UKIEG 2013 Scientific Conference

Healthy Indoor Environments: Latest Evidence and Future Challenges

Skipton House, Department of Health, London SE1
4th June 2013

Conference Programme

09:30-10.00	Registration & coffee	
10:00	Welcome & Chairman's introduction	Marcella Ucci University College London
	Zero-Carbon Buildings and Health	Chair: Paul Harrison
10:05	Health & wellbeing in buildings – latest guidance	Frank Mills Low Carbon Design Consultants
10:25	Building tight - ventilating wrong!	Paul Farren Assist Design Architects
10:45	Low energy retrofits have the potential to impact negatively on the occupant	Peter Keig Ulster University
11:05	The impact of super insulated windows on the health and wellbeing of building occupants	Lorraine McCauley Napier University
11:25	*Coffee*	
11:40	KEYNOTE PRESENTATION - Health refurbishment	Paul Wilkinson London School of Hygiene and Tropical Medicine
12:00	Poster 'quick fire session' (2 min presentations)	
12:40	*Lunch and Traditional Poster Viewing*	
13:30	*AGM*	
	Healthy Indoor Environments	Chair: Derrick Crump
14:00	Natural & renewable materials & their potential contribution to healthy indoor environments	Tom Woolley Rachel Bevan Architects
14:20	Pathways from housing improvement to health improvement: a synthesis of impacts on socio-economic determinants of health following housing improvement	Hilary Thomson Glasgow University
14:40	Daylighting in extra care housing	Alan Lewis University of Manchester
15:00	Risk factors regulating indoor fungi & adult asthma in Cornwall	Richard Sharpe University of Exeter
15.20	Indoor air quality investigation in Code for Sustainable Homes level 6: A UK case study	Grainne McGill Queen's University Belfast
	Discussion session	Chair: Marcella Ucci
15.40	General discussion, closing remarks	
16.00	*Close of Meeting*	

*The UKIEG Conference Organising Committee reserves the right to amend the programme at short notice.

Healthy Indoor Environments:

Latest Evidence and Future Challenges

Special Issue, *Indoor and Built Environment*

Selected papers will be offered an opportunity to be considered for a Special Issue of *the Indoor and Built Environment Journal* on zero carbon buildings, health and wellbeing, with a focus on the UK and Europe

This Conference addresses the future challenges and latest research evidence on the factors affecting health and wellbeing in buildings.

Topics include:

- Impact of zero carbon strategies on health and wellbeing;
- Climate Change and overheating impacts on buildings and health;
- Latest evidence and good practice on healthy housing;
- Neurological effects of indoor pollutants;
- Light and lighting.

The Conference will include a poster session, networking opportunities and will conclude with a discussion session.

The UKIEG AGM will take place during the lunch break.

A One-Day Conference Organised by the **UK Indoor Environments Group**
www.ukieg.org

Date: 4th June 2013

Venue: Department of Health, London SE1

***** Celebrating 10 Years of the UKIEG*****

The UKIEG annual meeting is a conference and networking event for a multidisciplinary audience academics, policy makers and industry experts an interest in improving indoor environments for health and wellbeing.

Supported by: the Department of Health and Public Health England

Keynote speaker: Professor Paul Wilkinson Department of Social and Environmental Health, London School of Hygiene and Tropical Medicine

Venue Details:
Department of Health, Skipton House, 80 London Road, London SE1 6LH

Conference Fee: Members £60, Non-Members £100

Registration please email: Gill.Fisher@PHE.gov.uk

Further Information: Isabella.Myers@PHE.gov.uk

UKIEG Website: www.ukieg.org

UKIEG 2013 Conference Booklet Contents

History of the UKIEG
Annual Conference 2013 Abstracts
AGM Agenda
Pages for Notes

History of the UKIEG

The UK Indoor Environments Group (UKIEG) was launched in 2003, with the aim to co-ordinate and provide a focus for UK activity concerned with improving indoor environments for people.

The fact that people spend the vast majority of their time inside buildings – at home, at work, in vehicles, shops, etc. – is widely acknowledged, yet while the outdoor environment has received much attention, the importance of the quality of the indoor environment in relation to human health and wellbeing is often unrecognised and under-researched. Moreover, addressing problems relating to the indoor environment, which might include issues as diverse as indoor air quality, lighting, ventilation and thermal comfort, requires a highly multidisciplinary approach and involves numerous different stakeholders. Based on these considerations, our objectives are:

- To promote the health and well being of people in indoor environments
- To promote research and research collaboration in all aspects of the indoor environment
- To increase awareness of current activity and knowledge gaps in areas concerned with indoor environments and people
- To disseminate knowledge concerned with indoor environments and people
- To promote the effective and efficient design and operation of indoor environments
- To communicate, integrate and network activity concerned with indoor environments and people
- To communicate and liaise with other relevant groups within the UK and abroad
- To promote good practice

Our Members

We currently have nearly 250 registered members with a wide range of expertise from medics to toxicologists, architects, designers, appliance manufacturers, academics, regulators, researchers, chemists, modellers, engineers, building managers, environmental health professionals, social scientists - and others working in fields connected with the built environment. Our members can choose to receive regular updates on the Group's activities and relevant news and events.

Membership

Membership is free of charge. If you would like to join the Group or ask for further information, please contact our Secretary: Isabella Myers, Isabella.Myers@phe.gov.uk.

Annual Conference 2013

Keynote Speaker: Paul Wilkinson, London School of Hygiene and Tropical Medicine.

After studying medicine at Oxford University, I spent several years in hospital medicine in London, before taking up an epidemiological research post at the National Heart & Lung Institute. From there I moved to the LSHTM in 1994.

It was then that I first began research into the links between the environment and health, initially studying hazards arising from localised chemical contamination of the environment - pollution of the air and from industrial emissions. Such hazards have been the focus of much international research effort in recent years reflecting the problems associated with industrialisation and urban living in both the developed and developing world.

More recently I have been part of a research team that has begun to focus on the health impacts of global environmental change. There is now increasing recognition that we face growing threats to human health from large-scale environmental changes - threats arising from our profligate consumption of the Earth's resources and from pollution of our environment at a global scale.

One of those threats is climate change, and its potential impacts on health is the theme of our co-operative research group on Climate change, ozone depletion and health sponsored by the Medical Research Council and the Natural Environment Research Council. Through this group we are working with climate scientists at the Tyndall Centre for Climate Change Research at the University of East Anglia. Our aim is to quantify vulnerability to climate change in different regions of the world, to predict future health impacts and to understand how we may ameliorate those impacts through public health action. This entails new approaches to epidemiological research and involves methodological complexities that we are only just beginning to resolve."

Abstracts

Health & wellbeing in buildings – latest guidance

Frank Mills
Low Carbon Design Consultants
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Abstract
CIBSE has provided guidance on healthy buildings through Guide A, Chapter 8, Health and Wellbeing and through Special publication TM.
These have recently been revised as part of CIBSE update on Guide A and due for publication in 2013.
This presentation describes the scope and content of latest CIBSE guidance and the source data used for its development.
The presentation also provides an insight into ASHRAE guidance explaining the approach taken and the ongoing research into issues needed for regular updates to the ASHRAE Handbooks, codes and standards, as well as initiatives toward special publications such as the second edition of the Healthcare design manual published in 2013.
The paper also provides an overview of the impact of renewed design targets toward zero carbon buildings onto health and wellbeing issues and achievement of environmental target such as BREEAM Excellent.

Abstracts cont……..

Building tight - ventilating wrong!

Paul Farren
Assist Design Architects

Abstract
SG Howieson(1) BArch(Hons) DipArch MPhil PhD CEng RIAS FCIBSE FHEA, P Farren(1) BSc Hons PgDip RIAS RIBA, T Sharpe(2) BSc BArch PhD FHEA
(1) Faculty of Engineering, University of Strathclyde, Glasgow, UK

(2) Mackintosh Environmental Architecture Research Unit, Glasgow School of Art, Glasgow, UK

A recent study commissioned by the Scottish Government, "The effect that increasing air-tightness may have on air quality within dwellings" concluded that dwellings built to 5m^3/m^2/hr@50Pa provide air change rates roughly in line with the CIBSE recommendation of 8l/s per person. With standard trickle vents fitted on all windows, air change rates were measured at 0.7 to 1.3ach^{-1} (equal to a ventilation rate of 37-69 l/s), on the upper floor and 0.4 to 0.6 ach^{-1} (equal to a ventilation rate of 21-32 l/s) on the ground floor. Measurements of CO_2 concentrations settled at circa 1000ppm in the living room and 600ppm in bedrooms. The test protocol had however one major flaw; the tests were undertaken with all internal doors wedged open creating a unified internal air mass of 192m^3. Such a test protocol does not produce a realistic scenario given that, in practice, occupants will tend to keep internal doors closed for reasons of privacy, noise transmission and thermal comfort, particularly during the heating season and in flatted accommodation will be required to do so for fire safety.

To address these methodological shortcomings it is necessary to investigate air quality under "real life" conditions. This was achieved by reverse engineering a 'tight' dwelling to achieve the standard. Carbon dioxide levels were then monitored in the occupied living room and bedroom for two 24 hour periods. CO_2 levels climbed at a rate of 514ppm/hour, peaking at just over 2600ppm. Two adults in the bedroom were able to maintain a level of 2200ppm for the 8 hour overnight sleeping period. The internal volumes in the test dwelling were 2.5 (living room) and 1.57 (bedroom) greater than those found in contemporary "affordable" housing where living room volumes are typically circa 30m^3 and bedrooms 28m^3. Under similar occupancy loads these concentrations would rise to circa 6500 and 3450ppm; levels that signify at least by proxy, exceptionally poor indoor air quality.

In an associated project 20 dwellings built after 2009 were monitored for CO_2 levels over a six month period. All bedrooms were characterised by a rapid increase in CO_2 on first occupancy that then levelled out depending on the rate of background ventilation. CO_2 levels were all above the 1000ppm threshold with an occupied mean peak of 2317ppm and an occupied time weighted average of 1834ppm.

Conclusions
Increasing air tightness to 5m^3/m^2/hr@50Pa where trickle ventilation is the sole planned strategy will produce exceptionally poor indoor air quality in dwellings where occupants utilise the internal doors.

When considered as a discrete volume, an occupied living room with 5 persons will need close to 40l/s to enter through an area of 12000mm^2. This requires an air speed of 3.3m/s equivalent to a pressure differential of close to 18Pa. Where rooms have a window vent in only one elevation cross ventilation will not occur. With external air pressure effectively working against a "dead end", the ventilation strategies that underpin the current technical standards are unlikely to be achieved under normal circumstances.

Therefore as currently framed, the Scottish Building Regulation/Technical Standards produce poor IAQ. Any increase in dwelling "tightness" will further reduce the effect of fortuitous background air infiltration that, in the past, has played a positive role in maintaining 'healthy'

Abstracts cont……..

indoor air quality. Reducing ventilation rates in the name of energy efficiency and lower carbon emissions will result in a more toxic and hazardous indoor environment with a concurrent and significant negative long term and insidious impact on public health.

Low energy retrofits have the potential to impact negatively on the occupant

Peter Keig
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Abstract
The Climate Change Act 2008 commits the UK to a legally binding long term framework to reduce CO_2 emissions by 80% by 2050. To meet this target an estimated 12,600 existing dwellings per week will need to be retrofitted over the next forty years.

The generally promoted retrofit sequence of applying draught proofing to a dwelling followed by the 'fabric first' approach of insulating to reduce heat loss often neglects the negative impact these interventions can have on reducing ventilation rates and creating poor indoor air quality (IAQ).

The natural ventilation rates of UK dwellings created by building envelope infiltration is estimated using a rule of thumb which originates from field work carried out at Princeton University in the 1970's. This rule which has no technical basis forms an intrinsic part of various technical documents including the UK Building Regulations.

The recommended minimum domestic ventilation rate of 0.5 air changes per hour emanates from Building Research Station (now the Building Research Establishment) research conducted circa 1950 and is based on the ventilation required to remove moisture generated by a typical family to maintain relative humidity at an acceptable level and alleviate the onset of mould growth.

To analyse the appropriateness of the rule of thumb for UK dwellings, a tracer gas decay technique was used on a selection of houses to measure natural ventilation rates created by buoyancy and wind driven envelope leakage. Monitoring of a high grade retrofit dwelling provided an insight into the moisture production of a post millennium family.

Research results indicate that natural ventilation rates of dwelling are often over estimated and moisture production underestimated leading to a low level of IAQ and elevated relative humidity levels with the potential for mould growth and house dust mite (HDM) proliferation.

The hypothesis explored in this paper is that low energy retrofits have the potential to impact negatively on the health and well being of occupants by creating unhealthy indoor environments. These findings are equally relevant for the future challenges to zero carbon strategies for new build dwellings.

The impact of super insulated windows on the health and wellbeing of building occupants

Lorraine McCauley
Napier University

Abstract
L. McCauley a, T.M. Muneer b,
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Super insulated windows have the potential for improving the comfort of an office environment for its occupants. This paper will look at the parameters and effects of daylight, acoustics and

Abstracts cont……..

thermal comfort on building occupants to explore the potential benefits of super insulated windows on health and wellbeing. The work demonstrates that super insulated windows improve the comfort factors of an office in relation to lighting, acoustics and temperature with positive effects on the health and wellbeing of staff which leads to knock on effects on absenteeism and productivity.

One of the most important aspects of the present work was the comparison of the performance of the newly developed super insulated windows against the more traditional Argon-filled, double-coated glazing. Whereas the super insulated windows provide an extremely low heat-loss index of 0.3W/m2-K, the latter usually offer a centre-glazing U-value of 1.4W/m2-K. With such low U-values, large super insulated windows may be deployed to good effect for harnessing daylight, particularly in winter time when gloomy interiors are not particularly welcome by the occupants.

The main area of concern, however, may be the potential overheating of buildings due to excessively high solar gains if the conventional, opaque walls are replaced by super insulated 'walls'. In the present work, two types of energy gains offered by the super insulated windows are compared against the conventional double-coated window, i.e. daylight availability indoors and solar gains. A third element to consider is the undesirable solar heat transmission for commercial and office buildings, and thus this additional parameter is also considered in this study and results for all parameters are presented.

Natural & renewable materials & their potential contribution to healthy indoor environments

Tom Woolley
Rachel Bevan Architects

Abstract
There has been a slow, gradual, growth in the use of natural renewable and low impact materials in buildings in the UK in recent years. These materials include Hemp, Hemp Lime, Flax, Sheep's Wool, Straw, Wood fibre, Earth and Earth based finishes. Apart from the lower embodied energy and environmental impact of such materials a number of claims are made about their health benefits. A boost was given to the use of such materials through the UK Department of Energy and Climate Change (DECC) funded 'Renewable House Programme' (RHP) which saw innovative renewable materials used by mainstream builders in social housing projects throughout the UK. The 12 projects funded under the DECC RHP project will be reviewed together with an analysis of the materials and products that were used in the programme.

The advocates of natural and renewable materials point out their moisture buffering and hygroscopic characteristics, the natural biocidal effects of lime and the benefits of thermal mass to more constant thermal environment. Such materials also contain fewer hazardous chemicals and some claim to be able to absorb dangerous chemicals like formaldehyde.

The paper will include a review of some of the scientific research that supports these claims and contrasts the nature of natural materials with synthetic petrochemical based equivalents. The paper will also review policy issues, assessment methods and standards that both support and also inhibit the use of such materials. Current policies such as the Green Deal and the enthusiasm for Passiv Haus projects are generally based on the use of synthetic petrochemical based materials. The paper will examine what changes are required to standards, assessment tools and policies to facilitate the greater uptake of natural materials and consider whether this could have a significant impact on healthier indoor environments.

References:
Woolley T. and Bevan R. Hemp Lime Construction, BRE/IHS Press 2008
ISBN 978-1-84806-033-3

Abstracts cont……..

Woolley T. The alternative eco-building movement and its impact on mainstream construction. Chapter 10 of Corporate Social Responsibility in the Construction Industry , ed M. Murray and A Dainty, Taylor and Francis 2008 Abingdon ISBN 978-0-415-36208-5

Woolley T Low Impact Building: Housing Using Renewable Materials 2013 Wiley Blackwell . ISBN 978-4443-3660-3

Pathways from housing improvement to health improvement: a synthesis of impacts on socio-economic determinants of health following housing improvement

Hilary Thomson
Glasgow University

Abstract

Hilary Thomson* (1) and Sian Thomas (1)
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Background: We recently completed a systematic review of the health impacts of housing. We concluded that housing improvement can lead to health impacts, but across the studies the reported impacts were typically small or unclear. There are many possible explanations for these small or unclear health impacts. One possibility is that housing improvements are accompanied by impacts on socio-economic determinants of health which mediate the potential for health improvement. Also it may be unrealistic to expect to see tangible health improvements in the relatively short timescale of an evaluation, especially among a population experiencing other forms of socio-economic deprivation.
Methods: Using all the studies included in the systematic review of housing improvement, we carried out further data extraction and analysis of the socio-economic impacts associated with housing improvement to investigate the possible mechanisms through which housing improvement may or may not lead to longer term health improvement.
Using the better quality studies, quantitative and qualitative data on proximal changes in socio-economic and behavioural outcomes, as well as longer term health outcomes were extracted along with any reported link between changes in housing conditions. A logic model of the reported impacts and links between reported impacts was prepared by two reviewers independently. A single logic model was produced to represent the areas of agreement between the two reviewers. The source and quality of the reported data were indicated on the logic model to maintain transparency.
Findings: The logic model provides a useful one page visual of the reported links between housing improvement, impacts on socio-economic determinants of health, and ultimately health impacts. The data indicate that housing improvement may have immediate beneficial or detrimental impacts on a wide range of socio-economic outcomes, such as housing costs, usable indoor space, and relationships. The level of impact varied and was related to the extent of improvement in housing condition actually experienced by residents.
Conclusion: This additional synthesis of impacts on proximal socio-economic outcomes associated with housing improvement provides tentative support for hypotheses that housing investment has the potential to lead to long term health improvement.

Abstracts cont……..

Daylighting in extra care housing

Alan Lewis
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Abstract
Previous research has demonstrated the benefits of good daylighting in the homes of people with sight loss, particularly in aiding detailed visual tasks. Daylight also has health benefits, particularly in helping the body to regulate the production of melatonin, which in turn helps to regulate sleep patterns, and in stimulating the body's production of serotonin, which can reduce the symptoms of depression.

Despite these benefits, an evaluation of 23 extra-care housing schemes, undertaken as part of the EPSRC-funded research project EVOLVE (Evaluation of Older People's Living Environments), revealed that only half complied with the current recommendations on minimum

daylight factors in lounges and bedrooms. This is surprising given the prevalence of sight loss amongst older people, and given that extra-care housing is intended primarily for older people.

This paper will present the findings of a study, funded by Thomas Pocklington Trust, which aims to identify barriers to compliance with current guidance on daylighting in extra-care housing, and to identify approaches to design that allow these barriers to be circumvented. The study draws on existing data from the EVOLVE project, and on semi-structured interviews with 20 people involved in developing and designing extra-care housing schemes, particularly those housing schemes in the EVOLVE sample. The study's findings will inform future design guidance for housing providers and architects.

Risk factors regulating indoor fungi & adult asthma in Cornwall

Richard Sharpe
University of Exeter

Abstract
Sharpe R, Thornton C Osborne NJ

Asthma affects 10% of the UK population and costs the NHS £1 billion per year. It is a complex disease with both genetic and environmental aetiologies and exposure to fungi has been implicated in increased risk of initiation, development and exacerbation of this disease. Health risks are thought to be further compounded by the trend in reducing heat loss by ventilation to achieve greater energy efficiency, which may increase indoor dampness and fungi. This project aims to investigate the association between fungi and adult asthma, and identify risk factors regulating fungi growth.

A pilot project was conducted during 2012 and postal questionnaires were sent to 435 properties, which were recruited through a social housing association in Cornwall, UK. The housing association provided built environment data, which was merged with the health and behavioural data obtained from participants (e.g. indoor fungi and asthma). Sampling of fungi occurred in a selection of homes and culturable fungi identified to species level by sequencing of the ITS1-5.8S-ITS2 rRNA-encoding regions of isolates.
A 20% response rate was achieved. Properties were predominantly built between the 1950-60s and had a mean energy efficiency SAP rating of 68. The study group had a higher prevalence of smoking, indoor fungi and adult asthma than UK averages. Fungi severity (>postcard-sized) was associated with increased risk of adult asthma (when compared to none or <postcard size). Potential risk factors for visible fungi included detached/semi-detached housing (crudeOR 6.2;95% CI 2.3-16.5), having a pet (crudeOR 7.3;95% CI 2.5-21.6) and SAP rating <65 (crudeOR 4.8;95% CI 1.6-15.1). Fungal severity was influenced by low energy efficiency, SAP<65 (crudeOR 2.8;95% CI 0.97-8.5), construction date <1960 (crudeOR 3.2;95% CI 1.2-8.7), roof insulation <200mm (crudeOR 5.4;95% CI 1.6-19.1)

and increased heating (crudeOR 3.4;95% CI 1.2-9.6). No associations were found with carpeting, ventilation or heating systems and drying clothes indoors. ITS sequencing identified a variety of different fungi species found in the domiciles.

The pilot study showed an association with both the presence and severity of fungi and adult asthma. Both built environment and behaviour factors of residents influences both the extent of indoor fungi growth and species diversity.

Indoor air quality investigation in Code for Sustainable Homes level 6: A UK case study

Grainne McGill
Queen's University Belfast

Abstract

Grainne McGill, Dr. Menghao Qin, Prof Greg Keeffe
Energy efficient building design strategies are growing in popularity, promoted through increased awareness of climate change, rising energy prices, global consciousness of ecological responsibility and a demand for economic security. To aid this design process, sustainable assessment tools such as the Code for Sustainable Homes were introduced, which provide the opportunity to rate a buildings environmental performance based on specific criterion. It is suggested however that these criteria prioritise energy efficiency over occupant health through a fundamental lack of attention to indoor air quality.
This paper discusses issues with the Code for Sustainable Homes and presents preliminary findings of an indoor air quality investigation in Code 6 homes in the UK during the winter season. The investigation consisted of indoor air quality measurements over a 24 hour period, occupant diaries and occupant interviews. Measurement parameters include temperature, relative humidity, carbon dioxide, formaldehyde, PM2.5 and PM10. The measurements found high levels of formaldehyde, particulates and carbon dioxide. Furthermore, issues with the use of mechanical ventilation systems were identified. These results may be used to recognize areas of improvement in the Code for Sustainable Homes, and the design of energy efficient homes in general. Research of this nature is essential to ensure occupant health is not sacrificed through the drive towards zero carbon.

Posters

Analysis of HES inpatient data for carbon monoxide hospital admissions in England

Close, R(1)., Ghosh, RE(2)., McCann, LJ(1)., Hansell, A(2)., Leonardi, GS(1).
(1) Centre for Radiation, Chemicals and Environmental Hazards, Public Health England
(2) Small Area Health Statistic Unit, Imperial College London

Background
Carbon monoxide (CO) is a known cause of fatalities and hospital admissions from accidental poisoning in the UK. We studied inpatient admissions due to CO exposure to provide a more accurate picture of the burden of disease in this setting and to contribute to establishing CO surveillance.

Methods
Admissions to hospital relating to carbon monoxide poisoning (ICD-10 code T58, ICD-9 code (986) were analysed in Hospital Episode Statistics (HES) inpatient data between 1998 and 2007.

Posters cont……..

Results
Total number of hospital admissions was 6185 over the 10 year period, an average of 619 per year. Of these, 45% (n=2771) admissions were hospitalised due to accidental CO poisoning, an average of 277 per year.

Initial results demonstrate that the regions with the highest relative risk for hospital admissions of CO poisoning compared to the England and Wales average are East Midlands (1.41, 95%CI 1.31-1.52) and Yorkshire and Humber (1.25, 95%CI 1.17-1.35).

The number of male admissions (n=4063) were more than twice that of females (n=2005). The region with the highest rate of admissions for both males and females was the East Midlands (2.23 (95%CI: 2.04-2.44) and 1.04 (95%CI:0.91-1.18) respectively).

Of those with accidental poisoning, the highest percentage of admissions was in females under 10 years of age and in males age 30-39 years old. The highest numbers of admissions were during the winter months.

Conclusions
Little is known about the number of hospital admissions due to CO poisoning in England and Wales; the results of this study so far suggest a significant burden of CO and important gender and regional differences. Further analysis will examine trends over time, seasonal trends, rates by ethnicity and deprivation.

Development of Burden of Disease Population Exposure Estimates for Accidental Carbon Monoxide Poisoning in Domestic Dwellings in England: A Systematic Approach

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Each year in England there are around 400 deaths from carbon monoxide (CO) poisoning in domestic dwellings of which around 40 are accidental, non-fire related. Compared with road traffic accident fatalities (n=1,594) for example, the burden of disease seems relatively modest. However there is a significant underlying burden of low dose, long term exposure which is not robustly quantified.

This paper describes a systematic approach to identifying sources of data and intelligence on the impact of CO exposure; either routinely gathered or from other potential providers. The methodological approach to combining these data sources to provide an estimate of the true population burden of disease from acute and chronic exposure to CO in domestic dwellings is outlined.

For example, there is a wide range of routine health data sources that include;

- Office for National Statistics - mortality data
- CO Gas Safety Society Database –on CO incidents
- Hospital episode statistics (HES) – inpatient episodes on acute CO poisonings (1)
- Emergency Department attendance data (Department of Health - experimental dataset)
- Health and Safety Executive –CO incident data
- NHS Pathology Departments' data- on biological samples diagnosing CO poisoning
- Primary care data – GP attendances for CO exposure related symptoms.

Routine environmental data sources can be gathered to infer exposure;

- English Housing Conditions Survey – Department of Communities and Local Government
- Local authority housing records- on condition and ages of boilers
- Local authority complaints registers- on CO/gas leaks
- Housing association maintenance and repair records

Posters cont……..

- Gas safety inspection reports.

Commissioned ad-hoc surveys of community based CO risks can also greatly help our understanding of the surveillance of CO related health burdens (2).

Most of our current knowledge is based on a single clinical diagnosis – death, which is the only routine systematic data on CO poisonings collected. This is a tiny fraction of the total burden of disease attributable to CO exposure and therefore misrepresents the true cost to the NHS, the economy and the social costs of ill health. There is almost a complete absence of sources of chronic exposure data due to difficulty of diagnosis using symptoms common to many other

causes. Only by collating and combining all these diverse sources of related data can we comprehensively map the true population burden of disease.

References:
1. Analysis of HES inpatient data for carbon monoxide hospital admissions in England. Close, R., Ghosh, RE., McCann, LJ., Hansell, A., Leonardi, GS. (Abstracted submitted to this conference)
2. Carbon monoxide alarms in private homes: prevalence of potential exposure in Hackney. McCann LJ, Close R, Staines L, Weaver M, Cutter G, Leonardi GS. (Abstracted submitted to this conference)

Carbon monoxide alarms in private homes: prevalence of potential exposure in Hackney

McCann LJ(1), Close R(1), Staines L(2), Weaver M(2), Cutter G(2), Leonardi GS(1)
(1) Centre for Radiation, Chemicals and Environmental Hazards, Public Health England
(2) Hackney Homes

Background: Exposure to CO in private homes can cause CO poisoning, but the extent of the problem is largely unquantified, with little reliable evidence. The burden of CO poisoning is likely to be underestimated due to presentation of non-specific health symptoms. Hackney Homes (HH) began fitting CO alarms in the 23,000 local authority homes they are responsible for, in January 2010.

Aim: To undertake a pilot study to provide a more accurate picture of potential population exposure to carbon monoxide and associated interventions in an inner-city community.

Methods: We undertook a descriptive study using data from the Gas Safe forms recorded by HH when an alarm is activated. Data captured included: source and concentration of CO indoor, interventions by HH (telephone call, visit by a gas engineer).

Results: Between November 2011 and April 2012, 106 alarm activations were reported. Possible reasons for these activations included: defective gas appliance (34.6%), misuse of cooker or cooking methods (10.6%) and a problem with the CO alarm (38.5%). The main interventions put in place included: disconnection of the gas appliance, replacing or resiting the CO alarm, providing advice to the tenant on cooking methods (e.g. placing foil around the cooker hob).

Discussion: Little is known about the burden of CO population exposure in private dwellings, which this study has gone some way to addressing. It has provided important information on the path to quantifying CO exposure in this population and has established a possible approach to accessing key information on population exposure to CO and realistic interventions to reduce it. The study makes recommendations to further develop research in this area in order to develop

Posters cont……..

understanding of the mechanisms involved in CO poisoning in private homes and the burden of disease in these settings.

Mapping vulnerability to extreme indoor temperatures across Delhi's housing stock

Emily Nix*, Payel Das, Michael Davies
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An unprecedented rise in population in Delhi and a lack of affordable housing has created extensive housing pressures, resulting in an escalation in the construction of low-quality informal and unregulated housing. The residential sector takes the largest share of the city's electricity demand, consuming 45%; the share of demand is larger in higher income households where the penetration of electrical appliances is more prominent. This suggests disparity between households in their potential to modify indoor temperatures (e.g. through the use of air conditioning). The aim of this study is to assess the variations in indoor temperatures extremes across Delhi dwellings, and to determine the extent to which these depend on settlement type and appliance usage.
Through a review of the literature, Delhi's housing stock can broadly split into four settlement types, which range from self-built single-zone independent housing to multi-storey planned apartments. Six case-study archetypes illustrating this range have been developed and modelled using EnergyPlus dynamic thermal simulations.
Variation in indoor temperatures across settlement types and access to comfort controls indicate huge disparities in both household carbon emissions and health risk from temperature extremes. These findings identify the most vulnerable households to extreme indoor temperatures, which will help focus strategies aimed at protection against the adverse effects of extreme temperatures. This understanding can be expanded to locations with similar climates and variations in settlement types.

Balancing housing interventions in the Delhi climate to optimize both indoor environmental quality and energy use

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Dwellings in Delhi need to provide an indoor environment that protects occupants from extreme heat in the summer, a humid monsoon season, cool temperatures in the winter, and high levels of air pollution throughout the year. In addition to providing a healthy indoor environment, the global requirement to dramatically reduce greenhouse gas emissions must be taken into account as the residential sector is responsible for about a third of the city's carbon dioxide emissions. Therefore adaptation strategies to improve the quality of the indoor environment or to reduce emissions need to be chosen using a measured approach that takes these often competing performance criteria into consideration. For example, increasing the air tightness of the building envelope may help improve winter indoor temperatures and inhibit the ingress of pollutants from the external environment, but it will also increase concentrations of pollutants from indoor sources and could increase summer indoor temperatures.
A multi-objective optimization method is developed alongside EnergyPlus to explore how combinations of U-value and permeability of the building envelope for a typical dwelling in the Delhi environment varies with indoor temperature, and indoor concentrations of $PM_{2.5.}$ This exploration will enable a limit to be placed on what can be achieved in terms of energy use and indoor environmental quality by these simple passive interventions.
The methodology developed in this work combining a building simulation tool with multi-objective optimization methods to explore the physical limits of housing interventions will be relevant for dwellings in any setting. The results derived for Delhi will provide a guide for dwellings in other cities with similar climatic and environmental conditions.

Posters cont……..

Conceptualise IAQ by bridging an academic and practitioner's application, pioneering the UK's IAQ training and website resources and influencing strategic change via leadership and discussion

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This Doctorate project is intended to understand the contextualised setting and positioning of IAQ within the UK, using my experiences as an internal researcher, working with organisations and

Local Authorities, to develop a cohesive body of understanding that contribution to the indoor air quality debate; in particular the transfer of embodied knowledge into contextual practices influencing key stakeholders for future sustainability.

This DProf project discusses the gap between knowledge and practical application, evaluating historical context, critiquing combined contaminates, reviewing fragrances, appraising competencies, resources and government policy, both UK and Worldwide. To explore risk perception and competencies within a real world situation, two types of surveys were conducted with Environmental Health Officers and health and safety practitioners.

The literature research and project activities raised further discussion points regarding the application of risk management, cost effective modelling, impact of body burden, the increase trend of scent marketing, understanding and influencing society risk perception and evaluation of the leadership of IAQ at local and government levels This project highlights some key recommendations such as the requirement to label products, particularly products like perfume where manufacturers claim brand protection, to enable the consumer to understand the ingredients and make choices about their purchases; Bio-monitoring and multi-pollutant frameworks to build on existing silo contaminate research and create a harmonised and structured approach in understanding psychological and physiological impact interactions from a mixture of pollutants. I further discussed the repositioning of IAQ within a strategy and leadership approach; thus engaging a transformative rather than additive **philosophy**; As a legacy of the project, the first accredited UK IAQ training certificate and website was developed, implemented and appraised I concluding with my reflection on my own epiphany of learning, how I traversed between academia and a professional application and my contribute towards my profession.

The effectiveness of retrofitted green and cool roofs on reducing overheating in naturally ventilated offices: direct and indirect effects in current and future climates

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Due to increasing urbanisation and projected climate change, the effects of urban warming in London will be exacerbated in future climate scenarios. The relationship between developments and urban climates is becoming increasingly relevant. The physical characteristics of cities modify urban climates leading to the creation of Urban Heat Islands (UHI) and microclimates within them. The impact of interventions and mitigations strategies that abate the negative effects of urban warming and the UHI effect will vary in terms of the direct and indirect effects of any specific strategy. Direct effects are those that will only impact the performance of the building, whilst indirect effects will impact the surrounding microclimate, which in turn then impacts the building. These effects can be measured in terms of their impact on the comfort and health of a building and its occupants.

This study assesses the microclimatic effects of two UHI mitigation strategies; retrofitted green and cool roofs. ADMS-4 Temperature and Humidity, a neighbourhood scale microclimatic

Posters cont……..

modelling software was used to model hourly near-surface air temperature perturbations. Two climate scenarios were used; a current typical meteorological data (CIBSE TRY data) and also projected meteorological data for 2050 (using UKCP09 data). The weather files were modified using the outputs of the microclimatic modelling and then used as inputs into Design Builder, a building modelling interface for the dynamic thermal simulation engine EnergyPlus.

The impact of the strategies on summertime overheating for a naturally ventilated office is assessed using the forthcoming CIBSE Overheating Criterion, which is based on the European Standard BS EN 15251. The balance between the direct and indirect impacts of the two roofing strategies and their effectiveness at increasing comfort and reducing overheating within the building is analysed for current and future climates. The results highlight the need for policy

makers to consider how the effective use of retrofitted technologies can significantly improve the health and comfort within a building in a warming climate.

Carbon monoxide – information sharing to protect and promote public health

Dr Thomas Waite – Extreme Events Health Protection, CRCE, Public Health England
Mr Huw Brunt – Environmental Health Protection, Public Health Wales

Carbon monoxide is a clear, odourless, colourless gas produced by the incomplete combustion of carbon based fuels. In England and Wales around 40 (range 25-45) people have died each year from 2006-11 in a variety of incidents [1]. A further 200 people are admitted to hospital each year and 4000 require assessment in A&E departments [2]. Such incidents require a multiagency response with timely assessment and communication of risks in order to protect public health [3].
Over the last few years, public awareness campaigns have highlighted the importance of regular maintenance of gas appliances. However, carbon monoxide poisoning continues to be a persistent and serious public health problem. There has been an increase in the number of domestic solid fuel and biomass heating and cooking appliances in recent years; it is of concern that this has been accompanied by recent reports of poisoning associated with such appliances [4].
In September 2012, Public Health Wales and Public Health England CRCE-Wales (then part of the Health Protection Agency) established a shared database to record details of all Environmental Public Health activity in Wales. In the first six months, seven events involving carbon monoxide poisoning were reported to the two organisations. However, staff members were aware that many more incidents were reported in the press in that same period without formal notification to either organisation. We therefore requested details of all carbon monoxide incidents attended by the Fire and Rescue Services (FRS) across Wales.
We present an overview of the distribution and characteristics of carbon monoxide poisonings notified to public health services in Wales since September 2012. We build on this by quantifying the number of people affected by carbon monoxide incidents which required FRS assistance and examining the factors prompting FRS or other first responders to notify public health services.
Finally, we present an overview of those proactive public health interventions which may currently be being missed (as a result of absent or late notification) and propose a revised notifications protocol between these Civil Contingencies Act Category One responders which can be evaluated to appraise its public health protection impact.

[1] Health Protection Agency (2012) Reducing the risk of carbon monoxide poisoning over winter. Available at http://www.hpa.org.uk/NewsCentre/NationalPressReleases/2012PressReleases/121119Reducingtheriskofcarbonmonoxidepoisoning/
[2] Department of Health, (2011) GP and Team Practice Bulletin. Available at: http://www.dh.gov.uk/en/Publicationsandstatistics/Bulletins/GPbulletin/index.htm
[3] Mindlin M and Ruggles R (2007) Development of a carbon monoxide 'action card' for public health practitioners. Available at: http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1274091458202

Posters cont……..

[4] Hayton et al (2013) Gas Safety Trust Carbon Monoxide Incident Report. Available at: http://www.gas-safety-trust.org.uk/wp-content/uploads/2013/03/DIDR-Report-2011-12.pdf

Lighting at home for people with sight loss
Thomas Pocklington Trust

Good light and lighting in the home are very important to people with sight loss. Thomas Pocklington Trust's research shows that effective lighting can assist people with carrying out daily activities and living more independently. Too often, people who do not have good lighting are not aware that lighting makes a difference and do not know how to make improvements. There is limited knowledge of practical lighting solutions among many professional advisors and support agencies.

There are four main design principles for domestic lighting:

- Achieve optimum levels of general room lighting
- Provide appropriate task lighting
- Maximise adjustability of all lighting sources
- Eliminate sources of glare

Flexibility and adjustability are essential, as individual needs vary and some people with eye conditions are adversely affected by bright light or require different light levels on different days. Attention to lighting also needs to go hand in hand with effective use of colour and contrast in internal design, home improvements and decoration e.g. good contrast between doors, door frames, bells, handles and locks.

Correct lighting can support individual safety and orientation, for example by illuminating steps and making it easier to use keys. People with sight loss fall more than others, with consequent personal injury and financial cost to the NHS. Poor quality lighting has been recognised as a contributory factor in falls among people with low vision.

While research shows the importance of lighting in carrying out activities and moving around, the individual health effects of good and poor lighting are difficult to assess. In Pocklington's studies, there is qualitative evidence of the value attached to daylight and window views among people with sight loss but their effects on mood and physical health are hard to measure.

A future challenge is the development of accessible technology that enables people with sight loss to use phones and remote systems to control their lighting. As such products are still in the early stages of use, there is an opportunity for researchers, designers and manufacturers to promote inclusive design that can make life easier.

AGM

UK INDOOR ENVIRONMENTS GROUP

ANNUAL GENERAL MEETING, London, 4th June 2013

AGENDA

1. Welcome and Chairman's Report
2. Status of Committee Membership
3. Changes to Constitution
4. Topics for the next UKIEG annual conference
5. Venue for next UKIEG annual conference
6. AOB: Motions/Comments from the floor