Transforming fire prevention: a case study

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Abstract

Purpose:
The purpose of the research project was to examine the transformation of fire prevention processes via improved targeting of fire prevention interventions over a four year period.

Design / methodology / approach:
A four year case study of the transformation of fire prevention processes involving a UK fire and rescue service, local council, NHS primary care trust and a police force was undertaken.

Findings:
Understanding the socio-economic causal factors underlying unintentional dwelling fires, and the need to work in collaborative partnerships to achieve change in such factors can support more targeted and effective fire prevention activities.

Research limitations / implications:
Analysis of underlying causal factors and their relationships, together with population segmentation and working in co-ordinated collaborative partnerships can support enhanced fire risk assessment and community safety. This supported more pro-active early intervention fire risk management.

Practical implications:
Analysis of socio-economic causal factors, and socio-economic groups associated with unintentional dwelling fires can assist in targeting fire prevention activities in a more effective and efficient manner. This enabled the fire and rescue service to target fire prevention to social groups most at risk of dwelling fires and the types of fires (for example, kitchen fires) relevant to the different social groups.

Social implications:
Collaborative public sector partnerships can achieve change in the socio-economic circumstances of at-risk individuals to support fire prevention. This enables the social and health related factors underlying fire risk to be addressed by the relevant partner health or social services agencies.

Originality / value:
The detailed analysis of the transformation of fire prevention activities that led to an implemented approach to enhanced community safety. In particular, the analysis and evaluation of the move to collaborative multi-agency partnerships to support and improve fire prevention activities.

Key words: fire prevention causal factors public sector partnership

1. Introduction

Public sector agencies may need to change their operational activities for a variety of reasons including changes required to improve efficiency or effectiveness, changes to the scope of their operations, or changes due to new legislation amongst others. In this paper we examine the transformation of fire prevention activities in a UK fire and rescue service mainly due to significant reductions in funding between 2008 and 2012.

Existing approaches to fire prevention typically utilize spatial analysis of fire incidence combined with measures of social deprivation (O'Grady, 2014). In this paper we examine the transformation of fire prevention in a UK fire and rescues service via socio-economic causal factor analysis, population segmentation analysis and multi-agency collaboration.

In the years preceding the study period there had been a steady decrease in the number of fire incidents, fire related injuries, and fire fatalities, however, the rate of decline had slowed, and it became apparent that the existing approach to fire prevention based upon spatial analysis of fire incidents could not yield required further improvements, hence a radically new form of fire risk analysis was required.

Initially a detailed literature review was undertaken into the socio-economic causal factors associated with unintentional dwelling fires. Socio-economic causal factors identified by previous research included: elderly individuals, disabled individuals, those living alone, smoking and alcohol consumption (Holborn et al, 2003; Leth et al, 1998; Jordan et al, 1999).

A multiple linear regression model was then developed to determine the main causal factors involved in unintentional dwelling fires in a region within the North West of England. The analysis was undertaken at the Lower Super Output Area level (Alnababtah et al, 2011) of geographical granularity based upon available data. This allowed analysis of different levels of fire risk based upon the causal factor model.

In order to improve the identification of vulnerable individuals and social groups in relation to fire risk, population segmentation analysis was undertaken using k-means cluster analysis to identify population segments (community profiles) within the region studied. Data available at the more detailed Output Area (Chainey, 2013) of geographical

granularity was then used to create customer insight profile groups for each output area within the region studied.

During the transformation of the process of fire prevention (resulting from significantly reduced budgets) it became apparent that although the fire and rescue service could better identify the causal factors associated with dwelling fires, and could advise individuals and households regarding such causal factors, it did not have the resources to support *change* in these causal factors. For example, elderly and disabled individuals living alone were at risk of dwelling fire, but the fire and rescue service could not change the circumstances of such individuals. However, by working in partnership with the local council, housing and social services could be used to change the circumstances of such individuals and thus reduce dwelling fire risk.

Analysis of fire incidence across the socio-economic groups was then used to further target fire prevention activities, for example, kitchen fires were found to predominantly occur within just three of the ten community profile groups.

The project upon which the case study research was based aimed to deliver initiatives to help reduce the risk of fires and improve the quality of life targeted at relevant households. The project aimed to proactively signpost relevant partners' services when contact was made with householders in the region concerned, for example when fire and rescue service officers were carrying out fire prevention activities, such as the home fire safety check (Kendrick et al, 2012). The aim of the project was that services would be better targeted based upon the needs and risks present in the community.

The strategy underlying the transformation of fire prevention within the organization studied aimed to:

- Reduce of the number of accidental dwelling fires and related injuries and fatalities within the region.

- Increase the number of citizens giving up smoking through smoking cessation services offered by the local UK NHS Primary Care Trust (Bauld et al, 2010)

- Improve signposting to early council-based intervention services enabling people to live independently in their own homes, such as 'Healthy Homes' and handy-person schemes (Hunter et al, 2011)

The novel theoretical contribution of the research reported in this paper is the detailed analysis of the transformation of fire prevention activities involving a set of UK public sector organizations, leading to an implemented approach to enhanced community fire safety. In particular, this research examined and evaluated the move to collaborative multi-agency partnerships as a mechanism for supporting and improving fire prevention activities.

2. Literature review

In the literature review existing research into dwelling fire risk, and approaches to fire prevention adopted by fire and rescue services were examined.

2.1 Dwelling fire risk

Previous research had indicated that accidental dwelling fires are not uniformly distributed among the population, but typically occur more frequently in areas that have higher proportions of individuals from at-risk groups such as the elderly, smokers, and the deprived (Leth et al, 1998; Jordan et al, 1999; Barillo and Goude, 1996; Mulvaney et al, 2008; Diekman et al, 2008; Duncanson et al, 2002). A deeper appreciation of the causal factors associated with dwelling fires can support more targeted fire prevention approaches.

Currently fire risk models adopted by UK fire and rescue services typically involve analysis of previous fire incidences, along with indices of multiple deprivation (Brown et al, 2010). The Fire Services Emergency Cover (FSEC) model of fire risk used by some UK fire and rescue services (O'Grady, 2014) utilizes previous dwelling fire incident data, resource location and the time taken to travel to a fire incident. The FSEC risk assessment analyzes the relationship between response time and fatality rates for fire incidents. The two main measures of dwelling fire risk produced by FSEC are the predicted number of deaths per year, and the predicted annual death rate per resident (O'Grady, 2014).

2.2 Fire prevention

Fire prevention activities (Rosenberg, 1999; Brussoni et al 2006; Hwang et al, 2006) have increasingly been used by fire and rescue services in order to attempt to achieve reductions in fire incidence. For example, the UK Home Fire Safety Check (Kendrick et al, 2012) was introduced in the UK in 1999. In order to attempt to improve the efficiency and effectiveness of fire prevention activities, fire and rescue services may target fire prevention initiatives to those individuals, social and economic groups and geographic areas perceived to have a higher risk of fires occurring (Diekman, 2010). Crawford (2005) stated that continual reassessment and adjustment of fire prevention activities is essential to providing a long term solution for reducing fire deaths, injuries and property damage.

2.2 Public sector partnerships

Ryan and Walsh (2004) commented that there is increasing pressure being placed on government agencies to act in a more collaborative, integrated manner. Greasley et al (2008) and Liddle (2009) commented that, while there can be clear benefits of public sector partnerships working, achieving successful collaboration is not straightforward. They argue that as future public sector partnerships develop, further research should be undertaken in this area. Partnerships and collaborative endeavours between public sector agencies are viewed as an increasing necessity, rather than just an opportunity for

improvement (Sorrentino and Simonetta, 2011). Ulbrich (2010) stated that in an era of declining budgets and increasing demands for service delivery and quality, public sector organisations are increasingly looking to sharing services as a possible means to achieve high quality service provision at reduced cost. Combe (2009) argued that collaborative data sharing practices across the public sector can lead to increased efficiencies and early intervention in social problems to support better targeted services. However, Bigdeli et al (2013) commented that although public sector organisations may wish to work collaboratively, electronic information sharing between the partner organisations can be problematic. Matthews (2014) stated that overall partnerships can break down barriers between different public sector agencies and prioritise action based on a strategy to support the local community.

Overall, there have been moves towards inter-organizational collaboration in the public sector (Yang and Maxwell, 2011), in order to attempt to improve policy and practice (Florence et al, 2011; Quigg et al, 2010). However, there is little if any research regarding inter-organizational partnerships in the area of fire prevention.

3. Research method

The purpose of the research reported in this paper was the analysis of the transformation of fire prevention through the use of statistical modelling of causal factors, population segments and collaborative public sector partnerships. The case study research method (Stake, 1995) was used. The case study research method was an appropriate research method, as it allowed an in-depth qualitative examination of the transformation of fire prevention approaches in actual practice. However, a limitation of the case study approach can be the generalizability of the results of the case study to other organisations.

The fire and rescue service studied needed to transform its fire prevention strategy and operations in order to further reduce instances of fire incidence, fire fatalities and fire injuries which had declined in previous years, but had only minimally reduced in the last few years. In addition, the fire and rescue service had undergone significant budget reductions which necessitated radical transformation in order to attempt to deliver the same level of service with much reduced resources. The transformation of fire prevention was initiated by senior management within the fire and rescue service and was carried out by staff in a variety of functional areas including community safety, strategy and planning and knowledge and information services.

3.1 Research aims

The focus of the research undertaken was the study of the changing nature of fire prevention. A four year case study of the transformation of fire prevention activities was undertaken involving a UK fire and rescue service, a UK NHS primary care trust, and the following departments in a UK local council: adult social care, early intervention, community health and well being, housing and benefits, and a UK police force between 2008 and 2012. The qualitative research techniques utilized included: meetings and discussions with management staff and relevant operational staff such as community fire

prevention officers, information analysts, managers, and councilors in the partner organizations. Quantitative analysis of data was performed by the Strategy and Performance department within the fire and rescue service using the multiple linear regression and k-means cluster analysis facilities with the SPSS statistical package (Mayes et al, 2014).

The research reported in this paper addressed the following research questions:

- How can fire risk be modelled?

- How can fire prevention be better targeted to those most at risk?

- How can the causal factors underlying fire incidence be addressed?

- How can public sector partnerships support fire prevention?

These research questions are important since current UK public sector budgets reductions imply that fire and rescue services need to operate more efficiently and more effectively.

3.2 Research data collection and analysis

In order to conduct research into the changing nature of fire prevention an appropriate data collection and data analysis strategy was devised.

3.2.1 Data collection

The transformation of fire prevention activities was discussed in meetings with those staff involved in fire prevention and customer insight within the organizations studied. These included: project managers, IT managers, data protection officers, and community fire safety officers within the fire and rescue service; councilors, and information analysts from the local council; information analysts from the NHS primary care trust, and a community liaison officer from the local police force. The meetings typically lasted for around one hour. The meeting notes were recorded on paper and then analyzed. These meetings facilitated discussions regarding the process of fire prevention, including the rationale for fire prevention, the mechanisms for fire prevention, and the management of fire prevention activities. A potential difficulty of the case study approach can be the access required to staff in the organisations studied.

3.2.2 Data analysis

The data collected was then content analyzed by identifying themes within the meeting texts. For example, what was involved in fire prevention, and what potential benefits were envisaged from fire prevention activities. This allowed an understanding of the issues associated with attempting to improve fire prevention, and the process of modelling community fire risk. The themes identified were used to analyse the changing nature of fire prevention. The overall aim of reducing dwelling fires and associated

injuries and deaths was supported by firstly understanding the causal factors associated with such fires, and then enhanced by understanding how these related to the different social groups within the region. A significant theme identified during the data analysis was the need to address the underlying health and social care factors associated with dwelling fires.

4. Research Results

The fire and rescue service studied had previously adopted an unintentional dwelling fire risk model (as part of its integrated risk management planning activities (Murphy et al, 2012)) that utilized analysis of previous incidence of fires, combined with indices of multiple deprivation (Brown et al, 2010). Other UK fire and rescue services used the Fire Services Emergency Cover (FSEC) model of fire risk (O'Grady, 2014) that utilizes data from previous dwelling fire incidents, resource location and the time taken to travel to an incident. However, the fire and rescue service studied chose not to adopt the FSEC model as it did not model the population characteristics that could lead to accidental dwelling fires.

The transformation of fire prevention within the fire and rescue service studied covered four main phases:

Phase 1 - socio-economic causal factor modelling (via multiple linear regression modelling) to analyze the nature of unintentional dwelling fire risk across geographic areas (lower super output area level of geography) within the region studied. This provided for more targeted fire prevention by identifying higher dwelling fire risk areas within the region based upon socio-economic characteristics.

Phase 2 - socio-economic group modelling (via k-means cluster analysis) to analyze the nature of the different socio-economic groups in relation to fire risk across finer grained geographic areas (output area level of geography) within the region. This identified the different socio-economic groups (community profiles) within the region studied. The different community profile groups had different levels of fire risk, which enabled more targeted fire prevention activities to those community profile groups within the region that had a higher risk of fire.

Phase 3 - enhanced referral and advocacy services to partner organisations (the NHS primary care trust, local council, and police) in order to attempt to achieve change in the underlying causal factors associated with fire risk (as identified in phase 1). For example, referral to smoking cessation initiatives to attempt to reduce smoking rates within the region, referral to council services with regard to attempting to reduce fire risk associated with elderly and disabled residents, and in particular, elderly residents living alone. This supported enhanced fire prevention activities by attempting via the partner orgnizations to directly reduce the identified underlying causal factors associated with fire risk.

Phase 4 - enhanced fire incidence modelling (via frequency analysis across identified community profile groups and geographic areas) to analyze the nature of the incidence of

different types of dwelling fires, for example kitchen fires, across the different socio-economic groups (community profiles) within the region. This supported advanced targeting of fire prevention activities by identifying the most frequent types of fire incidence associated with specific social groups (community profiles) at higher risk of dwelling fire within the region.

Overall the basis of the fire prevention strategy changed from one that targeted geographical areas that had previously had higher incidences of fires, to one that targeted geographical areas that had higher incidences of socio-economic causal factors associated with dwelling fires, to one that targeted specific population segments identified as being at higher risk of specific types of dwelling fires. In parallel, collaboration and co-ordinated work with partner health and social services aimed to address the underlying causal factors present in the identified social groups. In the wider research field of transforming government, this case study demonstrates that risk management can be enhanced by appropriate modelling of the specific risks, as well as analysis of how such risks are spread amongst different social groups. Collaborative public sector partnerships can be established to address the risks relevant to different social groups in a co-ordinated and pro-active manner.

Figure 1. shows how the basis of the risk modelling approach used to inform the fire prevention strategy changed over the timeframe of the research project (2008 to 2012).
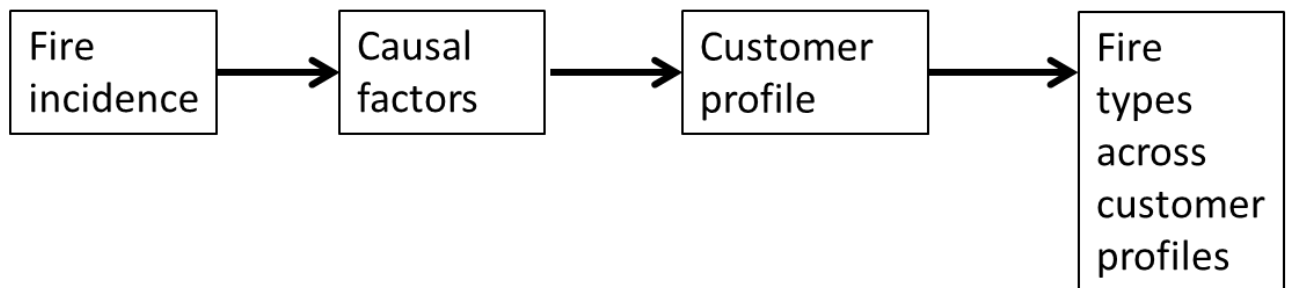

Figure 1. Transformation of risk modelling approach used to inform fire prevention strategy

4.1 Phase 1 - Socio-economic causal factor risk modelling

The multiple linear regression modelling of unintentional dwelling fire risk involved a number of socio-economic factors relating to mental health, living alone, disability, binge drinking, lone parents, and lack of smoke detectors. The SPSS (Mayes et al, 2014) statistical software package was used to develop the statistical model of unintentional dwelling fire risk. The weightings used for the multiple linear regression model were derived using a least squares approach which uses a mathematical rule to determine the best line of fit through the actual data values.

The developed multiple linear regression fire risk model for the region studied was:

Fire risk level =   0.035 * number of mental benefit claimants
                 + 0.012 * number of smoke alarms
                 - 0.116 * number of severe disability claimants
                 + 0.209 * percentage of binge drinkers
                 - 0.155 * number of lone parents
                 + 0.113 * number living alone
                 - 0.016 * number of disability living allowance claimants
                 - 6.532

(Higgins et al, 2012). The mathematical model of unintentional dwelling fire risk was used to develop a set of fire risk bands for the Lower Super Output Areas within the region (Taylor et al, 2011). The fire risk bandings were derived using operational management considerations from the fire risk level calculated for each Lower Super Output Areas (Alnababtah et al, 2010) by the multiple linear regression model. A Lower Super Output Area is part of a geographical area hierarchy developed by the UK Office for National Statistics. A lower super output area typically contains a mean population if 1500 and a minimum population of 1000. The operational fire risk bandings devised were:

High risk   =   highest 15% of lower super output areas fire risk levels

Medium risk   =   lower super output areas between highest 15% and lowest 42.5% fire risk levels

Low risk   =   lowest 42.5% of lower super output areas fire risk levels

4.2 Phase 2 - Socio-economic group modelling for improved targeting of fire prevention

Having identified geographical areas of higher dwelling fire risk within the region studied, population segmentation (via k-means cluster analysis) was then used to identify distinct social groups within the region in order to support analysis of risk of fire and level of need of health and social care services. Customer insight data included information on home fire safety checks, incident data collected by the fire and rescue service, adult social services data, primary care trust smoking cessation data, and police force crime data, and national data from the UK Office for National Statistics and the UK Department for Work and Pensions available at a local level. The population segmentation approach supported analysis to identify which social groups were most at risk and therefore would benefit from interventions. This in-depth analysis also helped the organizations involved in the project to understand the risks that were present in each area, resulting in the redesign of services.

The data for customer segmentation analysis available within the region studied related to population demographics, health, disability, deprivation, housing, and community safety. The decision regarding which data to utilize for cluster analysis was based upon consideration of co-linearity between the variables and the range of values of the

different data variables. It was important to check for co-linearity between the variables being considered for the cluster analysis. Where variables had a high level of co-linearity (correlation > 0.8) one of these was kept in the cluster analysis based upon practical usefulness, and the other removed. Without this step co-linearity between variables could potentially have distorted the cluster analysis. Binary data variables (for example, data with a value of yes or no) and data variables with a small range of discrete values were also removed, since such variables could also distort the results of the cluster analysis.

The variables below that were suitable for the cluster analysis were unique variables that resulted in a number of unique categories (Higgins et al, 2013):

Disability Living Allowance Claimants
Child Benefit Claimants
Residents living in converted flats
Middle rate care (Disability Living Allowance)
Broad age group
Social Grade
Pension Claimants aged 80+
Life Expectancy
Worried about crime
Residents living in a terraced property
High rate care (Disability Living Allowance)
Mobility nil rate (Disability Living Allowance)
Crime level
Revenue & Benefits Claimants
DASS Claimants

The remaining data variables were matched against the groups to build detailed community profiles. The population segmentation (customer profiling) was performed using k-means cluster analysis. The analysis was performed using the SPSS statistical software package (Mayes et al, 2014).

The community profiles were used to analyze the risks relating to the different community profiles. Table 1 shows the accidental dwelling fires, injuries and deaths associated with the different community profile groups over the three years between 2010/11 and 2012/13.

Profile Group	Approx. number of households	ADFs	ADFs (%)	Injuries	Injuries (%)	Fatalities	Fatalities (%)
1. Wealthy over 50 population living in semi-rural locations	107,375	286	7.45	25	6.61	1	4.17
2. Older retirees	36,625	165	4.30	24	6.35	1	4.17
3. Middle income residents living in privately owned properties	83,875	467	12.16	46	12.17	8	33.33

4. Average income older residents	68,250	313	8.15	29	7.67	1	4.17
5. Students living in city centre locations	86,250	109	2.84	5	1.32	0	0.00
6. Young families	10,000	386	10.05	44	11.64	1	4.17
7. Young families with high benefit need	20,375	729	18.98	70	18.52	5	20.83
8. Residents living in social housing with high need for benefits	48,125	335	8.72	30	7.94	0	0.00
9. Transient population living in poor quality housing	16,375	229	5.96	31	8.20	1	4.17
10. Younger, urban population living in high levels of deprivation	95,875	822	21.40	74	19.58	6	25.00

Table 1 Accidental dwelling fires, fire injuries and fires deaths by community profile group (Higgins et al, 2013).

The population characteristics data was used to appreciate the differing population segment (community profile group) needs within the region. The fire and rescue service also established working relationships with residents and tenants associations and groups, via links with the local council housing department, to gain further insight into the areas concerned.

4.3 Phase 3 - Enhanced referral and advocacy services to partner public sector organisations to address underlying causal factors

Typically the fire and rescue service studied visited approximately 40,000 dwelling per year. The project allowed the partner organizations to signpost individuals to services offered by partner agencies. The fire and rescue service were already working with the local NHS Primary Care Trust to refer individuals who may benefit from smoking cessation services, or perhaps require more help with access to benefits. This can then enable improved up take of services by the most vulnerable individuals and social groups within the community. It was identified that individuals may often lack awareness of public services that are available to them and support services to which they are entitled.

Community fire safety advocates, who conducted home visits, worked closely with front line staff from the partner organizations in order to share knowledge about what to look for when visiting homes in the community. For example, adult social care services recommended community fire safety advocates look for elderly people with mobility issues, and using identified communication methods, pass on information to the citizen regarding services that could be accessed. Data sharing agreements in place with adult social care services ensured that they also received information about relevant individuals and importantly, the fire and rescue service received relevant information back about that individual regarding services they have been provided. (Taylor et al, 2014). The

community fire safety team and key partners continued monitoring such vulnerable individual's risk until a suitable intervention was in place to reduce the risk.

4.4 Phase 4 - Enhanced fire incidence type modelling

Analysis of fire incidence across the different socio-economic groups (ten community profiles) via frequency analysis in SPSS was then used to further target fire prevention activities. For example, kitchen fires were found to predominantly occur within just three of the ten community profile groups. A pilot of the community profiles was completed within one area of the region studied. In this particular area, it was found that over 80% of kitchen fires occurred within three profile groups. This enabled fire prevention measures aimed at reducing kitchen fires to be targeted not only to identified higher risk geographical areas, but also more specifically to members of specific social groups within such areas. In this manner specific tailored fire prevention measures could be efficiently and effectively delivered to those in the community most in need of such.

5. Research implications

The implications of the research undertaken were that analysis of underlying causal factors and their relationships, together with population segmentation and working in co-ordinated collaborative partnerships can support enhanced fire risk assessment and community safety. This supported more pro-active early intervention fire risk management by the fire and rescue service studied. The analysis of socio-economic causal factors, and socio-economic groups associated with unintentional dwelling fires can assist in targeting fire prevention activities in a more effective and efficient manner. This enabled the fire and rescue service to target fire prevention to social groups most at risk of dwelling fires, and the types of fires (for example, kitchen fires) relevant to the different social groups. Collaborative public sector partnerships can achieve change in the socio-economic circumstances of at-risk individuals to support fire prevention. This enables the social and health related factors underlying fire risk to be addressed by the relevant partner health or social services agencies.

6. Conclusion

The fire and rescue service studied had identified that the reduction in fire incidence and fire fatalities within the region studied had started to 'flatten out'. It had also been identified that fire incidence and fire fatalities were occurring in areas that were not classified as high risk by the existing model of risk based upon the number of previous fire incidences and indices of multiple deprivation. To address these issues a more predictive approach to fire risk assessment was developed that utilized previously identified causal factors concerning population characteristics. Previous studies had indicated that fire incidence and fire fatalities were more likely amongst the elderly, the disabled, smokers and binge drinkers amongst other factors. The more predictive model of fire risk developed enabled targeting of geographical areas of higher risk associated with the known causal factors. The statistical analysis undertaken indicated that increased targeting of geographical areas with higher levels of risk based upon causal factors

relating to population characteristics could potentially assist in reducing fire incidence and fire fatalities in areas that were previously considered to be lower risk areas. In order to manage the provision of fire prevention services, the fire and rescue service studied created new risk bands equating to low, medium and high risk levels based upon the fire risk model. The classification of the fire risk bands was based upon the resources available within the fire and rescue service and the number of dwellings already visited within the region. This enabled each area within the region studied to be graded in terms of fire risk based upon the underlying causal factors associated with dwelling fires.

Further analysis of population characteristics within the region was performed via k-means cluster analysis as part of a population segmentation approach in order to attempt to identify specific social groups for further refined targeting not only for fire prevention, but also for associated health and social care interventions. This was based upon customer insight modelling as part of a partnership between the fire and rescue service studied and the local council, the local National Health Service primary care trust and the local police force. This partnership enabled enhanced advocacy and referral opportunities in order to attempt to address the underlying causal factors such as smoking, and care of the elderly and disabled (in particular those living alone) associated with dwelling fire risk.

The frequency analysis of fire incidence types across the identified community profiles enabled tailored fire prevention measures targeted to specific social groups within identified higher risk geographical areas. This enabled fire prevention to be targeted to the most at-risk social groups and also to the types of fire risk (e.g. kitchen fires) associated with such social groups.

The research reported in this paper contributes to the wider research field of public sector partnerships. The case study demonstrated that public sector partnerships can support pro-active targeting of at-risk social groups, and provide support mechanisms to assist in reducing the underlying causal factors associated with such risks. In this manner an early intervention approach can be adopted by the partnership agencies to address circumstances and behaviours that can provide a longer term reduction in more expensive future remedial actions.

It is hoped that the analysis of the transformation of fire prevention presented in this paper may be of benefit to other fire and rescue services. The limitations of the research undertaken were the availability of data at a lower level of geographical granularity, and the relatively limited time frame for study. Further research involving other fire and rescue services would be useful to further evaluate and refine the fire prevention transformation approach described in this paper. In addition, future research could investigate the benefits of multi-agency risk management for other groups of public sector partnerships.

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