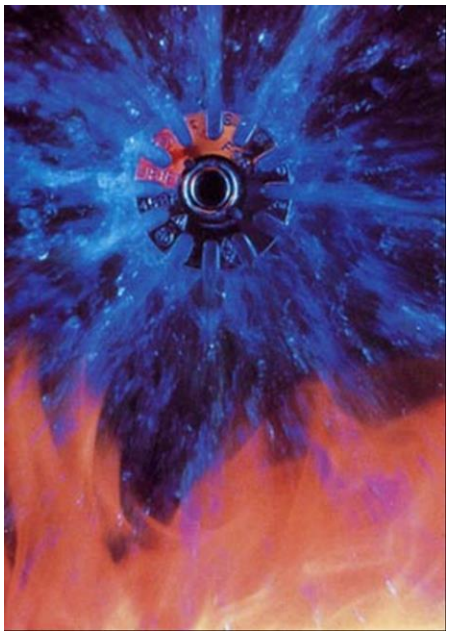
Efficiency and Effectiveness of Sprinkler Systems in the United Kingdom:
An Analysis from Fire Service Data



Incidence of Deaths and Injuries in Sprinklered Buildings:

A Supplementary Report

March 2019

NFSN National Fire Sprinkler Network

NFCC National Fire Chiefs Council

Contents

Foreword

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National Fire Chiefs Council for Protection and Business Safety

The National Fire Chiefs Council is committed to promoting the benefits of greater inclusion of sprinklers in the built environment. As the professional voice of the fire and rescue service, we know the benefits that sprinklers provide. When we attend fires where sprinklers have activated, we consistently see a measurable reduction in fire damage and injuries. Sprinklers mean firefighters face significantly safer conditions when they deal with any remaining fire and rescues. We have attended many fires where sprinklers have activated, and we are certain that lives would have otherwise been lost or the occupants suffered serious injury.

The previous report, Efficiency and Effectiveness of Sprinkler Systems, confirmed that sprinklers are incredibly reliable and very efficient. This further report now adds weight to the argument that sprinklers also have a role to play in reducing harm and protecting vulnerable people. In particular, the case for a greater inclusion of sprinklers in purpose-built blocks of flats is compelling.

Terry McDermott

Chief Fire Officer Derbyshire Fire & Rescue Service

National Fire Sprinkler Network Chair

The core membership of the National Fire Sprinkler Network comprises of representatives from every fire and rescue service operating within the United Kingdom. In addition, it includes representatives within Local Government Agencies, Politicians and MP's within the English, Scottish and Welsh Parliaments. The remaining members include national and international fire authorities and fire trade associations.

The primary aims of the network is to promote the wider use and understanding of fire sprinklers in the built environment, to save life and prevent damage to property from fire. The evidence in this report, taken from actual building fires, effectively describes the significant and positive contribution of fire sprinklers for life and property safety across a broad range of building types and fire scenarios. The evidence is consistent and compelling.

Summary

A study of all primary fires between 2013 and 2018 has been undertaken to assess the impact of sprinklers on fire fatalities and injuries. In total 192,094 fires occurred in all buildings including those without sprinklers. There were 42,001 non-fatal casualties and 1,462 fatalities.

3,046 buildings fires were recorded where sprinklers were present. Sprinklers were recorded as having activated in 1300. Of these 1300 fires, there were 156 recorded casualties. Five fatalities occurred in premises where a fixed system was present. All of these were in dwellings. There were no fatalities recorded in other types of non-residential buildings.

The data shows that you are 22% less likely to require hospital treatment if you are in a fire which is controlled by a sprinkler system. You are also 18% more likely to receive a precautionary check at the scene of the incident. A precautionary check is the lowest recordable level of support for a casualty by attending crews. This data shows that the incidence of harm experienced by those in a fire where a sprinkler has operated is significantly less than when sprinklers are not present.

Dwelling Fires

The study found that, on average, for every 142.5 dwelling fires there is a fatal casualty in a dwelling. However, where fixed sprinklers were present in dwelling fires, only five fatal casualties were reported.

A study of these fatal dwelling fires, where sprinklers were present, found that the circumstances of the fire fell outside the life-saving operating parameters of the system's design. Typically the casualty was directly involved in the fire with either their clothing or bedding ignited - often by smoking materials. Typically, they were also unable to move away from the fire or remove clothing due to mobility issues. Often they were medically more likely to succumb to burns or smoke inhalation due to age or infirmity. More work is needed to design systems that are specifically required and installed to protect those who are both vulnerable and at greater risk than the general population.

With regard to non-fatal injuries, the study of all primary fires between 2013 and 2018 found that on average there is a non-fatal casualty in every 5.27 dwelling fires. However, when sprinklers are fitted this reduces to one in every 10-11 fires - indicating that you are only half as likely to be injured when sprinklers are present in a dwelling fire.

The results of the study also offer confirmation of the general benefits of sprinkler installation. Sprinklers are not yet widely fitted in domestic dwellings, but where they are, they are typically fitted in dwellings due to an associated risk. Sometimes this is to protect a vulnerable individual or more broadly because of other associated higher risks (e.g. high-rise flats, social housing or sheltered housing).

Other Building Types

The study did not find a single incidence of a fire fatality in buildings other than dwellings where sprinklers were installed.

With regard to non-fatal injuries, the study found that for every 17.32 fires there is a non-fatal fire casualty in buildings not categorised as dwellings. Where sprinklers are installed, this improves to one casualty in every 33.1 fires. This indicates that you are only half as likely to be injured when sprinklers are installed in buildings other than dwellings.

Whether in a dwelling or other type of building, if sprinklers are fitted you are half as likely to be harmed by a fire.

The study also looked at the type and nature of injury rates compared to fires where sprinklers were, and were not fitted, and concluded that if you are in a fire in a building where sprinklers are fitted and unlucky enough to be harmed, then you are 22% less likely to require hospital treatment. You are also 18% more likely to receive just a precautionary check than receive any other form of treatment at the scene.

Case Study: Sprinklers Protecting Industrial Process

Lancashire: September 2018

Use of premises - Industrial Factory (Maritime safety equipment manufacturing plant)

Sprinkler system activated and contained the fire.

The fire occurred in a factory that makes buoys for the marine industry. A pipeline of liquid paraffin wax, fed from an external silo, fractured within the factory. Wax ran into pipeline insulation which was heated by a wire element and ignited.

The building became smoke logged and the fire started to spread by the burning wax escaping the pipeline. The sprinkler system quickly activated and prevented any further spread of the fire. The fire was held in check until fire crews attended and two firefighters tackled the fire using breathing apparatus and a hose-reel.

Overall damage was limited to less than 10 sq. m. with two metres of pipe insulation and an electrical distribution board damaged.

Without the presence of sprinklers the fire would have spread rapidly and would have posed a serious threat to staff safety, firefighter safety and also the business. The fact that there were no injuries meant that the business was able to carry on after only a short disruption.

Introduction

In May 2017 the National Fire Chiefs Council and the National Fire Sprinkler Network jointly published the report '*Efficiency and Effectiveness of Sprinkler Systems in the United Kingdom: An Analysis from Fire Service Data'.*

The report was based on an analysis of fires recorded in all United Kingdom fire and rescue services between 2011-2016, where sprinklers were recorded as being present.

The report presented the following headline results:

- The cases analysed amounted to 2,294 incidents of which 1,725 (75%) were in non-residential buildings and 414 (18%) in dwellings;
- The aim of the analysis was to provide an authoritative assessment of the reliability and effectiveness of sprinkler systems in controlling and extinguishing fires and in preventing damage;
- The effectiveness and reliability of sprinklers has been assessed with regard to two key criteria:
    - When sprinklers operate, how effective are they in extinguishing or controlling fires and thus preventing damage (performance effectiveness)?
    - How reliable are sprinklers in coming into operation when a fire breaks out (operational reliability)?
- In the data set there were 945 cases in which sprinklers were activated. The impact of the sprinkler system is known in 677 of these cases. Across all fires for which data was available, the sprinkler systems contained or controlled the fires in 62% of incidents and extinguished the fire in 37% of incidents. **Hence, the performance effectiveness of sprinkler systems was 99% across all building types;**
- A further measure of effectiveness was obtained by comparing average areas of damage from fires in residential buildings with sprinklers, with those from all fires in residential buildings. Fires in dwellings where sprinkler systems operated had an average area of fire damage of under 4 sq. m. This compares to an average area of fire damage of 18 to 21 sq. m. for all dwelling fires in England between 2011/12 and 2015/16;
- The average area of fire damage in a non-residential building where a sprinkler system was present was 30 sq. m. which is half the average area of fire damage of a comparable "other building" fires in England between 2011/12 and 2015/16;
- There were 1,316 fires recorded in the data where a sprinkler system was present but did not operate. Information on the reasons why the sprinkler system did not operate was recorded for 879 fires. In 370 of these cases the fire was in an area not covered by the system; in 115 cases the fire was too small to activate the system; in 18 cases the system was turned off; and, in 13 cases, the fire was extinguished before activation.

Only 57 cases out of 879 were identified where the system could have been expected to work but did not. **This indicates that the operational reliability of the systems was 94%.**

- In brief, this extensive data analysis shows that sprinklers are highly reliable and effective. They work as intended in 94% of cases and control or extinguish fires in 99% of cases.

After establishing, using empirical evidence, that sprinkler systems are both highly effective and reliable, further data analysis was carried out to supplement this report with a view to either substantiating or disproving the claim that the presence of sprinkler systems also saves lives and reduces the level of harm to those affected by a fire.

In order to do this every fire and rescue service (FRS) in the United Kingdom was written to with the following request for data:

“For the last five years, for all incidents involving deaths and injuries where a sprinkler system was present:

1. What was the sprinkler type?
2. Premises type.
3. Date and time of activation.
4. Was there a fatality?
5. Was there either a major or minor injury?
6. The nature of the major or minor injury (we are interested in precautionary checks);
7. The number of heads activated;
8. Were the injured/fatalities in the room of origin?
9. Were the activated heads in the room of origin?
10. if the sprinkler system did not activate, why was this?”

The Fire Statistics department of the Home Office, which is responsible for the collation of data from the national Incident Fire Recording System (IRS) was also approached to provide the same data. They provided the data requested in respect of every fire and rescue service in England.

Of the 53 possible returns, responses were received from 44 FRS - this included Scotland and all three Welsh services.

In order to calculate the relative rates of incidence of injury between all fires where sprinklers were and were not present, open source data from the English, Welsh and Scottish governments was used.

The data primarily relied upon was provided by the Home Office. This was due to the greater consistency of how the data was presented. However, it became clear that the data was not entirely complete, and the data from individual services was therefore referred to, in order make sure the analysis would be as thorough as possible.

To base the analysis purely on data provided by individual services was not practical due to wide ranging methods of recording and reporting data in the Incident Recording System. The data was particularly useful from individual services as some were able to provide more detail particularly in relation to those recorded with fatalities.

By studying both the government sourced and individual services' data it has been possible to provide a detailed overview of the performance of sprinkler systems in protecting life and reducing the incidence of harm.

Case Study: Sprinklers Protecting Vulnerable People

Sheffield, December 2018

A fire was deliberately started in a bedroom of a flat by a patient in a residential facility, which accommodates people with a range of physical and mental disabilities.

The flats had been fitted with a sprinkler system. The sprinkler system activated and successfully controlled the fire until the fire crews arrived and completely extinguished what was left burning.

If the fire had developed unchecked it would have put at risk the other occupants of the flats but because of the sprinkler system there were no casualties.

Data Analysis

Fire and Rescue Service Data.

In total individual services provided data on 317 incidents where it was recorded that there was at least one casualty and sprinklers were recorded as present.

Of these 317 incidents, 180 were recorded as the system having not operated. The reasons provided were broadly similar to the reasons recorded in the original report. Therefore, these were not considered as sprinkler failures as they were outside of the normal operating design parameters for sprinkler systems. Further analysis for the reasons for non-operation can be found in Appendix B.

Where sprinklers had not operated there were 111 reported casualties. 137 incidents were recorded as the sprinkler system having operated. In these incidents there were 29 casualties recorded.

Nine services (17%) reported that they had not experienced a single fatality or injury in fires which were controlled by sprinklers during the time period.

Eight services (15%) also provided details of the number of sprinkler activations in the time period where there had been no recorded casualties. In total, 166 such incidents were recorded. In terms of the general rate of injury in fires where sprinklers were not present, this would have resulted in 31 casualties in 166 dwelling fires or 9 casualties in 166 fires in buildings other than dwellings.

Home Office Data

In total, the Home Office provided data on 151 fires in England where it was recorded that there was at least one casualty and sprinklers were recorded as present.

Of these 151 incidents, 88 were recorded as the system having not operated. The reasons provided were broadly similar to the reasons recorded in the original report and those recorded above in data supplied by FRS.

Where sprinklers had not operated there were 111 reported casualties.
A direct comparison can now be made between available casualty data nationally and data on the number of sprinkler activations. The table below captures the recorded number of activations of sprinkler systems and the total number of casualties where sprinklers were recorded as having activated.

Figure 1: Number of Sprinkler Activations and Casualties Where Sprinklers

Year	Buildings other than Dwellings: Total Number of Sprinkler Activations	Buildings other than Dwellings: Number of casualties in a fire where sprinklers have activated	Dwellings: Total Number of sprinkler Activations	Dwellings: Number of casualties in a fire where sprinklers have activated
2013	335	6	22	2
2014	323	14	24	5
2015	307	15	31	3
Total	965	35	77	10

Figure 2: Average Rates Comparison

Year	Buildings other than Dwellings: Total Number of Sprinkler Activations	Buildings other than Dwellings: Number of casualties in a fire where sprinklers have activated	Rate: Number of Fires per Casualty	National Rate	Dwellings: Total Number of sprinkler Activations	Dwellings: Number of casualties in a fire where sprinklers have activated	Rate: Number of Fires per Casualty	National rate
2013	335	6	55.83	18.47	22	2	11	5.22
2014	323	14	23.07	17.52	24	5	4.8	5.29
2015	307	15	20.46	14.62	31	3	10.3	5.44

The above comparisons show that typically persons are safer in a fire where sprinklers activate, in both Dwellings and Other Buildings. The exception being 2014 where the rate in dwelling fires was slightly higher. In the other two years persons were twice as safe.

Figure 2 is derived from the statistical analysis of data provided by both the Home Office, providing FRS and open source data from the respective governments.

The data on the rates of sprinkler casualties is based on the calendar years 2013, 2014 and 2015. Data for all sprinkler activations was not available for 2016 and 2017 for Wales and Scotland.

The data for the general rates of casualties in all fires was collected for 2013 to 2017 from the Home Office and devolved administrations' open source data.

The rate is expressed in terms of the number of fires that occur per fatality or non-fatal casualty.

No fatalities were recorded in buildings other than dwellings where sprinklers were present. The rate in Great Britain is one fatality for every 848 fires.

The few recorded fatalities in dwellings where sprinklers were present meant that the overall statistic is slightly lower than in the general data i.e. where sprinklers are present there is a fatality in every 105 fires. In the general data, there is a fatality every 142.5 fires. This is likely to be due to fire size being larger to activate the sprinkler system. Also, a significant factor is that sprinkler systems are generally targeted at higher risk premises and occupants. Sprinklers are not routinely installed in new dwellings and tend to be fitted to protect individuals identified as being at risk, or in flats or social housing. The last two have a higher incidence of fire than the general population. Typically, individually targeted occupants tend to be higher risk (often there are fire behaviour, substance dependency, mental health and/or mobility issues involved). Also, age is often a factor which means the occupants are more vulnerable to the effects of smoke and burns. However, while the fatal casualty rate is slightly higher than the norm (even with the fatalities related to portable system discounted), where sprinklers are present the rate of injury is around half that experienced in dwellings where sprinklers are not present.

An analysis of the circumstances behind the fatal fires in sprinklered dwellings is found later in this document.

Injury Severity Analysis

Case Study: Homeless Hostel 16 June 2015

At about 15:45 on Tuesday 16 June 2015, a fire occurred in the kitchen on the fourth floor of a five storey block of flats housing homeless persons in Motherwell.

Three pumping appliances were mobilised to the incident and two Breathing apparatus wearers were committed to ventilate but no firefighting action was recorded as the fire had been extinguished by the flat's residential sprinkler system.

An analysis of the data available of injuries. Injuries are recorded in two ways:

- Nature of Injury
- type of Injury

The Nature of Injury is recorded as:

- First Aid at Scene
- Precautionary Check at Scene
- Hospital Treatment

Precautionary check at scene is the lowest level of intervention and does not result in any recording as a casualty. The next recording is first aid given at scene. Finally, the most severe is that a casualty is sent to hospital for treatment. Some data from services is further broken down into either hospitalised slight or hospitalised severe. As this was not uniformly recorded the categorisation of hospitalised includes both.

The 'type of injury' contains multiple types of injury and is not graded by severity. Typical types of injury are breathing difficulties, burns and types of physical injury. Some of the categories combine overcome with burns and overcome/smoke inhalation.

Figure 3: Comparison of Injury Nature between All Fires and Fire Where Sprinklers Activate

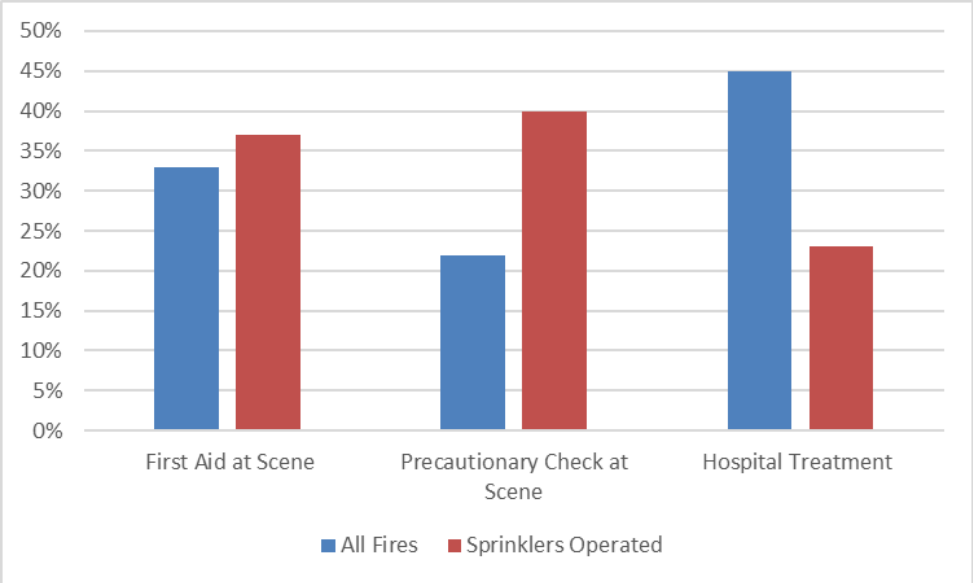
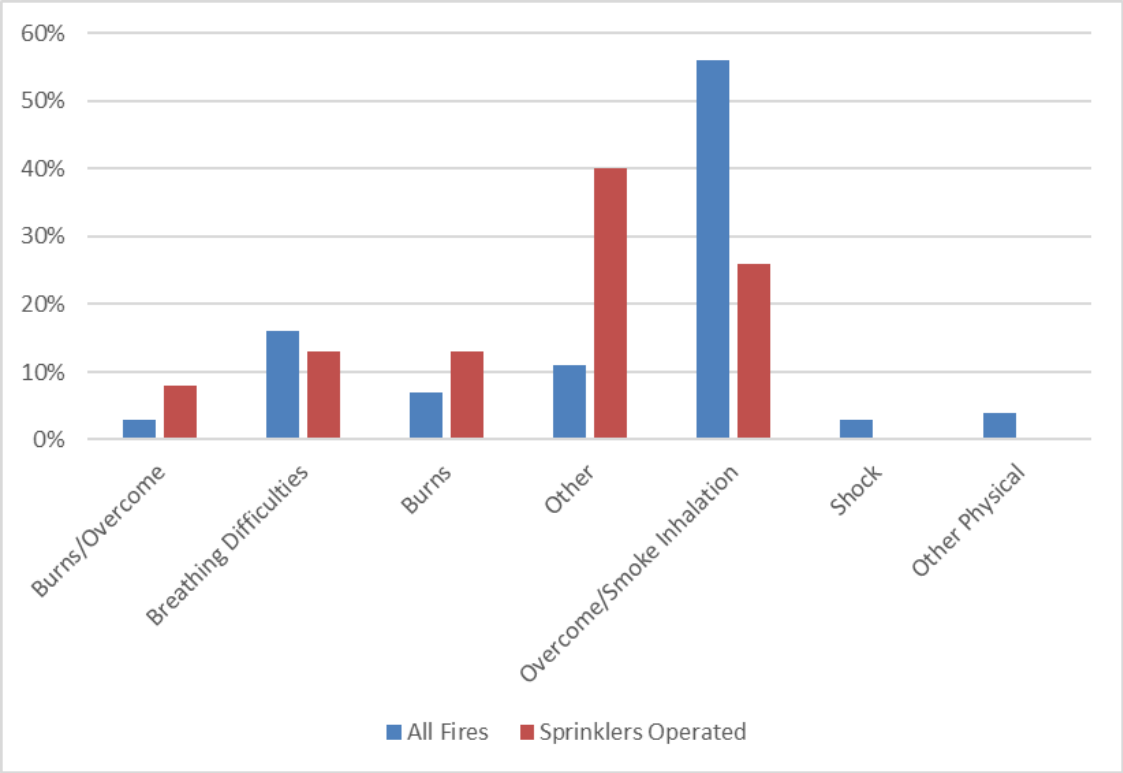


Figure 3 is a comparison of the analysis of the nature of injury in all fires between 2010 and 2018 and the analysis of the type of injury in all fires since 2013 where sprinklers had activated. The data shows that you are significantly less likely (22%) to require hospital treatment if you are in a fire which is controlled by a sprinkler system. You are also significantly more likely (18%) to receive a precautionary check at the scene of the incident. A precautionary check is the lowest recordable level of support for a casualty by attending crews. A precautionary check is usually carried out at the scene when there is no obvious injury but attending crews want to be completely certain an individual is unharmed. This data shows that the incidence of harm experienced by those in a fire, when a sprinkler has operated, is significantly less than when sprinklers are not present.

Figure 4: Comparison of Injury Types for All Fires and Where Sprinklers Activate.



Sprinkler systems are designed to operate when affected by the heat from a fire and, typically, this means there tends to be a period where the fire will be emitting some smoke. However, it is interesting to note that even then, you are 30% less likely to experience the effects from smoke to the point of being overcome. You are also less likely to experience breathing difficulties.

You are slightly more likely to experience burns. This may again be due to the size of a fire that is required to activate a sprinkler system, leading to a slightly increased chance of receiving direct burns or burns from radiant heat. It is entirely possible that where casualties had mobility issues and were unable to escape in the same way as an able-bodied person, the presence of sprinklers may have prevented a fatality.

Shock and other physical injuries (classed as fractures, head injuries, chest and abdominal injuries) are completely eliminated with not a single incidence found in the analysis.

There is a threefold increase in the recording of other injuries - which accounts for a raft of other minor injuries that are not accounted for in the main categories.

Case Study: Vulnerable Person in a Flat.

Bedfordshire FRS were called to a fire in a fifth floor flat in a 14 storey tower block of social housing. The call was at 11:06 pm on 31 July 2017. The resident had fallen asleep leaving a chip pan on, a fire had broken out whilst the resident slept. The fire activated a sprinkler head within the kitchen and extinguished the fire as well as raised the alarm. One female was escorted from the flat by fire service personnel and handed over to the ambulance service.

The fire officer in charge of the incident reported that without the sprinkler activation, the whole flat would have been lost and there was a real possibility that the occupant would have lost their life. The sprinkler system was reinstated the following day (01/08/2017).

Fatal Fires Analysis.

Dwellings

The analysis of the data has shown that there were eight fires in dwellings where there was a fatality recorded and a suppression system present. This has been divided into two subsections:

- Fixed Systems. These are conventional systems where a sprinkler or water-mist system has been built into the fabric of the building to a recognised standard. Typically these systems will be fitted throughout the property;

- Portable water-mist systems. These are an emerging technology. They are not a system built into the fabric of the building and can be quickly installed and removed. They are free-standing systems. They are typically provided by an Authority to protect an individual who is particularly vulnerable from fire. Typically, they are individuals who have mobility issues and/or a dependency on alcohol or other substance. They may also be smokers, further increasing the risk. The system would be located to provide them protection where they usually sit or sleep.

Fixed Systems

In the first fire studied, the fatality resulted from clothing igniting as a result of careless disposal of smoking materials. This was with a full water-mist system in place.

The second incident studied was again due to clothing of the individual being ignited by careless disposal of smoking materials. The deceased had mobility issues and was vulnerable due to their mental health. The deceased subsequently died of their burns. The fire did not reach a sufficient size for the sprinkler system to be activated. It is believed that the impact of the fire was exacerbated by the use of emollient cream by the individual. Emollient creams have been shown to act as a fire accelerant.

The third incident studied was as a result of a suicide attempt. The occupier deliberately set fire to their clothing in their chair beneath the sprinkler head. The sprinkler head operated. The Coroner concluded the cause of death was asphyxia secondary to suffocating gases.

In the fourth incident studied, the occupier was believed to have been filling lighters with lighter fuel in bed. The cause of the fire was most likely ignition of flammable vapours from lighter fuel. Sprinklers were fitted in the property, however not in the bedroom itself, only in the kitchen. They did operate. The Coroner concluded the cause of death was carbon monoxide poisoning and airway laryngeal oedema.

The fifth incident was as a result of careless disposal of smoking materials on a settee the deceased was sitting on. The deceased was alcohol dependent and had mobility issues. The system was a retrofitted sprinkler system in purpose built flats. By the time the fire was hot enough to activate the system, the deceased had already suffered injuries they would later succumb to.

Portable Watermist Systems

In the first fire studied the deceased died as a result of careless disposal of smoking materials which set light to bedding.

The second incident studied was again as a result of the clothing of the individual being ignited by careless disposal of smoking materials. They were provided with a portable ‘aquamist’ protection system by the fire service. The deceased unfortunately moved away from the system and the protection it could have provided. They subsequently died of their burns.

The third incident studied was where the system and casualty were both located in the room of origin. The system activated and raised the alarm but unfortunately the victim died of their injuries. The same service recorded four other incidents where ‘Ultraguard' successfully protected individuals.

Other Buildings

A significant fire where sprinklers were present occurred in 2015. The incident led to the deaths of four individuals. Sprinklers were present but the deaths were caused by an explosion in a flourmill. The presence of a sprinkler system was totally irrelevant to the nature and cause of this incident and therefore the deaths have not been included as part of the statistical analysis.

A further incident was reported where there was a death recorded and sprinklers being present. On investigation, it was discovered that the deceased had committed suicide through self-immolation in the curtilage of the sprinkler protected building and therefore has also not been included as part of the statistical analysis.

No other fatalities were found to be recorded in buildings other than dwellings.

Conclusion from the Incidence of Fatal Fires

The conclusion from this analysis is that where sprinklers and other personal protection systems are fitted, they are not always successful in protecting individuals from fires on their person or in bedding. Suppression systems do require some significant heat to trigger operation. Typically around 68 degrees centigrade. When an individual is involved in fire, by the time the temperature is high enough to activate the system, the victim will already have experienced both significant direct burns and damage to their airway.

All fatalities recorded in dwellings where sprinklers are present, have been used as part of the analysis apart from the three incidents where portable misting systems have been reported as being present. These are not fixed sprinkler or water-misting systems. Further data analysis is required to review the performance of these systems.

Further work is needed by the industry, in partnership with fire and rescue services, as to how those who are most vulnerable and immobile can be protected from fire. This is increasingly important as the nation has an aging population profile and needs to protect the most vulnerable. Whilst portable water-misting systems provide a temporary solution in high-risk cases, it is timely, in the wake of a review of building regulations, to revisit requirements for sprinklers in new buildings where increased vulnerability is a foreseeable risk.

In other parts of the world where sprinklers have been mandated to protect the general population there is growing evidence of their life safety benefits.

In Vancouver, sprinklers were required in all new residential accommodation since 1990. To date they have not recorded a single fire death in a home fitted with sprinklers.

In Scottsdale Arizona a local ordinance was passed requiring sprinklers in homes in 1985. In the first thirty years there was one recorded death in a sprinkler fitted dwelling. This too was a vulnerable individual who died as a result from their own direct burns because of smoking while using oxygen.

Analysis of Incidents where sprinkler systems are recorded as being present in flats.

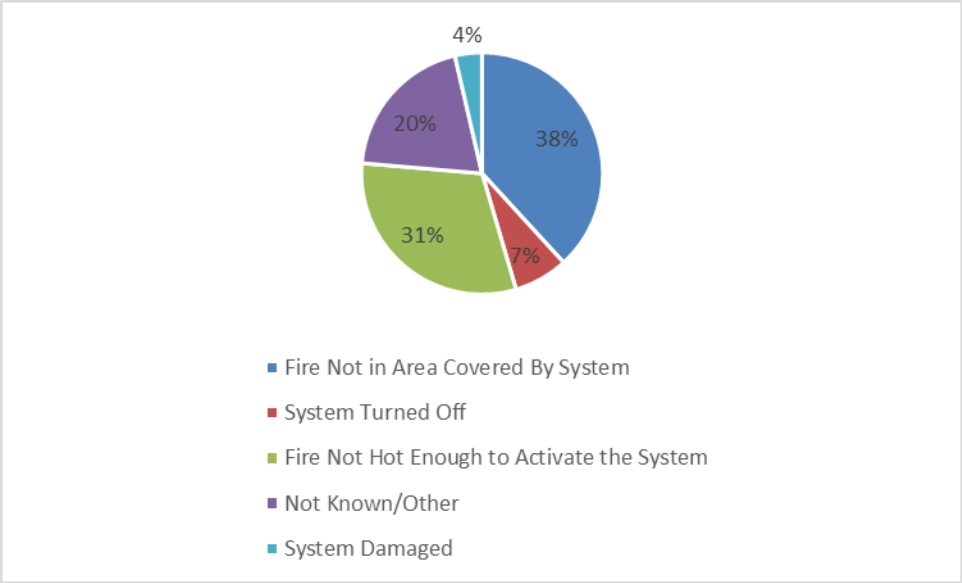
Analysis of FRS data provided where there was a recorded casualty and where sprinklers were present provided few returns. There were only five incidents recorded as sprinklers having operated and where there had been casualties.These incidents resulted in nine casualties - three were recorded as precautionary checks and two were recorded as having breathing difficulties. Four were recorded as ‘Hospitalised with Slight Injuries’. There was one recorded fatality that has been covered in the section on fatalities.

Due to the small amount of data available, a further study of Home Office data was undertaken using data from 2015/16 to 2017/18.

A total of 180 activations in flats were recorded. In these incidents there were only five casualties recorded. Detail of severity or type of injury was not available, but a comparison of the HO data with FRS data suggests this contains one fatality and two other causalities of a lesser nature. This equates to a casualty per 23.6 fires.

The most common reason for the system not operating is that the fire is not in an area where the sprinkler system was or the fire was not hot enough.

Figure 5: Reasons for Non-Activation of Sprinkler Systems in Flats



The general rate in dwellings in the UK is one casualty in every 5.27 fires. In flats the casualty rate is slightly lower with a casualty every 5.33 fires. Where sprinklers activate there is a casualty every 23.6 fires. You are four times safer in a fire in a flat when sprinklers activate.

Year	Fires	Casualties	Rate	Fatalities	Rate
2015/2016	9990	1907	5.24	57	175.26
2016/2017	9538	1760	5.42	58	164.45
2017/2018	9915	1861	5.33	57	173.95
	29443	5528	5.33	172	171.18

NB. The 73 fatalities in the Grenfell Towers fire were not included in the 2017/2018 fatality statistics as this was considered an exceptional event, which would create an unreasonable slant towards provision of sprinklers.

Case Study: Sprinklers Activation in a Tower Block

London: June 2018

Around 180 people were evacuated from the tower block after a fire broke out in a flat on the 13th floor of the building at around 4am. Most of the balcony and part of a four-bedroom flat in the block were damaged.

London Fire Brigade sent eight fire engines and nearly 60 firefighters to the incident. The sprinkler system inside the tower block was activated and suppressed the fire and prevented it from spreading further into the flat. The fire was brought under control within an hour of the alarm being raised and there were no injuries.

Conclusions

The analysis of the data has found that sprinkler systems are shown to reduce the likelihood that individuals will be injured in a fire. If they are injured then the severity of the injury is less and the need to receive hospital treatment is reduced.

Secondly, if you are unfortunate enough to be injured in a fire when a sprinkler activates the nature of the injury is much less likely to be something that causes you to be overcome by smoke or experience breathing difficulties. It is more likely to be an injury of a minor nature that can be dealt with at the scene of the incident in the form of a precautionary checkup.

There was not a single report of a death in a building other than a dwelling where sprinklers were recorded as being present and sprinklers could be expected to work. The two fires where there were deaths consisted of a catastrophic explosion in a flourmill and a suicide in the vicinity of a sprinkler protected building.

There were few recorded fatalities recorded in dwellings, which meant the rate of fatalities was broadly similar to the general rate. Examination of the circumstances of these few deaths suggests that this is due to sprinklers being more likely to be installed in dwellings because there is a specific risk to protect. This may be due to individuals at risk or because of a socio demographic factor that indicates that residents are likely to be more at risk (social housing, houses in multiple occupation or high-rise flats).

There is also a compelling case for the inclusion of sprinklers in the safety design of flats. We know already that they have a high reliability and effectiveness in flats from the original report. This analysis also shows that the occupiers are safer and less likely to be harmed if a flat is protected by a sprinkler system.

Case Study: Sprinklers Protecting Secondary School

Cleveland: October 2018

In a large secondary school, a fire started in a utility room in a washing machine. The school was fitted with a sprinkler system, which activated and confined the fire to the washing machine. There was only a small amount of radiated heat damage to a tumble dryer and fridge located either side of the washing machine. There was severe smoke damage to the remainder of the room but no smoke passed through the door of the Caretaker's room into the adjacent corridor. There was a potential for the products of combustion to leave the Caretaker's room and affect the adjacent corridor and rooms leading off it.

There was no casualties and the school classes ran as normal with no disruption.

Appendix A: Fire Casualty Rates in the United Kingdom

General Casualty Rates										
England										
Year	Dwellings					Other Buildings				
	Fires	Non-Fatal	Rate	Fatal	Rate	Fires	Non-Fatal	Rate	Fatal	Rate
2013/2014	31908	6116	5.22	217	147.04	17062	924	18.47	16	1066.38
2014/2015	31331	5922	5.29	194	161.50	15559	888	17.52	19	818.89
2015/2016	31371	5764	5.44	228	137.59	16023	1096	14.62	21	763.00
2016/2017	30343	5365	5.66	214	141.79	15858	897	17.68	18	881.00
2017/2018	30744	5447	5.64	263	116.90	15576	994	15.67	20	778.80
Total	155697	28614	5.44	1116	139.51	80078	4799	16.69	94	851.89
Wales										
Year	Dwellings					Other Buildings				
	Fires	Non-Fatal	Rate	Fatal	Rate	Fires	Non-Fatal	Rate	Fatal	Rate
2013/2014	1910	500	3.82	5	382.00	995	78	12.76	0	0.00
2014/2015	1808	420	4.30	16	113.00	1034	47	22.00	2	517.00
2015/2016	1775	457	3.88	13	136.54	963	65	14.82	5	192.60
2016/2017	1858	512	3.63	14	132.71	931	47	19.81	0	0.00
2017/2018	1617	407	3.97	11	147.00	922	65	14.18	0	0.00
Total	8968	2296	3.91	59	152.00	4845	302	16.04	7	692.14
Scotland										
Year	Dwellings					Other Buildings				
	Fires	Non-Fatal	Rate	Fatal	Rate	Fires	Non-Fatal	Rate	Fatal	Rate
2013/2014	5330	1533	3.48	29	183.79	2350	87	27.01	1	2350.00
2014/2015	5571	947	5.88	32	174.09	2393	91	26.30	3	797.67
2015/2016	5677	1063	5.34	39	145.56	2497	117	21.34	3	832.33
2016/2017	5541	1042	5.32	36	153.92	2279	72	31.65	3	759.67
2017/2018	5310	921	5.77	37	143.51	2281	117	19.50	3	760.33
Total	27429	5506	4.98	173	158.55	11800	484	24.38	13	907.69
Great Britain Combined										
Year	Dwellings					Other Buildings				
	Fires	Non-Fatal	Rate	Fatal	Rate	Fires	Non-Fatal	Rate	Fatal	Rate
2013/2014	39148	8149	4.80	251	155.97	20407	1089	18.74	17	1200.41
2014/2015	38710	7289	5.31	242	159.96	18986	1026	18.50	24	791.08
2015/2016	38823	7284	5.33	280	138.65	19483	1278	15.24	29	671.83
2016/2017	37742	6919	5.45	264	142.96	19068	1016	18.77	21	908.00
2017/2018	37671	6775	5.56	311	121.13	18779	1176	15.97	23	816.48
Total	192094	36416	5.27	1348	142.50	96723	5585	17.32	114	848.45

Appendix B: Non-Operation of Sprinkler Systems

In the original report, a detailed analysis of the reasons why sprinklers didn't operate was completed. This typically found the reasons why sprinklers did not operate was because it was outside of their operating parameters and therefore not a systems failure as such.

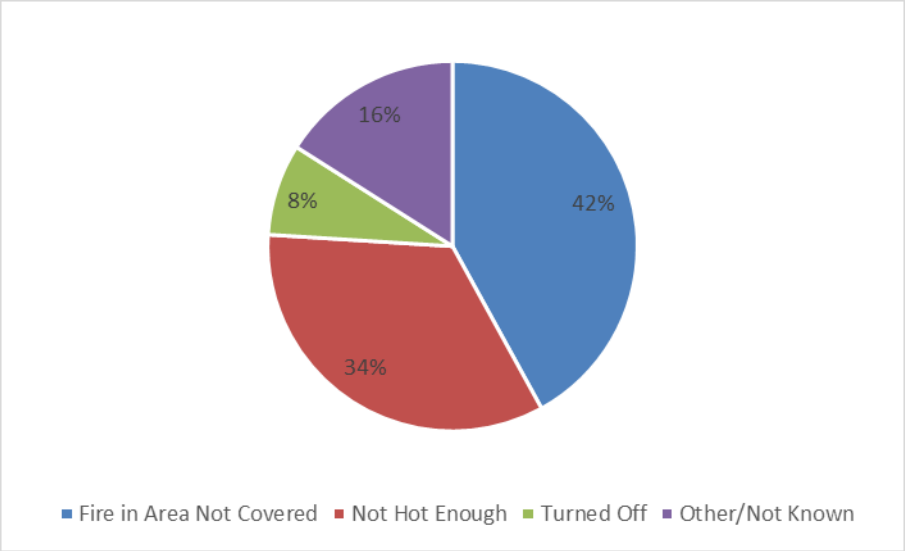
In dwelling fires, it was found that the main reason for non-operation was that the fire originated in a location where the sprinkler system was not installed. This was the case in 42.1% of occasions in this analysis. This was found to be the case in the original data analysis of the effectiveness and efficiency of sprinklers where the figure was also 42%.

In this analysis, it was also possible to identify the detail of the reasons why 'other' had been recorded. In the original report, 'other' accounted for 53.2% of occasions. This was because the data for this report provided an explanation of 'other'.

In 34% of occasions, this narrative explained that the fire was not hot enough or of a size that would activate the sprinkler system. This, together with 16% of reasons recorded as 'other', which didn't have an accompanying narrative, equates to 50%.

In the original report there were some occasions where it was recorded that the sprinkler system had been turned off. This was also found to be the case in this analysis.

Figure 5: Reasons for Sprinkler Systems Not Operating.



Appendix C: Data Sources

Open Data Sources

Home Office.

Scottish Government/Riaghaltas na h-Alba

Welsh Government/ Llywodraeth Cymru

Contributing Fire & Rescue Services

Avon	Lincolnshire
Buckinghamshire	London
Cambridgshire	Merseyside
Cheshire	Mid & West Wales
Cleveland	Norfolk
Cornwall	Northamptonshire
County Durham & Darlington	Northumberland
Cumbria	North wales
Derbyshire	North Yorkshire
Devon & Somerset	Nottinghamshire
Dorset & Wiltshire	Oxfordshire
East Sussex	Royal Berkshire
Essex County	Scotland
Gloucestershire	South wales
Guernsey	South Yorkshire
Hampshire	Staffordshire
Hertfordshire	Suffolk
Humberside	Surrey
States of Jersey	Tyne & Wear
Kent	Warwickshire
Lancashire	West Sussex
Leicestershire	West Yorkshire