common causes are ignition sources accessible to people unaware of the potential danger of fire, and faulty electrical appliances or wiring.

Cropp (1991) also found that carelessness was a significant factor contributing to residential fires and fatalities.

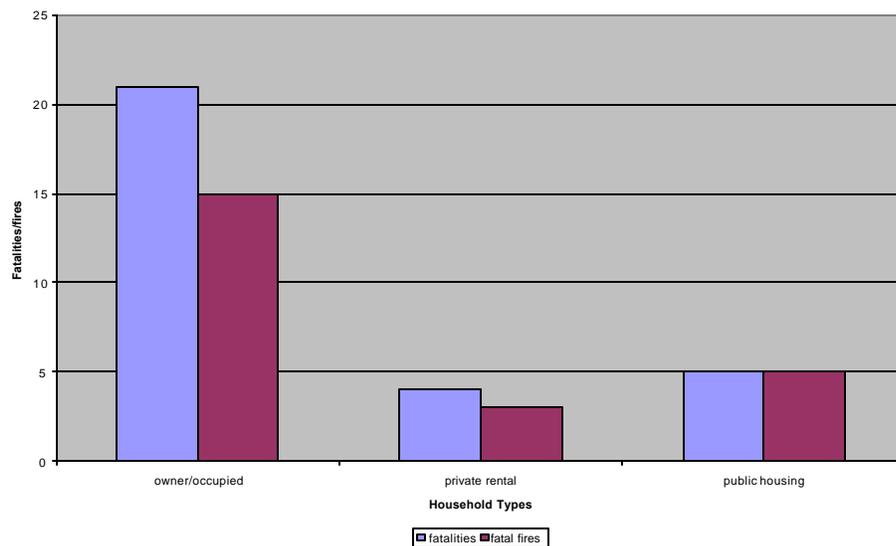
Smoking materials play a lesser role in Tasmania than in other jurisdictions. Most fatalities occur in the winter months, with 22% occurring in the coldest month of July (QF&RA, 1998). Fatal fires in Tasmania are most often caused by having combustibles too close to heaters, or faulty electric blanket switches. This suggests that Tasmania's cooler climate, longer periods spent in the home and the consequent increased use of heating appliances increases the risk of fire fatality compared to other parts of Australia.

Rhodes and Reinholdt (1998) found that once fire occurred, inappropriate behaviour such as remaining in the building or returning to it, or lack of a warning system, fire fighting equipment or an escape route all significantly increased the risk of fatality.

**Research Question 2 - What sectors of the Tasmanian community are most at risk from fire?**

**By household tenure type**

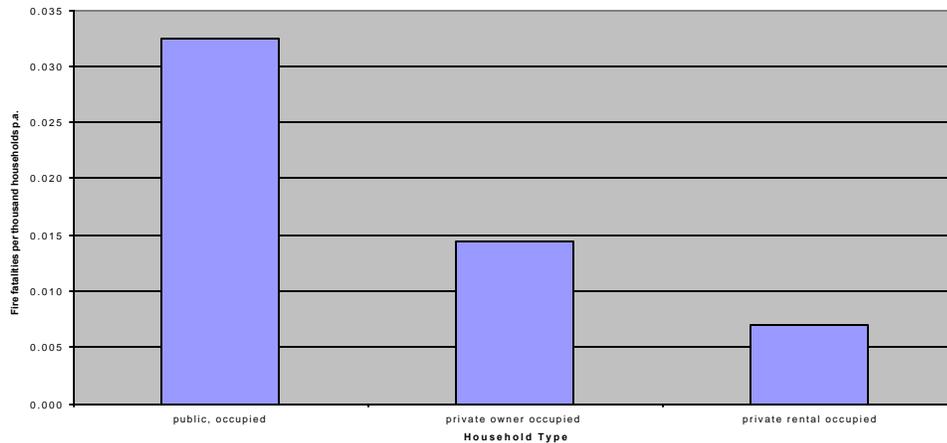
Based on coronial records and fire investigation reports for the five-year period from January 1994 to December 1998, there were 23 fires in Tasmanian households causing accidental death to 30 persons. Of the 30 deaths, 21 occurred in owner-occupied households, four in private rental property and five in public housing (refer Figure 1). Of the 30 deaths, three occurred in temporary accommodation including two mobile homes and a tent.



**Figure 1**  
**Fatal residential fires in Tasmania 1994-98**

The QF&RA (1998) report identified that in all States except Tasmania, residential fires occur most often in rental accommodation. However, in absolute terms most fatal fires in Tasmania occur in owner-occupied houses. To gain a better understanding of the fatal fire problem however, it is necessary to analyse the risk for each type of property; that is, the numbers of fatalities as a proportion of the number of households, by tenure type.

Based on the number of fire fatalities per thousand households by household type, there is a significantly greater risk of dying by fire in public housing than in private rental accommodation or owner-occupied households. In Tasmania, a person living in public housing is 3 times more likely to die in a fire than in an owner-occupied household, and 6 times more likely to die than in



a private rental household (refer Figure 2).

**Figure 2**  
**Fire fatality rate by household type, Tasmania 1994-98**

The fire rate shows a similar pattern; public housing, whether occupied or not, is far more likely to experience a fire than any other type of residential accommodation (refer Figure 3).

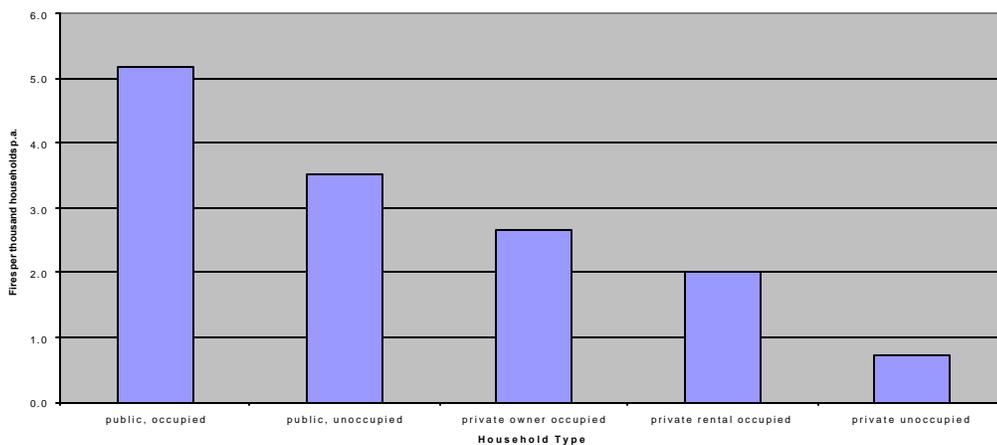


Figure 3

**Fire rate by household type, Tasmania 1994-98**

In Tasmania, public housing is occupied exclusively by low-income households, many of them relying entirely on welfare. Reinforcing the view that low-income households exhibit characteristics of high risk to a greater extent than high-income households do, the QF&RA (1998) report reveals that unemployed persons (including pensioners and other retirees) are most at risk from fire fatality. In Tasmania, unemployed people, pensioners and other low-income groups occupy public housing, and to a lesser extent, private rental accommodation and owner-occupied housing.

**By age and other human and behavioural factors**

For all preventable fire fatalities in Tasmania during the period, old age has been cited by Tasmanian fire investigation officers as a contributing factor in 48% of cases (refer Figure 4).

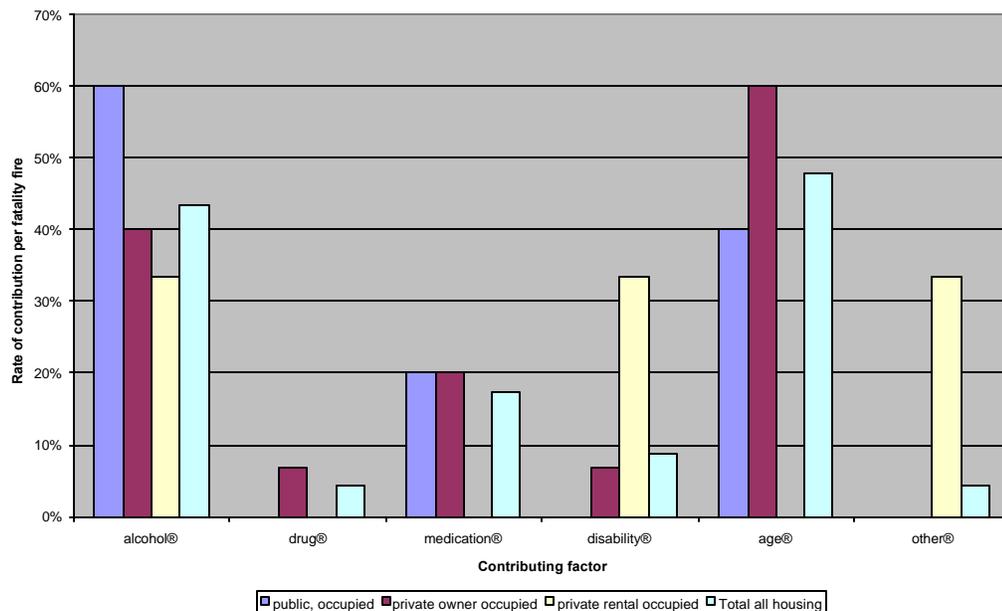


Figure 4

**Factors contributing to fire fatalities, Tasmania 1994-98**

In five out of the eleven old-age related fatalities, medication was also cited as a contributing factor, while alcohol was cited as a contributing factor in only one case. In the remaining five cases, only age and associated infirmity was cited as a major contributing factor. Average age in these age-related cases was 79 years.

A physical disability has affected the capacity of victims to escape in 9% of fatal fires.

Alcohol has been cited by Tasmanian fire investigation officers as a contributing factor in 43% of fatal fires, and 47% of fire fatalities.

There may have been only one fatal fire in Tasmania in the last five years where drugs, alcohol, medication, old age or physical disability has *not* been a factor. In this case, several adults were asleep in a house at about 9.00 a.m. when two young children lit a fire and subsequently died. There was no evidence that alcohol or drugs played a part in this incident.

According to fire investigators, in all five fatality cases involving children, seven children died in property occupied at the time by adults who were affected to some extent by alcohol and/or drugs (4 cases, 5 deaths), or were asleep (1 case, 2 deaths).

Clearly, the risk to children increases if they are inadequately supervised, particularly if they have direct access to ignition sources.

The QF&RA (1998) report supports the writer's view that those at greatest risk of death in a fire in Tasmania include those aged 65 years and older, children aged up to 4 years, adults affected by alcohol, and unemployed adults. Combining age with low income, a smoking habit and medication or substance abuse significantly increases risk, particularly if no smoke alarm is present.

### **Research Question 3 - What strategies should be adopted by Tasmania Fire Service to improve fire safety in dwellings for communities most at risk?**

As previously stated, Rhodes and Reinholdt (1998, p. 325) believe that:

Fatalities occur among the 'hard to reach' sector of the community: those who are less likely to be exposed to traditional fire intervention and safety measures. It is therefore unlikely that any single intervention will provide a solution. An integrated approach, using a variety of strategies targeted to address the needs of particular groups, is more likely to be effective.

Strategies that focus on the aged and low-income households are likely to have the greatest impact on reducing residential fire fatalities. Research supports the view that households need to be aware of the risk fire presents, what constitutes fire-risk behaviour and what steps to take should fire occur in the home. Research also supports the increased use of smoke alarms and domestic sprinklers, particularly in the homes of the aged, disabled and those with low household income.

#### **Education and publicity**

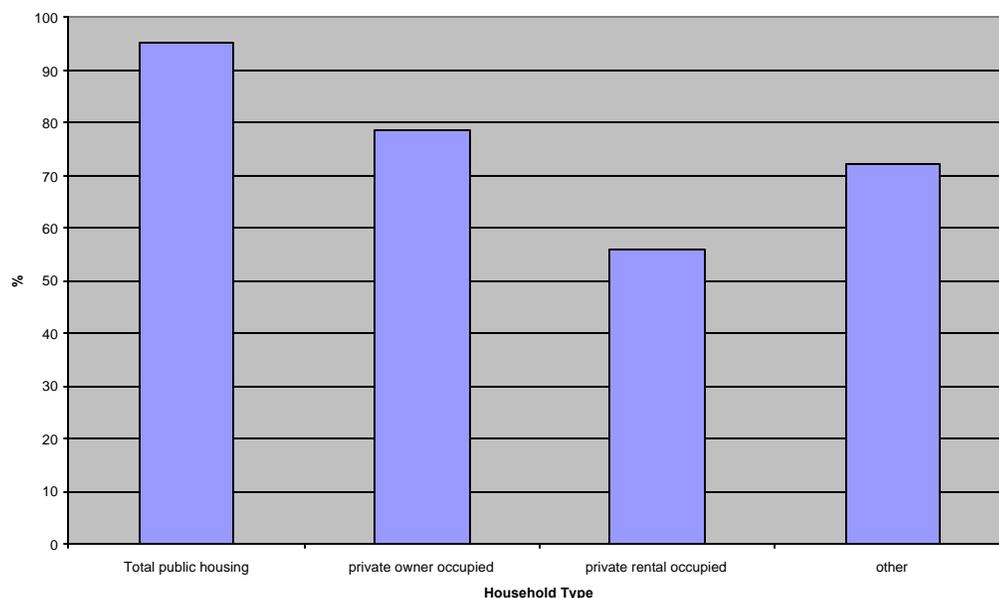
Based on advice from advertising executives, safety messages are best delivered to target households through a concerted television and radio advertising campaign, at time-slots and during programs favoured by at-risk groups. Daytime 'soaps', late-night shows and sports programs are favoured for TV advertising, as well as breakfast shows on commercial radio stations.

Conclusive results of the impact of education programs on home fire safety delivered to Tasmanian primary school children over the past five years are unavailable at this time, as these children are yet to become householders responsible for their own and their family's fire safety.

### Household smoke alarms

In a study in New South Wales, Nicholopoulos (1996) reports that only 3% of households that had fires in the 9 year period between 1987 and 1995 were reported to have a smoke alarm. Yet for the same period, significantly more than 3% of all households in New South Wales had alarms. This suggests that these devices were effective in raising the alarm sufficiently early for many householders to take action and not need the intervention of the fire department. While maintenance of a working smoke alarm doesn't prevent fires, it enables householders in most instances to take action to extinguish a fire or to escape. The British Home Office estimates that the fire department is not called to 90% of all fires in the home (Marriott, 1993).

The penetration of smoke alarms in Tasmanian homes is highest in public rental property (97%), followed by owner-occupied households (79%) and private rental households (56%)



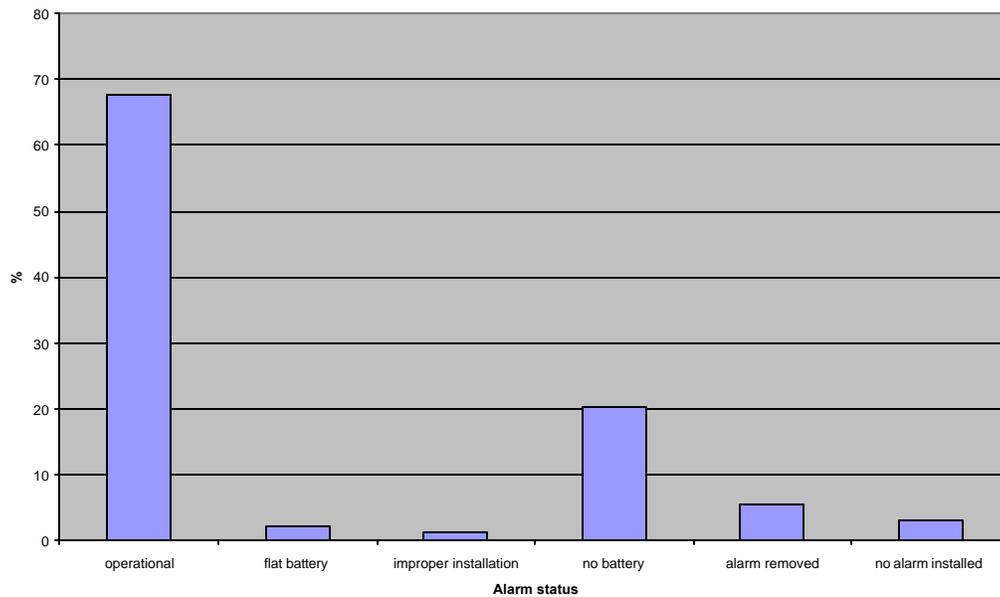
(ABS, 1998 – refer Figure 5). Use across all households is 79%.

**Figure 5**

**Percentage of Tasmanian households smoke alarmed, by household type, at Dec 1998**

Information derived from a smoke alarm survey of elderly persons units (EPUs) in Tasmania suggests a fresh approach needs to be taken in regard to smoke alarm installation and maintenance programs sponsored by the State (refer Figure 6). EPUs are typically

occupied by elderly persons on low incomes; these persons are amongst those at highest



risk of a fire fatality in the home.

**Figure 6**

**Smoke alarm status in elderly persons units in Tasmania, Jan-Mar 1999**

This survey supports the Australian Bureau of Statistics survey that approximately 3% of public housing is not equipped with a smoke alarm, despite government policy. Given that these

units are serviced on an annual basis, no reason is offered for the failure of these EPU's to be alarmed.

Of greater concern however is the proportion of alarms that were not in an operating condition. 20.4% of alarms had had the battery removed in the previous 12 months, and 5.4% of alarms had been removed altogether. Hall (1994) reports that the National Smoke Detector Project revealed that 20% of homes in the United States with smoke detectors have detectors that don't work; in Tasmania, 32% of surveyed EPU's had no working smoke alarm.

Anecdotal evidence from Tasmania Fire Service's Fire Equipment Officers suggests that batteries and alarms are removed in most instances when false alarms occur and householders are unaware of how to clear smoke from the alarms to re-set them. This suggests a need to ensure householders understand where to locate alarms in areas unlikely to generate false alarms yet where early warning of fire will be given, and of how to clear alarms of smoke in the event of a false alarm.

There also appears to be a need to advise householders (and perhaps Fire Equipment Officers) in the correct installation of batteries.

Finally, householders need to be able to recognise low-battery warning signals, and appreciate the need to change batteries regularly. For the elderly and disabled, a regular battery-replacement program managed by the fire department or community groups may be necessary.

It is likely in households not serviced on an annual basis by Tasmania Fire Service that significantly fewer than 68% of households equipped with an alarm will maintain the alarm in an operating condition. Given the disproportionately high risk of fires and fire fatalities in public

housing (refer Figures 2&3), extension of the alarm maintenance program to all public housing and other low-income households appears desirable.

## Discussion

The literature identifies many factors influencing the risk of fires occurring in the home, and circumstances that increase the risk of a fatality. Distilling from the wide range of factors a few common threads that will enable those groups in our communities who are most at risk to be identified will enable limited resources to be directed to where they can do the most good.

Similarly, identification of these at-risk groups will facilitate the development of strategies that will be *heeded* by them. The available evidence suggests that those that need them the most are simply ignoring many existing broad-based education and publicity campaigns.

The highest risk groups appear to be comprised of those people who are unable to look after themselves properly. Therefore the aged and infirm, the very young, the physically and mentally disabled, and those affected by medication, non-prescribed drugs or alcohol are particularly at risk unless assistance is available both generally, and at the time that fire occurs. Risk increases particularly for members of this group if they smoke, and increases for any group if working smoke alarms are not maintained in the home in appropriate locations. Combinations of risk factors, such as a medicated and disabled aged person who smokes in bed and lives alone, increases risk to a marked degree.

An interesting sidelight is that with sufficient data, the development of a risk assessment tool would be possible, which would be capable of alerting carers to the magnitude of the risk that those under their care are exposed to. Similarly, it could be used by fire departments to

prioritise households eligible for home fire safety audits, free smoke alarms or batteries, or similar initiatives.

Low-income households are disproportionately represented in fire fatality statistics. People in this group are typically less active, spend more time in the home, are less educated and take less notice of efforts to educate them about home fire safety practices. With little disposable income, they are also less inclined to spend money on smoke alarms and batteries, and other active measures such as sprinkler systems and monitored alarms are likely to be well beyond their means. It is also likely that members of this group exhibit other behaviour that increases the risk of fire and death from fire. Because those in public housing are in the low-income, high-risk sector, free smoke alarm maintenance programs currently available to elderly people in public housing should be extended to all public housing. Opportunities to extend such a program to all low-income households and households occupied by the elderly should be explored.

The elderly and disabled who live alone with little or no assistance are particularly vulnerable. Often exhibiting unsafe fire behaviour, they are often incapable of installing and maintaining smoke alarms without putting themselves at a significant additional risk of personal injury.

The proportion of smoke alarms installed in public housing that are not maintained in working condition is alarming. Clearly, householders need to be aware that in the event of fire, it is unlikely that the fire department will arrive until after the point at which any occupants still inside the building will have died. Clearly too, they need advice on where to install alarms, how to maintain them, and what to do if they give false alarms, or if the battery goes flat. To reduce the maintenance burden on householders who can afford them, and to provide added protection for

public housing tenants, hard-wired smoke alarms or those equipped with long-life batteries should be promoted.

Smoke alarms will continue to save lives, but appear to be less effective when adult householders are affected by alcohol, medication, non-prescribed drugs, or are aged and infirm or are disabled. Other measures to protect these particularly vulnerable groups may include active protection systems such as residential sprinkler systems or monitored alarm systems. The benefits of residential sprinkler systems need to be publicised, and their installation in low-income public housing needs to be considered. Public housing occupied by the elderly and disabled should be targeted in the first instance, as these two groups are often unable to escape quickly when fire occurs.

In Tasmania, the fire fatality rate is likely to grow unless new strategies to reduce it are resourced and implemented. An aging population, slow economic growth and increasing unemployment are increasing the number of people in the high-risk groups. Reduced government spending on maintenance in the public housing sector is also threatening the safety of low-income families in public housing.

In recent years too, there has been a trend in Tasmania to integrate aged and disabled persons into the community, rather than to institutionalise them. Many of the aged and mentally disabled are on prescribed medication, which often limits their capacity to reason, particularly when circumstances beyond their experience, such as a house fire, occur. While integration has certain social benefits for these groups, some may be put at additional risk from fire and other domestic hazards if inadequately supervised. For those incapable of dealing appropriately with domestic hazards and for whom adequate supervision is unavailable, such as the aged and infirm

and the severely mentally impaired, institutionalisation may be the only solution to ensure they are adequately protected from fire and other domestic hazards.

Due to economic circumstances or their level of education, low-income householders are least likely to respond to traditional education and publicity about safe fire practices in the home and are least likely to use or maintain smoke alarms. Similarly, higher levels of drug and alcohol abuse than in higher-income households is likely to render some of them less able to respond appropriately when fire occurs.

Therefore, education and publicity targeting low-income sectors of the community needs to be delivered in ways that are understood and assimilated by these groups. Education and publicity targeting high-risk groups needs to include the following elements:

- what behaviour increases, and decreases, fire risk in the home;
- the benefits of, and correct installation and maintenance of smoke alarms; and
- appropriate action to take in the event of fire in the home.

Delivering to the most vulnerable groups in the community a range of tailored strategies is likely to be more effective than the blanket approach adopted in many jurisdictions.

Finally, it is likely that the constituents of high-risk communities differ to some degree in different jurisdictions. Fire departments need to collect sufficient socio-economic data on fire fatality victims to facilitate the development and delivery of effective prevention and safety programs. Consideration should also be given to the collection of comparable data on all residential fires, whether or not a fatality occurs, so that the circumstances existing in a house fire that mitigate against a fatality can be measured.

Recognising that most residential fire fatalities occur prior to the arrival of fire crews requires fire departments relying predominantly on emergency response to protect the community to re-define their priorities. If residential fire fatalities are to be reduced, more resources must be made available to fire prevention and fire safety education efforts.

### **Recommendations**

Adoption of the following recommendations is likely to have a significant impact on reducing the number of preventable fire fatalities in Tasmanian dwellings.

1. That strategies aimed at reducing fires, and improving safe fire practices, be focussed particularly on low-income households and those that are predominantly comprised of aged or disabled persons.
2. That existing policy regarding the maintenance of smoke alarms in public housing be reviewed. To ensure that a higher proportion of alarms in public housing are in working condition, the current practice of servicing alarms in elderly persons units should be extended to all public housing.
3. That smoke alarms in public housing be progressively up-dated to alarms with an integral power supply (that is, smoke alarms that cannot have the power source removed). An alarm of a type that gives rise to few false alarms, such as carbon monoxide or photoelectric alarms, should be chosen.
4. That the benefits of residential sprinkler systems be publicised, and that their installation in low-income public housing be considered. Public housing occupied by the elderly and disabled should be targeted in the first instance.

5. That enhanced education and publicity about safe fire practices in the home (particularly targeted at the elderly and disabled and those in low-income households including public housing) be delivered.
6. That publicity about the benefits of correctly installed and maintained smoke alarms be delivered, and that messages supporting publicity campaigns be tailored to the needs of high-risk groups.
7. That education addressing the special needs of children and the hearing impaired in relation to suitable types and locations of smoke alarms be delivered.
8. That the provision of subsidised or free smoke alarms to private low-income households, aged persons households and households including disabled persons be considered, to increase the adoption rate of preferred smoke alarms for these high-risk groups not benefiting from public housing initiatives.
9. That Tasmania Fire Service gathers and uses socio-economic data on fire victims and residential fires to develop a greater understanding of at-risk groups and to facilitate development of targeted strategies.

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**Appendix A**

**Fire fatality data form**

### Tasmania Fire Service fire fatality data

**A. Incident characteristics** *(separate sections A&B are to be completed for each fatality)*

Incident number..... Date..... Number of fatalities .....

Address of incident .....

Type of incident.....

**B. Personal characteristics**

Name of victim ..... Date deceased .....

State when fire started: awake | asleep | unconscious | dead | unknown Time deceased .....

Manner of death: asphyxiation | burns | other ..... If burns: superficial | moderate | major

If alive and conscious, why didn't the victim escape?.....

.....

.....

Victim's activity at time of fire:.....

Did the victim contribute to the fire?.....

.....

Victim's reaction to the fire .....

.....

.....

Proximity of deceased to point of origin at time fire started: .....m At time of death:..... m

Age: .....years

Gender: male | female

Marital status: never married | married | defacto | separated | widowed

Main language spoken at home:..... English literacy: none | poor | good | unknown

Employment status: full-time | part-time | casual | unemployed | retired | unknown

Did the victim's physical health contribute to the fatality? Yes | no | unknown If yes, how?.....

.....

Did the victim's mental health contribute to the fatality? Yes | no | unknown If yes, how?.....

.....

Did alcohol | drugs | medication contribute to the fatality? Yes | no | unknown If yes, how?.....

.....

Physical disabilities: non-ambulatory | hearing impaired | blind | none | unknown | other.....

Smoking habit: smoker | non-smoker | unknown

Education level attained: none | primary | secondary | tertiary years of schooling:.....

Social activity outside the home: inactive | moderately active | very active

Past fire history.....

.....

.....

**C. Dwelling characteristics**

Type of tenure: owner-occupied | private rental | public rental | other (specify) .....

Type of dwelling: house | flat | unit | tent | boat | caravan | other (specify) .....

Dwelling construction:..... Age of dwelling..... Levels.....

**D. Household characteristics**

Annual household income: 0-\$10k | \$10-20k | \$20-30k | \$30-50 | \$50-70k | \$70+k

Household type: single adult | couple | single with dependents | couple with dependents | multi-family

Number in household: Normally: adults ..... children.....

At the time of the fire: adults ..... children.....

**E. Housekeeping characteristics**

Fuel loads: low | normal | high General house-keeping: good | poor

Flammable liquids: no | yes Location ..... contributed to fatality: yes | no

Electrical appliance maintenance: satisfactory | unsatisfactory | not applicable

**F. Fire characteristics**

Fire cause: accidental | deliberate | natural | undetermined

Ignition factor.....

Area of origin.....

Estimated time fire started .....am | pm Alarm time..... am | pm

**G. Fire protection characteristics**

Installed fire-fighting equipment: smoke alarm | sprinkler | fire extinguisher | fire blanket | hose  
(underline if installed, or circle if used)

Did a smoke alarm alert the victim? yes | no | unsure Another occupant? yes | no | unsure

Complete separate boxed section for each alarm:

Location.....

Type: ionisation | photoelectric | unknown | other (specify).....

Power supply: battery-operated | hard-wired Performance: operated | didn't operate | unknown

If alarm didn't operate, why? .....

If no working alarm was installed, could a working smoke alarm have saved the victim? yes | no | unsure

Firefighting water supplies: reticulated | not reticulated adequate | inadequate

Fire brigade type: career | volunteer

Arrival time: .....am | pm

Potential escape routes:.....

Door lock(s): lockable on inside: yes | no locked: yes | no key in lock: yes | no

Lock(s) contributed to death: yes | no | unknown

**H. Fire safety practices**

Access by minors or mentally disabled to ignition sources: appropriate | inappropriate | not applicable

Use of heaters (type):..... appropriate | inappropriate | not applicable

Use of electric blankets: appropriate | inappropriate | not applicable

Use of other appliances (type):..... appropriate | inappropriate | not applicable

**I. Other relevant comments:**

.....  
.....  
.....



## **Appendix B**

### **Smoke Alarm Survey - Public Housing**

### Smoke Alarm Survey - Public Housing

For each public housing unit serviced, please place a tick in the column that describes the condition of the smoke alarm immediately prior to the service. Where more than one alarm is installed, only count the alarm you consider most likely to alert the occupants if it was able to operate in the event of fire.

Alarm operational	Flat battery	Improper battery installation	No battery	Alarm removed	No alarm installed
<b>Totals:</b>					

Name:..... Date commenced:..... Date completed: .....

Please return completed forms to Damien Killalea, Director, Community Fire Safety by 7 April.