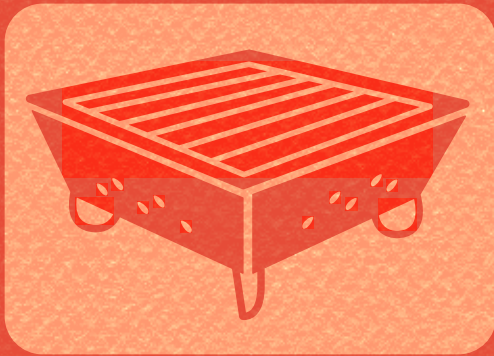


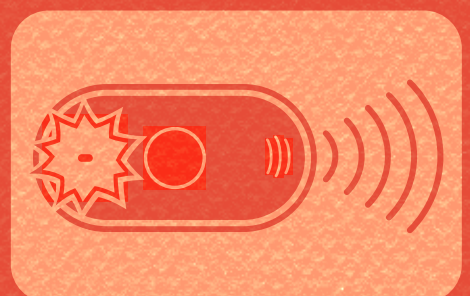
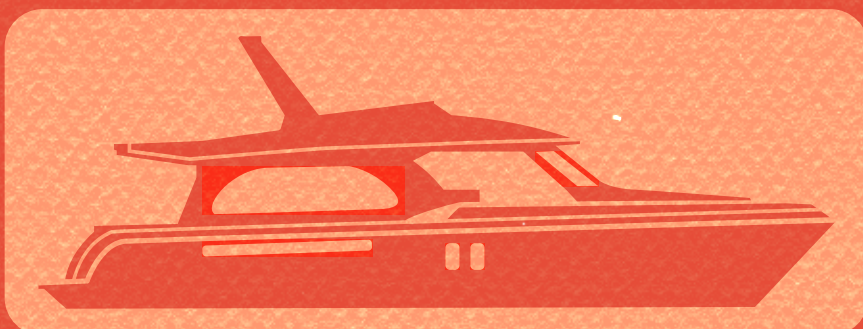
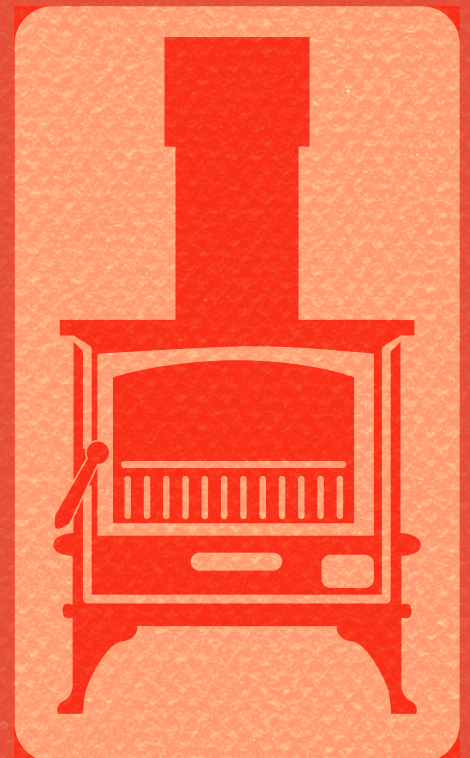
A report by the All-Party Parliamentary  
Carbon Monoxide Group



**CARBON MONOXIDE:**

# FROM AWARENESS TO ACTION

BRINGING BEHAVIOURAL INSIGHTS  
TO POISONING PREVENTION EFFORTS



**Carbon Monoxide: From Awareness to Action**  
January 2015

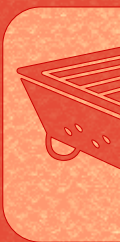
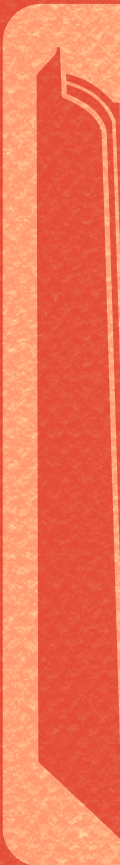
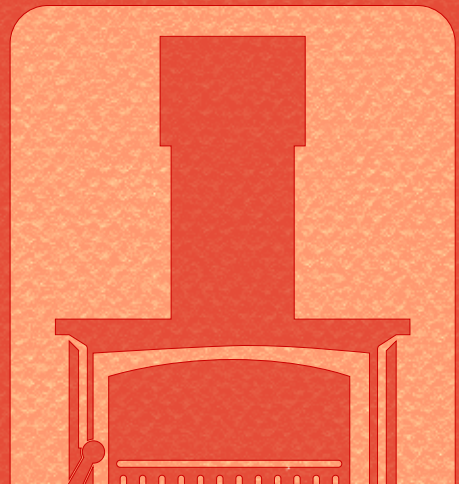
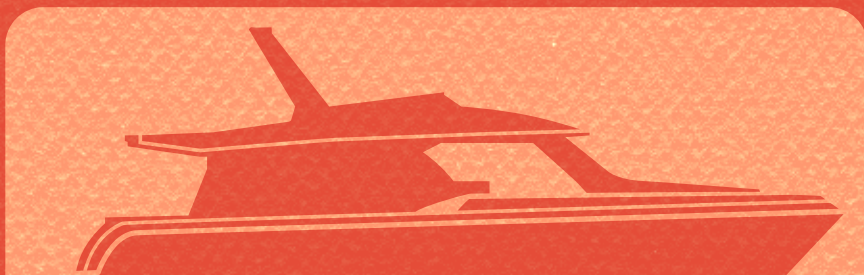
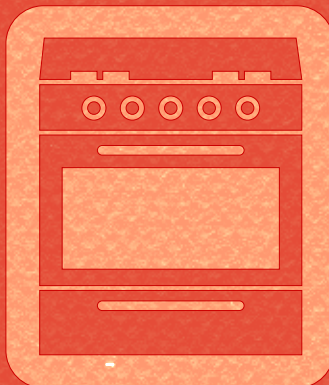
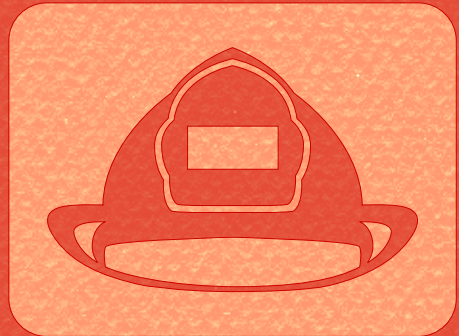
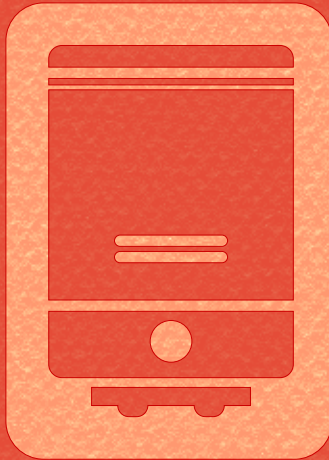
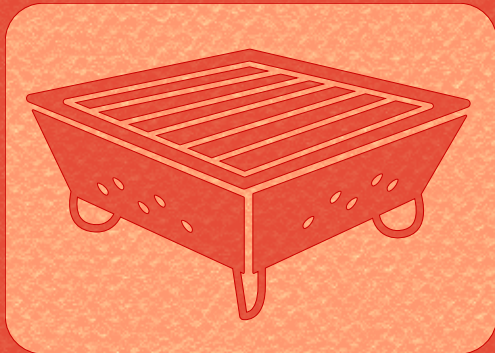
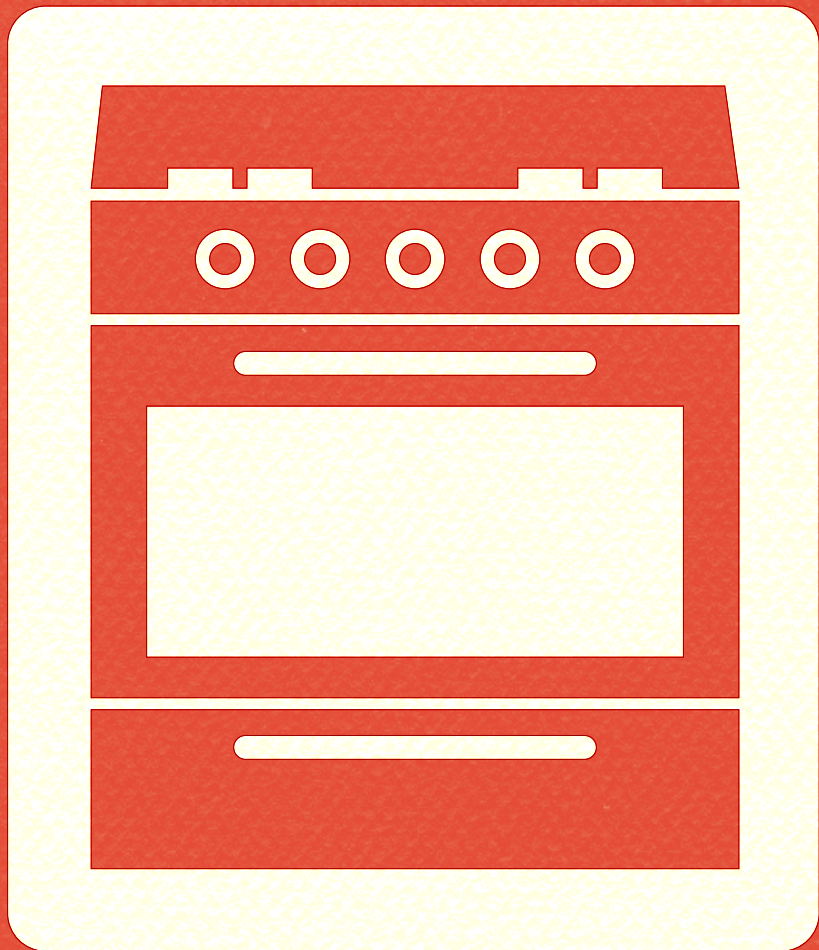
This report follows a nine month inquiry Chaired by Baroness Finlay of Llandaff (co-Chair, All-Party Parliamentary Carbon Monoxide Group; APPCOG) and Dr Rachel McCloy (University of Reading).

On behalf of the inquiry co-Chairs, the report was compiled and written by Dominic Gillan (Researcher and Project Coordinator, APPCOG) and Haley Bowcock (Manager, APPCOG). These individuals work for Policy Connect, a non-profit social enterprise that provides secretariat services to the APPCOG. The work programme of the APPCOG and its secretariat, including the production of this report, is kindly funded by the Council of Gas Detection and Environmental Monitoring, EnergyUK, The Institution of Gas Engineers and Managers, The Gas Industry Safety Group, National Grid Gas Distribution, Northern Gas Networks, SGN, UKLPG, and Wales & West Utilities.

This report is not an official publication of the House of Commons or the House of Lords. It has not been approved by either House or its committees. All-Party Groups are informal groups of Members of both Houses with a common interest in particular issues. The views expressed in this Report are those of the Group.

Contact the APPCOG secretariat at Policy Connect, CAN Mezzanine, 32-36 Loman Street, London SE1 0EH.

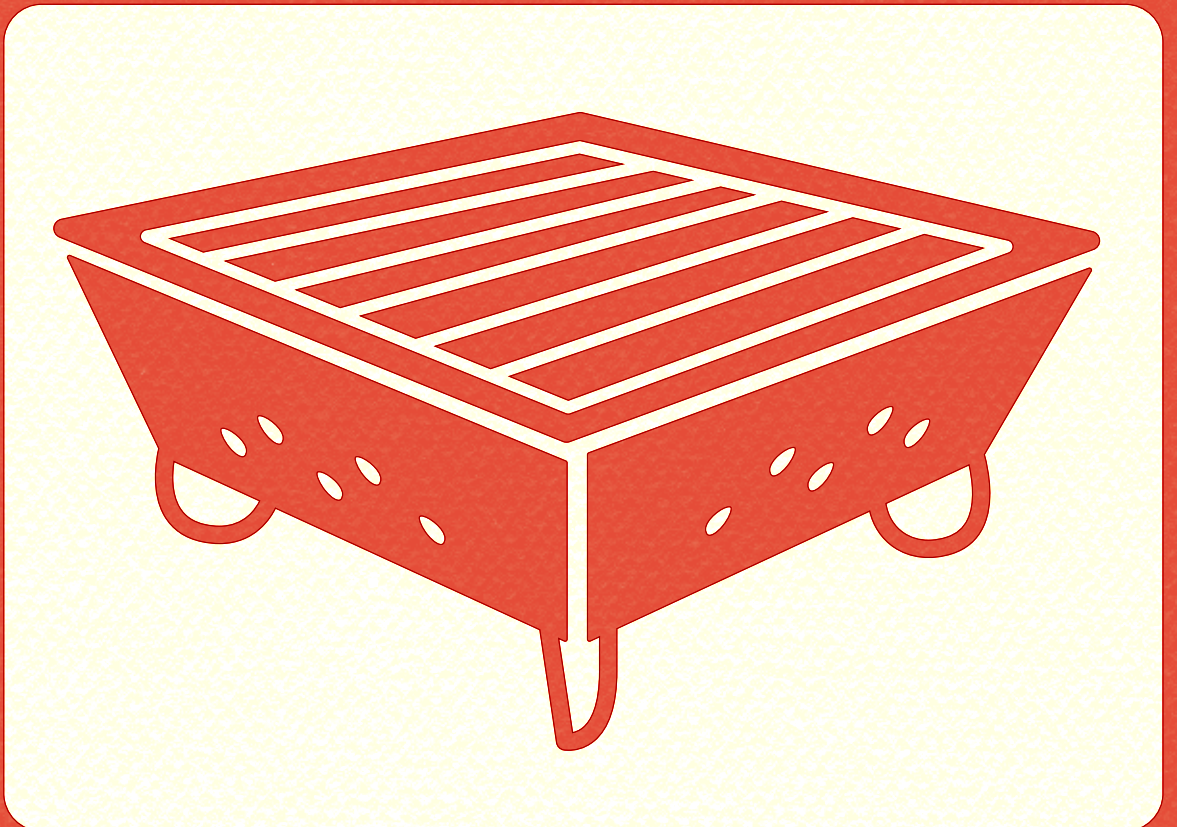
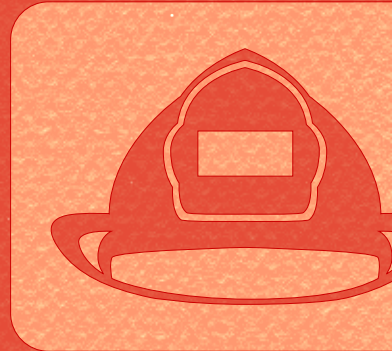
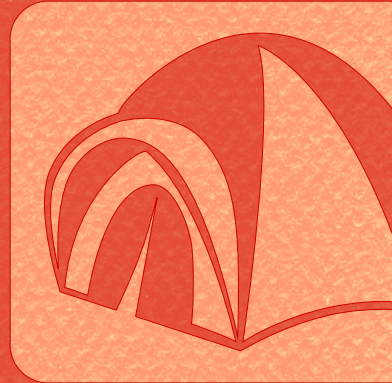
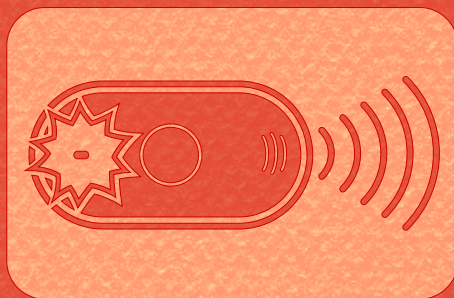
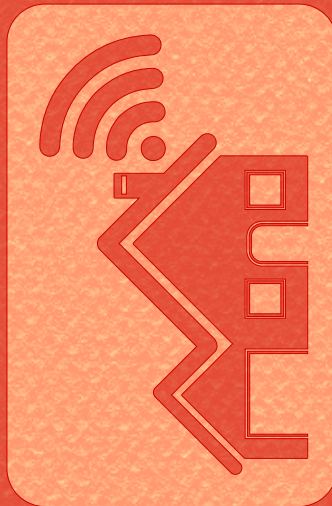
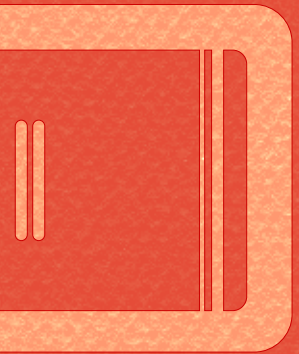
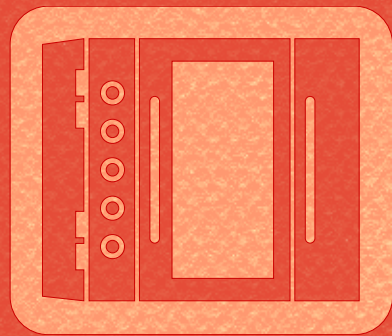
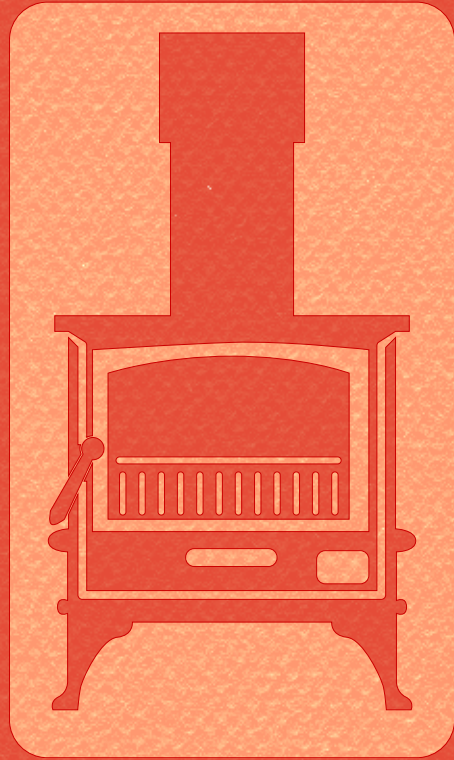
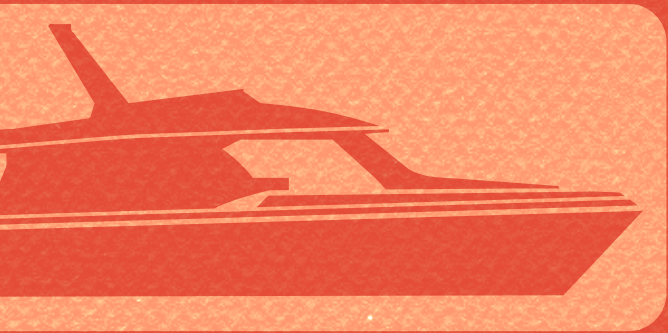
[policyconnect.org.uk/appcog](http://policyconnect.org.uk/appcog)



“Carbon monoxide has a range of sources and exposure environments.

Raising awareness in the right ways, relevant to each source and environment, is an important first step towards tackling CO poisoning.”

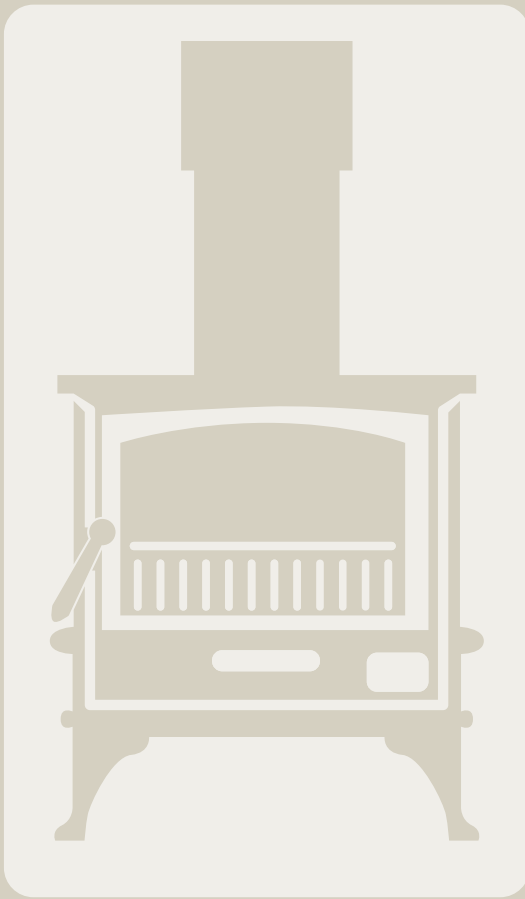
- Roland Wessling, Cranfield University



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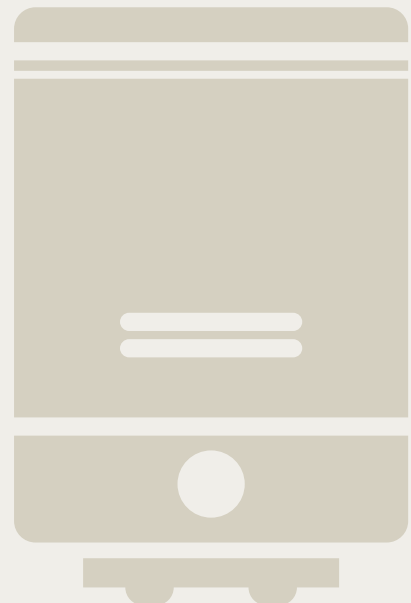
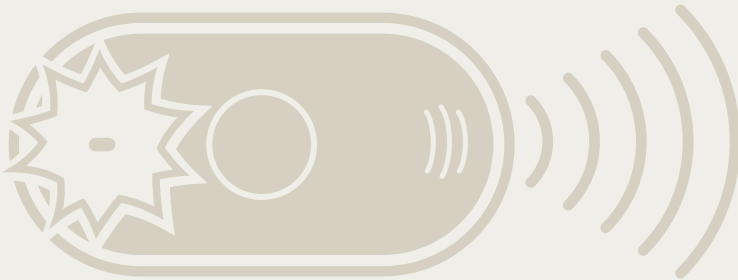
Preventing poisoning incidents through a behavioural approach will require focussed and coordinated efforts from a range of organisations, including **charities, government, public sector workers and industry bodies.**



This inquiry has identified  
three areas of focus –

**Domestic Appliances and Environments**  
**Detection and Technology**  
**Campsite and Boating Environments**

In addition to this, certain important themes and issues relevant across the sections were identified:





## **Awareness-raising matters –**

but as a starting point of a much longer process of behaviour change,

## **Data matters –**

successfully influencing behaviour requires better data than are currently at our disposal,

## **Context matters –**

successful interventions need a sophisticated understanding of people's environment, and,

## **Messengers matter –**

using trusted messengers at the right times, with the right approach, can bring results.

# Foreword

Carbon monoxide (chemical formula CO) is a colourless, odourless and poisonous gas produced by the incomplete combustion of carbon-based fuels. At high concentrations it can kill in minutes, while low concentrations can cause debilitating chronic problems that go undetected and untreated for years. The range of different sources both inside and outside the home, from appliances which burn wood, oil, gas or other fuels, means that tackling the issue as a whole is extremely difficult. By way of example, the final section of this inquiry highlights campsite and boating environments as areas of risk which may not have been considered in the past. Numerous high-profile incidents in recent years, which are covered within this report, have focussed our attention on these hitherto underexplored areas of risk.

In 2011, the All-Party Parliamentary Carbon Monoxide Group (then the All-Party Parliamentary Gas Safety Group) conducted an inquiry on ways to prevent CO poisoning, including through increased detection, better awareness and improved regulation. The 2011 report has made a real difference in many areas. For instance, a number of important research programmes into the impacts of CO and ways to improve detection have been initiated. Also, Gas Distribution Networks now require their Gas Emergency Service personnel to be equipped with personal CO alarms, which can help them to detect the presence of CO when they enter a potentially dangerous environment. And as we write, we eagerly await the outcomes of a government review into property conditions in privately rented homes, which could lead to mandatory provision of CO alarms in this sector of housing.

Importantly, collaboration has greatly improved following recommendations within that report, especially with the creation of the Carbon Monoxide All Fuels Action Forum. The Forum's work in bringing together organisations to share best practice and expertise in campaigning, data gathering and research has been highlighted at the national CO conferences organised by IGEM in 2013 and 2014 that were supported by the Forum member Gas Distribution Networks.

While this progress should be celebrated, we must never be complacent and there is still a way to go to prevent the unnecessary suffering and cost associated with CO poisoning in the UK. We are unashamedly building into new areas with this report. This inquiry, initiated in April 2014, explores new approaches to tackling CO poisoning, specifically by harnessing behavioural insights and the expertise of academics and industry behavioural professionals.

All of those organisations involved in the Forum, and others working to promote CO safety, invest a great deal of resources to prevent poisonings. At a time of squeezed public and private budgets, understanding how to deploy limited resources to the best effect is vital. This inquiry attempts to guide intervention designers to do exactly that. By applying behavioural insights, this inquiry encourages a range of new trials, studies and approaches that should be devised to improve the effectiveness of the push towards raising awareness and helping people keep themselves safe from CO, the 'silent killer'.

We hope that this inquiry leads to further and effective action by all of those involved in preventing CO poisoning. Each area, from academic research to industry safety campaigns, and government departmental action in targeting prevention, should be improved and guided by some of those behavioural insights included in this report and elsewhere. Both the requisite understanding and best methods for prevention of CO poisoning are incomplete, and require further collaboration, research and appreciation of the actual scale of this issue. This inquiry highlights where and how this could happen.

We would like to thank all of those who generously contributed to the process, through submitting written evidence and data, oral evidence in both group and individual sessions, or through ad-hoc requests. We would also like to thank the rest of the inquiry Advisory Board for their time and contributions.



A handwritten signature in blue ink that reads "Rachel McCloy".

Dr Rachel McCloy  
Inquiry co-Chair



A handwritten signature in blue ink that reads "D. Finlay".

Professor the Baroness Finlay of Llandaff  
Inquiry co-Chair

# Executive Summary

Carbon monoxide (chemical formula CO) poisoning is a serious but preventable cause of death and injury. The central objective of this All-Party Parliamentary Carbon Monoxide Group inquiry is to re-focus and improve the important efforts being made to prevent accidental CO poisoning from all fuel sources in the UK. This aim is motivated by a key concern: traditional awareness-raising approaches, although critically important, will on their own likely be insufficient to bring about the key behavioural shifts necessary to prevent CO poisoning in the short and long term. This inquiry therefore seeks to highlight and incorporate relevant insights of behavioural science, to increase the effectiveness of those working hard to prevent CO poisoning incidents.

Behavioural insights have been increasingly used by government in recent years to improve the effectiveness of campaigns to encourage better health, more efficient energy use behaviours, and various other initiatives. Principles applied with success elsewhere, such as using ‘trusted messengers’ and ‘default options’, as well as an understanding of the different stages that people go through to establish and maintain certain behaviours, can be readily applied to efforts to promote CO safety.

## Cross-cutting Lessons

Carbon monoxide gas can come from many sources and exposure can happen in numerous different environments. This means that there are myriad behaviours to consider when designing interventions to promote CO safety. Furthermore, many preventative behaviours require actions that must be repeated annually, or more frequently, to ensure safety.

In order to address these issues, this inquiry has identified three areas of focus – ‘Domestic Appliances and Environments’, ‘Detection and Technology’, and ‘Campsite and Boating Environments’. In addition to this, certain important themes and issues relevant across the sections were identified:

- Awareness-raising matters – but as a starting point of a much longer process of behaviour change,
- Data matters – successfully influencing behaviour requires better data than are currently at our disposal,
- Context matters – successful interventions need a sophisticated understanding of people’s environment, and,
- Messengers matter – using trusted messengers at the right times, and with the right approach, can bring results.

Preventing poisoning incidents through a behavioural approach will require focussed and coordinated efforts from a range of organisations, including charities, government, public sector workers and industry bodies. Departmental ownership is important to drive through and lead initiatives such as data gathering and campaigning efforts at government level, to ensure the population is kept safe.

### Recommendation 1

The Department for Communities and Local Government should second a full-time staff member to coordinate activity within the department for carbon monoxide, and to provide the Cross Government Group on Gas Safety and CO Awareness with a dedicated person to lead and promote coordination of activity and resources.

### Recommendation 2

The Cross Government Group on Gas Safety and CO Awareness should develop and adequately resource a coordinated data strategy for carbon monoxide incidents, impacts and responses, to be led by Public Health England and coordinated with current industry, academic and other efforts.

Fire & Rescue Services, due to their status as trusted messengers, and with success in other areas of their work, should be enabled to take on a more prominent role by increasing their CO safety remit. Working closely with Gas Distribution Networks and other partners, Fire & Rescue Services can use local knowledge of an area to tailor CO safety campaigns, and target those different characteristics within each area. Data collected by Fire & Rescue Services should also feed into a central hub, with consideration of technological advances and opportunities.

### Recommendation 3

Data on carbon monoxide levels and incidents should be collected and shared, with a central hub approved through Ofgem supplier conditions, building on existing purely incident-based data. To enable this, alarm and data collection standards should pre-empt the large amounts of data soon to be recorded through 'smart' homes, and a framework for pooling this with input from academia should be created. Public Health England, with a remit to cover incidents involving all fuels, should be involved in the population-level data work.

### Recommendations 4 & 5

- The Fire and Rescue Services Act 2004 should be amended to include a statutory requirement for Fire & Rescue Services to include carbon monoxide safety in their work.
- Fire & Rescue Services should nationally coordinate their data gathering and carbon monoxide prevention activities through the Chief Fire Officers Association, building on current incident-information gathering, and making it available to researchers, public health professionals and other data portals (see Recommendation 3).

Currently, various bodies, charities and groups each use slightly different branding for CO campaigning. The provision of a single icon, with a set of key messages, building on the example of 'Fire Kills', will allow ease of use and recognition by the public.

### Recommendation 6

A single, coordinated carbon monoxide campaign brand, messaging, and set of materials should be developed and made freely available for use through a national, central portal. This could be related to a government department or a relevant emergency service such as Fire & Rescue, and should be coordinated with industry and charity campaigning efforts through the Carbon Monoxide All Fuels Action Forum.

### Domestic Appliances and Environments

The range of appliances used in the domestic environment each pose unique CO risks due to the different interactions people have with them. Natural gas boilers, despite being the best-known source of CO risk, have been responsible for decreasing numbers of incidents in recent years. Other sources, including gas cookers and wood burning stoves, pose new risks which may not be as well recognised, and require extra consideration by relevant bodies.

The context of 'home' is very important when considering behaviour – targeting safety measures is difficult due to the unpredictable nature of people's behaviour in their home environment. Reflective of this insight, some social housing providers have decided to minimise CO risk by replacing gas appliances with electric. Additionally, energy behaviours are highly habitual and difficult to change. An effective method of creating and reinforcing a repeated behaviour, such as annual servicing, is by linking it to other behaviours. Associating these with a consistent servicing date, or a reminder service, could help ensure servicing is done at the correct time. Consistent servicing dates would be of particular use for the social housing sector, where access to the boiler that requires servicing is a particular challenge.

The regular servicing of properly installed appliances by a competent person will act as the best method in preventing CO production at source. All campaigning and advice given to reduce CO poisoning incidents should promote a 'belt and braces' approach of proper appliance use and servicing, along with the installation and use of BS EN 50291 Standard-compliant CO alarms as a vital back-up.

A study by Hackney Homes/ Public Health England revealed that even within a fully serviced housing stock, CO risk remained in a relatively large number of properties. A lack of similar studies has led to difficulties in national-level comparison; however the large number of alarm activations makes it clear that the provision of Standard-compliant CO alarms is an important intervention for the housing provider to make.

### Recommendation 7

Building Regulations should be amended to require social housing providers to fit and maintain Standard-compliant carbon monoxide alarms wherever a fuel burning appliance is installed, and providers should commit to replace fuel-burning appliances with lower-risk versions in certain vulnerable situations.

### Recommendation 8

The Gas Safety (Installation and Use) Regulations 1998 should be amended to introduce MOT-style (13-month validity) appliance servicing rules, allowing the same service date to be used annually.

Multiple mechanisms now exist for the energy sector to better serve vulnerable customers. Targeting fuel-poor households with CO safety measures, such as gas safety checks and CO alarms, will protect those energy customers most at risk of fuel poverty, and potentially CO poisoning. The increasing air-tightness of homes, while welcomed in the context of energy efficiency, may inadvertently cause increased risk from CO.

### Recommendation 9

Ofgem's Consumer Vulnerability Strategy should include within energy supplier Priority Services Register requirements, the provision and installation of Standard-compliant carbon monoxide alarms for vulnerable customers.

### Recommendation 10

The UK Government should introduce a boiler replacement scheme with a view to Green Deal energy efficiency measures, tied in the first instance to the energy supplier Priority Services Register to target the most dangerous appliances in the most vulnerable situations.

### Recommendation 11

The Department of Energy and Climate Change should ensure that results and recommendations emerging from research into the risks associated with increased air-tightness of homes are appropriately incorporated into Green Deal assessments and guidance.

### Detection and Technology

Carbon monoxide alarms, if compliant with the relevant Standard, provide a valuable safety back-up in environments both inside and outside the home. Changes and upgrades to alarm technology have led to longer-life alarms, and the new 2015 Standard should allow even greater flexibility and ease of use, to make them as convenient as possible.

Increasing the purchase and uptake, correct installation and maintenance of alarms are all key steps within the stages towards maintaining safe CO behaviour. Removing barriers to each of these steps, through improving availability and usability of alarms, will encourage increased CO emergency detection. Simplified instructions will also help.

### Recommendation 12

An 'Innovation Standard' for carbon monoxide alarms should be created, allowing flexibility within existing rules without compromising safety, to encourage the design of novel carbon monoxide detection applications.

Alarm provision needs to be combined with education on the purpose and importance of the equipment, and in some cases, installation. Free giveaways of alarms have led to some remaining unused, ignored or unfitted.

### Recommendation 13

Providers of 'Home Care Plans' of annual heating system servicing and maintenance, should include carbon monoxide alarms as a 'default' option within each package.

### Recommendation 14

Carbon monoxide alarm manufacturers, in line with an updated alarm Standard, should simplify alarm installation instructions, and include cartoons and single-page checklists for easier interpretation of fitting.

Improvements in detection technologies also provide two other key areas of opportunity to promote CO safety; connected alarm and home appliance systems, and increasing data-recording which could contribute valuable information for CO safety-related work (see Recommendation 3).

Medical and healthcare professionals have a vital role to play in the detection, diagnosis and treatment of CO poisoning incidents, as well as the prevention of further incidents. At the same time, the difficulty of diagnosing CO poisoning is well recognised, as is the recognition that official mortality and morbidity statistics underestimate the number of people affected by CO poisoning.

### Recommendation 15

Public Health England and the Department of Health should review the effectiveness of existing tools used by medical and healthcare professionals for approaching carbon monoxide issues with specific groups, such as algorithms for midwives, with a view to identifying and developing further examples.



### Campsite and Boating Environments

The environments outside of the home in which CO poisoning incidents occur, such as campsite and boating environments, need to be addressed separately from the home context. Campaigning to improve CO awareness and safety in these environments can be a real challenge, especially as the consumer may be in such an environment only for a short time. They may also bring with them a 'holiday mind-set' that entails different attitudes to risk than when in the home environment.

Multiple high profile fatal incidents in recent years have highlighted the danger of disposable and other portable barbecues and camping stoves being used or kept inside tents. Clearer risk information, segregated cooking areas and the provision of alarms are all safeguards for campsite CO safety. Ensuring suitable alarms are readily available and clarifying the recommended action following alarm activations are all important actions, especially with increasing advisory messages to carry CO alarms on holiday.

#### Recommendation 16

All campsites should provide isolated, clearly marked areas for barbecue use and disposal.

#### Recommendation 17

All recreation parks should offer suitable carbon monoxide alarms to purchase, or loan for the duration of stay. These could include those developed through a new, 'Innovation Standard' to ensure optimal performance in these environments.

#### Recommendation 18

Carbon monoxide alarms should display clear 'next steps' following an alarm activation, either on a fold-away area or on the external casing, including moving to a ventilated area and calling a relevant emergency service. These instructions should differ for 'outdoor environment' alarms designed through a new, 'Innovation Standard'.

Large, temporary accommodation areas such as those at festivals contain many different locations of CO risk, including tents, caravans, catering vans and so on. A single warning symbol or icon (see Recommendation 6) would be a valuable trigger in people's minds to improve safety in these environments, to unify and simplify warnings around recognition of the symptoms of CO poisoning.

#### Recommendation 19

Public Health England should commission and support a study of low-level carbon monoxide exposure in leisure and recreation environments, similar to those undertaken in homes by Liverpool John Moores University.

**Recommendation 20**

Festival organisers should ensure that staff receive carbon monoxide promotional material and information during training, to enable them to act as trusted 'safety ambassadors' internal to the festival population and create a multiplier effect of safety awareness. Ambulance and medical staff at each festival should be a part of this process.

Boats, used for either leisure or professional activity can provide a high-risk environment for CO poisoning. Engines and/or cooking and heating equipment often produce the gas in close proximity to confined habitable quarters. Boat users may not be responsible for the maintenance regime of fuel-burning appliances on board, and may be using the boat only temporarily or for leisure purposes. Detection therefore becomes increasingly important as a line of defence against CO poisoning.

**Recommendation 21**

The Maritime and Coastguard Agency, in line with the 2014 *'Eshcol'* Marine Accident Investigation Branch Report, should include in the Code of Practice for the Safety of Small Fishing Vessels a requirement for a Standard-compliant carbon monoxide alarm to be fitted in the accommodation on all vessels. Similar requirements should be carried over to vessels used on inland waterways, including those for hire and other purposes, regardless of the fuel type used on board.

# Methodology and Steering Group

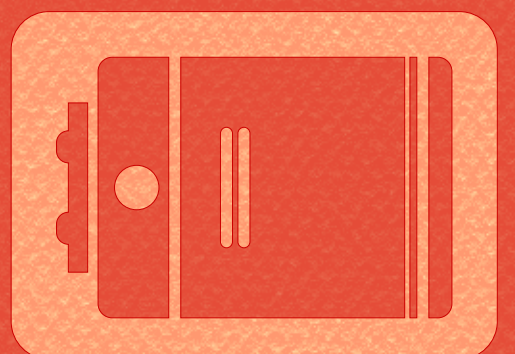
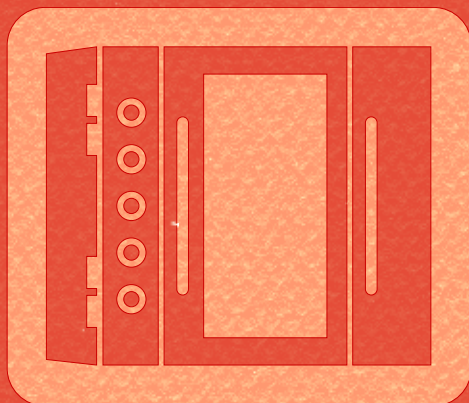
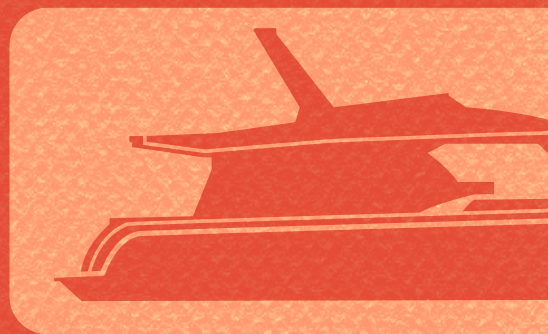
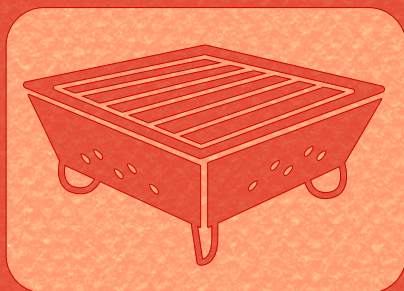
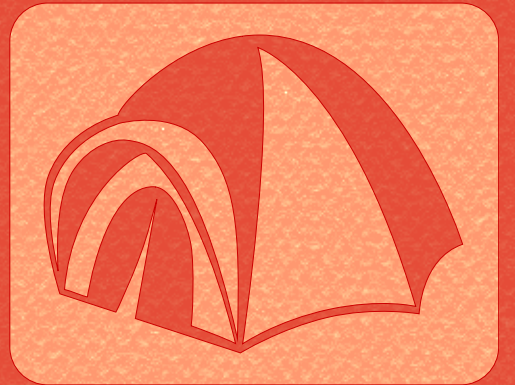
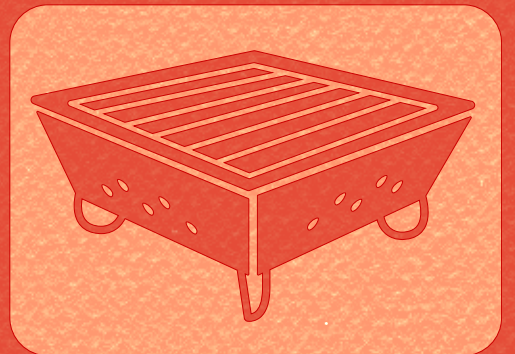
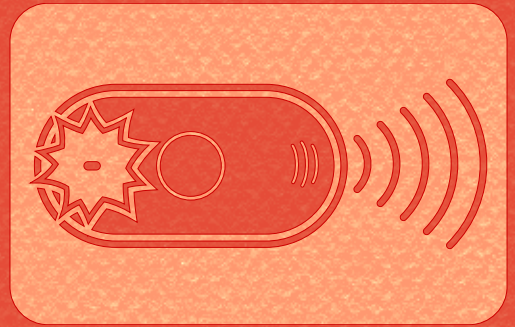
The All-Party Parliamentary Carbon Monoxide Group (APPCOG) launched this inquiry in April 2014. A call for written evidence followed in May to highlight key areas of focus. More than 30 submissions were received from industry bodies, government agencies, Fire & Rescue Services, charity groups and others.<sup>1</sup> Three areas emerged for further investigation: (1) ‘domestic appliances and environments’, (2) ‘detection and technology’, and (3) ‘campsite and boating environments’. These were explored through literature review, and individual and group evidence sessions. This included a focus group discussion with a cohort of elderly people in Knowsley, to provide householder insights from a group generally seen as more vulnerable to CO poisoning and its related factors<sup>2</sup>.

An advisory board of parliamentarians, behavioural and other scientists, industry and campaigning specialists, and those personally affected by CO poisoning steered the inquiry:

- **Professor the Baroness Finlay of Llandaff**, Parliamentary co-Chair of the inquiry, is an Independent Crossbench member of the House of Lords, an internationally renowned expert in palliative medicine, and a co-Chair of the APPCOG.
- **Dr Rachel McCloy**, academic co-Chair of the inquiry, is Director of the Centre for Applied Behavioural Science, and Associate Professor in Applied Behavioural Science, School of Psychology & Clinical Language Sciences at the University of Reading.
- **Barry Sheerman** is the Member of Parliament for Huddersfield, and a co-Chair of the APPCOG.
- **David Palferman** is Senior Psychologist at the UK Health and Safety Executive (HSE) Economic & Social Analysis Unit.
- **Dr Mary Benwell**, a behavioural scientist, is an independent Trustee of the Gas Safety Trust and former Professor and Director of the Business School, Oxford Brookes University.
- **Roland Wessling** is a Research Fellow in Forensic Archaeology & Anthropology at Cranfield University, and Project Director of a study into the impacts of CO on the UK population.
- **Scott Darroch** is Head of Communications at the Gas Safe Register, the UK’s official gas registration body.
- **Professor Stephen Sutton** is Professor of Behavioural Science and Director of the Behavioural Science Group in the Institute of Public Health, University of Cambridge.
- **Steve Miller** is Chair of the Carbon Monoxide All Fuels Action Forum, a Chartered Environmental Health Practitioner and a Fellow and Trustee of The Chartered Institute of Environmental Health.

1 See page 90 for a full list of those who contributed written and oral evidence to the inquiry.

2 For details of the focus group session, see Appendix 2.



# Introduction and Background

“Accidental (and therefore preventable) carbon monoxide poisoning still result in recorded cases of around 40 deaths and 200 hospitalisations each year in England & Wales. Recent figures from the Department of Health indicate that there are 4,000 attendances at accident and emergency departments for treatment for CO poisoning each year in England. Whilst a considerable number of people die from accidental acute CO poisoning, it is now confirmed many more are injured by sub-lethal exposure. It is likely that the true number exposed in this way is even greater than reported.”<sup>3</sup>

Carbon monoxide (chemical formula CO) poisoning is a serious but preventable cause of death and injury. In addition to the human tragedy and suffering caused by fatalities and injuries, a crude calculation in the previous inquiry report by the All-Party Parliamentary Carbon Monoxide Group (APPCOG) suggests that CO poisoning could be costing the country as much as £178m each year, an estimate that still holds based on official statistics.<sup>4</sup> The APPCOG is committed to tackling this issue and addressing the potential for accidental CO poisoning from all fuel sources.<sup>5</sup> To achieve this wide scope it works closely with the CO All Fuels Action Forum,<sup>6</sup> members of which have made vital contributions to this inquiry.

Carbon monoxide (CO) gas is produced when fuels such as gas, oil, coal or wood do not burn with sufficient oxygen. In enclosed spaces, it can quickly build up to levels dangerous to humans.

After breathing in CO, it enters your bloodstream and mixes with haemoglobin (the part of red blood cells that carry oxygen around your body). When this happens, the blood is no longer able to carry oxygen, and this lack of oxygen causes the body's cells and tissue to die.

The symptoms of exposure to low levels of CO can be similar to those of many other conditions, such as food poisoning and flu. The most common symptoms include: headache, nausea and vomiting, dizziness, tiredness and confusion, stomach pain and shortness of breath and difficulty breathing.

Source: NHS Choices ‘carbon monoxide poisoning’

<sup>3</sup> Joint letter on CO from the Chief Medical Officer, Chief Nursing Officer and Director of Nursing at the Department of Health and Public Health England (November 2013). Available at: [www.gov.uk/government/publications/carbon-monoxide-poisoning](http://www.gov.uk/government/publications/carbon-monoxide-poisoning).

<sup>4</sup> All-Party Parliamentary Gas Safety Group (November 2011) ‘Preventing Carbon Monoxide Poisoning’, available from: [www.policyconnect.org.uk/appcog/research/report-preventing-carbon-monoxide-poisoning](http://www.policyconnect.org.uk/appcog/research/report-preventing-carbon-monoxide-poisoning).

<sup>5</sup> This is reflected by the re-launch as the All-Party Parliamentary Carbon Monoxide Group on 15th October 2012, prior to which it was known as the All-Party Parliamentary Gas Safety Group.

<sup>6</sup> See: [www.policyconnect.org.uk/allfuelsforum](http://www.policyconnect.org.uk/allfuelsforum).

## A New Approach to Preventing Carbon Monoxide Poisoning

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The central objective of this inquiry is to re-focus and improve the important efforts being made to prevent CO poisoning in the UK. In particular, it seeks to highlight and incorporate relevant insights of behavioural science. This aim is motivated by a key concern: traditional awareness-raising approaches, although critically important, are unlikely on their own to be sufficient to bring about the key behavioural shifts necessary to prevent CO poisoning in the short and long term.

*“Although it is recognised that increased awareness does not inevitably lead to action, it is an essential precursor to the possibility of action...Future awareness-raising work must be refined and developed to ensure that it has the best chance of changing people’s behaviour and that it is important to find ways of measuring the extent of behaviour change.”<sup>7</sup>*

Many of the policy areas in which behavioural insights have been applied, such as smoking cessation, diet improvement or medication adherence, are examples of behaviour where the benefits of change are well-known (for example stopping smoking or eating more healthily), and relatively simple steps can yield impressive results.<sup>8</sup> Comparatively, it is likely that once people are aware of CO risks, the benefits of relevant CO-safe behaviours will also be generally well known;<sup>9</sup> however a variety of factors have prevented policy in this area having similar successes. Interventions that are guided by targeting people’s underlying motivations are required, to promote CO safety.<sup>10</sup>

This inquiry brings together some of the key principles of behavioural science, as supplied by academics, government bodies and other organisations. It further provides an extensive base of evidence, gathered from related industries and organisations, to support the adoption and adaptation of these principles to effectively address CO poisoning.

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7 The Royal Society for the Prevention of Accidents, written evidence (May 2014).

8 For examples of use across Government, see: House of Lords Science and Technology Committee investigation (2010-2011) and follow-up (2014) into Behaviour Change. Available at: [www.parliament.uk/business/committees/committees-a-z/lords-select/science-and-technology-committee/](http://www.parliament.uk/business/committees/committees-a-z/lords-select/science-and-technology-committee/).

9 For example, if surveyed, people are likely to respond positively to the question ‘should you get your appliances regularly serviced by a qualified engineer to keep them working safely?’ Dr Lou Atkins, UCL, oral evidence (November 2014).

10 For relevant examples of smoking cessation and other health programmes, see Cabinet Office (December 2010) ‘Applying Behavioural Insight to Health’, available at: [www.gov.uk/government/publications/applying-behavioural-insight-to-health-behavioural-insights-team-paper](http://www.gov.uk/government/publications/applying-behavioural-insight-to-health-behavioural-insights-team-paper).

## Behavioural Theories, Models and Frameworks

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A range of academic literature is available that discusses and assesses the effectiveness of different behavioural theories, models and frameworks.<sup>11</sup> Findings from theories, models and frameworks with the most relevance to CO poisoning are discussed here, and this inquiry encourages research, trials and further analysis be undertaken by government, industry and academics, to identify and implement the most effective routes forward.

### A Stage Theory - the Precaution Adoption Process Model

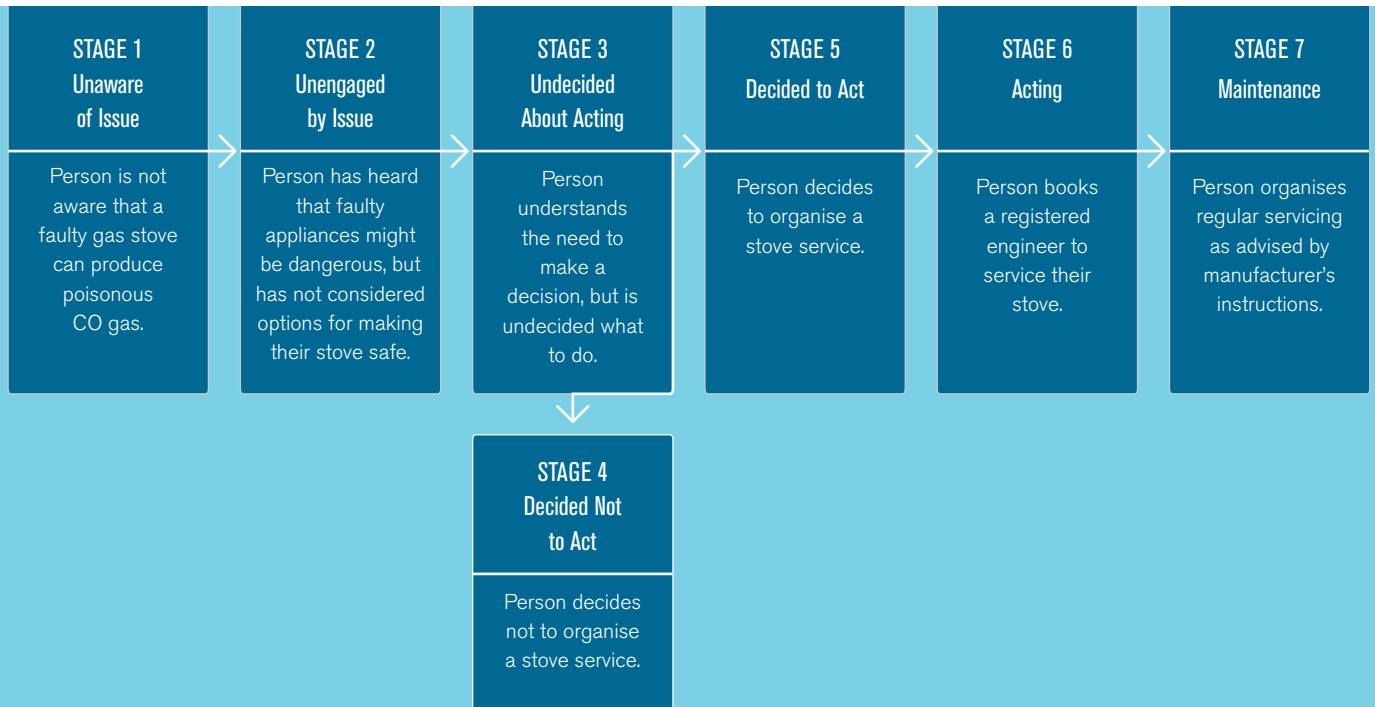
'Stage theories' such as the Precaution Adoption Process Model (PAPM) provide some of the most useful perspectives for examining the full behavioural process necessary for preventing CO poisoning. The PAPM has an advantage over other theories in this context as it does not take for granted an awareness of the health risk posed by CO. This is important as there is a notable lack of awareness amongst the population of this risk.<sup>12</sup> The model provides a way of segmenting the population with respect to a particular issue/behaviour, shows how progress towards behaviour change may be hindered by different barriers at different stages, and suggests ways of overcoming the barriers, starting with information campaigns to move people out of Stage 1 ('Unaware of Issue'). The stages formulated through the PAPM, with a specific example of an illustrative CO-safety related behaviour, are shown in figure 1.

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11 For example, see Michie S., West R. et al. (2014) 'ABC of Behaviour Change Theories', Silverback Publishing, Great Britain.

12 Lack of awareness was frequently highlighted in evidence gathering, and through a May 2014 poll commissioned by the Gas Safety Trust. It found that only 13 per cent of those questioned were able to identify the main symptoms and characteristics of CO poisoning (see [www.gassafetytrust.org/news-and-press/2014/a-new-gst-poll-finds-shockingly-low-understanding-of-the-symptoms](http://www.gassafetytrust.org/news-and-press/2014/a-new-gst-poll-finds-shockingly-low-understanding-of-the-symptoms)).

Figure 1: Stages of the Precaution Adoption Process Model



The PAPM authors<sup>13</sup> recommend defining “stages in terms of concrete behaviours”, for example ‘wearing a hat’, rather than “in terms of broad health goals”, such as ‘protecting oneself from the sun’. This inquiry therefore identifies key individual actions which can be encouraged to advance people towards the safety benefits of Stages 6 and 7. Examples of the factors that influence the movement between stages are listed in figure 2; they map closely onto the oral and written evidence received by this inquiry and are explored later in this report.

13 Weinstein, N., Sandman, P., and Blalock, S. (2008) The precaution adoption process model. In Glanz, K., Rimer, B., and Viswanath, K. (Eds), ‘Health Behavior and Health Education’, 4th ed., Jossey-Bass, San Francisco, 123-148.



**Figure 2: Factors in PAPM Stage Progression**

Stage Transition	Factor
Stage 1 to Stage 2	Media messages about the hazard and precaution
Stage 2 to Stage 3	Media messages about the hazard and precaution Communications from significant others Personal experiences from hazard
Stage 3 to Stage 4 or Stage 5	Beliefs about hazard likelihood and severity Beliefs about personal susceptibility Beliefs about precaution effectiveness and difficulty Behaviours and recommendations of others Perceived social norms Fear and worry
Stage 5 to Stage 6	Time, effort and resources needed to act Detailed 'how-to' information Reminders and other cues to action Assistance in carrying out action

### Behavioural Frameworks

This inquiry encourages CO safety by working through three broad stages: awareness creation, behaviour alteration and behaviour maintenance. It also explores ways of removing behaviour from the creation of risk entirely.<sup>14</sup> In order to determine concrete actions relating to these stages and their corresponding factors it is useful to supplement the PAPM approach with principles from various other frameworks designed by behavioural change experts. A few prominent examples are highlighted below (along with a further example in Appendix 1; 'the Behaviour Change Wheel'). As behavioural insights offer a new approach to tackling CO poisoning, and "[t]here exists a plethora of frameworks for classifying behaviour change interventions",<sup>15</sup> no one approach should be considered definitive.

14 For example, the replacement of gas appliances with electric ones by social housing providers, as detailed in the Hackney Homes case study on page 43.

15 Michie S., van Stralen M., and West R. (2011) *The Behaviour Change Wheel: A new method for characterising and designing behaviour change interventions*. 'Implementation Science', 6, 42.

## MINDSPACE

MINDSPACE<sup>16</sup>, published by the Institute for Government, sets out nine key influences on behaviour. These are helpfully captured in a simple mnemonic – ‘MINDSPACE’ – which can be used as a quick checklist when making policy. By keeping these influences in mind, campaigns and policy can be improved and made more effective. Examples of how this has been done in practice can be found throughout the MINDSPACE report.

### MINDSPACE is a checklist of influences on our behaviour for use when making policy

Messenger	we are heavily influenced by who communicates information
Incentives	our responses to incentives are shaped by predictable mental shortcuts such as strongly avoided losses
Norms	we are strongly influenced by what others do
Defaults	we ‘go with the flow’ of pre-set options
Salience	our attention is drawn to what is novel and seems relevant to us
Priming	our acts are often influenced by sub-conscious cues
Affect	our emotional associations can powerfully shape our actions
Commitments	we seek to be consistent with our public promises, and reciprocate acts
Priming	our acts are often influenced by sub-conscious cues
Ego	we act in ways that make us feel better about ourselves

16 See: [www.instituteforgovernment.org.uk/publications/mindspace](http://www.instituteforgovernment.org.uk/publications/mindspace).

## The EAST framework

The EAST framework<sup>17</sup> was developed by the Behavioural Insights Team. It complements the existing MINDSPACE report by focusing on the practical application of behavioural insights. Four key principles are set out for improving the effectiveness of policy: ‘make it Easy, Attractive, Social and Timely’. Again, these are captured in a helpful mnemonic: ‘EAST’.

<b>E</b> Make it Easy	Harness the power of defaults Reduce the ‘hassle factor’ of taking up a service Simplify messages
<b>A</b> Make it Attractive	Attract attention Design rewards and sanctions for maximum effect
<b>S</b> Make it Social	Show that most people perform the desired behaviour Use the power of networks Encourage people to make a commitment to others
<b>T</b> Make it Timely	Prompt people when they are likely to be most receptive Consider the immediate costs and benefits Help people plan their response to events

Similar themes and principles arise from the examples covered, and this inquiry makes reference to each of them, depending on the suitability of such principles to the range of behaviours, triggers and messages identified.

17 See: [www.behaviouralinsights.co.uk/publications/east-four-simple-ways-apply-behavioural-insights](http://www.behaviouralinsights.co.uk/publications/east-four-simple-ways-apply-behavioural-insights).

# Inquiry findings

There are problems inherent to tackling CO poisoning: a wide range of sources; incident locations are varied; preventative measures often require repetition; and it is difficult to record and gather data.

In order to address these issues, this inquiry has identified three areas of focus that will be addressed in following sections of the report:

- ‘Domestic Appliances and Environments’
- ‘Detection and Technology’
- ‘Campsite and Boating Environments’

In addition to this, there are certain important themes and issues relevant across the sections.

# Cross-cutting Lessons and Recommendations

## Setting the Scene: How Behavioural Insights Can Improve Safety

There are successful examples of the use of behavioural frameworks by policymakers, academics and others.<sup>18</sup> Despite this, they have had limited uptake in areas relevant to CO safety,<sup>19</sup> although the Gas Safe Register successfully took on the focus in 2013 with their pilot project, as detailed in the ‘Domestic Appliances and Environments’ section.

Humberside Fire & Rescue has also undertaken an improved safety campaign based on behavioural insights. Their work provides useful lessons for CO poisoning prevention efforts, and highlights a number of the cross-cutting lessons from this inquiry, particularly related to trusted messengers (see Case Study on pages 30-31).

## What Matters: Awareness, Data, Context and Messengers

Certain important themes and issues that have relevance across this inquiry’s areas of focus are listed below.

### Awareness-raising matters – but as a starting point of a much longer process

Multiple instruments in addition to awareness-raising (regulation, product innovations, etc.) and deployed over the long term will be necessary to encourage certain behaviours and discourage others.

High-profile incidents create a time-limited increased level of alarm and increase in the salience of safety messages among the population, as long as suggested actions are easy to understand and act on. Fictional high-profile CO incidents, such as the one depicted in *Coronation Street* in 2012,<sup>20</sup> have similar effects; however sustained behaviour change is unlikely to be achieved through these single events.

*“In terms of campaigning, what doesn’t work is telling people what to do. Instead, make it easy and attractive for them; make them ask ‘what’s in it for me?’”*

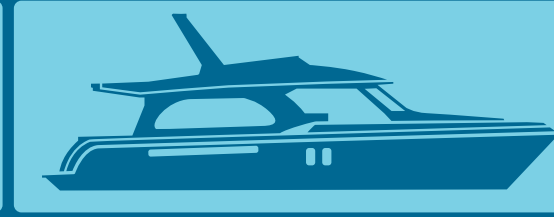
*“Raising awareness is not an end in itself ... Making the abstract issue as salient as possible will be beneficial, and address the mind-set of ‘I know I should act but it’s not relevant to me.’”*

– Dr Lou Atkins, UCL

18 The inquiry process took evidence and knowledge from a range of publications and behavioural scientists, who are listed in the ‘Contributors to the Inquiry’ section. For examples of applied use within publications, see Demos/Green Alliance (2003) ‘Carrots, Sticks and Sermons: influencing public behaviour for environmental goals’; NEF (2005) ‘Behavioural Economics: Seven Principles for Policy Makers’; HSE (2009) ‘Behavioural Economics: A review of the literature and proposals for further research in the context of workplace health and safety’; Green Alliance (2011) ‘Bringing it Home: using behavioural insights to make green living policy work’; and publications by the Behavioural Insights Team on health, energy use, charitable giving and other areas (available at [www.behaviouralinsights.co.uk](http://www.behaviouralinsights.co.uk)).

19 For example, see: University of Warwick/Gas Safety Trust (December 2011) ‘Effectiveness of Campaigns on CO Awareness Among Students in Private Rented Accommodation’.

20 See Gas Safe Register: [www.gassaferegister.co.uk/news/gas\\_safe\\_register\\_news/gas\\_safe\\_works\\_with\\_corrie.aspx](http://www.gassaferegister.co.uk/news/gas_safe_register_news/gas_safe_works_with_corrie.aspx).



## CASE STUDY

### HUMBERSIDE FIRE & RESCUE SERVICE

#### 'CHANGING BEHAVIOURS TO SAVE LIVES' PROGRAMME

Against a backdrop of shrinking resources and a long-run downturn in the number of fire-related deaths, the Humberside Fire & Rescue Service launched the programme 'Changing Behaviours to Save Lives'. Using insights from behavioural science, the programme focusses the Service's resources on assisting hard-to-reach high risk groups.

By combining the market intelligence tool 'Mosaic' with incident data, the Service was able to develop an in-depth understanding of the demographics, lifestyles, preferences and behaviours of the most at risk groups. Smoking and cooking behaviours, particularly in older, single men were identified as particularly important, and with such examples the service could develop suitable targeting methods. Advocates can use these insights to target 'who' to approach and 'how' to do it.

The impact of visits is measured through point-of-engagement information fed in to a 'Community Fire Risk Management Information System', allowing advocates to record particular resulting changes in behaviour. This is of particular value given the long term nature of changing habitual but risky behaviours.

As a result of the progress in Humberside Fire & Rescue Service's programme, other Services, such as Cheshire Fire & Rescue, are looking at taking similar approaches, and an increased focus on vulnerability is being developed with partners in public health and social care.

Relevant lessons have already emerged from this ongoing programme:

First, as far as home safety is concerned, approaches must be situation-sensitive; a blanket approach to safety awareness may, for instance, be required before a more nuanced approach targeting specific at-risk groups or situations can be implemented. In the context of shrinking budgets, investing in correctly targeted interventions is essential.

Second, although preventative technologies perform a vital role in risk prevention, behavioural patterns are paramount. It is therefore crucial to supplement a well targeted safety initiative with a competent understanding of the motivations and influences of the targeted group. This will require a significant data collection exercise. A useful basis is available in the initiatives being undertaken by the Gas Distribution Networks to better understand and protect those groups most vulnerable to CO poisoning.<sup>21</sup>

Third, carbon monoxide risk is spread around demographics and appears ‘indiscriminate’ to an extent that other types of hazard may not be.<sup>22</sup> As such, focussed efforts such as that undertaken by Humberside Fire & Rescue Service may be effective for one area of preventing CO poisoning (such as gas appliance servicing), but will not provide a one-size-fits-all preventative measure. Different approaches are required for different audiences and different exposure environments.

*“I joined the [smoke and CO alarm] industry in 1995, and the main type of fire in the home was chip pan, followed by electrical... it was easier to target and educate people about fire, than it is CO. That is a difference – we can’t say that this person is going to be more vulnerable to CO than that person based on income and the size of the house, and things like that. It just exposes how much more complicated the matter of CO is.”*

– Zoe Forman<sup>23</sup>

Finally, the programme shows that changing behaviours requires a long and adaptable viewpoint. Although behaviour change is the method defended here, the programme highlights instances where adaptation equipment – changing the ‘default’ – may be useful. For instance, the provision of fire retardant blankets may be necessitated when efforts to stop behaviours such as smoking cigarettes in bed are ineffective. As will be explored later, some social housing providers have taken this message on with regard to the CO risk from gas appliances in their housing stock.

21 Written evidence; National Grid, Northern Gas Networks, SGN and Wales & West Utilities (May 2014).

22 Zoe Forman, PR consultant to CoGDEM, oral evidence (September 2014).

23 Ibid., 22.

### **Data matters – successfully influencing behaviour requires better data than are currently at our disposal**

Intervention designers require rich and complete data in order to successfully target at risk groups and address dangerous behaviour. The lack of complete nationwide datasets and the numerous different sources and settings of CO poisoning makes this a challenging task. The potential data gathering implications of new technologies (such as smart meters and ‘connected homes’, explored later) are promising, but their reach and associated data protection concerns are important considerations.

### **Context matters – successful interventions need a sophisticated understanding of people’s environment**

People use carbon-based fuels in a number of different contexts, which have a variety of meanings and associations. For instance, a purely practical analysis of the energy use required for heating the home fails to register how appliances are habitually used to create a specific environment: one of comfort and homeliness.<sup>24</sup> Also, households often have multiple devices and fuel types that they use to heat and cook; successful interventions related to energy use require a sophisticated understanding of the environment.<sup>25</sup> Additionally, attitudes to risk are likely to vary across different environments, particularly in leisure or boating contexts where interaction with appliances may be only temporary.

### **Messengers matter – using trusted messengers at the right times, and with the right approach, can bring results**

Given the complexity of meanings and behaviours related to energy use, successful interventions should exploit key, salient moments where people may be particularly receptive to safety messages, and use trusted messengers to do so. This could include tailored advice (and potentially detection devices) given by midwives during pregnancy, when an engineer or fire and rescue personnel are visiting a home, or by volunteer teams that interact with festival-goers. Care should be taken when delivering messages to avoid stereotyping and alienating particular demographic groups (e.g. older people<sup>26</sup>), and to avoid contradictory or overloaded messaging.

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24 Devine-Wright, P. et al., forthcoming, *Low carbon heating and older adults: comfort, cosiness and glow*. In 'Building Research & Information'.

25 Wrapson, W. and Devine-Wright, P., (2014) "Domesticating" low carbon thermal technologies: Diversity, multiplicity and variability in older person, off grid households. *'Energy Policy'*, 67, 807-17.

26 For example, see Day, R. and Hitchings, R., (2009) 'Older People and Their Winter Warmth Behaviours: Understanding the Contextual Dynamics.' A report for the Nuffield Foundation.



## Securing Issue Ownership at Government Level

*“Gas safety and more broadly CO awareness is a truly cross government issue with the majority of Government departments, the devolved administrations and other governmental bodies having an interest from their particular perspective.”<sup>27</sup>*

The Cross Government Group on Gas Safety and CO Awareness takes a ‘network’ approach to promoting government action addressing CO risk. It consists of a range of government departments and agencies that meet quarterly, and has brought together their relevant work into annual reports since 2009.

Whilst this network approach allows a useful overview of the various strands of work being undertaken across government, it also reflects the problem that no one government department ‘owns’ the issue of CO safety in its totality, in the same way as, for instance, fire safety. Departmental ownership is important to drive through and lead initiatives such as data gathering and campaigning efforts at national, government level. As such, this inquiry found that the Department for Communities and Local Government should take a more prominent role in promoting CO safety at both acute and low-levels, and lead coordination on the issue with other government departments.

### Recommendation 1

The Department for Communities and Local Government should second a full-time staff member to coordinate activity within the department for carbon monoxide, and to provide the Cross Government Group on Gas Safety and CO Awareness with a dedicated person to lead and promote coordination of activity and resources.

The need for increased awareness and coordinated campaigning, supported by government and better data gathering, arose consistently throughout the inquiry. A key task of the ‘Cross Government Group’ should be to develop and adequately resource a coordinated data strategy for CO incidents, impacts and responses. This work – properly resourced – could be led by Public Health England, building on work already done by the agency to develop an environmental public health tracking system for CO, and coordinated with industry, academic and other efforts to more systematically capture and make available relevant CO data, research and resources.<sup>28</sup>

### Recommendation 2

The Cross Government Group on Gas Safety and CO Awareness should develop and adequately resource a coordinated data strategy for carbon monoxide incidents, impacts and responses, to be led by Public Health England and coordinated with current industry, academic and other efforts.

27 Cross Government Group on Gas Safety and Carbon Monoxide (CO) Awareness (November 2014) ‘Annual Report 2013/14’, available at: [www.hse.gov.uk/gas/domestic/cross-government-group-1314.pdf](http://www.hse.gov.uk/gas/domestic/cross-government-group-1314.pdf).

28 For instance, the Gas Safety Trust is developing a CO portal, that will include data on CO incidents, research and normative documents, which will be available to government, academics, and the general public.

In terms of campaigning to encourage transition from the early stages of the PAPM discussed, the important role of government leadership and the Fire & Rescue Services was highlighted throughout the evidence gathered, and several recommendations arose.

### The Important Role of Fire & Rescue Services

Fire & Rescue Services were repeatedly highlighted as trusted messengers during oral evidence, and have played vital parts in CO safety in the past. There is currently no statutory duty for Fire & Rescue Services to provide safety advice and education in regard to CO, though many forces have undertaken effective campaigns for some years, such as those interviewed for this inquiry. Through the national coordinating body, the Chief Fire Officers Association (CFOA), Chief Fire Officers are committed to contributing to a “holistic safety and wellbeing assessment for people in their homes”, including CO awareness, as prioritised in the CFOA Home Safety Strategy 2013-16.<sup>29</sup>

All Fire & Rescue Service-attended incidents are recorded through a national system, broken down into suspected cases, false alarms, and confirmed cases.<sup>30</sup> CO data from this are not combined and analysed by external bodies, unlike fire and other related incidents.

*“I could give you figures [for CO incidents], and the number of people hospitalised. It wouldn’t be a cross-country set, but it is there because it is recorded. Each Fire & Rescue Service holds it, and I believe [they don’t share it]... because nobody asks them.”<sup>31</sup>*

The data could be extrapolated and fed into data portals under development and used by academic researchers. These also provide opportunity for designing a method of collecting ‘smart’ alarm CO data, as further discussed in the ‘Detection and Technology’ section. Vulnerable people could be identified through combining incident and deprivation data, as trialled in the Staffordshire Fire & Rescue Service / National Grid example, and provided with safety information and equipment.

### Recommendation 3

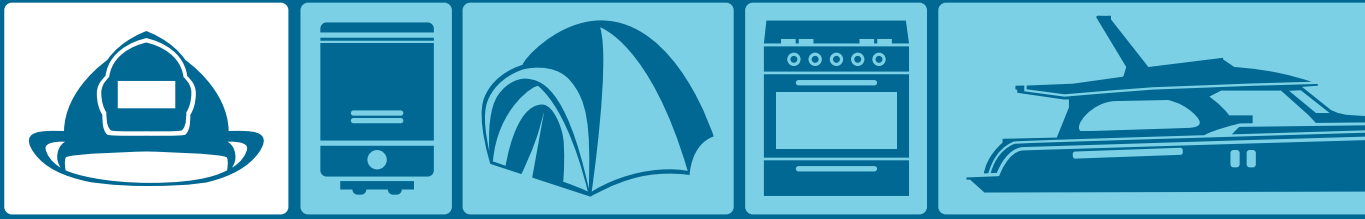
Data on carbon monoxide levels and incidents should be collected and shared, with a central hub approved through Ofgem supplier conditions, building on existing purely incident-based data. To enable this, alarm and data collection standards should preempt the large amounts of data soon to be recorded through ‘smart’ homes, and a framework for pooling this with input from academia should be created. Public Health England, with a remit to cover incidents involving all fuels, should be involved in the population-level data work.

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29 CFOA, written evidence (May 2014).

30 Mark Pratten, Cornwall Fire & Rescue Service, oral evidence (September 2014).

31 Ibid., 30.



**CASE STUDY**  
**NATIONAL GRID,  
STAFFORDSHIRE  
FIRE & RESCUE  
SERVICE AND  
BLUE WATCH**

Starting in March 2014, National Grid, Staffordshire Fire & Rescue Service and the CFOA / Blue Watch scheme undertook a twelve week pilot to enhance Home Fire Risk Checks (HFRC) by issuing free CO alarms and providing advice about the dangers of CO to vulnerable people.

The partnership was agreed to provide the Service with 3,000 alarms for HFRC Technicians and Community Safety Officers to issue to households identified as at an increased risk to the dangers of CO poisoning.

Vulnerability was targeted through combining incident hot spot data - identified for use with the Gas Safe Register / Gas Distribution Network 'Gas Map' - with Fire & Rescue Service population data and knowledge in those areas. CO alarms were given out at 82 per cent of visits.

In addition to the alarms, advice was provided on their use and fitting, with reference to manufacturer's instructions where required. Immediate surveys conducted as part of the Ofgem/Gas Distribution Network licence conditions found that 69 per cent reported an increase in their CO awareness; 99 per cent of respondents would take at least one method of further action as a follow on, and 95 per cent of respondents indicated they would share their knowledge of the dangers of CO with family and friends. A second stage of the project is in development.

As the lead department for deprivation, Fire & Rescue Services and housing, the Department for Communities and Local Government should act to improve public safety around CO for all fuels. This should be primarily channelled through the Fire & Rescue Services at a statutory, unified, and UK-wide level, at a time when fire deaths statistics show a trend that has seen nearly a 40 per cent drop in fire deaths since 2004, through the excellent work of the Services.<sup>32</sup> The legislative basis for this enhanced role would be the Fire and Rescue Services Act 2014.

This success should be built upon by increasing the mandate and resources for Fire & Rescue services to promote CO safety across all fuels. This would allow them to use their knowledge and skills to provide education on CO dangers, especially in the home, along with the free provision and fitting of CO alarms for vulnerable people. They should work closely with the Gas Distribution Networks in this role – an example of which has been provided by the Staffordshire Fire & Rescue Service / National Grid partnership outlined – given requirements on the Networks to raise CO awareness amongst gas customers. Calculations of cost-savings, such as those included within the APPCOG's 2011 report, highlight the public good-implications and economic sense of targeted investment, even using conservative estimates for economic benefit.<sup>33</sup>

Building on the commitment by CFOA to improve wellbeing in the home, a national home CO safety strategy should be developed by CFOA, in conjunction with DCLG, to guide and harmonise current work, and bring up the standards in every Service area to that of the current best.

## Recommendations 4 & 5

- The Fire and Rescue Services Act 2004 should be amended to include a statutory requirement for Fire & Rescue Services to include carbon monoxide safety in their work.
- Fire & Rescue Services should nationally coordinate their data gathering and carbon monoxide prevention activities through the Chief Fire Officers Association, building on current incident-information gathering, and making it available to researchers, public health professionals and other data portals (see Recommendation 3).

A central brand and set of agreed messages for CO awareness-raising and campaigning is highly sought after, especially by organisations highlighted in the 'Campsite and Boating Environments' section. Various bodies, charities and groups each use slightly different branding, and the provision of a single icon and set of messages, building on the example of 'Fire Kills', will allow ease of use and recognition by the public. Amongst other considerations, the icon and messages would need to be adaptable so that organisations can apply them across different projects and with different audiences, using multiple media, and be broad and inclusive enough to cover all fuels and risks.

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32 See: [www.gov.uk/government/news/official-statistics-reveal-fire-deaths-fallen-by-40-in-last-decade](http://www.gov.uk/government/news/official-statistics-reveal-fire-deaths-fallen-by-40-in-last-decade).

33 Even using the limited data and conservative incidence estimates available, the 2011 All-Party Parliamentary Gas Safety Group's inquiry calculated that CO poisoning could be costing the country as much as £178m each year: Ibid., 4.

A meeting between Gas Distribution Networks, gas suppliers and other partners in early 2014 provided a useful grounding to this work, and a potential way to coordinate activities through the CO All Fuels Action Forum. However, in concert with this, leadership or strong support by a Government or emergency service body would help administer a response inclusive of all fuel sources.<sup>34</sup> The Health and Safety Executive Northern Ireland has provided a model for this through their awareness-raising activities.<sup>35</sup>

The recognisable government-licensed Gas Safe Register colour scheme and licensing is already adopted and used by many other organisations.<sup>36</sup>



Fire-related campaigns such as 'Fire Kills' are often highlighted as good examples for CO campaigns to follow, due to their success in targeting salient moments, along with the relevance of messaging on owning and testing safety alarms.

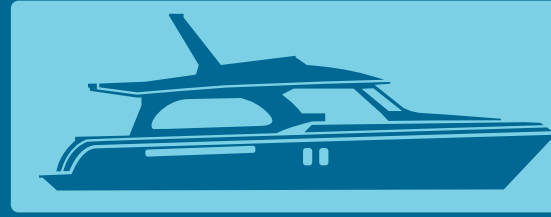
### Recommendation 6

A single, coordinated carbon monoxide campaign brand, messaging, and set of materials should be developed and made freely available for use through a national, central portal. This could be related to a government department or a relevant emergency service such as Fire & Rescue, and should be coordinated with industry and charity campaigning efforts through the Carbon Monoxide All Fuels Action Forum.

34 Ongoing campaign work through the CO All Fuels Action Forum has been building towards this, and involvement by the Fire & Rescue Services should build on and coordinate with this, for example through a Forum campaigns-focussed 'sub-group'. Ownership by Fire & Rescue Services, with support from DCLG, will help ensure long-term, national buy-in for the campaign.

35 See: [watchout.hseni.gov.uk](http://watchout.hseni.gov.uk).

36 See: [www.gassaferegister.co.uk/learn/carbon\\_monoxide\\_poisoning.aspx](http://www.gassaferegister.co.uk/learn/carbon_monoxide_poisoning.aspx).



## CASE STUDY

### 'FIRE KILLS' CAMPAIGN & DCLG BEHAVIOURAL TARGETING

The 'Fire Kills' campaign was designed to nudge people into testing their smoke alarms by capitalising on their existing behaviour – the twice-yearly clock change, as people are at least four times more likely to die in a fire if they do not have a working smoke alarm.<sup>37</sup>

Shifting behaviour from thinking about to actually testing alarms was the aim, with the desired result of either a confirmed-working alarm, or realisation that action, such as battery replacement, needed to take place.

During interview, Mary-Ann Auckland and Alison Hoad from the campaign highlighted that, *“a simple direct message works best for this type of campaign....by linking [testing the alarm] to an action every household has to do, we could achieve remarkable results.”*

They also noted the importance of applying behavioural theories, including targeting *“people’s automatic actions instead of focusing on their conscious attitudes”*, reframing *“people’s motivation to test... [into one] perceived as an easier task”*, and encouraging *“a new social norm: by owning a calendar date, we created the potential for an ongoing memory reminder that didn’t rely solely on marketing investment.”*

<sup>37</sup> IPA (2014) 'Fire Safety - How a clock nudged a nation so fire couldn't kill', IPA Effectiveness Awards Case Study, available at [www.ipa.co.uk/effectiveness/entry/shortlisted/751](http://www.ipa.co.uk/effectiveness/entry/shortlisted/751).

# Domestic Appliances and Environments

## Appliance Use

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When fuel-burning appliances are used according to manufacturers' instructions, and serviced as advised by a competent person, the risk of CO being produced at levels dangerous to humans is relatively low. Ensuring these circumstances is extremely important, although even with a new appliance, external circumstances or a combination of factors can lead to a poisoning incident. All campaigning and advice given to reduce CO poisoning incidents should promote a 'belt and braces' approach of proper appliance use and servicing, along with the installation and use of Standard-compliant CO alarms.

### Domestic Heating

The 2012/2013 Downstream Incident Data Report (DIDR) shows that CO fatalities and serious incidents from piped natural gas used for heating have fallen to minimal levels over the last decade (see figure 3 on page 40), due in part to the phasing out of open-flued appliances and increased regulation.<sup>38</sup> The DIDR highlighted that:

*“Lack of servicing or sub-standard servicing was the most frequently reported preventable contributory factor in a gas related CO incident. Owner occupiers and private landlords in particular should be aware of the importance of regular servicing in accordance with British Standards and the appliance manufacturer’s instructions.”*

A lack of awareness that CO is produced by fuel-burning appliances other than natural gas boilers used for heating, such as wood burning or oil stoves, or gas cookers, was repeatedly highlighted in evidence gathering.

*“There is such a widespread belief amongst the public (and perhaps some medics) that CO is only a gas-appliance issue. There is often a surprised reaction from helpline callers to hear that their CO alarm activation might have come from inappropriate use (or DIY installation) of their multi-fuel stove or petrol-engined devices. The requirement for greater CO awareness and advice needs more buy-in from coal/wood stove manufacturers and suppliers and installers.”<sup>39</sup>*

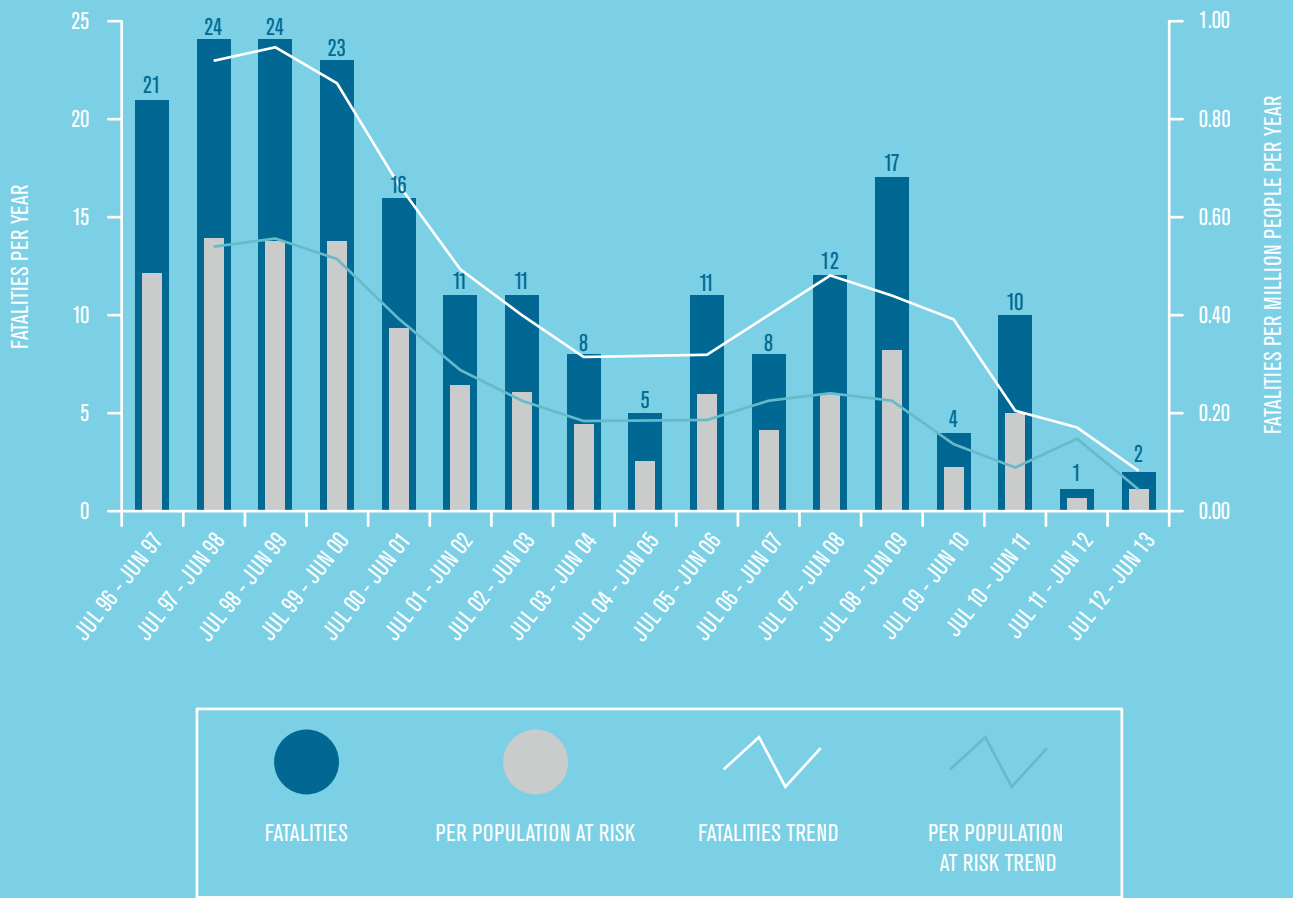
As such, large sections of the public will occupy Stage 1 ('Unaware of Issue') of the PAPM framework<sup>40</sup>, and behaviour may not be targetable by direct campaign messages or prevention advice. Even if an alarm is present and activates, it may be ignored or removed if what is believed to be the most obvious source - the gas boiler - is not at fault.

38 In Great Britain, Downstream Incident Data Report (DIDR) forms are completed by investigators following the investigation of accidental CO poisonings associated with the use of mains natural gas or piped LPG in the home.

39 CoGDEN written evidence (May 2014).

40 See page 24.

Figure 3: Downstream Incident Data Report 2012/13<sup>41</sup>



Yearly trends recorded for fatality rates: see source for full calculations.

41 See: Gas Safety Trust, DIDR Carbon Monoxide Incident Report 2012/13.



Equally, the lack of recognition of the potential danger in, for example, opening the door of a cooling wood-burning stoves to 'let the last heat out', means that risk is increased. These actions can come from a lack of awareness of the dangers of the fuel, and similarly from a lack of understanding in how to use the appliance properly, if it is new or unfamiliar. A diversification of heating methods in homes, for example with the use of 'fashionable' appliances such as solid fuel burners, may lead to an increasing risk of CO exposure, if not understood or used properly. Wherever possible, those responsible for the house or appliances should ensure manufacturer's instructions are present and read by new appliance users, to immediately shortcut the initial lack-of-awareness Stage 1 ('Unaware of Issue') in the PAPM.

Regulatory oversight of the competency of those working on appliances needs to be consistent across different fuel sources. This will ensure that the servicing and installation of appliances is undertaken safely.<sup>42</sup> There is legislative recognition of the risks presented by the use of different fuels, notably with solid fuel appliances requiring the mandatory fitting of CO alarms where any new or replacement appliance is installed. This followed government findings that "[s]olid fuel appliances are about 10 times more likely than gas to generate CO emissions when they should not do."<sup>43</sup> The APPCOG welcomed this change, and this inquiry further recommends that Standard-compliant alarms should be fitted where any fuel-burning appliance is installed.

### Cooking Appliances

The misuse of gas cooking appliances in homes was highlighted in oral and written evidence as a problematic area.<sup>44</sup> Use of oversized pots and pans, combined with failure to keep cookers in good condition, can lead to increased emissions of CO.

Safety management staff at Hackney Homes identified the need to focus on the safety of gas cookers. During maintenance and incident inspections, staff found many appliances exceeding 20 years old, with no inspection or servicing during that time.

*"[A]lthough boilers are considered one of the commonest hazards for CO exposure at home, this study has highlighted that cookers are also a major source of CO exposure at home, both in terms of faulty cookers giving off excess CO and methods of cooking which produce excessive amounts of CO."*<sup>45</sup>

The misuse of cooking appliances is a topic which is not well understood, and should be subject to further research to inform interventions. The replacement of gas appliances with an electric alternative is currently favoured by some Housing Association<sup>46</sup>, along with safety warnings about the 'lazy orange flame'.<sup>47</sup>

42 Paul Rose from the Oil Firing Technical Association (OFTEC) highlighted cases where work "has been done by non-registered people, there is a problem with the installation, and just because the installation is more than 6 months old, Building Control will not investigate and bring about enforcement. The customer is then left to fend for themselves." Oral evidence (August 2014).

43 Andrew Stunell, Minister, Department for Communities and Local Government (CLG), evidence to the CLG Select Committee (February 2012), 'Building Regulations applying to electrical and gas installations and repairs in dwellings'.

44 This was also highlighted in *ibid.*, 3

45 McCann L., Close R. et al. (2013) *Indoor CO: A case study in England for detection and interventions to reduce population exposure*, 'Journal of Environmental and Public Health', 2013, available at: [dx.doi.org/10.1155/2013/735952](https://doi.org/10.1155/2013/735952).

46 See the Hackney Homes Case Study on page 43.

47 For example, see Gas Safe Register's advice: 'Signs that your appliances need servicing?' Available at: [www.gassaferegister.co.uk/advice/gas\\_safety\\_in\\_the\\_home/get\\_your\\_appliances\\_checked.aspx](http://www.gassaferegister.co.uk/advice/gas_safety_in_the_home/get_your_appliances_checked.aspx).

## Behaviour in the Home Environment

The context of 'home' is very important when considering behaviour. There is no 'one size fits all'<sup>48</sup>, and the 'affective' associations<sup>49</sup> people have with devices - such as feelings of comfort and homeliness - may have implications for how to communicate safety. Emphasising the danger of fuels can be counterproductive.

To avoid these complications, adapting the 'defaults' within the home environment to reduce the possibility of risk can be an effective way of improving safety. The 'Detection and Technology' section addresses the direct provision and installation of CO alarms, and the use of appliances and 'connected home' systems with automatic shut-down on detection of CO.<sup>50</sup> Problems inherent to such systems, such as health risks associated with being in a cold home environment, should also be considered.

A Dying To Keep Warm (DTKW) pilot project in Liverpool, Wyre & Fylde and Blackpool identified vulnerable older people at high risk from the cold, fires, gas leaks and CO poisoning, by using referral partners including Community Mental Health Services, Social Services and Fire & Rescue Services.<sup>51</sup>

Following referral, delivery partners such as Care & Repair provided free-of-charge heating equipment and safety services, funded by DTKW. In addition, DTKW funded Gas Safe registered engineers to permanently 'make safe' any gas powered cooking or heating appliances, by fitting lockable gas isolation switches or disconnecting them where necessary.

Low-cost, targeted interventions to directly remove risk may be the only viable option for ensuring the safety of certain vulnerable groups. The safety of some groups of particularly vulnerable individuals, such as those with dementia, can be improved through installing tamper-proof gas isolation switches and other 'default' CO safety devices.

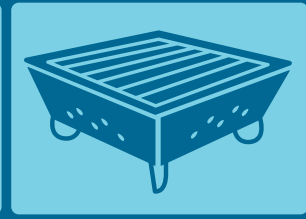
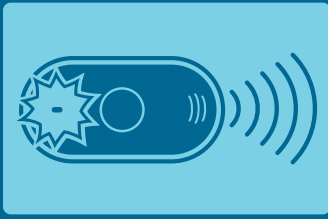
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48 Professor Patrick Devine-Wright, University of Exeter, oral evidence (October 2014).

49 See MINDSPACE mnemonic on page 26.

50 For example, see H&V News article (November 2014): 'noCO boiler shut-off system offers enhanced protection against carbon monoxide'.

51 Pinto, A. (September 2014) *Old Age Psychiatrist*, Issue 60, pp 21-24. 'Dying To Keep Warm' is a registered charity founded by Afroza Ahmed, a Senior Occupational Therapist.



## CASE STUDY HACKNEY HOMES STUDY

In 2010, engineers installed CO alarms in all of the households that Hackney Homes managed on behalf of Hackney Council, covering a social housing stock of 22,831 homes. Public Health England undertook a cross-sectional study of alarm activation-record forms, and performed a descriptive analysis including monthly variation, cause of alarm activation, and actions taken to ensure safety.

The study revealed that gas cookers, while not subject to the same regulatory rigour, are of greater concern for CO safety than boilers. The increased risk from gas cookers in homes was not uniquely a result of appliance fault. In numerous instances, cooking methods unsuited to the appliance type were leading to the production of excessive CO gas. Of the 106 incidents reported over six months from November 2011, 29.9 per cent were due to a faulty cooker (the most common reason recorded), while 10.6 per cent were due to improper cooking methods.<sup>52</sup>

The Hackney Homes study revealed that even within a fully serviced housing stock, CO risk remains high. The large number of alarm activations makes it clear that the provision of CO alarms by housing providers is essential.

It is also clear that other boroughs would benefit from similar initiatives to Hackney and that those efforts to gauge the impact of low-level poisoning, such as the ongoing studies by Liverpool John Moores University discussed later, are vitally important.

<sup>52</sup> Ibid., 45.

Associations such as Hackney Homes and North Lincolnshire Homes adapt their properties to become safer, by sealing and removing gas fires and open-flued gas appliances on change of tenancy. However, tenants may still install their own appliances and ignore education provided. Although landlords are mostly diligent with undertaking annual safety checks, this may be limited to the landlord supplied appliances, thus excluding what are often the highest risk items in the view of Hackney Homes: cookers and fires.

Detection by audible CO alarms is also a crucial back-up intervention, given that there are behaviours over which a Housing Authority has little influence, beyond the provision of information. For instance, appliances may be used in the household that should not be (e.g. barbecues brought indoors), and CO can also come from neighbouring properties through connecting walls.

#### **Recommendation 7**

Building Regulations should be amended to require social housing providers to fit and maintain Standard-compliant carbon monoxide alarms wherever a fuel burning appliance is installed, and providers should commit to replace fuel-burning appliances with lower-risk versions in certain vulnerable situations.

## Appliance Servicing

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The regular servicing of properly installed appliances by a competent person<sup>53</sup> is the best method for preventing CO production at the source. Different groups – for example, home owners or landlords – are responsible for organising servicing, and the behaviour of each should be considered when designing interventions.

The resulting improvements to CO safety from the servicing of appliances are often, in the mind of the customer, a by-product of the process. British Gas engineers have found that although customers acknowledge the safety benefits and the potential cost savings of efficient appliances, factors such as warmth and comfort are often the prevalent reasons behind having appliances serviced, especially when an appliance develops a fault.<sup>54</sup> Gas Safe Register segmentation also identified that “[a]wareness of gas safety and related issues is often patchy. Even someone who services their appliances every year may not know much about CO”.<sup>55</sup>

‘Trigger’ moments can be targeted to more effectively promote an annually repeated behaviour such as servicing an appliance, including through the promotion of ‘risk awareness’. For instance, in 2012, a Gas Safe Register focus group study identified such trigger moments, which could be targeted to raise awareness of risk. These fed into their behaviour change programme;

- Having something go wrong with an appliance - usually the boiler,
- Arrival of children / grandchildren,
- Being prompted (and able) to call on a local, trusted engineer,
- Receiving an annual reminder by letter, card, or phone,
- Having a service agreement that includes an annual check,
- Moving house.

Energy behaviours are highly habitual and intransigent to change. An effective method of combatting this and encouraging a repeated behaviour, such as annual servicing, is to link the new actions to other habitual behaviours.<sup>56</sup> Reminder service schemes<sup>57</sup> introduced by the Gas Safe Register has built upon this, and their annual ‘Gas Safety Week’ campaign is designed to coincide with the salient heating ‘switch-on season’ of early autumn. As helpful as such schemes are they can be counterproductive as they risk creating periods of unanswerable demand. In order to increase effectiveness, efforts should be made to spread such schemes across multiple annual events.

The inquiry heard from social housing providers responsible for organising the required annual servicing of appliances. They highlighted access issues as a key factor preventing these services being carried out, and to ensure compliance many have launched a 10-month servicing programme. However, this leads to an extra service being undertaken every six years, which does little to improve safety, wastes resources and

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53 See ‘Competent Persons Schemes’: [www.gov.uk/building-regulations-competent-person-schemes](http://www.gov.uk/building-regulations-competent-person-schemes).

54 British Gas, oral evidence (August 2014). This conclusion ties in with oral evidence gathered from Dr Rosie Day, University of Birmingham, and her publication: ‘Thermal management practices of older people during winter: accounting for the contextual dynamics’. In it, she and Dr Russell Hitchings point to the importance of context in understanding energy use behaviours, and so in shaping interventions, and also the importance of sensitivity and careful framing when engaging certain groups with messages related to energy use.

55 Gas Safe Register, written evidence (May 2014).

56 Dr Lou Atkins, UCL, oral evidence (November 2014).

57 Gas Safe Register focus group work found that an annual reminder to check appliances was well-received by participants.

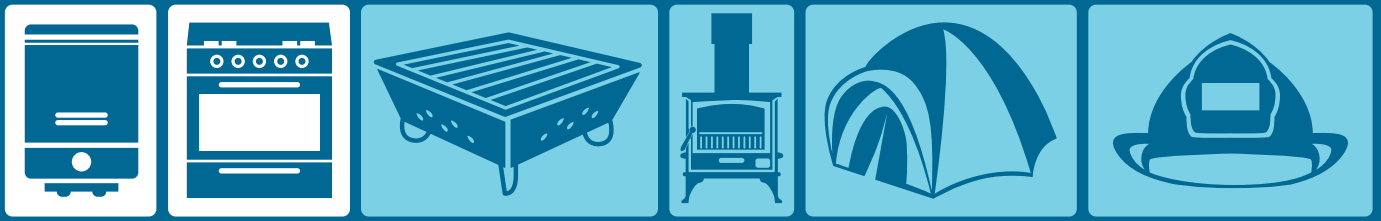
results in an irregular service date.<sup>58</sup> MOT-style requirements, allowing the annual date to remain the same as long as servicing takes place within a four week window before certificate expiration, would provide an effective alternative.

### **Recommendation 8**

The Gas Safety (Installation and Use) Regulations 1998 should be amended to introduce MOT-style (13-month validity) appliance servicing rules, allowing the same service date to be used annually.

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58 Association of Gas Safety Managers. See: [www.agsm.uk.com/mot-style-of-servicing-survey-results](http://www.agsm.uk.com/mot-style-of-servicing-survey-results).



## CASE STUDY GAS SAFE REGISTER: BEHAVIOUR CHANGE PILOT

A focus group-led population segmentation lay at the foundation of a behaviour change pilot conducted by the Gas Safe Register. Outputs of a series of focus groups supported identification of six different segments, with distinct attitudes to risk.<sup>59</sup>

The Gas Safe Register selected two segments to focus on for the pilot: ‘Dismissive Sceptics’ and ‘Ostriches’. Dismissive Sceptics – often young, home-owning families – are hard to convince about the importance of gas safety, and tend to be concerned with cost. Ostriches – often students and private tenants – are least engaged and are often totally unaware of the dangers of unsafe gas work. These segments were focussed on because of their wilful ignorance of safety messages – ‘Dismissive Sceptics’ (who occupy Stage 4 of the PAPM framework: Decided Not to Act) – or simple lack of awareness of the risks - ‘Ostriches’ (who occupy Stage 1: ‘Unaware of Issue’).

The segmentation study enabled the Gas Safe Register to reach their audiences in a tightly targeted and relevant manner. This led to results which significantly exceeded the aims of the campaign. There was a 300 per cent increase in annual gas safety checks within Dismissive Sceptic households in the North West England pilot region. This is particularly impressive when compared to a 3.5 per cent increase over the same time period for Dismissive Sceptic households in untargeted regions.

In its first years of operation, the Gas Safe Register focussed much of its campaign activity on raising awareness of the risks of unsafe gas work, through events such as the annual national Gas Safety Week.

Under a behavioural model, awareness-raising should be seen as the first step in behaviour alteration; transition from PAPM Stage 1 (‘Unaware of Issue’). It is this transition that the HSE wants the Gas Safe Register to move towards.<sup>60</sup> It will be important to understand how tools such as the Gas Map<sup>61</sup> and annual reminder services (which serve as a commitment to maintain behaviour) effectively translate into long-term behavioural adjustment. Gas Safe Register is currently gathering data in order to analyse the efficacy of reminder schemes.

59 The segments identified were; Apprehensive Preventers, Insecure Worriers, Bargain Hunters, Over-confident DIYers, Dismissive Sceptics, and Ostriches. See: [www.policyconnect.org.uk/appcog/sites/site\\_appcog/files/gas\\_safe\\_behaviour\\_change\\_report.pdf](http://www.policyconnect.org.uk/appcog/sites/site_appcog/files/gas_safe_behaviour_change_report.pdf).

60 Gas Safe Register, oral evidence, November 2014.

61 The map (see: [www.staygassafe.co.uk](http://www.staygassafe.co.uk)), increases the recognition that incidents do occur ‘to people like me’, through revealing how many unsafe gas appliances have been found in a postcode area, incorporating data from Gas Safe Register and the Gas Distribution Networks.

## Enabling Safe Appliance Behaviours

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### Giving Advice and Education

MINDSPACE emphasises the importance of the ‘messenger’ giving information; their perceived authority, and the recipient’s personal feelings towards them.

Using trusted messengers during salient moments to promote CO safety interventions can help ensure an engaged response. One-on-one interactions from engineers, health visitors, Fire & Rescue Services and other trusted figures ‘invited in’ to the home are essential.<sup>62</sup>

National Grid and the other Gas Distribution Networks have recognised this, training registered gas engineers “on the use of dual gas and CO detection equipment, and to provide in-home CO and safety advice.”<sup>63</sup> Data provided by the Networks have shown increased levels of awareness of CO. However, whether that has translated into long-term changes in behaviour is often very difficult to measure.

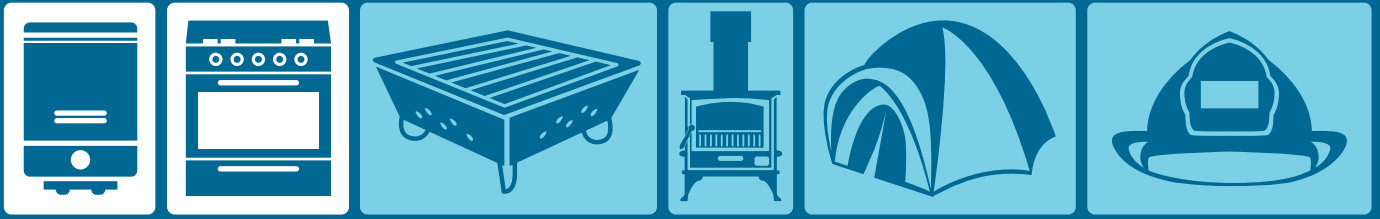
The importance of conducting trials and pilot programmes is highlighted by the initial success of the Gas Safe Register programme. A trial undertaken by the Department of Energy and Climate Change (DECC) emphasised the considerations that need to be taken into account when using trusted messengers to promote certain behaviours. In an analogous area – energy efficiency behaviours – DECC discovered that advice from engineers did not significantly produce the desired effect of more energy efficient behaviours. However, this conclusion is qualified by a range of factors.

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62 Dr Rosie Day, University of Birmingham, oral evidence (October 2014). The RoSPA ‘Be Gas Safe’ programme case study on page 60 also emphasises this.

63 National Grid written evidence (May 2014).





**CASE STUDY**  
**TRIALLING**  
**ENERGY**  
**EFFICIENCY**  
**APPROACHES**

DECC commissioned a Randomised Control Trial (RCT) in 2014 to test whether tailored advice from a trusted messenger on the use of standard heating controls is noticeably more effective at encouraging a reduction in energy consumption than a 'leave behind' information leaflet, or no intervention at all. In this case, boiler engineers conducting annual gas safety checks were selected for the role of trusted messenger.<sup>64</sup>

Results from the trial show that the use of in-home advice or informative leaflets within social housing did not significantly reduce gas consumption during the trial period. Significant impact was also not measured within specific characteristic groups, such as different property type or size. Further analysis and trials are required in this area.

64 Department of Energy and Climate Change (2014) 'Advice on How to Use Heating Controls: Evaluation of a trial in Newcastle', available at: <https://www.gov.uk/government/publications/advice-on-how-to-use-heating-controls-evaluation-of-a-trial-in-newcastle>.

## Vulnerable Energy Customers

The targeting of vulnerable energy customers and those in fuel poverty has been gathering momentum, due in part to Ofgem's Consumer Vulnerability Strategy, and schemes such as the Priority Services Register operated by energy suppliers.<sup>65</sup>

*"If you are over 60, chronically sick, disabled, deaf or hearing-impaired, blind or visually impaired, you are entitled to join your supplier's Priority Service Register. It is free to join and once a member you are entitled, among other things, to a free annual gas safety check."*<sup>66</sup>

Another initiative is the Discretionary Rewards Scheme applied by Ofgem to the Gas Distribution Networks. The scheme encourages CO and fuel-poverty related safety activities, and has led to a better understanding of the challenges in identifying and assisting eligible customers.<sup>67</sup> Phase 1 of the Liverpool John Moores University study highlighted in the next section found "a noticeable trend that deprived areas were less likely to own audible CO alarms than homes in non-deprived areas."<sup>68</sup>

## Recommendation 9

**Ofgem's Consumer Vulnerability Strategy should include within energy supplier Priority Services Register requirements, the provision and installation of Standard-compliant carbon monoxide alarms for vulnerable customers.**

The Staffordshire Fire & Rescue Service / National Grid trial of alarm provision and CO safety targeting, outlined on page 35, is an example of a positive intervention. Schemes such as these are particularly useful when cost is identified as a key barrier to advancing through the stages outlined in the PAPM. For instance, a focus group of older people (see Appendix 1) who were reasonably well-informed about the risks associated with CO, stressed that the price of certain safety measures (such as servicing and alarm installation) prevented their adoption.

The DIDR 2012/13 identified disproportionate incident numbers resulting from the use of particular at-risk appliances.<sup>69</sup> The use of targeted interventions should be extended to identify those with the oldest and most 'at-risk' fuel-burning appliances. The 2010 Government-supported boiler replacement ('scrappage') scheme increased safety and energy efficiency in 118,000 households in England,<sup>70</sup> and other schemes have been implemented. However, the last such examples ended in 2013.<sup>71</sup> Introducing a new initiative for appliances beyond their 'shelf-life', initially targeted at priority customers through the use of the Priority Services Register, could remove the cost-block of necessary appliance upgrades. If successful, the scheme could be rolled out in other 'at-risk' properties.

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65 See: [www.ofgem.gov.uk/about-us/how-we-work/working-consumers/protecting-vulnerable-consumers](http://www.ofgem.gov.uk/about-us/how-we-work/working-consumers/protecting-vulnerable-consumers).

66 HSE leaflet: 'Gas appliances - Get them checked, Keep them safe', available from [www.hse.gov.uk/pubns/indg238.pdf](http://www.hse.gov.uk/pubns/indg238.pdf).

67 Ofgem (2014), Review of the Priority Services Register.

68 Kokkarinen, N., Shaw, A., Cullen, J., Pedrola, M., Mason, A., Al-Shamma'a, A. (2014) "Investigation of audible carbon monoxide alarm ownership", Smart and Sustainable Built Environment, Vol 3, No. 1, pp72-86.

69 Ibid., 41.

70 Gas Safety Trust Chairman Chris Bielby: available from [www.gas-safety-trust.org.uk/2014/09/gas-safety-trust-report-highlights-dangers-open-flue-boilers-calls-boiler-scrappage-scheme/](http://www.gas-safety-trust.org.uk/2014/09/gas-safety-trust-report-highlights-dangers-open-flue-boilers-calls-boiler-scrappage-scheme/).

71 See: [www.which.co.uk/energy/saving-money/guides/boiler-scrappage-scheme](http://www.which.co.uk/energy/saving-money/guides/boiler-scrappage-scheme).

## Recommendation 10

The UK Government should introduce a boiler replacement scheme with a view to Green Deal energy efficiency measures, tied in the first instance to the energy supplier Priority Services Register to target the most dangerous appliances in the most vulnerable situations.

The DIDR 2012/13 also notes that “[t]here is little evidence to suggest different property types pose different risks”, though the occupancy type of houses, such as privately rented housing, provides some opportunity to target groups at increased risk of CO exposure and poisoning. Equally, the potential impact of an appliance fault will be greater in properties or buildings containing more people.

### Private Rented Housing

A Gas Safe Register study found that private renters tend to assume “everything is in order” with regard to their gas appliances, and leave safety concerns to their landlord.<sup>72</sup> According to the DIDR 2012/13, “[t]he risk of someone in the private rented sector being involved in a reportable CO incident where mains natural gas was the fuel remains greater than in any other housing sector”, due to older appliances and a limited servicing regime.

Although it is difficult to conclusively identify any demographic trends of CO incidents, the offsetting of legal safety responsibilities within rented housing can lead to situations of increased CO risk.<sup>73</sup> Landlords who do not fulfil their obligations with regard gas and other combustion fuels put their tenants’ lives in danger.

Landlords are legally required<sup>74</sup> to get a Gas Safety record (formerly a CP12 certificate) from a Gas Safe Registered engineer every twelve months for all “pipe work, gas appliances and flues” installed.<sup>75</sup> Although CO alarms are not mandatory in rented properties, other than those in Scotland, it is recommended that landlords provide and install them. This inquiry hopes that the Government makes them mandatory in England and Wales as part of the ongoing Department for Communities and Local Government review of property conditions in the private rented sector.

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72 Gas Safe Register written submission (May 2014).

73 Shelter has highlighted this: See [england.shelter.org.uk/campaigns/fixing\\_private\\_renting](http://england.shelter.org.uk/campaigns/fixing_private_renting).

74 Gas Safety (Installation and Use) Regulations 1998.

75 See: [www.britishgas.co.uk/products-and-services/landlords/information-for-landlords/gas-safety-certificate-cp12-explained.html](http://www.britishgas.co.uk/products-and-services/landlords/information-for-landlords/gas-safety-certificate-cp12-explained.html).

## Home Ventilation

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The Green Deal, the government's flagship energy efficiency programme, has encouraged increasing levels of energy efficiency in homes to reduce energy bills.<sup>76</sup> With decreased ventilation in homes, CO and other toxins in the air may be more likely to build up to dangerous levels. This means that no matter what safety measures householders take as far as appliances are concerned, their adoption of energy efficiency measures may lead to perverse, unanticipated effects. The Green Deal only includes partial consideration of the increased CO risk of increasing air-tightness.<sup>77</sup>

Establishing the burden of risk attached to ventilation measures is important, and there are research programmes underway to this end. For instance, the Institution of Gas Engineers and Managers, through the Health and Safety Laboratory and the Gas Safety Trust, is exploring the impact energy efficiency measures have on the outputs of fully functioning, appropriately installed appliances.<sup>78</sup> The results of this and other relevant research should be included in energy efficiency programmes such as the Green Deal, to ensure CO and indoor air quality is adequately considered when increasing air tightness.

### Recommendation 11

The Department of Energy and Climate Change should ensure that results and recommendations emerging from research into the risks associated with increased air-tightness of homes are appropriately incorporated into Green Deal assessments and guidance.

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76 See: [www.gov.uk/green-deal-energy-saving-measures/overview](http://www.gov.uk/green-deal-energy-saving-measures/overview).

77 This is despite assurances in 2012 from the then Minister of State at the Department of Energy & Climate Change that, "all installers must assess the impact of their work on the air tightness of the property and any associated increase in risks of CO poisoning that might occur as a result. If there is any increase, installers will be required to fit a CO monitor. They will also be required to check properties where there is an existing monitor to ensure it is fully working." House of Commons CLG Committee report, available at: [www.publications.parliament.uk/pa/cm201012/cmselect/cmcomloc/1851/1851.pdf](http://www.publications.parliament.uk/pa/cm201012/cmselect/cmcomloc/1851/1851.pdf).

78 See: [www.igem.org.uk/news/igem-news/igem-news/igem-wins-research-grant-for-energy-efficiency-probe-into-gas-safety.aspx](http://www.igem.org.uk/news/igem-news/igem-news/igem-wins-research-grant-for-energy-efficiency-probe-into-gas-safety.aspx).

# Detection and Technology

Detection and other technologies provide ever-evolving opportunities for improving CO safety. As well as ongoing improvements in detection, developments and innovations in other technologies provide novel ways to interact with the home, gather rich data on incidents and low-level CO, which will help build the evidence-base for future policy and campaigning.

## Carbon Monoxide Alarms

*“Whatever the cause of CO gas, detection has to be the prime focus of any campaign to address social behaviour and awareness. The ‘behaviour’ of the potential victim of CO poisoning is governed by what they believe to be true.*

*“The presence of CO alarms/detector is now noted by all chimney sweeps, and this has forced a conversation with every householder that is asked to sign the form. It’s clear from these conversations that there is lack of awareness not only as to the level of risk, but how CO works.*

*“Detection is not an answer to the problem, but provides an affordable means of protection, which can be deployed quickly and effectively.”<sup>79</sup>*

According to the Health and Safety Executive, “CO alarms are widely recommended as one of a number of important measures to protect against the health risks associated with CO leaks from fuel appliances.”<sup>80</sup>

The fitting of CO alarms does not negate the need to be aware of the dangers of CO poisoning, or act as a substitute for the proper servicing and use of carbon-fuel burning appliances. Nevertheless, correctly fitted, audible CO alarms are essential; in addition to their obvious emergency-prevention role, their presence provides a visual means of communicating safety. This inquiry examined factors likely to improve the uptake and use of alarms. It also explored whether alarm technology might lend itself to encouraging certain safety behaviours.

<sup>79</sup> Mark Aylett, chimney sweep, written evidence (May 2014).

<sup>80</sup> Health & Safety Executive (2011) ‘Domestic CO Alarms: Long-term Reliability and Use Scoping Study’, available at: [www.hse.gov.uk/research/rrpdf/rr847.pdf](http://www.hse.gov.uk/research/rrpdf/rr847.pdf).

## The Standard of Carbon Monoxide Alarms

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### The Recommended Standard: BS EN 50291

*“Before purchasing a CO alarm, always ensure it complies with British Standard EN 50291 and carries a British or European approval mark, such as a Kitemark. Standards for the performance of CO alarms have become more stringent over recent years and so older alarms may not react as quickly as newer alarms. Check the manufacturer’s recommendations about how you can test your alarm to ensure that the unit and the batteries are in good condition.”<sup>81</sup>*

Although compliance is voluntary, the British (European) Standard BS EN 50291 (‘the Standard’) guarantees a level of safety, as long as compliant CO alarms are fitted and used according to the manufacturer’s instructions. The majority of alarms on sale in the UK comply with the Standard, which covers a wide variety of quality assurances and tests, and is due to be updated in 2015, in part to include and allow innovations.

Audible alarms manufactured to the Standard will activate at specified thresholds that could contribute to acute-level poisoning. However, these alarms will not alert people to lower concentrations of CO build-up, which, over long periods of time, may contribute to low-level poisoning.<sup>82</sup> There is not generally thought to be a ‘safe’ level of CO exposure, however the World Health Organisation (WHO) has published guidance.<sup>83</sup> Some devices have a screen that can display lower concentrations of CO than the lowest audible notification alarm threshold level specified in BS EN 50291.<sup>84</sup>

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81 Ibid., 80.

82 Extract from APPCOG response to Department for Communities and Local Government February 2014 discussion document, ‘Review of Property Conditions in the Private Rented Sector’.

83 World Health Organisation (1999) ‘Environmental Health Criteria 213: CO (second edition)’, available from: [www.who.int/ipcs/publications/ehc/ehc\\_213/en/](http://www.who.int/ipcs/publications/ehc/ehc_213/en/).

84 Oral evidence, CoGDEN (September 2014).

## Acquiring and Installing Alarms

### Desired Behaviour 1: Encouraging the Purchase and Uptake of Alarms

Removing barriers to the acquisition and use of CO alarms is crucial for improving CO safety. Once people have entered Stage 5 ('Decided to Act') of the PAPM, it is important that the action is made as easy and attractive as possible, to encourage movement to Stage 6 ('Acting'), and finally to Stage 7 ('Maintenance').

Much existing CO campaigning focusses on encouraging the purchase of alarms, but multiple push factors are required to encourage wider uptake. Oral evidence from alarm manufacturers suggests around 19 per cent of the population own an alarm, although a certain number will not be fitted or with working batteries installed. This figure will also vary across geographical regions. For example, Merseyside Fire & Rescue Service visited more than 22,000 homes in 2011, and found that fewer than one in 10 had a CO alarm.<sup>85</sup>

Carbon monoxide detection technology is improving constantly.<sup>86</sup> Detectors are either being, or could be, developed for use in devices such as baby monitors, mobile phone cases, or even umbrellas.<sup>87</sup> These devices may not provide the visual warning stimulus of the traditional alarm casing, but could appeal to audiences which previously did not place a value on a CO alarm, for whatever reason.

Making alarms more attractive or fit-for purpose may encourage their uptake and ongoing maintenance, while improvements in alarm technology may also support this. The expected lifetime of CO alarms is also increasing: as sensor and battery technology improves, some alarms are now guaranteed for 10 years.<sup>88</sup> In addition, smaller sensors are being developed, which could fit into the innovative locations and contexts listed above, but are unlikely to comply with the Standard as it is currently written.

The Standard currently requires the alarm to be active all the time, which is unsuitable for any such battery powered devices with a short lifespan, or for the use of alarms on holiday if it needs to be carried in luggage on aircraft. Removing the batteries in those alarms where they are not sealed-in is not a convenient solution. In addition to any conclusions reached in the 2015 review of the Standard, special consideration should be given to the development of an 'Innovation Standard', allowing the development and placement of CO detectors in a range of technologies whilst maintaining a rigorous safety level relevant to the product context.

### Recommendation 12

An 'Innovation Standard' for carbon monoxide alarms should be created, allowing flexibility within existing rules without compromising safety, to encourage the design of novel carbon monoxide detection applications.

85 See: [www.merseyfire.gov.uk/asp/pages/rss/LatestRssPortal.aspx?id=427](http://www.merseyfire.gov.uk/asp/pages/rss/LatestRssPortal.aspx?id=427).

86 Innovation and competition has driven down the price of alarms, to the extent that some figures used previously by government legislative cost-benefit analyses in the past are now out of date, CoGDEM, oral evidence (September 2014).

87 The Observer (2014) 'Smart umbrellas keep you dry and check the air you breathe', available at: [www.theguardian.com/environment/2014/jun/19/smart-umbrellas-check-air-quality](http://www.theguardian.com/environment/2014/jun/19/smart-umbrellas-check-air-quality).

88 Ibid., 80.

Financial cost acts as a barrier to the purchase of alarms for some groups. Although the cost of alarms – generally between £10-30 – is relatively minimal when considered over 5-10 years, it can be seen as significant up front. Another option is to allow payment to be spread out over a period of time, for instance, paying 33p per week for a bolt-on to Carelink systems.<sup>89</sup> For those who cannot afford an alarm, schemes such as the Priority Services Register operated by energy suppliers identified in the ‘Domestic Appliances and Environments’ section, should automatically provide, install, and educate vulnerable customers about CO alarms (see Recommendation 9).

Efforts to combine this expenditure with larger purchases, such as ‘Home Care’ plans<sup>90</sup> or as part of a new-mothers safety kits<sup>91</sup> should be encouraged.

### Recommendation 13

Providers of ‘Home Care Plans’ of annual heating system servicing and maintenance, should include carbon monoxide alarms as a ‘default’ option within each package.

### Comparison with smoke alarms

A lack of knowledge of the importance of fitting an alarm is also a barrier to ownership. In comparison to smoke alarms, as CO cannot be seen, smelt or, tasted, the importance of CO alarms needs deeper explanation. The “same simplistic approach” and “the trickle, constant messaging” of smoke danger awareness is less likely to work.<sup>92</sup>

The parallel of CO alarms and smoke alarms may help encourage purchase, installation and use. The Gas Safe Register qualitative analysis suggested that “people were surprised that smoke alarms and CO alarms were not promoted as a package by the fire brigade, and thought this would make perfect sense.” The survey also found that people “associated smoke alarms with fire service advertising, and wanted the two devices to be promoted together to raise awareness”.<sup>93</sup>

The alarms are often marketed together at point of sale in store, either side-by-side or as a combined package, but not through other distribution channels such as home safety checks.<sup>94</sup> The purchase of each safety device allows a cross-over salient moment to encourage the purchase of the other.

It is also crucial that the distinct purposes and functionality of smoke and CO alarms is not confused. Despite their physical similarities, the alarms possess important internal differences, and the differences in appropriate positioning and suitable action following alarm activation should be highlighted.<sup>95</sup> Without knowledge of a CO alarm’s purpose and operation, the alarms will often be incorrectly treated as substitutes for each other.

89 Healthwatch Knowsley highlighted this during the focus group conducted in October 2014 – see Appendix 2. They encourage use of the CO add-on to their ‘Lifeline’ monitoring system, which costs 33p per week in addition to the base price. The detector activates a call to the monitoring centre at certain thresholds, which can alert the emergency services.

90 See: [www.britishgas.co.uk/products-and-services/homecare/](http://www.britishgas.co.uk/products-and-services/homecare/).

91 See [www.mothercare.com/new-baby-essentials/advice-ms-preg-essentials-root,default,pg.html](http://www.mothercare.com/new-baby-essentials/advice-ms-preg-essentials-root,default,pg.html).

92 *Ibid.*, 22.

93 Gas Safe Register, written evidence (May 2014).

94 Colin Mitchell, oral evidence (September 2014).

95 Leigh Greenham, oral evidence (September 2014). Smoke alarms act as a virtual ‘on/off’ switch on detecting smoke, while CO alarms continually monitor and detect CO, before activating at prescribed thresholds over certain periods.



## Desired Behaviour 2: Correct Alarm Installation and Positioning

The correct installation and positioning of CO alarms is important to ensure they work at full functionality. The use of third parties is often the most effective method for encouraging people to adapt their behaviour to properly install and maintain an alarm. Various studies have highlighted the incorrect placement of alarms to be a widespread issue;

*“Data suggested that alarms were significantly more likely to be incorrectly deployed when deployed in lounges (35.5 per cent), compared to kitchens (9.8 per cent)... Considering HSE’s 2006 review of Gas Safety reported that CO poisoning related incidents most commonly involved poisonings in lounges and bedrooms, maximising the potential of alarms to detect CO leaks as early as possible in such rooms in particular is obviously critical.”<sup>96</sup>*

## Following instructions

*“Ensure that your CO alarm is correctly located – check the instructions from the manufacturer. Over 20 per cent of alarms sampled were not fitted correctly, mainly due to being at the wrong height or not close enough to the potential source of CO.”<sup>97</sup>*

– HSE Advice

One identified obstacle to the correct installation and use of alarms is the ability to follow the manufacturer’s instructions.

*“Not reading instructions is actually a common human flaw – thinking ‘I don’t need it’.”<sup>98</sup>*

The Standard prescribes the amount of detail required in the instructions. This should be supplemented by a simple one page cartoon and summary outlining clear steps for correct installation and use. An example of this is shown on page 58 with the installation of a simple, battery-operated device.

## Recommendation 14

Carbon monoxide alarm manufacturers, in line with an updated alarm Standard, should simplify alarm installation instructions, and include cartoons and single-page checklists for easier interpretation of fitting.

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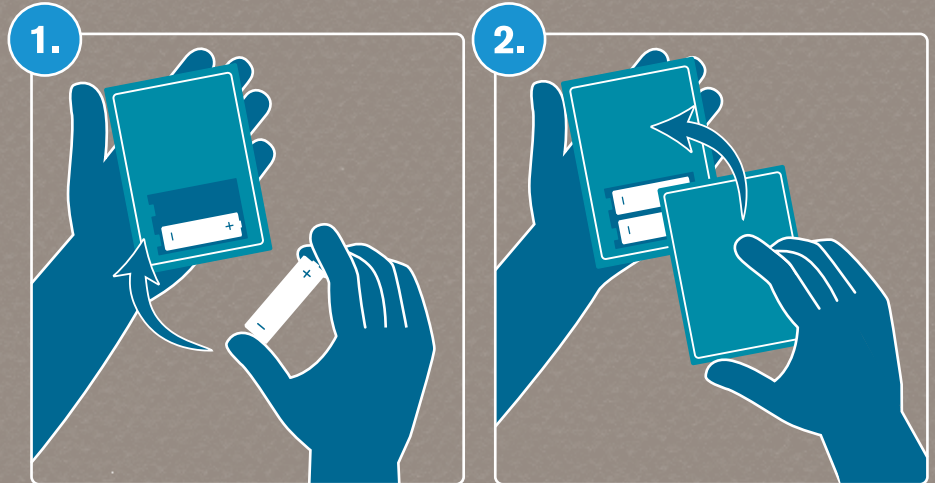
<sup>96</sup> Ibid., 80.

<sup>97</sup> Ibid., 80.

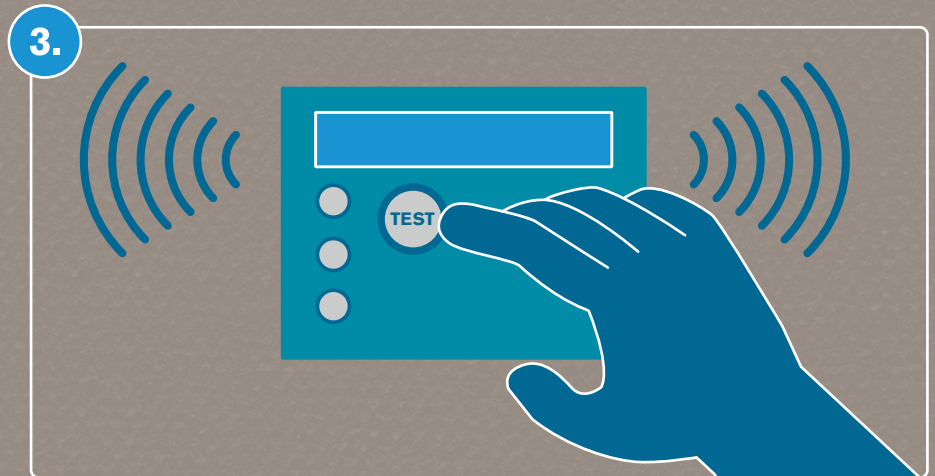
<sup>98</sup> Ibid., 22.

1. Putting batteries in CO alarm

2. Putting case on

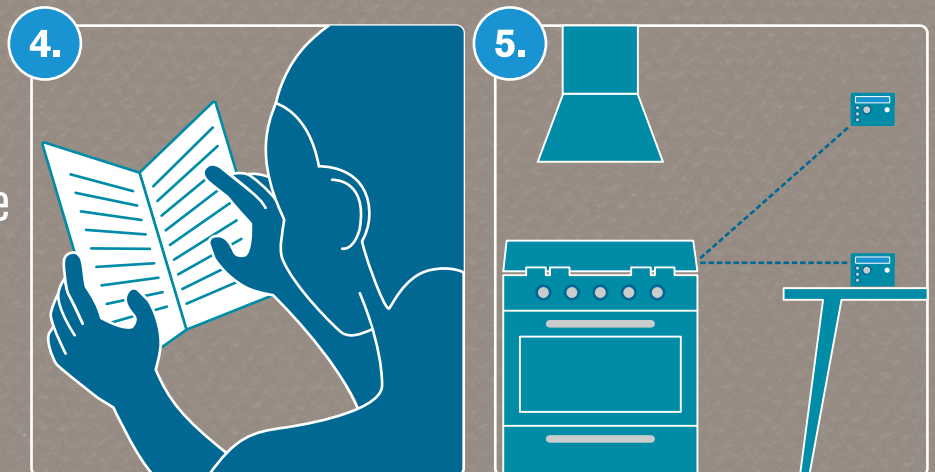


3. Testing the alarm sound

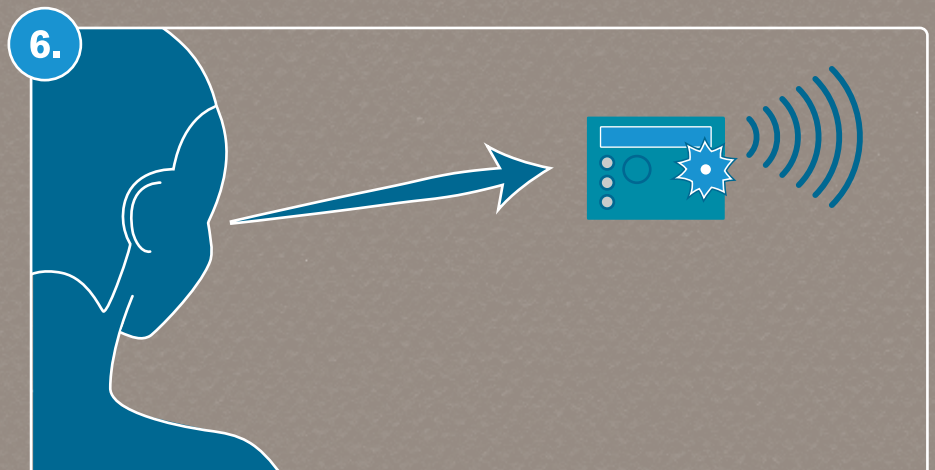


4. Reading instructions

5. Positioning the alarm at a horizontal distance of 1-3m from the potential source



6. Once in place, checking to see the light flashing intermittently



## Providing and Fitting Alarms

Providing equipment alone is unlikely to have a long term impact in improving safety; it is improbable that one-off hits will lead to Stage 7 ('Maintenance') PAPM behaviours.<sup>99</sup> Alarm provision needs to be combined with education on the purpose and importance of the equipment, as well as installation in some instances. Free giveaways of alarms have led to them remaining unused, ignored or unfitted as people often do not attach value to items received for free,<sup>100</sup> especially if they do not understand their purpose. Education of the purpose of pre-installed alarms to new tenants is also important, to encourage alarm maintenance and testing.

Mark Pratten from Cornwall Fire & Rescue Service highlighted that some elderly people find manufacturer's instructions too complex:

*"From experience, the elderly population are more likely to go and purchase a CO detector but more likely not to install it, and the younger generation are more likely not to buy, but they do install them; they would install it if they had one."*

*"Every time we run awareness or education press releases or radio...about 35 per cent of our calls are elderly people with CO detectors that are still boxed because they don't know how to fit them. When we actually visit, as we don't supply or fit detectors, we refer them to the manufacturer's instructions...and sit down and go through the instructions with them."<sup>101</sup>*

Engineers, or other trusted messengers such as the Fire & Rescue Services, can assist with the installation of alarms, to ensure compliance with manufacturer's instructions.

Partnerships between Fire & Rescue Services and outside organisations for equipment provision or delivering messages have taken place for many years. One example highlighted by the Devon and Somerset Fire & Rescue Service (DSFRS) is the 'GoodPoint' alarm testing kit rollout in partnership with the manufacturer and a home care provider.<sup>102</sup> Building on this model locally, DSFRS has suggested creating approved 'CO Inclusion schemes', to improve reach of safety messages and provide mechanisms for providing equipment.

The RoSPA Be Gas Safe Programme combined equipment provision with education, and has saved at least eight lives to date. They calculated "a saving to society of around £12.8 million... from an investment of £201k", using HSE and Transport Research Laboratory life-value figures.<sup>103</sup>

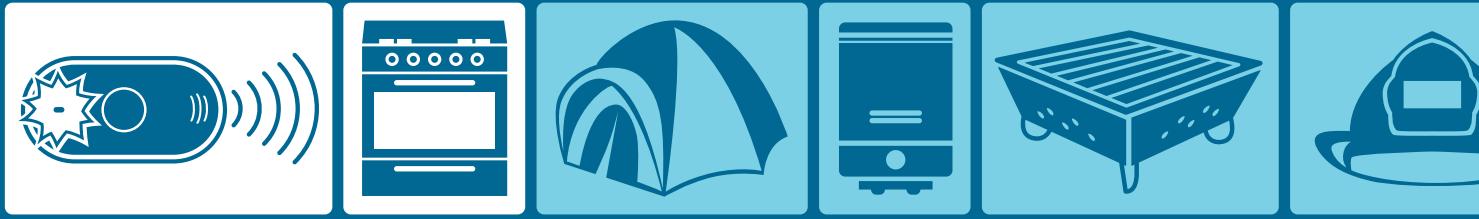
99 Jeremy Vincent, DECC, oral evidence (August 2014): In the analogous example of energy efficiency, the behaviours in play are both technical and habitual. When looking at energy efficiency in the home, DECC has found that technical measures such as more efficient boilers make the biggest savings, though habitual ones around heating, such as thermostat settings, daily start of heating and using thermostatic radiators, aren't far behind.

100 Ibid., 95.

101 Ibid., 31.

102 See: [www.goodpointcampaign.com/press-release-service-invents-new-way-to-keep-people-safe/](http://www.goodpointcampaign.com/press-release-service-invents-new-way-to-keep-people-safe/).

103 RoSPA (2014): 'Be Gas Safe Programme Report 2011-2014'.



## CASE STUDY

### RoSPA 'BE GAS SAFE' PROGRAMME: EDUCATION ACCOMPANYING ALARM PROVISION

The Royal Society for the Prevention of Accidents (RoSPA) has actively promoted awareness and alarm ownership through the Be Gas Safe programme.<sup>104</sup> It has distributed CO alarms to over 13,000 families and advice and information to over 100,000, utilising local partnerships.<sup>105</sup>

A key insight from the programme is the success of distributing alarms in combination with fitting and guidance. Despite being the 'last line of defence', RoSPA research has shown that programmes that combine provision of equipment with safety education are more effective than equipment provision or education alone.<sup>106</sup>

The provision of 7-year, Standard-compliant alarms helped to maximise the effectiveness of the education programme as well as providing practical protection for a limited number of families most at risk. Distribution through home visits provided the opportunity to address any CO safety issues in situ, ensure the CO alarm was correctly located, and to cover additional safety issues that may arise. Fire services often assisted with the installation as part of their home Fire Safety Check.

Additionally, education, advice and information were provided to families to encourage the organic growth of CO community awareness, including information on the availability of free gas safety checks for vulnerable people.

<sup>104</sup> This programme has been supported by the Gas Safe Charity.

<sup>105</sup> RoSPA has campaigned on CO for many years, including via its home safety training. It has also delivered programmes for Government departments. Of relevance to the 'Campsite and Boating environments' section, RoSPA also actively promotes awareness and advice on the dangers of CO when camping, caravanning or boating and the safe use of cooking equipment, barbecues and heaters.

<sup>106</sup> The model was based on the National Home Safety Equipment Scheme, 'Safe At Home', which was successfully delivered by RoSPA for the Department for Education between 2009 and 2011. In that programme, RoSPA worked with over 130 Local Authority partners to deliver home safety equipment to 67,000 families, and provide advice and information to a further 350,000 families.

Similar insights to those from the RoSPA programme have arisen from campaigns to encourage the use of cycle helmets amongst children. Encouraging the use of cycle helmets bears similarities to the use of CO alarms in a number of ways: they cost a similar amount, are recommended but generally not mandatory, and both may be the only viable safety option in some situations. A 2011 review<sup>107</sup> of non-legislative interventions to increase cycle helmet wearing by children also highlighted the importance of equipment provision and education together.

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107 Owen R., Kendrick D., et al. (2011) *Non-legislative interventions for the promotion of cycle helmet wearing by children*, 'Cochrane Database Syst. Rev.', available at: [www.ncbi.nlm.nih.gov/pubmed/22071810](http://www.ncbi.nlm.nih.gov/pubmed/22071810).

## Harmonisation of Regulation and Legislation

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An important aid to protecting certain vulnerable groups is the creation of legislation and regulations requiring the mandatory installation of alarms. This was repeatedly highlighted during the focus group session conducted.<sup>108</sup> Provision of alarms by landlords may be best encouraged through legislation, and as highlighted in the previous section, this inquiry hopes that the Government review of property conditions in the private rented sector reaches a similar verdict.

Differences in building regulation requirements for the mandatory fitting of alarms exist between the countries of the UK, largely due to the different departments and calculations involved in the formulation of regulation.<sup>109</sup> Although demographic differences exist between the countries, there are no substantive reasons for regulations to differ.

Extending the mandatory fitting of Standard-compliant alarms, through changes to Building Regulations, is a suggestion highlighted in the 2012 Communities and Local Government Select Committee report:

*“Confusion between government departments, particularly in respect of public safety issues, is unacceptable and we conclude that the Government needs a comprehensive policy. We recommend that Part J [in England and Wales] should... require audible, wired-up EN 50291-compliant CO alarms to be fitted wherever a relevant heating appliance is installed in any new-build or existing homes.”<sup>110</sup>*

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108 See Appendix 2.

109 For example, the Building Regulations (Northern Ireland) have required the installation of Standard-compliant CO detectors since 2012, where a new or replacement combustion appliance, not designed solely for cooking purposes, is installed in a dwelling. Scotland has taken this further, with the requirement to have alarms installed for new build and rented properties.

110 House of Commons Communities and Local Government Committee (2012), ‘Building Regulations applying to electrical and gas installation and repairs in dwellings’, available at: [www.publications.parliament.uk/pa/cm201012/cmselect/cmcomloc/1851/1851.pdf](http://www.publications.parliament.uk/pa/cm201012/cmselect/cmcomloc/1851/1851.pdf).

## Connected Alarms and Homes

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A new possibility for encouraging alarm uptake and use is the emerging market of smart devices and energy systems within the ‘internet of things’.<sup>111</sup> The ability to interact in novel ways with appliances and devices has great potential for influencing CO-related behaviour.

### Smart Alarms

Connected and ‘smart’ CO alarms which promote usability and regular interaction provide a convenient method of improving safety. Remote-alert systems introduce the ‘default option’ of regular testing with direct updates to consumers through mobile phone messages and alerts, while enabling remote alerts of a CO risk. They also offer improved data collection and monitoring over time, and this can be fed into health-focussed data analysis.<sup>112</sup>

Alarm devices are often seen as a nuisance to be tolerated; the most common interaction with it may be a warning beep, generally communicating a low battery. New systems within the internet of things will help shift the ‘traditional’ image of alarms – “a device invariably seen as a nuisance, albeit one that could save lives”<sup>113</sup> – making them easier and more enjoyable to use. Spoken warnings, as available with the Nest Protect device, can, for instance, provide more detailed warnings about hazard location and type, differentiating between low battery and emergency activations.<sup>114</sup>

### Connected Alarms and Homes

This inquiry took evidence from different connected homes systems currently in development, which deliver and link up health, energy and other services over broadband home internet. It found there to be a variety of motivations for consumers to think about having a connected home, with comfort, convenience, control, cost efficiencies, and wellbeing of relatives as some of the most frequently cited.<sup>115</sup>

The systems enable people to engage with their heating system beyond, for instance, simply a ‘distress purchase’ made following a boiler breakdown. Each builds on the basic premise of increasing the amount of information available to customers, in order to allow them the opportunity of tailoring their energy use to save money, increase comfort, or both.

Carbon monoxide safety has been a secondary concern for many of the systems being developed. Each contains the possibility of ‘bolt-ons’ of remote-alert CO alarm equipment, with Standard-compliant gas detection supplemented by the enhanced system connectivity. As either a default option, or technologically attractive add-on, these systems present a novel method of engaging new audiences with CO.

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111 Examples of these systems include British Gas Connected Homes/Hive, Scottish Power Connect, npower/Nest, and developing smart metering systems in line with the DECC Smart Meter programme. The ‘Scottish Power Connect’ system is feeding into requirements in Scotland and Northern Ireland with CO detection being mandatory in new build homes, and with installation of new or replacement appliances.

112 For example, see details of the Gas Distribution Network / Smart Compliance / Energy Innovation Centre partnership: [www.northerngasnetworks.co.uk/2014/10/trial-of-an-innovative-new-type-of-carbon-monoxide-detector-that-will-save-lives](http://www.northerngasnetworks.co.uk/2014/10/trial-of-an-innovative-new-type-of-carbon-monoxide-detector-that-will-save-lives).

113 Tony Fadell, Nest, see: [www.theguardian.com/business/2014/nov/16/ipod-tony-fadell-nest-thermostat-innovators](http://www.theguardian.com/business/2014/nov/16/ipod-tony-fadell-nest-thermostat-innovators).

114 See: [nest.com/uk/smoke-co-alarm/life-with-nest-protect/](http://nest.com/uk/smoke-co-alarm/life-with-nest-protect/).

115 Oral evidence, British Gas Connected Homes (October 2014) & Scottish Power Connect (October 2014).

## Audience and Targeting

The audience for such technologies is generally seen as a young and tech-savvy one. Research by Nesta identified and segmented this group as ‘innovation futurists’, and highlighted that as many as 19 per cent of the UK population fall into this group.<sup>116</sup> Further audiences to target continue to be researched.

Smart alarms and connected homes systems can play a relevant part in increasing safety for other groups. Interviews highlighted the emerging practice of ‘gifting’ systems to elderly or more vulnerable family members or friends, to ensure they are maintaining home temperature. Oral evidence highlighted that Housing Associations may also be encouraged to install such systems. Alarms can also be used as part of networks with the ability to “shut down the faulty appliance” and turn off the gas supply if relevant, while communicating with an outside system to keep track of various problems.<sup>117</sup>

## Data Collection and Use

Understanding and influencing behaviour requires relatively rich data. However, a long-standing problem of promoting CO safety is the lack of large, usable data-sets across fuel types on which to build and base conclusions.<sup>118</sup> This is not only a result of the difficulty of collecting and monitoring incidents due to their vague indicators, but also a lack of willingness by government or institutions to conduct research.

*“In the same way that black boxes on aircraft record a lot of information about what happened to that aircraft, there’s absolutely no reason why safety devices like CO alarms couldn’t do the same, and increasingly now the manufacturers have got that facility inside the unit.”<sup>119</sup>*

Connected alarm/monitoring technology should feed into the improving landscape of CO-incident recording.<sup>120</sup> However, the security of data is an ongoing discussion for smart meter and connected homes developers, especially with private companies independently involved in these large-scale projects.<sup>121</sup>

As these systems develop, a Standard should be developed, in conjunction with the roll-out of smart metering, to properly store, compare and use data for benefits to public health and vulnerability targeting. This could be developed through Ofgem licensing agreements, in conjunction with DECC plans for standards on smart meter data collection. Public Health England, as the body responsible for “researching, collecting and analysing data to improve our understanding of health and come up with answers to public health problems”,<sup>122</sup> should also play a major role.

116 See: [www.nesta.org.uk/publications/innovation-population](http://www.nesta.org.uk/publications/innovation-population).

117 Ibid., 95. Also see for example, the Gas Distribution Network / Smart Compliance / Energy Innovation Centre partnership *ibid.*, 112.

118 Ibid., 4, Section 1.2: ‘How common is CO poisoning?’

119 Ibid., 95.

120 The Gas Safety trust CO Portal ([www.gassafetytrust.org/co-portal](http://www.gassafetytrust.org/co-portal)) is an example of a developing data system. An example of the potential for data collection and use is shown in the July 2014 ‘Nest Protect in the real world: CO White Paper’. Findings from device analysis included the observed length of ‘CO events’ ranging “from 3 minutes to over 24 hours, with a median of 1 hour and 17 minutes”. Analysis within the Paper, albeit concerned with a range of countries with different alarm thresholds and regulations, concluded that “at least one million households across the US, UK and Canada are exposed to high levels of CO each year”. See [nest.com/blog/2014/06/16/nest-protect-in-the-real-world/](http://nest.com/blog/2014/06/16/nest-protect-in-the-real-world/) (Nest was repeatedly contacted for comment on the inquiry, but did not respond).

121 December 2014 UK Government Chief Scientific Adviser review: Internet of things: making the most of the second digital revolution ([www.gov.uk/government/publications/internet-of-things-blackett-review](http://www.gov.uk/government/publications/internet-of-things-blackett-review)).

122 See: [www.gov.uk/government/organisations/public-health-england/about](http://www.gov.uk/government/organisations/public-health-england/about).



## Liverpool John Moores University studies

Liverpool John Moores University (LJMU) has been carrying out different studies looking at CO alarm ownership and the levels of CO in homes since 2011. After CO was found, at varying levels, in all of the sample homes within the initial phase, the work has expanded to take into account different dwelling types, more rural areas, and different types of fuel for cooking and heating.<sup>123</sup>

The study now uses CO data loggers to build a more detailed picture. Fire & Rescue Services are utilised as trusted messengers to fit and record information about devices, and academics in Psychology and Public Health & Nursing are studying the effects and risk of the low-levels of CO and chronic poisoning detected.<sup>124</sup>

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<sup>123</sup> Ibid., 85; the findings of the Phase 1 study looking at the CO alarm ownership in Merseyside and Coventry.

<sup>124</sup> Written evidence, Dr. Andy Shaw, Liverpool John Moores University (December 2014).

## Medical and Healthcare Professionals

Medical and healthcare professionals have a vital role to play in the detection, diagnosis and treatment of CO poisoning incidents, as well as the prevention of further incidents. At the same time, the difficulty of diagnosing CO poisoning (its symptomology is similar to many other common, and potentially less serious illnesses) is well recognised, as is the recognition that official mortality and morbidity statistics underestimate the number of people affected.<sup>125</sup> Various respondents pointed to the need for increased awareness about CO amongst medical and healthcare professionals to support improvement in the diagnosis of low and acute level poisoning. Also identified was a need for enhanced methods of detection and treatment.<sup>126</sup>

Supporting the above changes is clearly an important task, and a large one; only a small set of relevant initiatives and tools is included here, as treating the topic in sufficient depth is out of the scope of this inquiry. At time of writing, the 'Medical and Healthcare Professionals Group' of the CO All Fuels Action Forum is developing a report that will explore and promote action on many of the areas above.<sup>127</sup>

The Department of Health (DH), along with Public Health England (PHE), has undertaken a number of initiatives to raise awareness amongst medical and healthcare professionals, as well as to support improved diagnosis. For instance, in 2013, the Chief Medical Officer, the Chief Nursing Officer and the Director of Nursing issued a joint letter to all medical and healthcare professionals that was designed to raise awareness of CO poisoning.<sup>128</sup>

The letter also includes a diagnostic tool that provides a useful mnemonic for practitioners to recall the core questions to ask patients in order to establish a possible CO poisoning diagnosis: 'C.O.M.A.'. It directs general practitioners to ask:

- **Cohabitees/companions**  
Is anyone else in the property affected (including pets)?
- **Outdoors**  
Do your symptoms improve when out of the building? ('better outdoors')
- **Maintenance**  
Are your fuel-burning appliances and vents properly maintained?
- **Alarm**  
Do you have a CO alarm?

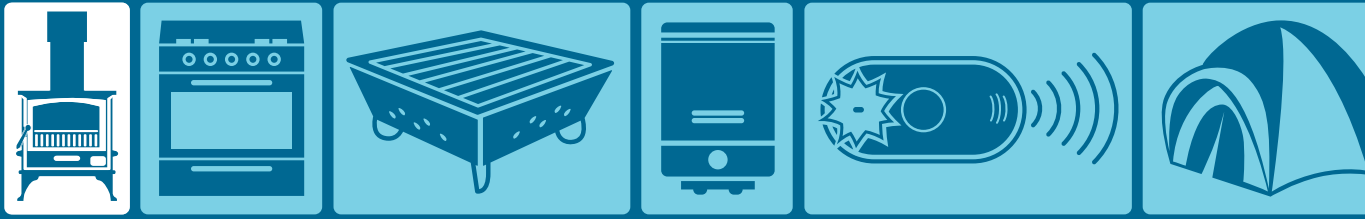
On account of the particular vulnerability of the developing fetus to CO poisoning, PHE has very recently developed a similar tool midwives can utilise, to help diagnose CO poisoning when assessing smoking status in pregnant women (see Appendix 4).

<sup>125</sup> Ibid., 3.

<sup>126</sup> Written evidence, Department of Health (May 2014).

<sup>127</sup> The CO All Fuels Action Forum Medical and Healthcare Professionals Group brings together a range of professionals to tackle and prepare for the problems of CO poisoning. Its review of current practice and priority actions to improve detection, diagnosis and treatment across the professions is expected in early 2015.

<sup>128</sup> Ibid., 3.



## CASE STUDY MIDWIFE ALGORITHM AND TARGETING KEY AUDIENCES

Public Health England and the Department of Health consider pregnant women to be a group that is particularly ‘at risk’ with regards to CO poisoning. This is due to the significant risk to the health of the developing fetus from CO exposure, as a result of fetal blood taking up CO more readily, and releasing it more slowly, than an adult’s. This means that the developing fetus can continue to be exposed to CO even after the mother is no longer facing exposure. Exposure by the fetus to CO has been linked to inter alia birth defects, fetal and infant mortality.

PHE, with support from DH and the Gas Safety Trust, has developed a diagnostic algorithm to support midwives who diagnose CO poisoning when assessing the smoking status of pregnant woman.<sup>129</sup> Using a breath analyser and a series of diagnostic questions, the tool helps to test for exposure to CO from smoking or other environmental sources, and outlines a series of actions that the midwife can advise to prevent further exposure, and for treatment, if applicable.

<sup>129</sup> Public Health England (2014) ‘Antenatal Checks: Carbon Monoxide’, see Appendix 4, and available at: [www.gov.uk/government/publications/carbon-monoxide-co-antenatal-checks-algorithm-for-midwives](http://www.gov.uk/government/publications/carbon-monoxide-co-antenatal-checks-algorithm-for-midwives).

These diagnostic tools are a good example of well-targeted high impact initiatives: they utilise those that are responsible for diagnosing (and treating) patients and that serve as trusted messengers at salient moments. It would be advisable for PHE and DH to assess the impact of these tools: asking, for instance, how frequently they are used and a diagnosis made, what preventative actions were advised by the midwife, what subsequent action was taken by women in which poisoning was diagnosed, and what resources were used.<sup>130</sup> This would provide important incidence data, and an understanding of the impact of the tool on the diagnostic and preventative behaviours of healthcare professionals and patients.

### **Recommendation 15**

Public Health England and the Department of Health should review the effectiveness of existing tools used by medical and healthcare professionals for approaching carbon monoxide issues with specific groups, such as algorithms for midwives, with a view to identifying and developing further examples.

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130 For example, TOXBASE and the National Poisons Information Service.

# Campsite and Boating Environments

This inquiry identified CO poisoning incidents occurring in ‘campsite and boating environments’ as a key issue to address. Although these are generally recreational environments, many comparable incidents occur in occupational settings.

Campaigning to improve CO awareness and safety in these environments is extremely difficult, especially as people may only be in such an environment for a short time. In addition, there is evidence to suggest that behavioural norms may be temporarily abandoned in the ‘holiday mind-set’.<sup>131</sup>

Building in safety measures, as has happened with some caravans and motor homes in recent years,<sup>132</sup> may therefore be the most effective route to improving safety in this context, in conjunction with increasing detection and knowledge.

In recent years, CO incidents in recreation environments have occurred in a variety of locations, with certain recurring patterns, such as the use of appliances and fuel types different to those found in the home.

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<sup>131</sup> Thomas (2005) sees data that “suggest that freedom from the constraints and realities of domestic life is a crucial aspect of the holiday experience”, and identifies a ‘liminoid period’ in which norms of behaviour are temporarily abandoned within the ‘holiday mind-set’. Thomas, M. (2005) ‘What happens in Tenerife stays in Tenerife’: Understanding women’s sexual behaviour on holiday. *Culture, Health & Sexuality: An International Journal for Research, Intervention and Care*, 7,6, available at: [www.tandfonline.com/doi/abs/10.1080/13691050500256807#.VF0s\\_vmsUmM](http://www.tandfonline.com/doi/abs/10.1080/13691050500256807#.VF0s_vmsUmM).

<sup>132</sup> See Appendix 3.

## Camping

### Gas Safety Trust Surveys 2012<sup>133</sup> and 2014<sup>134</sup>

3.7%

When asked what the biggest perceived danger of cooking when camping is, unprompted, only 3.7 per cent made reference to CO poisoning.

49%

Almost half of those questioned who had been to a festival in the last six months said that they would use a barbecue inside their tent.

61%

More than six in ten of the same festival-goers thought it safe to do the same with a gas cooker.

52%

Over half of the same group would use a cooking appliance to heat the tent.

Recent high-profile fatal incidents have highlighted the danger of using or keeping disposable and portable barbecues and camping stoves inside tents. With the increasing air-tightness of modern tent designs, and easy access to cheap disposable cooking devices, the risk continues to increase.<sup>135</sup> Incidents over the last 20 years have been spread across the population, although a certain trend has been identified, with incidents occurring more frequently in the autumn, with males between 30 and 50 years old appearing more likely to suffer an incident.<sup>136</sup>

One important issue to address is the counter-intuitive risk of seemingly inactive 'cooling down' barbecues. These are often brought inside tents by people anxious not to leave litter outside or hoping to reuse the appliance. However, in such a state they continue to pose a serious risk of CO poisoning. Research focussing on the technical aspects of cooling barbecues is important: traditional extinguishing methods, such as pouring on water, may actually increase the overall CO produced by interrupting the combustion process.<sup>137</sup>

Acting on recognition of the symptoms of CO poisoning is less likely to be successful in the campsite environment. The enclosed space is likely to speed the effects, and

<sup>133</sup> 3.7 per cent figure recorded in 2012: survey of 1800 campers, 84 per cent of who go once a year; 77 per cent have been in the last year; 60 per cent go at least twice a year. See: [www.gas-safety-trust.org.uk/2012/12/gas-safety-trust-camping-survey-results-june-2012/](http://www.gas-safety-trust.org.uk/2012/12/gas-safety-trust-camping-survey-results-june-2012/).

<sup>134</sup> 49 per cent, 61 per cent, 52 per cent figures recorded in 2014: an online poll of 2,000 people carried out by OnePoll on behalf of the Gas Safety Trust. See: [www.gas-safety-trust.org.uk/2014/06/festival-goers-urged-wise-dangers-carbon-monoxide-poisoning/](http://www.gas-safety-trust.org.uk/2014/06/festival-goers-urged-wise-dangers-carbon-monoxide-poisoning/).

<sup>135</sup> For example: Hannah Thomas-Jones, died of CO poisoning at a campsite after a used barbecue was left inside the porch of her tent in 2012: [www.bbc.co.uk/news/uk-england-21059594](http://www.bbc.co.uk/news/uk-england-21059594), and, Bethan O'Brien died after using a camping stove in 2013: [www.northdevongazette.co.uk/news/coroner\\_warns\\_against\\_barbecues\\_in\\_tents\\_after\\_carbon\\_monoxide\\_death\\_1\\_3696510](http://www.northdevongazette.co.uk/news/coroner_warns_against_barbecues_in_tents_after_carbon_monoxide_death_1_3696510).

<sup>136</sup> Ian Hewlett, Camping & Caravanning Club, oral evidence (October 2014).

<sup>137</sup> Roland Wessling, citing MSc research at Cranfield University, oral evidence (October 2014).

occupants may be asleep when CO builds to dangerous levels. Inquiry evidence highlighted that tents purely designed for habitation rather than as a place in which to use fuel burning appliances are extremely vulnerable to CO retention at dangerous levels, due to the minimal ventilation requirement specified.<sup>138</sup>

Preventing improper appliance use is essential in order to combat this issue. Although CO poisoning is unlikely to occur in tents if a combustion source is not present, the use of alarms can also offer peace of mind and has been encouraged in recent years. Packaging and warning labels have also increased in prominence, and distributors of barbecues are encouraged to highlight the dangers of misuse.

### Roland Wessling

Inquiry Advisory Board member Roland Wessling lost his partner Hazel Woodhams to CO poisoning after bringing a cold-to-the-touch bucket barbecue inside a tent before going to sleep.<sup>139</sup>

*“It was a lovely summer’s evening. We stayed outside, chatting and reading until the barbecue embers had burnt out. Two hours later, we carried the barbecue inside our tent so it wouldn’t get wet if it rained. By now there was no heat in it at all.*

*“A few nights earlier a bird had flown into our tent, so we zipped the door carefully to seal all the gaps.*

*“When I woke it was daylight. I felt disorientated and my right arm, trapped beneath me, was completely numb. My senses were screaming that something was terribly wrong. With huge effort, I reached over to touch Hazel, lying a few feet away.*

*“Hazel and I had both been very conscious of CO poisoning. We even had a detector we took with us when we travelled, but it hadn’t crossed our minds to bring it camping.”*

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<sup>138</sup> Ibid., 136; ventilation requirements contained within BS EN ISO 5912 only require a minimum of two ventilation openings of at least 100cm<sup>2</sup>. The increasing air-tightness of tents due to sewn-in groundsheets, combined with increasing caravan safety, has led to a shift in location of CO incidents, with data showing relevant incidents were based mainly in caravans “up to 2008, and since then it has been all tents”.

<sup>139</sup> See: [www.theguardian.com/lifeandstyle/2013/jul/20/experience-partner-killed-by-barbecue](http://www.theguardian.com/lifeandstyle/2013/jul/20/experience-partner-killed-by-barbecue).

## Proposals for Safer Camping

### a. Clearer Risk Information

Making product information as clear as possible is an essential safeguard. All disposable barbecues come with detailed warnings that they are not for use in an enclosed/poor ventilation areas. However, these warnings are not always effective. Simplifying information, making it more prominent and including pictograms where possible, should improve effectiveness.<sup>140</sup> Particular attention should be given to the discussed recreation 'mind-set' when designing labelling.

### b. Segregated Cooking Areas

In order to bypass lack of awareness of the risk of CO poisoning, campsites can provide clearly marked 'barbecue areas'. These can be a comfortable and convenient location for people to safely use their appliances, and are a useful, salient setting for the provision of safety warnings, such as 'leave your barbecue behind – don't take it back to your tent'.<sup>141</sup> As officially-marked areas, linked with fire safety, it is likely that their importance will be recognised.

## Recommendation 16

All campsites should provide isolated, clearly marked areas for barbecue use and disposal.

### c. Provision of Alarms

Tragic incidents highlight the importance of understanding the different sources of CO poisoning. People who possess alarms and a basic awareness of CO at home may not understand the risks of portable, recreation appliances. Those with no awareness of CO may be at a high-level of risk due to their holiday mind-set. In these cases provision of equipment (such as 'travel' or ruggedized CO alarms)<sup>142</sup> may be the only method for guaranteeing information gets through.

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<sup>140</sup> Ibid., 136.

<sup>141</sup> The Camping & Caravanning Club "has been raising awareness of the dangers of CO for the last few years in light of the increase in incidents on campsites", including placing posters and leaflets throughout their network, and providing CO leaflets to every camper on arrival. Camping & Caravanning Club, written evidence (May 2014).

<sup>142</sup> See 'Alarm Suitability' section on page 73: alarms should be designed to be hard-wearing.



## Alarm Suitability, Availability and Action

### 1. Alarm Suitability

Many CO alarms are now tested for use in caravans and boats, and some tent manufacturers have agreed that they will promote alarm use, partly through novel tent design features such as internal pockets for alarms.<sup>143</sup> With alarms becoming more robust and adaptable to more environments, their ease and reliability of use increases.

Zoe Forman, PR consultant to CoGDEM, highlighted that:

*“the technology has not gone into the tents, but the alarm technology can now go into environments like tents and caravans. Go back five years, the condensation, the coldness and so on would have meant that the circuits and sensors would not have been up to the task.”*

Issues surrounding alarm portability arose frequently in oral evidence. The current alarm Standard requires that alarms cannot be disabled. This makes it difficult to carry alarms in aircraft hold luggage and other similar environments without risk of the alarm sounding when not required. Battery removal is not possible in all alarms, and is not as convenient a solution as a temporary on-off switch.

A new ‘Innovation Standard’, as recommended in the ‘Detection and Technology’ section, should be created in order to remove such issues. Such alarms could feature rechargeable batteries for use during shorter periods, and should be designed specifically for those environments mentioned.

### 2. Alarm Availability

The EAST model emphasises the importance of desired actions being easy and timely. It must be made easy for people to act on recommendations<sup>144</sup> to carry and use CO alarms in leisure environments. Campsites and leisure shops should display information messages advising alarm use, and should offer alarms for rent or sale to enable tourists to take heed of the advice with little effort.

People may be unlikely to want to buy a new alarm, especially if they already own one at home. As such, alarm rental schemes, potentially incorporating the on/off ‘leisure alarms’ mentioned above, should be on offer at campsites and other suitable areas. Local Authorities, as the licensing bodies for small-scale camping and caravan sites, could require the availability of CO alarms, in a similar style to fire buckets.

## Recommendation 17

All recreation parks should offer suitable carbon monoxide alarms to purchase, or loan for the duration of stay. These could include those developed through a new, ‘Innovation Standard’ to ensure optimal performance in these environments.

<sup>143</sup> Ibid., 136.

<sup>144</sup> For examples of these recommendations, see the June 2014 Gas Safety Trust press release: [www.cumbriacrack.com/2014/06/19/festival-goers-urged-wise-dangers-carbon-monoxide-poisoning/](http://www.cumbriacrack.com/2014/06/19/festival-goers-urged-wise-dangers-carbon-monoxide-poisoning/), and the Camping & Caravanning Club: [www.campingandcaravanningclub.co.uk/helpandadvice/camping-safety/carbon-monoxide-poisoning/](http://www.campingandcaravanningclub.co.uk/helpandadvice/camping-safety/carbon-monoxide-poisoning/).

### 3. What's the Recommended Action?

Once an alarm activates, there needs to be an easy and obvious action for people to follow. Often, alarms carry the telephone number of the gas emergency helpline. However if the alarm sounds in a tent, or in a leisure environment with little telephone reception, then this may not be of use. The alarm itself may be the only source of information available.

#### **Recommendation 18**

Carbon monoxide alarms should display clear 'next steps' following an alarm activation, either on a fold-away area or on the external casing, including moving to a ventilated area and calling a relevant emergency service. These instructions should differ for 'outdoor environment' alarms designed through a new, 'Innovation Standard'.

## Festivals

Large, temporary accommodation areas such as those at festivals contain many different locations of CO risk, including tents, caravans, catering vans and so on. Although there are greater safety oversight requirements for such events and areas than small campsites, the variety of environments and people make it hard to identify any trends in behaviour and incidents. Separate to this, the reporting and analysis of incidents is difficult due to the lack of a trusted, centralised and complete incident-tracking system to refer to, limiting the quality of data available for analysis.<sup>145</sup>

The same could be said for leisure contexts more broadly, and there is an urgent need for relevant CO risk and exposure research projects in these environments, comparable to that conducted by Liverpool John Moores University in homes.<sup>146</sup> As suggested in the 'Detection and Technology' section, an improved incident recording system for CO, combined nationally, would allow for a better-evidenced strategy.

### Recommendation 19

Public Health England should commission and support a study of low-level carbon monoxide exposure in leisure and recreation environments, similar to those undertaken in homes by Liverpool John Moores University.

Devon and Somerset Fire & Rescue Service undertake a range of activities at festivals in their area, including provision of alarms to the working communities of gypsies, travellers and showmen, with at least one recent example of lives saved.<sup>147</sup> Evidence from Devon & Somerset FRS highlighted:

*“Raising awareness of the risks associated with CO is a challenge for us... We get such a wide range of that risk for such a narrow period of time.”<sup>148</sup>*

Campaigns targeting the catering staff at festivals have also been identified through UKLPG, in partnership with the Nationwide Caterers Association. These have focussed on adherence to regulations and instructions.<sup>149</sup>

Glastonbury Festival utilises safety posters and tasks stewards and safety officers with walking around the site, looking for potential hazards and encouraging campsite 'communities' to look out for those around them.<sup>150</sup> For festivals more generally, using trusted messengers at salient moments within the festival will be an effective safety method, along with implementing campsite barbecue areas.

145 A desire to see an easy, centralised reporting system for CO incidents was highlighted repeatedly during oral evidence. The Gas Safety Trust is leading and supporting a number of projects aimed at increasing and coordinating data gathering of such incidents.

146 See the Liverpool John Moores University Projects outlined on page 65.

147 See: [www.dsfire.gov.uk/news/newsdesk/PressReleaseArticle.cfm?ReleaseID=1239&siteCategoryId=3&T1ID=26&T2ID=36](http://www.dsfire.gov.uk/news/newsdesk/PressReleaseArticle.cfm?ReleaseID=1239&siteCategoryId=3&T1ID=26&T2ID=36).

148 Dave Church, Devon and Somerset Fire & Rescue Service, oral evidence (October 2014).

149 See: [www.uklpg.org/advice-and-information/news-room/uklpg-and-ncass-highlight-the-safe-use-of-lpg-for-growing-uk-catering-market/](http://www.uklpg.org/advice-and-information/news-room/uklpg-and-ncass-highlight-the-safe-use-of-lpg-for-growing-uk-catering-market/).

150 Press Release - Michael Eavis supporting fire safety at Glastonbury Festival, see:

[www.dsfire.gov.uk/News/Newsdesk/PressReleaseArticle.cfm?ReleaseID=1386&siteCategoryId=3&T1ID=26&T2ID=36](http://www.dsfire.gov.uk/News/Newsdesk/PressReleaseArticle.cfm?ReleaseID=1386&siteCategoryId=3&T1ID=26&T2ID=36).

A multiplier effect of safety-awareness can occur with increasing risk recognition within these campsite communities. This can be encouraged by festival staff acting as ‘safety ambassadors’, with clear messaging targeted at the festival population demographic. The wider network of fire staff, stewards and site workers should receive a brief about recognising CO hazards during their site training.

### Recommendation 20

Festival organisers should ensure that staff receive carbon monoxide promotional material and information during training, to enable them to act as trusted ‘safety ambassadors’ internal to the festival population and create a multiplier effect of safety awareness. Ambulance and medical staff at each festival should be a part of this process.

### Campaigns

As highlighted previously, a single warning symbol or icon would function as a valuable trigger in people’s minds, to unify and simplify warnings encouraging the recognition of CO poisoning symptoms.<sup>151</sup> This is especially important in recreation environments due to the unfamiliar and short-term risks faced;

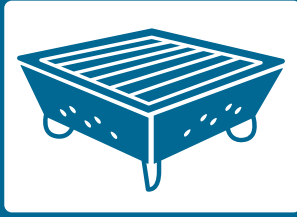
*“People are relaxing in a leisure or recreational environment, and therefore they don’t really apply what they would at home. They don’t necessarily take a common sense approach and apply it.”<sup>152</sup>*

The campaign should build upon existing efforts, such as the coordinated campaign by the Gas Safe Register and UKLPG.

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151 Graham Watts, Boat Safety Scheme, oral evidence (October 2014).

152 Lisa Thomson, UKLPG, oral evidence (October 2014).



## CASE STUDY

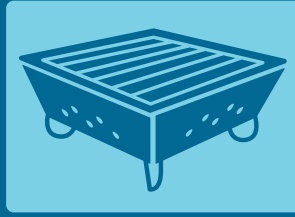
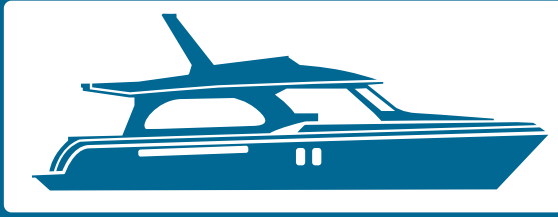
### GAS SAFE REGISTER & UKLPG CAMPAIGN

The Gas Safe Register has recently run campaigns in conjunction with UKLPG to improve CO safety in recreation and leisure environments.<sup>153</sup> These focussed on the use of charcoal and gas barbecues in confined spaces. They also raised awareness of general gas safety risks on holiday, following 12 deaths and 28 recorded injuries between 2011 and 2013.

The campaign worked in close partnership with Fire & Rescue Services across several counties and had key support from CO charities (in particular the Dominic Rogers Trust), Glastonbury Festival, Go Outdoors, British Gas, and the Camping & Caravanning Club. Using TV appearances, social media, online exposure, and radio and print coverage, the campaign had a 'reach' in excess of 150 million people during the summer months of 2013.

These partnerships allowed a single branding and message to be applied, increasing the likelihood of recognition and resulting action, especially in conjunction with the same work done in the domestic home environment.

<sup>153</sup> Gas Safe Register, written evidence, (May 2014).



## CASE STUDY

### WHITBY HARBOUR INCIDENT: MAIB INVESTIGATION AND REPORT

The Whitby harbour incident which occurred in January 2014 on a fishing vessel is indicative of some of the CO risks on boats, and highlights priority actions necessary for promoting safety. According to the Marine Accident Investigation Board (MAIB) accident report,<sup>154</sup> on 15 January 2014, two fishermen were found in the bunk on the fishing vessel *Eshcol* in Whitby, Yorkshire. The men had died from CO poisoning, a result of the grill of a butane-fuelled gas cooker being used for warmth.

As in the other boat-related cases over the year, there were particular features of the *Eshcol* case that contributed to the tragedy. The *Eshcol* was not well-equipped for overnight sleeping, and it was likely that the fisherman were extremely tired and cold. The cooker was four years old and was unlikely to have been serviced in this time. Neither the guidance on installation of gas appliances on board fishing vessels, nor the manufacturer's instructions, had been followed when the cooker was fitted. No audible CO was alarm installed on board.

<sup>154</sup> Marine Accident Information Branch (June 2014). 'Very Serious Marine Casualty Report No 14/2014: Report on the investigation of CO poisoning on board the fishing vessel *Eshcol* resulting in two fatalities Whitby on 15 January 2014'.

## Boating

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Three high-profile incidents of accidental CO poisoning occurred on boats over a 10 month period in 2013-14, and resulted in five fatalities. All involved the boat owner or its occupants altering the boat or using appliances for purposes other than intended, leading to build-up of fatal CO gas in living quarters.<sup>155</sup> In none of the cases was an audible CO alarm present. These cases arose in both leisure and professional settings, each of which has associated but different legal responsibilities.<sup>156</sup>

Boats can provide a high-risk environment for CO poisoning: engines, cooking and heating equipment often produce the gas in close proximity to confined habitable quarters. Due to this enclosed atmosphere, small changes to ventilation systems and/or the misguided use of fossil-fuelled equipment can easily have unforeseen and unintended consequences, even if boat users are aware of safety literature. As such, the use of an alarm is vital.<sup>157</sup>

During oral evidence, it was highlighted that in some of the fatal incidents, tiredness and/or the cold caused strain on boat-users, causing them to increase risk by closing windows and reducing ventilation in the cabin. Tackling these problems is extremely challenging; building-in safety measures, including the use of Standard-compliant alarms, will circumvent the difficult conditions.

One such incident was a double fatality on the fishing vessel *Eshcol*. In its report into the incident, the Marine Accident Investigation Branch (MAIB) made a number of recommendations, including awareness-raising campaigns and the alignment of regulations covering gas installations across vessel types. The mandatory installation of CO alarms in the accommodation on all small fishing vessels was also recommended.

This latter recommendation is highly relevant across different boating contexts, especially to situations where boats have multiple, temporary occupants and are used for leisure, with the associated altered attitudes to risk. These contexts may lead to a limited or absent appliance maintenance regime and a propensity to use appliances for purposes other than intended.

Detection therefore becomes increasingly important as a line of defence against CO poisoning. Audible, Standards-compliant CO alarms should be the norm in the wheelhouses and areas designated for accommodation on all vessels, regardless of size and context.

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155 Tony Brown, Marine Accident Investigation Branch, oral evidence (October 2014).

156 HSE gas appliance regulations apply to houseboats, where the boat is used solely or primarily for domestic or residential purposes. Also included are those hired out in the course of business (e.g. holiday accommodation) and those made available to the public in the course of business (such as floating restaurants). Privately owned boats used for leisure and not hired out are not captured by the regulations.

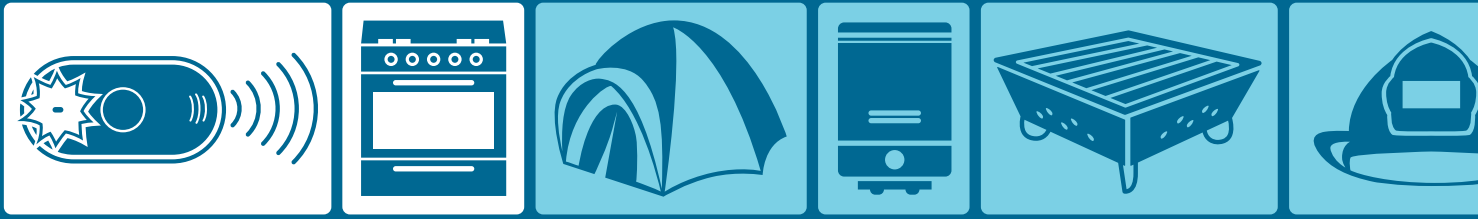
157 Ibid., 155.

### Recommendation 21

The Maritime and Coastguard Agency, in line with the 2014 *'Eshcol'* Marine Accident Investigation Branch Report, should include in the Code of Practice for the Safety of Small Fishing Vessels a requirement for a Standard-compliant carbon monoxide alarm to be fitted in the accommodation on all vessels. Similar requirements should be carried over to vessels used on inland waterways, including those for hire and other purposes, regardless of the fuel type used on board.

Organising 'default' safety requirements and recommendations through large, national bodies is an effective way of highlighting issues, especially to those who are new to the problem. An example of this, which could be applied to the boating sector, is provided by the NCC with CO alarm fitting in new caravans and other leisure vehicles (see Appendix 3).





## CASE STUDY A COMPARABLE CO RISK ENVIRONMENT – FLOODING

Risk-creating behaviours during flooding incidents provide an analogous example of a temporary and unfamiliar behavioural mind-set, and have received increased media exposure recently. CO poisoning risk is increased as the use of outdoor generators to clear homes, along with changes to ventilation levels, combines with a ‘distressed’ mind-set and the use of technology in an environment it is not intended for.<sup>158</sup>

The irregular nature of the hazard means that advice and information has to be timely, with short-term, targeted campaigns. As an example, during the February 2014 UK floods, Public Health England produced radio adverts containing key messages on staying safe and well when cleaning up. These were broadcast for two weeks on commercial radio stations in areas affected by the flooding.<sup>159</sup>

Similarly, the Devon and Somerset Fire & Rescue Service, which deals with a range of CO risk environments, use a range of engagement strategies including local partnerships with staff and village agents to prepare for “those changing their heating and cooking habits while cut off” during floods.<sup>160</sup>

Due to the transient nature of the population moving through the area, a constant stream of messages and interventions through a variety of channels has been agreed as suitable, using radio safety messages, local press, promotional partnerships, community talks and forums, and event engagement.

158 The difficulty of predicting behaviour in the home environment, and the problem of behaviours in the home often being difficult for technology designers to foresee, were highlighted during oral evidence given by Professor Patrick Devine-Wright, University of Exeter (October 2014).

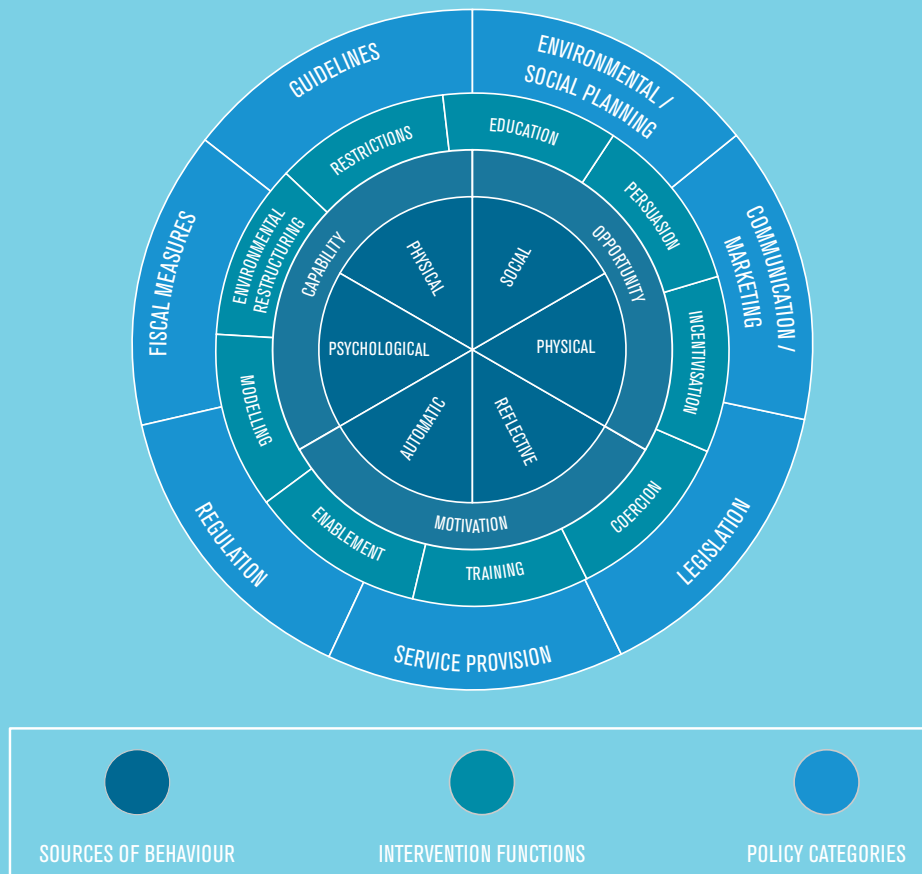
159 See: [www.gov.uk/government/news/radio-adverts-launched-to-help-safeguard-flooding-clean-up-operation](http://www.gov.uk/government/news/radio-adverts-launched-to-help-safeguard-flooding-clean-up-operation).

160 Devon and Somerset Fire & Rescue Service, written evidence (October 2014).

# Appendices

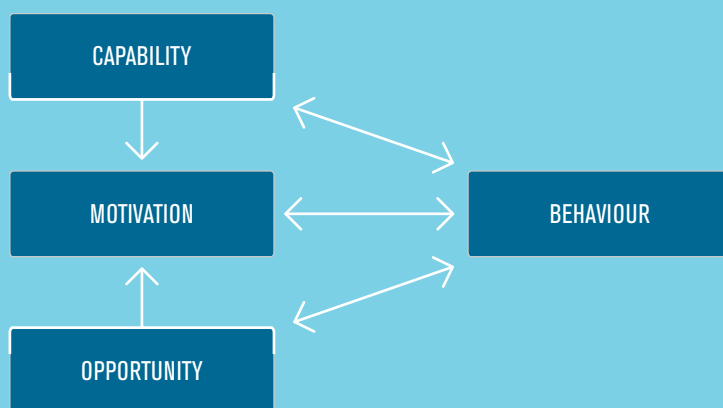
## Appendix 1: The Behaviour Change Wheel

A further option for designing interventions is the Behaviour Change Wheel, which brings together nineteen frameworks of behaviour intervention identified through a systematic literature review into a three-stage process represented by a wheel (Appendix figure 1).



Appendix figure 1: The Behaviour Change Wheel

The wheel ‘hub’ initially is used to identify the sources of the behaviour that could “prove fruitful targets for intervention”,<sup>161</sup> using the COM-B (‘capability’, ‘opportunity’, ‘motivation’ and ‘behaviour’) model of behavioural components (Appendix figure 2). An intervention might change one or more of the components that shape behaviour within the three-pronged COM-B system, and the ‘causal links’ within the system can work to “reduce or amplify the effect of particular interventions by leading to changes elsewhere”,<sup>162</sup> in a given context. Following this initial stage and depending on the particular COM-B analysis conclusions, the wheel’s second layer of nine intervention function options comes into play, and seven outer layer policy categories are used to support the delivery of these intervention functions.



Appendix figure 2: The COM-B Model

161 See: [www.behaviourchangewheel.com/about-wheel](http://www.behaviourchangewheel.com/about-wheel).

162 Ibid., 11.

## Appendix 2: Inquiry Focus Group

The inquiry conducted a focus group session with a group of older people in Knowsley, Merseyside.<sup>163</sup> Within the group, different housing and heating types were used and highlighted, and certain key conclusions of relevance to CO safety were identified.

The group affirmed the need for greater awareness of CO risk to prompt safe behaviours. While the focus group was reasonably well-informed about CO and what to do to minimise risk, awareness and understanding of the issue came up as a cross-cutting issue when participants were asked what would support increased alarm ownership and annual servicing.

For those that organised their own annual servicing, service contracts with their gas suppliers, and stickers left on boilers with servicing reminders, acted as effective stimuli. For those without a contract, and where they had expired, servicing was done 'as and when needed', with cost, trust and reliability serious considerations for the group. Age- and circumstance-appropriate advice is important to promote safe behaviours. Numerous participants identified trust issues with engineers, citing previous experience with 'cowboys' and their advice on suitable equipment. Trust and 'peace of mind' with inclusive services, such as 'Care and Repair' schemes, were emphasised.

Cost was cited as a factor to take into consideration, across both servicing and alarm purchasing. Even the relatively low cost of a CO alarm was something that could be prohibitive, especially if the safety implications were not understood. Weekly-payment Carelink alarms, with a CO detection bolt-on available, are offered and part-subsidised through the Local Authority.

Safety media campaigns timed to different points of the year, especially the autumn, and notices at GP surgeries were highlighted as potentially successful avenues. Legal requirements and direction, especially around the requirement to fit CO alarms in certain situations, were emphasised as particularly important.

Two innovative campaign forms were particularly highlighted; drama workshops and community messaging services:

- The group had witnessed drama presentations on a number of issues of safety or importance.<sup>164</sup> Following one-such performance on CO, a participant identified a friend's symptoms as CO poisoning, and ensured they had their appliances checked.
- The Knowsley Local Authority community messaging service, which uses telephone calls, text messages and emails to provide a useful outlet for safety messages that are free for households to access, though incur some cost to Local Authorities. This service was previously run by local police to provide crime updates.

<sup>163</sup> The session was conducted in October 2014 through Healthwatch Knowsley; the host organisation of Knowsley Older People's Voice, which gives those who use health and social care services an opportunity to have their say on local provision. See [www.healthwatchknowsley.co.uk](http://www.healthwatchknowsley.co.uk) and [www.kopv.org.uk](http://www.kopv.org.uk).

<sup>164</sup> Separately, Wales & West Utilities has worked in partnership with the Royal Welsh College of Music & Drama to create a carbon monoxide 'puppet' which has been used for dramatic performance. See: [youtu.be/RDLYiXwevE8](https://youtu.be/RDLYiXwevE8).

### **Appendix 3: Leisure Vehicles, Caravans and Holiday Parks**

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Organising 'default' safety requirements and recommendations through large, national bodies is an effective way of highlighting issues to people, especially those who are new to an area or issue, and may not want to have to consider safety while on holiday. Caravan-based CO incidents have reduced in number in recent years, which may be due in part to increasing standards of safety and alarm provision.

NCC<sup>165</sup> product-approved caravan holiday homes and residential park homes require a minimum of two CO detectors to be fitted. Touring caravans and motorhomes require one alarm. Other vehicles in the market are not required to meet these requirements.<sup>166</sup> Servicing of appliances and testing of CO alarms within caravans is also encouraged through NCC Approved Workshop Schemes.

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<sup>165</sup> The NCC is the UK trade body for the tourer, motorhome, caravan holiday home and residential park home industries.

<sup>166</sup> Stephen Hickey, oral evidence (October 2014).

## Appendix 4: Antenatal Checks: Carbon Monoxide

Public Health  
EnglandAntenatal Checks:  
Carbon Monoxide (CO)

## Testing for exposure to CO from smoking or other sources

**Inform the woman** *Why the test is important, what the procedure is for taking the test and that you will provide solutions to reducing her exposure to CO, if levels are higher than expected*

**Ask the woman** *Approximately what time did you leave home?  
Are you lactose intolerant? (if not already known)*

1

Woman breathes into analyser

**Reading >5 ppm**

Tell the woman her reading is higher than 5 ppm and she is exposed to sources of CO.

**Reading is 5 ppm**

Tell the woman her reading is 5 ppm and she could be exposed to sources of CO.

**Reading <5 ppm**

Tell the woman her reading is less than 5 ppm and she is unlikely to be exposed to smoke or other sources of CO.

2

Compare the reading with previous readings (*if none available, go to box 4*)**Reading is higher or the same as previous readings**

The woman may not be compliant with her smoking cessation programme **OR** she could be exposed to other sources of CO.

**Reading is lower than previous readings**

She is compliant with her smoking cessation programme **OR** a previously identified environmental exposure has ceased. But if a previous smoker has stabilised at a level above 5 ppm (see notes) she could be exposed to other sources of CO.

3

You are suspicious: the woman could be exposed to environmental sources of CO

Ask the woman

*Have you smoked or been exposed to smoke in the last 12 hours?*

No

**You are confident:**

- the woman is not exposed to other environmental sources of CO
- if the woman is an active smoker refer her to NHS stop smoking services
- if the woman's partner is an active smoker discuss ways to reduce her exposure and advice on quitting for her partner

Yes

4

Could this be a case of environmental CO poisoning? (*Positive responses raise suspicion*)

Ask the woman

*Does your work involve possible exposure to smoke, fumes or motor vehicle exhaust?*

*Do you have gas, oil or solid fuel appliances in your home?*

*Do you ever use your gas stove or oven for heating purposes as well as cooking?*

*Has there been any change in ventilation in your home recently (eg fitting double glazing)?*

*Do you or any other occupants in your home suffer from headache, flu-like symptoms, drowsiness and/or nausea?*

*Is your home detached, semi-detached, terraced, flat, bedsit, hostel or mobile home?*

5

You are suspicious: this could be a case of environmental CO poisoning

Action to take

Recommend that the woman:

- does not use any appliance she identifies as being a possible source of CO
- contacts an appropriately registered engineer to check all household gas, oil or solid fuelled appliances
- contacts her GP or attends a hospital emergency department, especially if she also has young children
- installs a CO alarm (EN 50291 compliant)

*You should* notify the local PHE health protection team (HPT)

6

See over for notes on boxes 1–6

For advice from the National Poisons Information Service on clinical management, consult the TOXBASE® website, [www.toxbase.org](http://www.toxbase.org), or phone 0844 892 0111.

**Notes**

**Carbon monoxide, smoking and pregnancy**  
 CO is produced when tobacco products are burnt. It is found in inhaled, exhaled and sidestream smoke. CO levels in the exhaled breath of smokers are higher than those in non-smokers. Those exposed to sidestream smoke may have higher levels of CO in their exhaled breath than non-smokers. Analysis of exhaled breath is a useful indicator of exposure to CO and to tobacco smoke. CO can also be emitted from malfunctioning or poorly ventilated fossil or wood fuelled heating and cooking appliances. Ruling out alternative sources of exposure is important – it could save the fetus and woman's life.

**Box 1 Taking the test**  
 Helping pregnant women to quit smoking is important. Some pregnant women find it difficult to say that they smoke. For pregnant women who do not smoke, they should be made aware of other sources of CO.  
 CO levels in blood decline with a half-life of about 6 hours. Asking the woman what time she left home might provide an indication as to whether domestic exposure to CO is likely to be identified. A lactose-intolerant woman can produce a higher reading than a non-smoker.

**Box 2 Informing the woman of the breath test result and what this might mean**  
**CO reading**  
**>5 ppm** If she is not a smoker, is the reading high enough to raise suspicion? Go to box 5 to ensure the woman is not being exposed to levels of CO from other sources.  
**5 ppm** The woman is exposed to CO. You need to establish the source of CO exposure.  
**<5 ppm** The woman is unlikely to be exposed to smoke or other sources of CO.  
*Note: For smoking cessation purposes, stabilisation at <5 ppm shows compliance with the programme. For women who stabilise at 5 ppm, it is recommended that the questions in box 5 are asked as a precautionary measure to eliminate the possibility of exposure to other sources of CO.*

**Box 3 Carbon monoxide reading not decreasing**  
 Compare each reading with readings taken on any previous visits to the clinic. Establish why expected decreases in CO levels are not occurring. Is the woman complying with the smoking cessation programme? Is the woman exposed to other sources of CO?

**Box 4 Exposure to tobacco smoke**  
 Encourage the woman to quit smoking if she is an active smoker. Encouraging other members of the household to quit is important for the woman, and her fetus and its future health.

**Box 5 There are many sources of carbon monoxide**  
 The source of CO may be found in the home, car or workplace. Gas, oil, coal and wood heating appliances are the most common sources in the home other than tobacco smoke. More than one appliance may be causing the problem. Inappropriate appliance use and inappropriate use of generators and BBQs indoors can lead to a build up of potentially fatal CO.  
 It is also worth asking: "Has an appliance been newly installed?" or "Have you recently started to re-use heating appliances/boilers after the summer break/during an unexpected cold spell?"  
 Recent fitting of double glazing or blocking vents will suddenly reduce ventilation. If there is a problem appliance, CO will build up in the property.  
 CO is a mimic, simulating other more common conditions including flu-like illnesses, food poisoning, headache and depression. Headache is the most common symptom.  
 Poisoning can occur in all income groups and types of housing.  
 CO can leak into a semi-detached or terraced house/flat from neighbouring premises.

**Box 6 Stopping further exposure is essential**  
 Preventing further exposure is the most important thing you can do. Advise the woman on returning home to turn off all fossil fuelled appliances, open windows, make sure other occupants are safe and contact an appropriately registered engineer to check appliances. Any occupant experiencing any of the symptoms listed above should seek medical attention immediately.  
 Recommend the purchase of an audible CO alarm for installation in the home, but stress that an alarm is not a substitute for regular maintenance of appliances by an appropriately registered engineer.  
*It is essential that you contact your local HPT to notify them of your suspicions. The team will be able to coordinate services to help protect the woman if necessary.*

**Useful contact numbers**

999	0800 111 999	0800 408 5500	0800 300 363
Ambulance/Police	Gas Emergency	Gas Safe Register	HSE Gas Safety Line
0844 892 0555	01684 278170	0845 658 5080	111
Local HPT	HETAS (solid fuel)	OFTEC (oil)	NHS 111

For queries or feedback on this card please email [cofeedback@phe.gov.uk](mailto:cofeedback@phe.gov.uk)



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# Glossary and Abbreviations

APPCOG	The All-Party Parliamentary Carbon Monoxide Group, the leading forum for Parliamentarians to discover, discuss and promote ways of tackling CO poisoning in the UK.
CFOA	The Chief Fire Officers Association, the professional body representing senior fire officers in the UK.
CO	CO is the chemical symbol for carbon monoxide, a colourless, odourless, tasteless and highly poisonous gas that is commonly produced when carbon-based fuels (such as wood, oil and gas) do not burn properly.
CoGDEM	The Council of Gas Detection and Environmental Monitoring, the trade body of the gas detection, gas analysis and environmental monitoring industry.
Competent person	A competent person has sufficient training and experience or knowledge and other qualities that allow them to perform certain works. There are various industry- and government-operated schemes that provide consumers with verification of competence by engineers that work on appliances that may produce CO. The Gas Safe Register is not technically a competent person scheme, but in practice its installers have the same responsibilities for complying with building regulations.
Connected home	A connected home is networked so that multiple services, such as healthcare, energy and media, and home automation, are delivered over broadband internet.
Discretionary Rewards Scheme	The Discretionary Rewards Scheme (DRS) is administered by Ofgem and is designed to incentivise the Gas Distribution Networks to promote improvements in environmental performance, affordability and safety of gas distribution. Safety initiatives promoted under the DRS include those related to CO awareness.
DCLG	The Department for Communities and Local Government, within the UK Government.
DECC	The Department of Energy and Climate Change, within the UK Government.
DH	The Department of Health, within the UK Government.
Gas Distribution Networks (GDNs)	Gas Distribution Networks (GDNs) are the companies responsible for the connections from the pipes of the main gas transmission system up to a household's gas meter. They have specific responsibilities related to gas emergency response, with their Gas Emergency Service personnel attending incidences of gas escapes and reports of carbon monoxide exposure.
MINDSPACE	MINDSPACE is a mnemonic setting out nine influences on behaviour, developed by the Cabinet Office and the Institute of Government.
NCC	NCC, formerly the National Caravan Council, is the body that represents the motorhome, holiday home and park home industries in the UK.



Ofgem	Ofgem is the regulator of the electricity and gas markets in Great Britain.
PAPM	The Precaution Adoption Process Model. It is used to understand how people go through certain, specific behavioural stages, moving from ignorance of a problem through to adoption and maintenance of certain behaviours.
Reachable moments	Reachable moments are those opportunities to engage directly with an individual whose behaviour is being targeted. For instance, this could include midwives using antenatal appointments as an opportunity to engage pregnant women about ways to keep themselves and the developing fetus safe from CO exposure.
Risk awareness	Risk awareness refers to a person's understanding of how dangerous a certain situation is to them. It entails more than a person simply knowing about a potential risk, but also an appreciation of how likely it is to happen to them, and its consequences.
Saliency	The term 'saliency' is used by behavioural scientists to describe the way in which people are more likely to respond to stimuli that are novel, simple, accessible, and of specific importance to them. For instance, the Gas Safe Register has developed a 'Gas Map', enabling the public to see how many unsafe gas fires, cookers and boilers have been found in an area, to make messaging more relevant to their surroundings.
Segmentation	Segmentation is a common tool used in marketing to divide consumers into groups, to enable firms to target them with specific products, advertising, and so forth. Behavioural segmentation is a more focused subset of this, which identifies and analyses the specific behavioural patterns of sets of people.
Smart alarms	Smart alarms, including smoke and CO alarms, perform additional functions to the detection and alerts performed by traditional devices, often through a connection to Wi-Fi or another telecommunications network. For instance, a smart CO device may communicate information about the extent and specific location of an incident in a property to a mobile phone, in addition to sounding an alarm at specified levels.
Triggers	In e behavioural context, triggers are important cues to action that can lead to the completion of certain behaviours. These may be deliberate and overt, such as a radio campaign during the heating system 'switch on' season, which reminds people to arrange a service for their gas boiler before the arrival of cold weather. Alternatively, triggers may be incidental, short-lived or even subconscious, such as the arrival of children causing a heightened concern about home safety and so the purchase by a new parent of a CO alarm.

# Contributors to the Inquiry

[AgeUK Knowsley & West Mersey](#)  
[Association of Gas Safety Managers](#)  
[Association of Plumbing and Heating Contractors](#)  
[Dr Lou Atkins, University College London](#)  
[Boat Safety Scheme](#)  
[Bord Gáis](#)  
[British Gas](#)  
[British Gas Connected Homes](#)  
[Camping & Caravanning Club](#)  
[Chief Fire Officers Association](#)  
[ChimneyDoc](#)  
[CO-Gas Safety](#)  
[Council of Gas Detection and Environmental Monitoring](#)  
[Cornwall Fire & Rescue Service](#)  
[Dr Rosie Day, University of Birmingham](#)  
[Department for Business, Innovation & Skills](#)  
[Department of Health](#)  
[Professor Patrick Devine-Wright, University of Essex](#)  
[Devon and Somerset Fire & Rescue Service](#)  
[Dying to Keep Warm](#)  
[Ecotech Building Management](#)  
[Ei Electronics](#)  
[Gareth Hughes](#)  
[Gas Industry Safety Group](#)  
[Gas Safe Charity](#)  
[Gas Safe Register](#)  
[Hackney Homes](#)  
[Hampshire Fire & Rescue Service](#)  
[Health and Safety Executive](#)  
[Healthwatch Knowsley and Knowsley Older Peoples Voice](#)  
[HolidayTravelWatch](#)  
[Honeywell](#)  
[Humberside Fire & Rescue Service](#)  
[Katie Haines Memorial Trust](#)  
[Kidde Safety](#)  
[L&Q Housing](#)  
[Liverpool John Moores University](#)  
[Marine Accident Investigation Branch](#)  
[National Grid Gas Distribution](#)  
[NCC](#)  
[Northern Gas Networks](#)  
[North Lincolnshire Homes](#)  
[OFTEC](#)  
[Public Health England](#)

[The Royal Society for the Prevention of Accidents](#)

[Scottish Power Connected Homes](#)

[SGN](#)

[Shelter](#)

[Smart Systems Scotland \(Smart Compliance\)](#)

[Sprue Safety](#)

[Swift Group Ltd](#)

[TRN Ltd](#)

[UKLPG](#)

[Dr Jeremy Vincent, Department for Energy and Climate Change](#)

[Wales & West Utilities](#)

[Zonegard Ltd](#)





# About the All-Party Parliamentary Carbon Monoxide Group

The All-Party Parliamentary Carbon Monoxide Group (APPCOG)<sup>167</sup> is the leading, cross-party forum for Parliamentarians to discover, discuss and promote ways of tackling CO poisoning in the UK. It is Chaired by Barry Sheerman MP, Jason McCartney MP, Baroness Finlay of Llandaff and Baroness Maddock. The APPCOG works closely with the CO All Fuels Action Forum,<sup>168</sup> a coalition of energy industry representatives, medical professionals, researchers, campaigners, and others committed to tackling CO poisoning in the UK.

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[The Council of Gas Detection and Environmental Monitoring](#)

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[Tera Allas](#)

[Peter Barrett](#)

[Adrian McConnell](#)

[Joanne Reinhard](#)

[The Lord O'Donnell GCB](#)

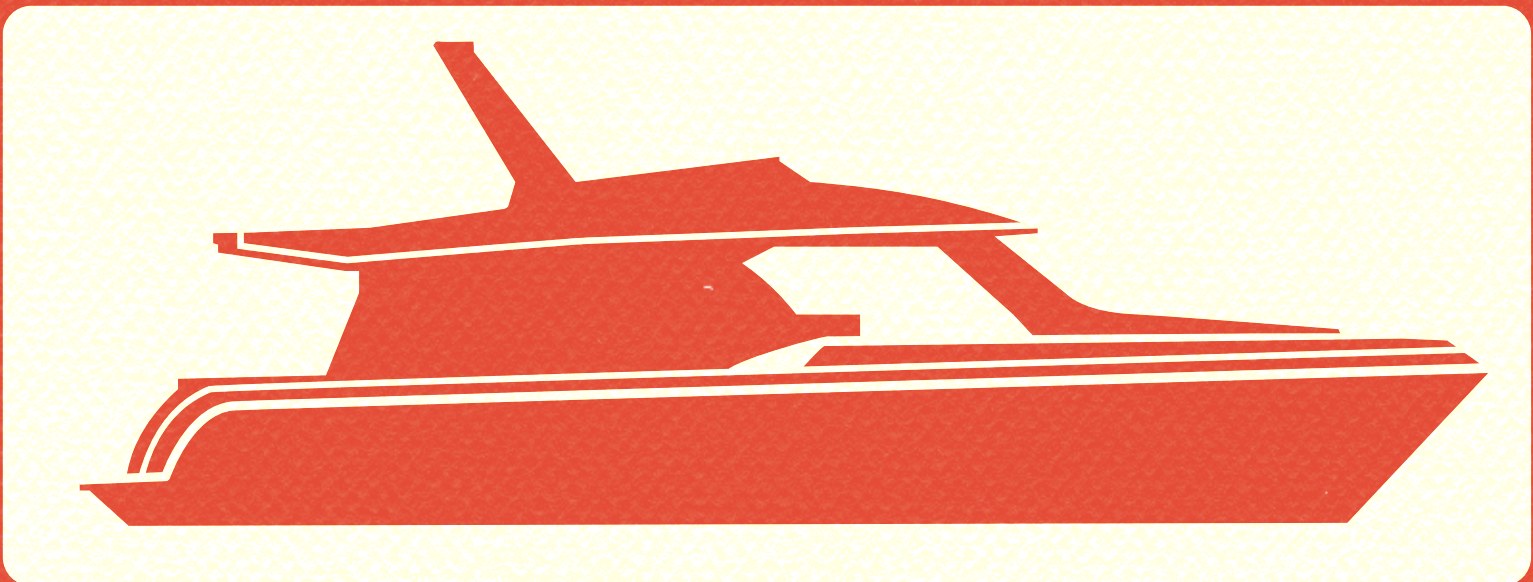
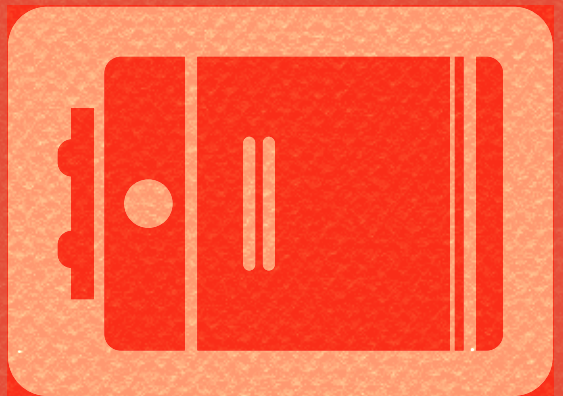
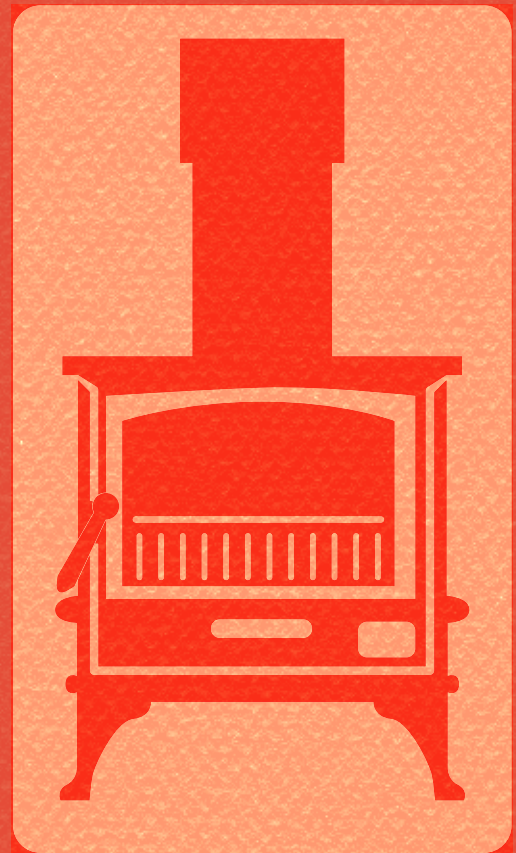
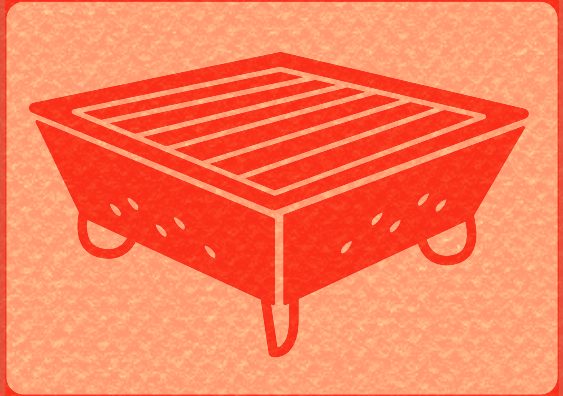
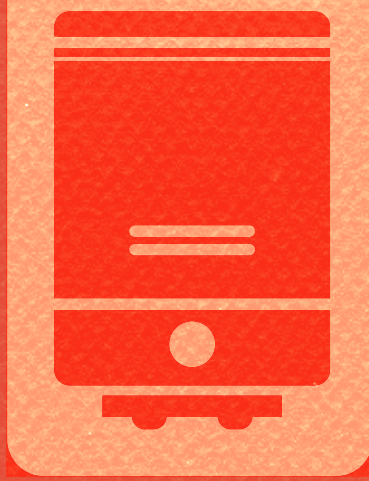
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<sup>167</sup> See: [www.policyconnect.org.uk/appcog/](http://www.policyconnect.org.uk/appcog/).

<sup>168</sup> Ibid., 6.



For further information, please contact  
Haley Bowcock (Manager, All-Party Parliamentary Carbon  
Monoxide Group)  
Dominic Gillan (Researcher and Project Coordinator, All-  
Party Parliamentary Carbon Monoxide Group)

All-Party Parliamentary Carbon Monoxide Group  
Policy Connect  
CAN Mezzanine  
32-36 Loman Street  
London SE1 0EH

[haley.bowcock@policyconnect.org.uk](mailto:haley.bowcock@policyconnect.org.uk)  
020 7202 8582

[dominic.gillan@policyconnect.org.uk](mailto:dominic.gillan@policyconnect.org.uk)  
020 7922 7804

[www.policyconnect.org.uk/appcog](http://www.policyconnect.org.uk/appcog)  
[www.policyconnect.org.uk](http://www.policyconnect.org.uk)

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