National Institute for Health and Care Excellence

FINAL

Indoor air quality at home

[4] Evidence review on effective strategies for raising awareness

NICE guideline NG149

Evidence review

January 2020

Final

These evidence reviews were developed by the Public Health Internal Guideline Development team

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Review question

What are the effective strategies for raising awareness of the risks of poor indoor air quality at home?

Introduction

People spend up to 90% of their lives indoors and 60% of that time at home. Exposure to indoor air pollutants including nitrogen dioxide (NO2), carbon monoxide (CO), particulate matter (PM), biological agents and volatile organic compounds (VOCs) is widespread. These pollutants are associated with respiratory and other diseases and premature death.

Table 1 below outlines the PICO criteria for this review and the full protocol is available in Appendix A:

Table 1: PICO table

Field	Content
Population	People in all dwellings
Interventions	Interventions designed to raise awareness of the risks of poor indoor air quality: <u>Information campaigns:</u> • Targeted campaigns for example, campaigns targeted to building and construction industries • community based, including local radio campaigns, local council / housing organisation mail outs • settings based • online campaigns, including social media and mobile apps • national broadcast media • leaflet distribution <u>Education:</u> • home-based education • educational tools • peer education (carried out by a community member who shares similar life experiences to the community they are working with) • lay education (carried out by community members working in a non-professional capacity) • leaflet distribution <u>Tailored information and advice delivered:</u> • During home visits • During consultation with health and social care workers • At group meetings for housing residents. • Improved occupant guidance and advice

Field	Content
	Recommendations from: • Patient groups e.g. asthma UK, Allergy UK • Community health worker • health or social care worker • carer • volunteer • council / housing organisation representative • family member
Comparator(s)/control	Reduced intensities or reduced frequencies of awareness interventions or do nothing
Outcomes	• Change in knowledge • Change in attitudes • Changes in behaviour • Change in beliefs • Changes in health related symptoms associated with exposure to poor indoor air quality

Methods and process

This evidence review was developed using the methods and process described in Developing NICE guidelines: the manual. Methods specific to this review question are described in the review protocol in Appendix A:

Declarations of interest were recorded according to NICE's 2018 conflicts of interest policy.

Public health evidence

7,216 references were identified from literature searches outlined in Appendix B: and 263 references from the reruns of the literature search. 9 papers were ordered in full-text. Of these 5 papers reporting on 3 randomised controlled trials (RCTs) met the inclusion criteria outlined in the review protocol and 4 studies were excluded. See Appendix C: for evidence study selection

Included studies

3 RCTs (reported in 5 papers) were included for this review. Studies identified were from the United States (US) and contributed information on healthy people, people with asthma and pregnant women whose child was at risk of developing asthma. Interventions identified were on intensive (targeted) strategies to raise awareness of the risks of poor indoor air quality at home. For outcomes, included studies reported on participants' belief (self-efficacy), precaution adoption, care giver quality of life, changes in behaviours (trigger reduction behaviours), urgent health service (emergency department) use and health related outcomes. For indoor air pollutants, studies reported on carbon monoxide (CO), volatile organic compounds (from water contaminants), mould/mildew, pet dander, and house dust mite.

Home assessments carried out before interventions were delivered. Interventions aligned with needs i.e. interventions were conducted to address pollutant identified at home assessment. Experienced/trained professional delivered interventions

See

Table 2 below for summary of the included studies.

Excluded studies

4 studies were excluded from this review. See Appendix G: for full list of studies excluded with the reasons for exclusion.

Summary of public health studies included in the evidence review

Table 2: Summary of included studies

Study	Population	Intervention	Comparator	Outcome used	Risk of bias
Butterfield 2011 (US)	Healthy adults and children	Intensive programme: tailored health information delivered by trained public health nurses involving 4 home visits	A letter that included household pollutant test results and threshold values for each risk	• Environmental health self-efficacy: defined as the belief that one's actions could produce desired results • Environmental health precaution adoption: conceptualized as one's stage of precautionary action	High (concerns over lack of randomisation, allocation concealment and blinding participants, personnel, and outcome assessment)
Krieger 2005 (US)	Adults and children with asthma	High-intensity intervention consisting of 7 home visits by community health workers (CHWs) and a full set of trigger control resources for example vacuuming child's bedroom at least twice/2 weeks, using allergy control covers on mattress and pillows	Low-intensity intervention consisting of a single home visit and limited resources	• Self-reported asthma-related urgent health service use • Trigger reduction behaviours	High (concerns over lack of blinding outcome assessment and high attrition rate)
Persky 2009 (US)	Pregnant women whose unborn child had a first-degree relative with an allergic history	3 home intervention visits by a community health educator focused on modification of the environment in addition to basic education	Basic health education	• Respiratory health effect • Treatment in the emergency department for breathing problems • Physician-diagnosed asthma • Physician-diagnosed eczema	High (concerns over lack of randomisation, allocation concealment and blinding participants, personnel, and outcome assessment)

See Appendix D: for full evidence tables.

Economic evidence

For the review of published cost effectiveness evidence see Evidence reviews for indoor air quality at home:

Economic model

For the results of the economic analysis see Indoor Air Quality at Home Economic Model Report and Community Health Worker Appendix.

Evidence statements

Education, tailored information and advice on raising awareness for poor indoor air quality at home (see GRADE profile F.1)

General self-efficacy scores

- Low quality evidence from 1 RCT with a follow up of 3 months on adults and children showed significant improvement in general self-efficacy scores with high intensity tailored information programme (including 4 home visits) to raise awareness of the risks of poor indoor air quality at home compared to the control group (n = 235; MD 9.2 higher [7.98 to 10.42 higher])

Risk specific self-efficacy scores

- Low quality evidence from 1 RCT with a follow up of 3 months on adults and children showed significant improvement in risk specific self-efficacy scores with high intensity tailored information programme (including 4 home visits) to raise awareness of the risks of CO at home compared to the control group (n = 235; MD 9 higher [4.76 to 13.24 higher])
- Very low quality evidence from 1 RCT on adults and children with a follow up of 3 months showed significant improvement in risk specific self-efficacy scores with high intensity tailored information programme (comprising of 4 home visits) to raise awareness of the risks of trace amount of VOC in potable water at home compared to the control group (n = 235; MD 8.4 higher [4.13 to 12.67 higher])
- Very low quality evidence from 1 RCT with a follow up of 3 months on adults and children showed significant improvement in risk specific self-efficacy scores with the high intensity tailored information programme (including 4 home visits) to raise awareness of the risks of in wall humidity (proxy for mould/mildew) compared to the control group (n = 235; MD 8.8 higher [4.83 to 12.77 higher])

General precaution adoption

- Low quality evidence from 1 RCT with a follow up of 3 months on adults and children showed significant improvement in general precaution adoption with high intensity tailored information programme (comprising including 4 home visits) to raise awareness of the risks of poor indoor air quality at home compared to the control group (n = 235; OR 3.77 95% CI 2.19 to 6.49; 318 more per 1000 [from 193 more to 419 more])

Risk specific precaution adoption

- Low quality evidence from 1 RCT with a follow up of 3 months on adults and children showed significant improvement in risk specific precaution adoption with high intensity tailored information programme (including 4 home visits) to raise

awareness of the risks of CO at home compared to the control group (n = 235; OR 2.43 95% CI 1.43 to 4.16; 210 more per 1000 [from 80 more to 341 more])

- Very low quality evidence from 1 RCT with a follow up of 3 months on adults and children showed significant improvement in risk specific precaution adoption with high intensity tailored information programme (including 4 home visits) to raise awareness of the risks of trace amount of VOC in water at home compared to the control group (n = 235; OR 1.76 95% CI 1.05 to 2.95; 140 more per 1000 [from 12 more to 256 more])
- Low quality evidence from 1 RCT with a follow up of 3 months on adults and children showed significant improvement in risk specific precaution adoption scores with high intensity tailored information programme (including 4 home visits) to raise awareness of the risks of wall humidity (proxy for mould/mildew) at home compared to the control group (n = 235; OR 2.5 95% CI 1.48 to 4.23; 225 more per 1000 [from 96 more to 339 more])

Urgent health services use

- Low quality evidence from 1 RCT with a follow up of 12 months on adults and children with asthma showed significant reduction in urgent health services use with high intensity tailored information programme (including 7 home visits) to raise awareness of the risks of poor indoor air quality at home compared to the control group (n = 214; OR 0.38 95% CI 0.16 to 0.89; number of events not reported)
- Very low quality evidence from 1 RCT with a follow up of 12 months on pregnant women whose unborn child had a first-degree relative with an allergic history showed no difference in urgent health services use with high intensity tailored information programme (including 3 home visits) to raise awareness of the risks of poor indoor air quality at home compared to the control group (n = 347; OR 0.94 95% CI 0.58 to 1.51; number of events not reported)

Any respiratory symptom

- Very low quality evidence from 1 RCT with a follow up of 12 months on pregnant women with asthma showed no difference in any respiratory symptom with high intensity tailored information programme (including 3 home visits) to raise awareness of the risks of poor indoor air quality at home compared to the control group (n =347; OR 0.69 95% CI 0.30 to 1.98; number of events not reported)

Trigger reduction behaviours

- Low quality evidence from 1 RCT with a follow up of 12 months on adults and children showed significant improvement in vacuuming child's bedroom at least twice/2 weeks with high intensity tailored information programme (including 7home visits) to raise awareness of the risks of poor indoor air quality at home compared to the control group (n = 214; OR 2.09 95% CI 1.13 to 3.85; 147 more per 1000 [from 27 more to 230 more])
- Very low quality evidence from 1 RCT with a follow up of 12 months on adults and children showed no difference in dusting child's bedroom at least twice/2weeks with high intensity tailored information programme (including of 7 home visits) to raise awareness of the risks of poor indoor air quality at home compared to the control group (n = 214; OR 1.18 95% CI 0.67 to 2.11; 36 more per 1000 [from 94 fewer to 143 more])
- Moderate quality evidence from 1 RCT with a follow up of 12 months on adults and children with asthma showed significant improvement in using vacuum cloth-covered furniture at least twice/2 weeks or remove it with high intensity tailored

information programme (including 7 home visits) to raise awareness of the risks of poor indoor air quality at home compared to the control group (n = 214; OR 3.16 95% CI 1.81 to 5.53; 280 more per 1000 [from 145 more to 396 more])

- Low quality evidence from 1 RCT with a follow up of 12 months on adults and children with asthma showed significant improvement in using doormat or removing shoes with high intensity tailored information programme (including 7 home visits) to raise awareness of the risks of poor indoor air quality at home compared to the control group (n = 214; OR 2.12 95% CI 1.01 to 4.45; 103 more per 1000 [from 2 more to 161 more])
- Low quality evidence from 1 RCT with a follow up of 12 months on adults and children with asthma showed significant improvement in using allergy control covers on mattress and pillows with high intensity tailored information programme (including 7 home visits) to raise awareness of the risks of poor indoor air quality at home compared to the control group (n = 214; OR 2.27 95% CI 1.15 to 4.49; 133 more per 1000 [from 27 more to 200 more])
- Very low quality evidence from 1 RCT with a follow up of 12 months on adults and children with asthma showed no difference with pet in the home with high intensity tailored information programme (including 7 home visits) to raise awareness of the risks of poor indoor air quality at home compared to the control group (n = 214; OR 1.5 95% CI 0.78 to 2.89; 68 more per 1000 [from 49 fewer to 147 more])
- Very low quality evidence from 1 RCT with a follow up of 12 months on adults and children with asthma showed no difference with no smoking allowed in the home with high intensity tailored information programme (including 7 home visits) to raise awareness of the risks of poor indoor air quality at home compared to the control group (n = 214; OR 0.86 95% CI 0.45 to 1.65; 25 fewer per 1000 [from 158 fewer to 69 more])
- Very low quality evidence from 1 RCT with a follow up of 12 months adults and children with asthma showed no difference with the presence and use of a working bath exhaust fan with high intensity tailored information programme (including 7 home visits) to raise awareness of the risks of poor indoor air quality at home compared to the control group (n = 214; OR 1.3 95% CI 0.72 to 2.35; 54 more per 1000 [from 75 fewer to 152 more])
- Very low quality evidence from 1 RCT with a follow up of 12 months on adults and children with asthma showed no difference with the presence and use of a working kitchen exhaust fan with high intensity tailored information programme (including 7 home visits) to raise awareness of the risks of poor indoor air quality at home compared to the control group (n = 214; OR 0.87 95% CI 0.49 to 1.56; 30 fewer per 1000 [from 166 fewer to 84 more])

Asthma diagnosis

- Very low quality evidence from 1 RCT with a follow up of 12 months showed significant reduction in asthma diagnosis in children at high risk of allergy related conditions with high intensity tailored information programme for (including 3 home visits) for pregnant women to raise awareness of the risks of poor indoor air quality at home compared to the control group (n =347; OR 0.45 95% CI 0.25 to 0.81; number of events not reported)

Eczema diagnosis

- Very low quality evidence from 1 RCT with a follow up of 12 months showed no difference in eczema diagnosis in children at high risk of developing allergy-related conditions with a high intensity tailored information programme (including 3

home visits) for pregnant women to raise awareness of the risks of poor indoor air quality at home compared to the control group (n =347; OR 1.15 95% CI 0.44 to 2.99; number of events not reported)

Information campaigns

- No evidence was identified for this intervention

Providing recommendations

- No evidence was identified for this intervention

No evidence was identified for the following subgroups

- People on low income
- Older people
- People with disabilities
- Children and young people

The committee's discussion of the evidence

Interpreting the evidence

The outcomes that matter most

The committee considered that all reported outcomes should be of equal importance. Outcomes reported and analysed were on self-efficacy, precaution adoption, urgent health service use, trigger reduction behaviours, respiratory symptoms, physician-diagnosed asthma, and physician-diagnosed eczema. The self-efficacy and precaution adoption outcomes were discussed as it was not clear from the study what was being measured and how these were measured. Self-efficacy was defined in the study report as the belief that one's actions could produce desired results while precautionary adoption was described as one's stage of precautionary action conceptualized as a cognitive behavioural process ranging from (1) unaware of issue, (2) unengaged by issue, (3) decided not to act, (4) decided to act, to (5) already taken action. Precaution adoption at follow up was defined as a movement forward from baseline by at least 1 step in the stages of the precaution adoption process model. The committee highlighted that the self-efficacy and precaution adoption outcomes are cognitive behavioural processes and are consistent with participants complying with advice/recommendations given by trained professionals to reduce the risk of exposure to poor indoor air quality.

The quality of the evidence

Three studies were included for this review. All 3 studies were considered to be at high risk of bias (ROB) due to the lack of information on random sequence generation, lack of allocation concealment, blinding of participants and personnel, blinding of outcome assessment. In addition to these limitations, a 22% attrition rate (incomplete outcome data) was reported for Krieger 2005.

The committee acknowledged the methodological limitations identified but noted that blinding of participants and study personnel may be difficult or impossible to achieve due to the nature of interventions delivered. The lack of evidence on people with low income, older people and people with disabilities was also noted.

The committee noted that number of home visits reported in the interventions was high. To this end, the committee agreed that these interventions were very intensive and as such does not reflect current practice in the UK. The committee also noted that these intensive interventions were compared to information leaflet or tailored advice which are also 'active' interventions but were not compared to no intervention/usual care.

There was no evidence to help the committee in determining a minimum or maximum home visit that may be effective. The committee also noted that there were no investigations of effects of awareness raising for members of the public or professional groups including those with responsibility for either developing or maintain standards in building. There was also no evidence for awareness raising for dwellings where poor air quality is not suspected.

The committee agreed that the overall quality of available evidence was poor.

Benefits and harms

The committee noted that significant benefits were observed with the high intensity intervention (3 – 7 home visits) in terms of reduction in asthma diagnosis in children at risk, reducing urgent health service use in people with asthma, general precaution adoption, risk specific precaution adoption for carbon monoxide (CO), volatile organic compounds (VOCs), in wall humidity (proxy for mould/mildew), general self-efficacy, risk specific self-efficacy for CO, VOCs and in wall humidity (proxy for mould/mildew).

The high intensity interventions also showed benefits in triggering pollutant reduction behaviours (pollutant reduction behaviours) in terms of vacuuming child's bedroom at least twice/2 weeks, using vacuum cloth-covered furniture at least twice/2 weeks, using doormat or removing shoes, and using allergy control covers on mattress and pillows.

No differences in effect were observed with urgent health service use in the first year of life, respiratory symptoms and pollutant reduction behaviours such as washing sheets weekly and using hot wash or rinse, no pet at home, working bath exhaust fan present and used, working kitchen exhaust fan present and used and eczema diagnosis with intensive programme during pregnancy.

There were discussions around how the evidence on triggering reduction behaviours in terms of the presence and use of a working exhaust fan in the bathroom and kitchen did not show benefit. In the absence of any detail on this in the articles, the topic experts suggested that probably, participants may not have understood the advice or just did not comply with advice/recommendations provided during intervention home visits.

The committee agreed that giving people advice, including on how to get a housing assessment, could reduce their risk of exposure. This includes general advice on the use of ventilation systems, and more specific advice about particular situations and occupant activities (for example use of household products, personal care products and decorating materials) that may increase the risk of exposure.

Cost effectiveness and resource use

The committee noted the absence of published studies on the cost effectiveness of interventions to raise awareness of the risks of poor indoor air quality at home. However, they were mindful that the education component of some studies included an element of raising awareness. The economic model suggested that interventions to reduce exposure to indoor air pollution could be cost saving. However, the

committee were concerned that intensive interventions would be costly and therefore unlikely to be cost effective. To that end an intensive intervention involving in-home environmental assessments, education, support for behaviour change, and the provision of resources to reduce exposure to triggers of asthma was run through the economic model. The results showed in general that as the level of effectiveness increases, the number of annual visits per dwelling can be higher and remain cost saving. The same relationship was visible throughout all types of dwellings, whether non-decent, a usable floor size <90m^2 or with a damp problem. However, in the base case analysis, the results show that at seven visits annually, the high intensity intervention is unlikely to be cost-saving assuming a relative reduction of overall health condition associated symptoms of 1%. The committee noted that the model is based on a number of assumptions around key variables and given the data available is likely to have overestimated the benefits of the intervention and underestimated the cost of the intervention. Other limitations were also noted such as the limited generalisability between the US paediatric population within uncontrolled asthma used in the effectiveness study and the UK asthma population used within the model as well as changes in the routine treatment of asthma and baseline rate of asthma. Therefore, the committee interpreted the results of this analysis with caution.

Improved health outcomes and increased tenant satisfaction should result in resource savings elsewhere in the system and will offset costs.

Other factors the committee took into account

The committee noted that included studies reported on healthy adults and children, adults and children with asthma as well as pregnant women whose unborn child had a first-degree relative with an allergic history. Included studies carried out home assessments before interventions were delivered. The home assessments were conducted to identify sources of indoor air pollution and pollutant severity. The interventions were then tailored to address those specific pollutants identified at home assessment. The committee also noted that experienced/ trained professionals delivered interventions and considered that there are many professional groups, including health visitors who could be trained to carry out this role in the UK. The committee was made aware that the studies included for this review question were from the United States (US) and evidence applicability to United Kingdom (UK) was discussed. It was agreed that results presented can be generalised to the UK, though the committee noted that in the UK, home inspection is carried out by the local authority health environmental officer (EHO) if the resident reports a problem.

Though the committee noted that in the studies, raising awareness or providing information was not compared to usual care but to different intensities of providing information. The committee highlighted that the interventions were beneficial irrespective of the intensity. The committee then drafted recommendations based on these. The committee also referred to the evidence on individual or building factors that are associated with increased exposure to poor indoor air quality at home and used these to support recommendations on raising awareness.

The committee highlighted that the self-efficacy and precaution adoption outcomes were not good outcome measures of strategies for raising awareness because they only captured participants' compliance to advice/recommendations. This raised concerns that the evidence base did not fully answer the review question. The committee also noted the lack of effective strategies for raising awareness of the risks of poor indoor air quality in the UK as well as the lack of professionals to deliver awareness strategies. There were also concerns that individuals, especially vulnerable groups, may not be fully aware of the risks of poor indoor quality at home and ways to reduce or prevent these. To this end, committee suggested that people

giving advice should identify people most vulnerable to poor indoor air quality. The committee mentioned that people may not know who to go to for advice on poor indoor air quality and many people may not be able to afford the kind of repairs or modifications needed to improve indoor air quality.

The clean air strategy 2019 was highlighted. This outlines how the government and local authorities should act to raise awareness of poor indoor air quality. For social landlords, improved tenant satisfaction reduces both the time properties are left vacant and the likelihood of compensation claims.

The committee stressed that advice should be given in a positive manner so that occupants, especially those on low incomes, are not stigmatised.

Appendices

Appendix A: Review protocol

Review protocol for effective strategies for raising awareness of the risks of poor indoor air quality at home.

Field	Content
Review question	What are the effective strategies for raising awareness of the risks of poor indoor air quality at home?
Type of review question	Intervention and qualitative
Objective of the review	To identify effective strategies for raising awareness of the risks of poor indoor air quality at home
Eligibility criteria – population/disease/condition/issue/domain	People in all dwellings
Eligibility criteria – intervention(s)	Interventions designed to raise awareness of the risks of poor indoor air quality: Information campaigns: Targeted campaigns for example, campaigns targeted to building and construction industries community based, including local radio campaigns, local council / housing organisation mail outs settings based online campaigns, including social media and mobile apps national broadcast media leaflet distribution Education: home-based education educational tools peer education (carried out by a community member who shares similar life experiences to the community they are working with) lay education (carried out by community members working in a non-professional capacity) leaflet distribution Tailored information and advice delivered: During home visits During consultation with health and social care workers At group meetings for housing residents. Improved occupant guidance and advice Recommendations from: Patient groups e.g. asthma UK, Allergy UK Community health worker health or social care worker carer volunteer

Field	Content
	council / housing organisation representative family member
Eligibility criteria – comparator(s)/control	Reduced intensities or reduced frequencies of awareness interventions or do nothing
Outcomes and prioritisation	Changes in behaviour Change in knowledge Change in attitudes Change in beliefs Changes in health related symptoms associated with exposure to poor indoor air quality
Eligibility criteria – study design	Studies of effectiveness and cost-effectiveness Inclusion: RCTs Cluster RCTs UK based qualitative studies Economic studies: Cost-utility (cost per QALY) Cost benefit (i.e. Net benefit) Cost-effectiveness (Cost per unit of effect) Cost minimization Cost-consequence Exclusion: Systematic reviews will not be included but may be used as a source of primary studies Cross-sectional and other surveys Case control studies
Other inclusion/exclusion criteria	Inclusion: English language only Published peer-reviewed studies only Studies conducted in home settings with similar building and environmental conditions to the UK Studies conducted from 1970 onwards Exclusion: Conference abstract, letter, opinion piece, review articles
Proposed sensitivity/sub-group analysis, or meta-regression	Where evidence allows, sub-group analysis will be conducted to include those at increased risk of poor indoor air quality: Subgroup People on low incomes Older people Ethnicity People with disabilities Pregnant women Children and young people

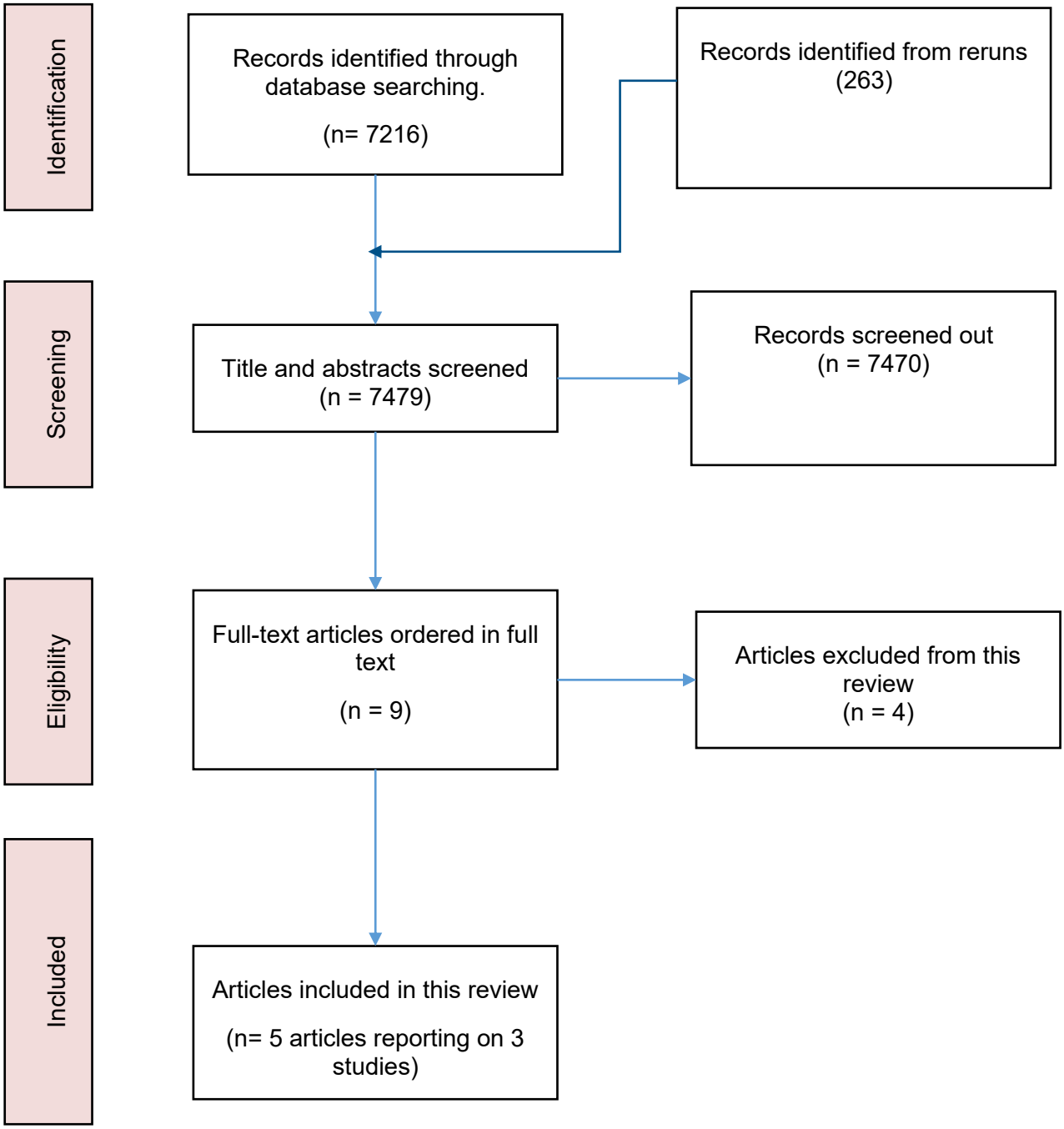
Field	Content
	People with conditions associated with or exacerbated by indoor air pollution, such as stroke, heart disease, allergic disease and asthma
Selection process – duplicate screening/selection/analysis	A 10% random sample of abstracts will be duplicate screened as a reliability check. Any disagreement will be resolved by discussion, or if necessary, a third independent reviewer. If the initial level of agreement is below 90%, a second round of screening will be considered. A 10% random sample of data extraction and critical appraisal will be checked by a second reviewer. Any disagreements will be resolved by the two reviewers, and escalated to a third reviewer if agreement cannot be reached. Only 10% of the search results will be checked as this is an intervention and qualitative review and there is confidence that RCTs, controlled studies or related qualitative studies are unlikely to be missed at the sifting stage. The inclusion list will be double checked with PHAC to ensure no studies are excluded inappropriately
Information sources – databases	A systematic search of relevant databases will be carried out to identify relevant studies and evidence. Appropriate limits will be applied. Database functionality will be used, where available, to exclude: Non-English language papers Animal studies Editorials, letters, news items and commentaries Conference abstracts and posters Theses and dissertations Duplicates Websites will be browsed or searched to focus on relevant evidence. The bibliographies of relevant reports and findings may also be used to capture evidence. The following databases will be searched: MEDLINE and MEDLINE in Process (OVID) Embase (OVID) Health Management Information Consortium (HMIC) (OVID) Social Policy and Practice (OVID) CENTRAL (Wiley) Cochrane Database of Systematic Reviews (Wiley) DARE (Wiley) Greenfile (EBSCO) NHS EED (legacy database) (Wiley) EconLit (OVID) OpenGrey Web of Science The following websites will be searched: Google and Google scholar (with appropriate limits and looking specifically for reports or evaluations of interventions related to indoor air quality)
Data management (software)	Where feasible data management will be undertaken using EPPI-reviewer software.

Field	Content
	Any pairwise meta-analyses will be performed using Cochrane Review Manager (RevMan5). Where appropriate qualitative data will be summarised using an appropriate qualitative synthesis approach, for example, narrative synthesis.
Methods for assessing bias at outcome/study level	Standard study checklists will be used to critically appraise individual studies. For details please see section 6.2 of Developing NICE guidelines: the manual For intervention studies the Cochrane Risk of Bias 2.0 tool will be used and for qualitative studies, the Cochrane qualitative checklist will be used. The Grading of Recommendations Assessment, Development and Evaluation (short GRADE) developed by the GRADE working group http://www.gradeworkinggroup.org/ will be used to assess the quality of evidence across outcomes. Where necessary, GRADE will be modified to meet the needs of the review question. GRADE-CERQUAL will be used for qualitative findings.
Criteria for quantitative synthesis	Data from eligible studies will be extracted for inclusion in evidence tables. For details please see section 6.4 of Developing NICE guidelines: the manual
Methods of quantitative analysis – combining studies and exploring (in)consistency	Data from eligible studies will be meta-analysed (combined) if studies are judged to be similar enough in terms of population, interventions, outcomes, study design or risk of bias. Where appropriate, inconsistency will be explored by conducting subgroup analyses. Where appropriate, inconsistency will be incorporated by performing random-effect analyses If the studies are found to be too heterogeneous to be pooled statistically, a narrative synthesis will be conducted.
Meta-bias assessment – publication bias, selective reporting bias	For details please see section 6.2 of Developing NICE guidelines: the manual.
Confidence in cumulative evidence	For details please see sections 6.4 and 9.1 of Developing NICE guidelines: the manual

Appendix B: Literature search strategies

Please see search strategies here

Appendix C: Public health evidence study selection



Appendix D: Public health evidence tables

D.1 Intensive strategies: Tailored information

Butterfield 2011

Bibliographic reference	Butterfield P G, Hill W, Postma J, Butterfield P W, and Odom-Maryon T. (2011). Effectiveness of a household environmental health intervention delivered by rural public health nurses. American journal of public health, 101 Suppl 1, pp.S262-70.		
Registration	Not reported		
Study type	Cluster randomised controlled study		
Study dates	2009		
Objective	To analyse the effectiveness of a public health nurse delivered multi agent intervention on parents' (1) environmental health self-efficacy and (2) stage of environmental health precaution adoption.		
Country/ Setting	United States		
Number of participants	235 households (441 adults; 399 children)		
Participant characteristics	Demographic characteristics	Intervention group n (%)	Control group n (%)
	No. of children	199	200
	Age Mean (SD)	Not reported	Not reported
	Sex	Not reported	Not reported
	Ethnicity	Not reported	Not reported
	Socio-economic status	Not reported	Not reported
	Building characteristics		
	No. of household	119	116
	Carbon monoxide ≥35 ppm	7 (8)	13 (15)
	Electric utilities	35 (30)	30 (26)
	Water contaminants (includes trace amount of VOCs)	36 (30)	34 (29)
	In wall humidity ≥18% wood moisture equivalent	37 (31)	37 (32)
Exposure	• Biomarker (lead, cotinine) and household samples (carbon monoxide (CO), radon, mould/mildew, and drinking water contaminants) • CO from combustion sources (e.g. wood stove) • In wall humidity as a proxy for mould/mildew risk		
Inclusion criteria	• If they lived outside the city limits i.e. households receiving county versus city level services		

Bibliographic reference	Butterfield P G, Hill W, Postma J, Butterfield P W, and Odom-Maryon T. (2011). Effectiveness of a household environmental health intervention delivered by rural public health nurses. American journal of public health, 101 Suppl 1, pp.S262-70.		
	• Household income at or less than 250% of the federal poverty level, • Child aged 7 years or younger, • English language literacy, • Potable water from a non-municipal source		
Exclusion criteria	Not reported		
Intervention	TIDieR Checklist criteria	Paper/Location	Details
	Brief Name	S265	Environmental risk reduction through nursing interventions and education (ERRNIE)
	Rationale/theory/Goal	S262	To analyse the effectiveness of a public health nurse delivered multi agent intervention on parents' (1) environmental health self-efficacy and (2) stage of environmental health precaution adoption
	Materials used	S263	Tailored health information by trained public health nurses involving 4 home visits; visits were completed over a 4- to 6-week period between baseline (T1) and 3 months (T2). Each visit lasted approximately 1 hour
	Procedures used	S263	The public health nurse used an interactive book to guide the family through a review of risks room by room. Each family's household/biomarker results were posted into window cut-outs throughout the book. Health information was tailored by having the nurse first differentiate between household/biomarker test results that were below versus above the threshold value (or presence vs absence). Standard messages were used to discuss all results within threshold levels; messages were also developed for tests that were frequently found to be above the threshold
	Provider	-	Public health nurse
	Method of delivery	-	Not applicable
	Location	-	Information delivered at home

Bibliographic reference	Butterfield P G, Hill W, Postma J, Butterfield P W, and Odom-Maryon T. (2011). Effectiveness of a household environmental health intervention delivered by rural public health nurses. American journal of public health, 101 Suppl 1, pp.S262-70.		
	Duration	S263	3 months
	Intensity	-	Not applicable
	Tailoring/adaptation	-	Not applicable
	Modifications	-	Not applicable
	Planned treatment fidelity	-	Not applicable
	Actual treatment fidelity	-	Not applicable
	Other details	-	None
Comparison	TIDieR Checklist criteria	Paper/Location	Details
	Brief Name	S265	Environmental risk reduction through nursing interventions and education (ERRNIE)
	Rationale/theory/Goal	S262	To analyse the effectiveness of a public health nurse delivered multi agent intervention on parents' (1) environmental health self-efficacy and (2) stage of environmental health precaution adoption
	Materials used	S263	Control group received a letter that included their test results and threshold values for each risk. Phone numbers for the health department and other resources were also provided
	Procedures used	-	Not applicable
	Provider	-	Not applicable
	Method of delivery	-	Not applicable
	Location	-	Intervention delivered at home
	Duration	S263	3 months
	Intensity	-	Not applicable
	Tailoring/adaptation	-	Not applicable
	Modifications	-	Not applicable
	Planned treatment fidelity	-	Not applicable
	Actual treatment fidelity	-	Not applicable
	Other details	-	None
Follow up	3 months		
Study Methods	Method of randomisation	Not reported	
	Method of allocation concealment	Not reported	

Bibliographic reference	Butterfield P G, Hill W, Postma J, Butterfield P W, and Odom-Maryon T. (2011). Effectiveness of a household environmental health intervention delivered by rural public health nurses. American journal of public health, 101 Suppl 1, pp.S262-70.			
	Statistical method(s) used to analyse data	Analyses were based on original group allocation. Analyses focused on intervention effectiveness at 3 months. To examine treatment effects, both linear and logistic generalized estimating equation (GEE) models were used. For analyses examining self-efficacy, the baseline value was included as a covariate to adjust for any differences among participants at baseline. Potential confounding by baseline variables was examined by assessing (1) whether inclusion of the variable changed the group and group*time coefficients by greater than 10% and (2) if the x^2 P value for the parameter was significant (P<.05).		
	Unit of allocation	Household		
	Unit of analysis	Household		
	Attrition	Number of participants completing the study: 223		Reasons for not completing the study: discontinued study; moved/evicted; lost to follow up; divorce
Outcomes	Environmental health self-efficacy: defined as the belief that one's actions could produce desired results. Bandura's Guide for Constructing Self-Efficacy Scales was used to develop and pilot test the self-efficacy instrument (range 0 – 100). Each risk specific self-efficacy score addressed 3 facets of risk reduction (i.e., identify the risk, determine if home is safe, and act to reduce exposure) Environmental health precaution adoption: conceptualized as one's stage of precautionary action and measured using Weinstein's Precaution Adoption Process Model. Precautionary action was conceptualized as a cognitive behavioural process ranging from (1) unaware of issue, (2) unengaged by issue, (3) decided not to act, (4) decided to act, to (5) already taken action			
Outcomes measures and effect size.	Precaution Adoption of Intervention and Control Groups at 3 Months: Household Environmental Health (EH) Intervention Delivered by Rural Public			
	EH Measure	Intervention Group, No. (%)	Control, No. (%)	OR (95% CI)
	General EH precaution adoption ≥3 EH risks	83 (69.8)	44 (37.9)	3.9 (2.2, 6.7)
	EH risk specific precaution adoption			
	CO	61 (51.3)	35 (30.2)	2.4 (1.4, 4.2)
	Water contaminants (includes trace amount of VOCs)	71 (59.7)	53 (45.7)	1.8 (1.1, 2.9)
	In-wall humidity	74 (62.2)	46 (39.7)	2.5 (1.5, 4.2)
	Self-efficacy scores of intervention and control at 3 Months: Household Environmental Health (EH) Intervention Delivered by Rural Public			

Bibliographic reference	Butterfield P G, Hill W, Postma J, Butterfield P W, and Odom-Maryon T. (2011). Effectiveness of a household environmental health intervention delivered by rural public health nurses. American journal of public health, 101 Suppl 1, pp.S262-70.		
	EH measure	Intervention Group, Mean (SD)	Control Group, Mean (SD)
	General EH self-efficacy scores	88.0 ±2.1	78.8 ±6.4
	EH risk specific self-efficacy scores		
	CO	91.9 ±13.5	82.9 ±19.1
	Water contaminants (includes trace amount of VOCs)	91.0 ±14.1	82.6 ±18.9
	In-wall humidity	90.8 ±14.2	82.0 ±16.7
Risk of bias (ROB)	Outcome	Judgement	Comments
	Random sequence generation	High	Not reported
	Allocation concealment	High	Not reported
	Blinding of participants and personnel	High	Not reported
	Blinding of outcome assessment	High	Not reported
	Incomplete outcome data	Low	5% loss to follow up unlikely to affect study result
	Selective reporting	Low	Pre-specified outcomes analysed and reported
	Other sources of bias	None	
Overall ROB	High		
Source of funding	This study was supported by the National Institute of Nursing Research (NIH R01NR009239 to P.G. Butterfield and K01NR009984 to W. Hill)		
Comments	Ten public health nurses delivered the intervention. All the public health nurses held either a bachelor's or master's degree in nursing, and had worked as a public health nurse an average of 12.9 years		
Additional references	None		

Krieger 2005

Bibliographic reference	Krieger J W, Takaro T K, Song L, and Weaver M. (2005). The Seattle-King County Healthy Homes Project: a randomized, controlled trial of a community health worker intervention to decrease exposure to indoor asthma triggers. American journal of public health, 95(4), pp.652-659.
Registration	Not reported
Study type	Randomised controlled study
Study dates	Enrolment occurred between January 1999 and May 2000
Objective	To test the hypothesis that a high-intensity intervention would be more effective than a low-intensity intervention for changing asthma-related behaviours, reducing

Bibliographic reference	Krieger J W, Takaro T K, Song L, and Weaver M. (2005). The Seattle-King County Healthy Homes Project: a randomized, controlled trial of a community health worker intervention to decrease exposure to indoor asthma triggers. American journal of public health, 95(4), pp.652-659.		
	trigger exposure, and decreasing asthma morbidity among low-income, ethnically diverse urban households		
Country/ Setting	United States		
Number of participants	274 adults and children		
Participant characteristics	Demographic characteristics	High-Intensity group (n=138) n (%)	Low intensity group (n=136) n (%)
	Child's age (Mean years)	7.4	7.3
	Sex (male)	77 (55.8)	84 (61.8)
	Ethnicity		
	Caregiver's Ethnicity		
	Non-Hispanic White	17 (12.3)	29 (21.3)
	Non-Hispanic African American	44 (31.9)	38 (27.9)
	Vietnamese	35 (25.4)	30 (22.1)
	Other Asian	13 (9.4)	7 (5.2)
	Hispanic	24 (17.4)	24 (17.7)
	Other	5 (3.6)	8 (5.9)
	Socio-economic status		
	Caregiver's education (%)		
	Less than high school	40.9	37.6
	High school graduate or general equivalency diploma	25.8	27.8
	Some college	26.5	25.6
	College graduate	6.8	9.0
	Building characteristics (%)		
	Mould	41.1	46.2
	Water damage/moisture/leak	17.8	23.9
Exposure	Mould, pet dander, house dust mite		
Inclusion criteria	• Home to a child aged 4–12 years with diagnosed persistent asthma • Income was below 200% of the 1996 federal poverty threshold or the child was enrolled in Medicaid; • The caregiver was verbally proficient in English, Spanish, or Vietnamese • The child spent at least 50% of nights in the house; • House was in King County		
Exclusion criteria	• A child with another chronic illness requiring daily medications • Household participation in other asthma case management or care coordination programs in the past 2 years • Plans to leave King County during the next 6 months		

Bibliographic reference	Krieger J W, Takaro T K, Song L, and Weaver M. (2005). The Seattle-King County Healthy Homes Project: a randomized, controlled trial of a community health worker intervention to decrease exposure to indoor asthma triggers. American journal of public health, 95(4), pp.652-659.		
Intervention	TIDieR Checklist criteria	Paper/Location	Details
	Brief Name	P652	Effectiveness of a community health worker intervention focused on reducing exposure to indoor asthma triggers
	Rationale/theory/Goal	P652	To test the hypothesis that a high-intensity intervention would be more effective than a low-intensity intervention for changing asthma-related behaviours, reducing trigger exposure, and decreasing asthma morbidity among low-income, ethnically diverse urban households
	Materials used	P652	The high-intensity intervention consisted of 7 home visits by community health workers (CHWs) over a year and a full set of trigger control resources
	Procedures used	P653	A CHW conducted a structured home environmental assessment at the first visit. Each assessment finding generated specific actions for the participant and CHW. The CHW and participant prioritized the actions to prepare an action plan. The CHW made 4–8 additional visits to encourage completion of the action plan, provide education and social support, deliver resources to reduce exposures, offer assistance with roach and rodent eradication, and advocate for improved housing conditions
	Provider	-	Not applicable
	Method of delivery	-	Not applicable

Bibliographic reference	Krieger J W, Takaro T K, Song L, and Weaver M. (2005). The Seattle-King County Healthy Homes Project: a randomized, controlled trial of a community health worker intervention to decrease exposure to indoor asthma triggers. American journal of public health, 95(4), pp.652-659.		
	Location	-	Intervention delivered at home
	Duration	P653	12 months
	Intensity	-	Not applicable
	Tailoring/adaptation	-	Not applicable
	Modifications	-	Not applicable
	Planned treatment fidelity	-	Not applicable
	Actual treatment fidelity	-	Not applicable
	Other details	-	None
Comparison	TIDieR Checklist criteria	Paper/Location	Details
	Brief Name	P652	Effectiveness of a community health worker intervention focused on reducing exposure to indoor asthma triggers
	Rationale/theory/Goal	P652	To test the hypothesis that a high-intensity intervention would be more effective than a low-intensity intervention for changing asthma-related behaviours, reducing trigger exposure, and decreasing asthma morbidity among low-income, ethnically diverse urban households
	Materials used	P652	Low-intensity intervention included a single home visit and limited resources
	Procedures used	P653	Low-intensity group received a single CHW visit, which consisted of the home environmental assessment, an action plan, limited education, and bedding encasements.
	Provider	-	Not applicable
	Method of delivery	-	Not applicable
	Location	-	Intervention delivered at home
	Duration	P653	12 months
	Intensity	-	Not applicable

Bibliographic reference	Krieger J W, Takaro T K, Song L, and Weaver M. (2005). The Seattle-King County Healthy Homes Project: a randomized, controlled trial of a community health worker intervention to decrease exposure to indoor asthma triggers. American journal of public health, 95(4), pp.652-659.		
	Tailoring/adaptation	-	Not applicable
	Modifications	-	Not applicable
	Planned treatment fidelity	-	Not applicable
	Actual treatment fidelity	-	Not applicable
	Other details	-	None
Follow up	12 months		
Study Methods	Method of randomisation	Permuted block design with varying block size.	
	Method of allocation concealment	Sequence numbers and group allocation were concealed in sealed, opaque, numbered envelopes prepared centrally and provided sequentially to interviewers	
	Statistical method(s) used to analyse data	Analysis was based on original allocation, and no participants crossed over between groups. Authors used generalized estimating equation (GEE) models with the robust option (using the Huber/White/Sandwich estimator of variance) and the equal within group working correlation structure. Tested for potential confounding by baseline variables (child's age, gender, and asthma severity; household income; caregiver's race/ethnicity, employment status, than 10%. No confounding was present, so these variables were not included in the models	
	Unit of allocation	Individual	
	Unit of analysis	Individual	
	Attrition	Number of participants completing the study: 214	Reasons for not completing the study: discontinued intervention; refused to continue; caregiver change; unsafe/difficult situation; caregiver hired
Outcomes	Paediatric Asthma Caregiver Quality of Life Scale score (ranging from 1 to 7, with higher scores indicating better quality of life) Asthma symptom days (self-reported number of 24-hour periods during the 2 weeks before interview with asthma symptoms: wheeze, tightness in chest, cough, shortness of breath, slowing down activities because of asthma, or night-time awakening because of asthma) Proportion with self-reported asthma-related urgent health service use during the past 2 months (emergency department, hospital, or unscheduled clinic visit).		
Outcomes measures and effect size.	Health and Functional Outcomes: Baseline and Exit Values and Comparison of Baseline-to-Exit Changes		
		High-Intensity Group (n=110)	Low Intensity Group (n=104)	Comparison of Baseline-to-Exit Changes Across Groups

Bibliographic reference	Krieger J W, Takaro T K, Song L, and Weaver M. (2005). The Seattle-King County Healthy Homes Project: a randomized, controlled trial of a community health worker intervention to decrease exposure to indoor asthma triggers. American journal of public health, 95(4), pp.652-659.						
		Base	Exit	Base	Exit	GEE Coefficient (95% CI)	Odds ratio (95% CI)
	Urgent health services use/ 2 months (%)	23.4	8.4	20.2	16.4	-0.97 (-1.8, -0.12)	0.38 (0.16, 0.89)
	Trigger Reduction Behaviours: Baseline and Exit Values and Comparison of Baseline-to-Exit Changes						
		High intensity group (n=110) %				Low intensity group (n=104) %	
	Individualised behaviour summary score	Base	Exit			Base	Exit
	Vacuum child's bedroom at least twice/2 weeks	63.9	78.7			62.5	64.4
	Dust child's bedroom at least twice/2 weeks	63.9	70.4			69.2	66.3
	Vacuum cloth-covered furniture at least twice/2 weeks or remove it	35.5	64.5			26.2	36.9
	Use doormat or remove shoes	67.3	88.1			70.6	77.5
	Use allergy control covers on mattress and pillows	5.7	85.9			7.8	71.8
	Wash sheets weekly and use hot wash or rinse	47.3	41.8			42.3	42.3
	No pet in the home	81.5	81.5			77.9	75.0
	No smoking allowed in the home	80.0	77.3			76.0	79.8
	Working bath exhaust fan present and used	55.5	73.3			68.1	68.1
	Working kitchen exhaust fan present and used	70.9	67.3			54.8	70.2

Bibliographic reference	Krieger J W, Takaro T K, Song L, and Weaver M. (2005). The Seattle-King County Healthy Homes Project: a randomized, controlled trial of a community health worker intervention to decrease exposure to indoor asthma triggers. American journal of public health, 95(4), pp.652-659.		
Risk of bias (ROB)	Outcome	Judgement	Comments
	Random sequence generation	Low	Permuted block design with varying block size
	Allocation concealment	Low	Sequence numbers and group allocation were concealed in sealed, opaque, numbered envelopes prepared centrally and provided sequentially to interviewers
	Blinding of participants and personnel	Unclear	The nature of the intervention made it impossible to blind participants and staff to group assignment.
	Blinding of outcome assessment	High	Not reported
	Incomplete outcome data	High	22% loss to follow up. High attrition rate
	Selective reporting	Low	Pre-specified outcomes analysed and reported
	Other sources of bias	None	
Overall ROB	High		
Source of funding	Primary funding was provided by the National Institute of Environmental Health Sciences (grant 5 R21 ES09095 to James Krieger, principle investigator). Additional support was provided by Seattle Partners for Healthy Communities (a Centres for Disease Control and Prevention–funded Urban Research Centre) (grant U48/CCU009654-07), the Nesholm Foundation, and the Seattle Foundation. The Hoover Vacuum Company provided low emission vacuums at cost. Group Health Cooperative of Puget Sound donated free enrolment in their Free & Clear tobacco cessation program. The Local Hazardous Waste Management Program of King County donated green cleaning kits and pails		
Comments	None		
Additional references	Krieger J W, Song L, Takaro T K, and Stout J. (2000). Asthma and the home environment of low-income urban children: preliminary findings from the Seattle-King County healthy homes project. Journal of urban health: bulletin of the New York Academy of Medicine, 77(1), pp.50-67. Krieger J K, Takaro T K, Allen C, Song L, Weaver M, Chai S, and Dickey P. (2002). The Seattle-King County healthy homes project: implementation of a comprehensive approach to improving indoor environmental quality for low-income children with asthma. Environmental health perspectives, 110 Suppl 2, pp.311-322.		

Persky 2009

Bibliographic reference	Persky V, Piorkowski J, Hernandez E et.al. (2009). The effect of low-cost modification of the home environment on the development of respiratory symptoms in the first year of life. Annals of allergy, asthma & immunology: official publication of the American College of Allergy, Asthma, and & Immunology, 103(6), pp.480-7.		
Registration	Not reported		
Study type	Randomised controlled study		
Study dates	September 24, 1998, through October 4, 2004		
Objective	To determine the effect of community educators working with low-income pregnant women at risk of having a child with asthma on modification of factors in the home known to exacerbate the disease		
Country/ Setting	United States		
Number of participants	383 pregnant women whose unborn child had a first-degree relative with an allergic history		
Participant characteristics	Demographic characteristics	Intensive education group (n=192) %	Non-intensive education group (n=191) %
	Maternal age; mean (range)	25.5 (15–43)	25.7 (15–40)
	Sex	Not applicable	Not applicable
	Ethnicity		
	Mexican	57.3	68.1
	Puerto Rican	16.7	14.1
	Other/mixed Hispanic	12.0	10.0
	African American	7.3	4.7
	Other	6.8	3.1
	Socio-economic status		
	Education completed		
	<High school	41.2	41.4
	High school graduate	33.9	34.0
	Some college graduate	22.4	17.8
	College graduate	2.6	6.8
	Building characteristics	Not reported	Not reported
Exposure	House dust mite, pets, water leaks		
Inclusion criteria	Pregnant woman was eligible: • If her unborn child had a first-degree relative with asthma, eczema, or hay fever; • She lived in a selected community area on the west side of Chicago; • She was in the first 4 months of pregnancy; and she did not intend to move in the next year		
Exclusion criteria	Not reported		
Intervention	TIDieR Checklist criteria	Paper/Location	Details
	Brief Name	P1	The Peer Education in Pregnancy Study

Bibliographic reference	Persky V, Piorkowski J, Hernandez E et.al. (2009). The effect of low-cost modification of the home environment on the development of respiratory symptoms in the first year of life. Annals of allergy, asthma & immunology: official publication of the American College of Allergy, Asthma, and & Immunology, 103(6), pp.480-7.		
	Rationale/theory/Goal	P2	To determine the effect of community educators working with low-income pregnant women at risk of having a child with asthma on modification of factors in the home known to exacerbate the disease.
	Materials used	P3	In addition to receiving basic health education, the intensive education group received 3 home intervention visits by a community health educator focused on modification of the environment
	Procedures used	P3	Two of the 3 visits were during pregnancy (at 5–6 and 7–8 months of gestation) and 1 was when the child was aged 4 months. The intervention included advice about dust control, removal of pets from the house, washing bed linens in hot water, cost-effective means of controlling water leaks, pest and rodent control through Integrated Pest Management, identification of cockroach droppings and use of gel baits, removal of carpets when feasible, use of clothes hampers, and use of wet mopping. Mothers received dust mite–impermeable mattress covers for their beds. They did not receive covers for pillows or box springs
	Provider	P3	Community health educator
	Method of delivery	-	Not applicable
	Location	-	Intervention delivered at home
	Duration	P3	12 months
	Intensity	-	Not applicable
	Tailoring/adaptation	-	Not applicable
	Modifications	-	Not applicable

Bibliographic reference	Persky V, Piorkowski J, Hernandez E et.al. (2009). The effect of low-cost modification of the home environment on the development of respiratory symptoms in the first year of life. Annals of allergy, asthma & immunology: official publication of the American College of Allergy, Asthma, and & Immunology, 103(6), pp.480-7.		
	Planned treatment fidelity	-	Not applicable
	Actual treatment fidelity	-	Not applicable
	Other details	-	None
Comparison	TIDieR Checklist criteria	Paper/Location	Details
	Brief Name	P1	The Peer Education in Pregnancy Study
	Rationale/theory/Goal	P2	To determine the effect of community educators working with low-income pregnant women at risk of having a child with asthma on modification of factors in the home known to exacerbate the disease.
	Materials used	P3	Basic health education
	Procedures used	P3	Not reported
	Provider	P3	Community health educator
	Method of delivery	-	Not applicable
	Location	-	Intervention delivered at home
	Duration	P3	12 months
	Intensity	-	Not applicable
	Tailoring/adaptation	-	Not applicable
	Modifications	-	Not applicable
	Planned treatment fidelity	-	Not applicable
	Actual treatment fidelity	-	Not applicable
	Other details	-	None
Follow up	12 months		
Study Methods	Method of randomisation	Not reported	
	Method of allocation concealment	Not reported	
	Statistical method(s) used to analyse data	Logistic regression models were used to estimate the effect of being in the intervention group on the child's respiratory symptoms in the first year of life. Multiple logistic regression was used to obtain odds ratios adjusted for maternal age, child's sex, maternal Mexican ethnicity, child breastfed for 4 or more weeks, active smoking in mid to late pregnancy, exposure to passive smoke during pregnancy, low birth weight (<2,500 g), antibiotic use in late pregnancy, age when formula was introduced (categorized by birth, <4 weeks, 4–12	

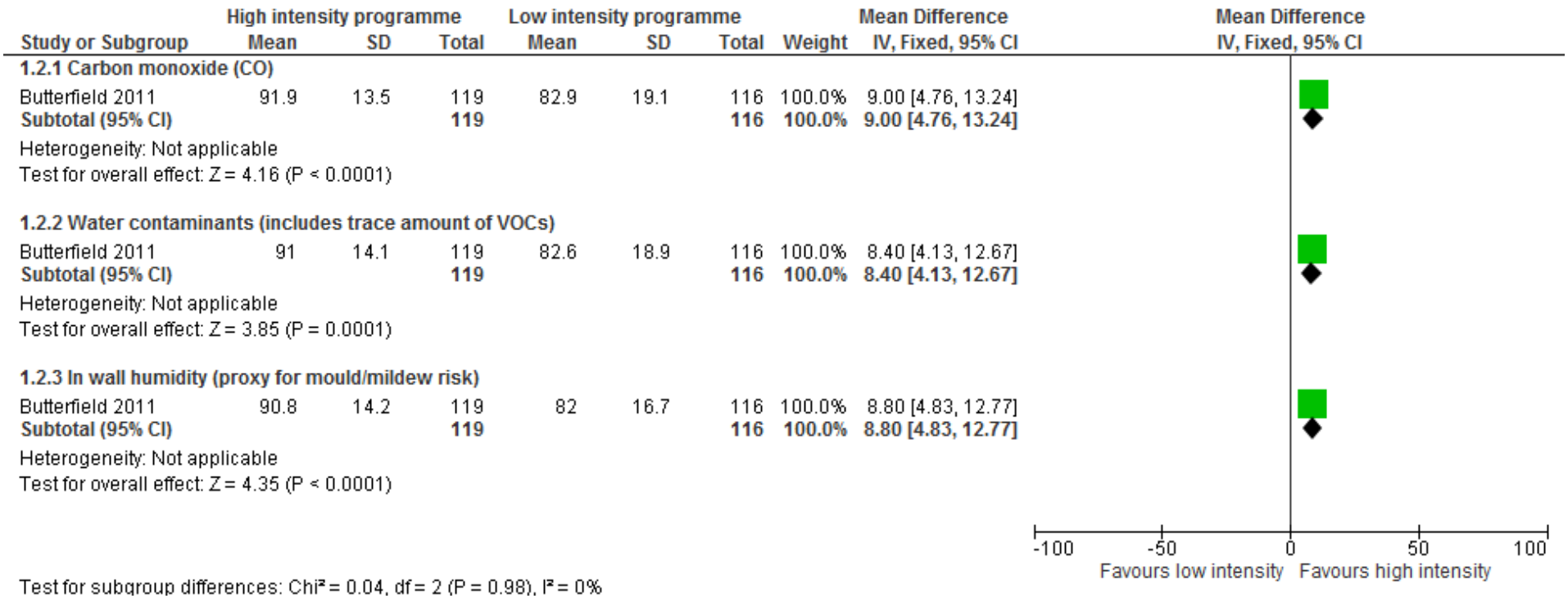
Bibliographic reference	Persky V, Piorkowski J, Hernandez E et.al. (2009). The effect of low-cost modification of the home environment on the development of respiratory symptoms in the first year of life. Annals of allergy, asthma & immunology: official publication of the American College of Allergy, Asthma, and & Immunology, 103(6), pp.480-7.			
		weeks, and >12 weeks), and family history of asthma		
	Unit of allocation	Individual		
	Unit of analysis	Individual		
	Attrition	Number of participants completing the study: 347	Reasons for not completing the study: miscarriage (n = 1), moved out of the study area (n = 1), stillbirth (n = 1), hysterical pregnancy (n = 1), new born deceased (n = 1), and not interested (n = 6).	
Outcomes	Development of respiratory end points was determined by any positive response at visit 4 (child aged 4–6 weeks), visit 5 (child aged 6 months), or visit 6 (child aged 12 months) or telephone calls at 3 and 9 months concerning any wheezing (whistling in the chest), wheezing ever disturbing sleep at night, any coughing frequently throughout the day or night, coughing ever disturbing sleep at night, treatment in the emergency department for breathing problems (coughing, congestion, runny nose, or wheezing), admission to the hospital for breathing problems, physician-diagnosed asthma, or physician-diagnosed eczema.			
Outcomes measures and effect size.	Health and Functional Outcomes: Baseline and Exit Values and Comparison of Baseline-to-Exit Changes			
		Intensive education group, %	Non intensive education group, %	Adjusted Odds ratio (95% CI)
	Any respiratory symptom	90.8	93.1	0.69 (0.30–1.58)
	Emergency department visit for respiratory symptoms	33.5	35.1	0.94 (0.58–1.51)
	Asthma diagnosis	3.5	6.3	0.45 (0.15–1.33)
	Eczema diagnosis	10.4	8.6	1.15 (0.54–2.45)
Risk of bias (ROB)	Outcome	Judgement		Comments
	Random sequence generation	High		Not reported
	Allocation concealment	High		Not reported
	Blinding of participants and personnel	High		Not reported
	Blinding of outcome assessment	High		Not reported
	Incomplete outcome data	Low		5% loss to follow up unlikely to affect study result
	Selective reporting	Low		Pre-specified outcomes analysed and reported
	Other sources of bias	None		
Overall ROB	High			

Bibliographic reference	Persky V, Piorkowski J, Hernandez E et.al. (2009). The effect of low-cost modification of the home environment on the development of respiratory symptoms in the first year of life. Annals of allergy, asthma & immunology: official publication of the American College of Allergy, Asthma, and & Immunology, 103(6), pp.480-7.
Source of funding	Study was supported by grants R21ES08716 and R01ES011377 from National Institute of Environmental Health Sciences.
Comments	None
Additional references	None

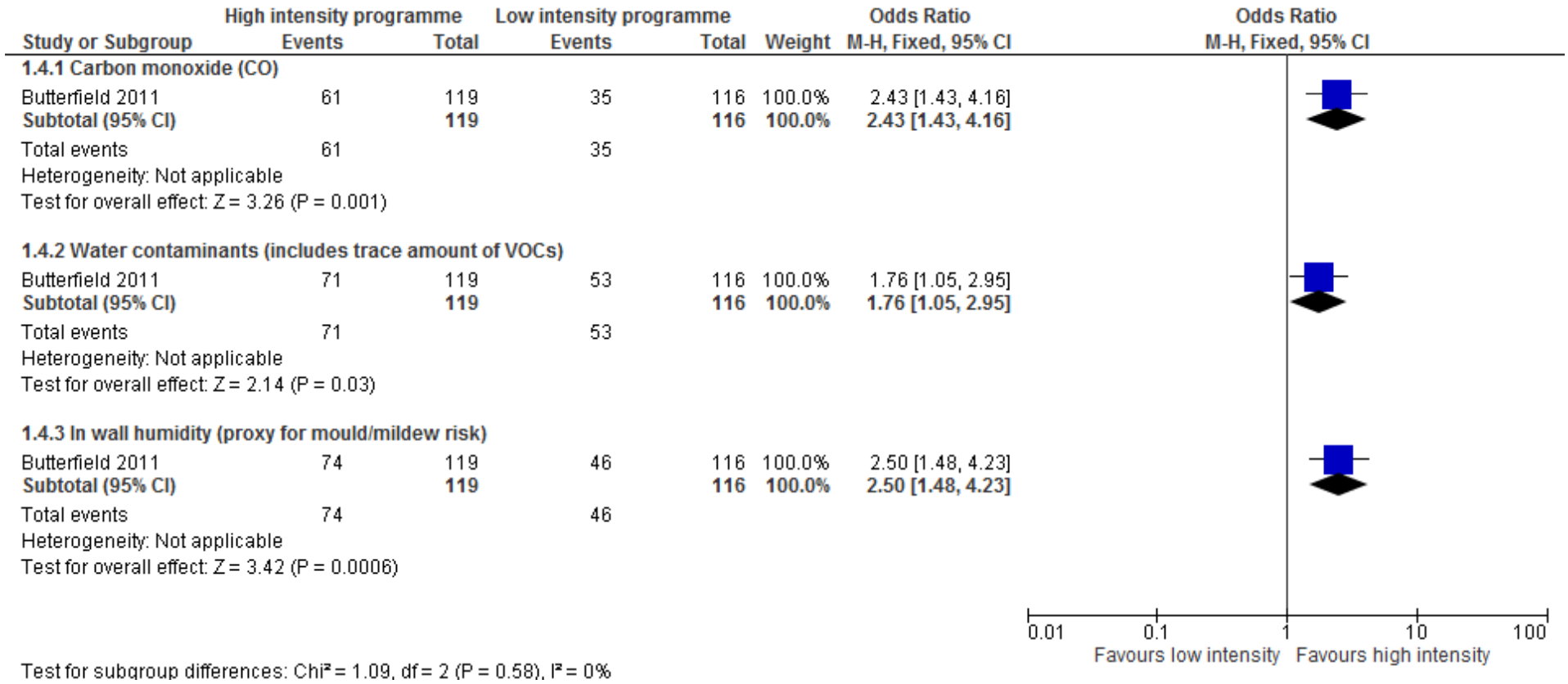
Appendix E: Forest plots

E.1 Education, tailored information and advice on raising awareness for poor indoor air quality at home

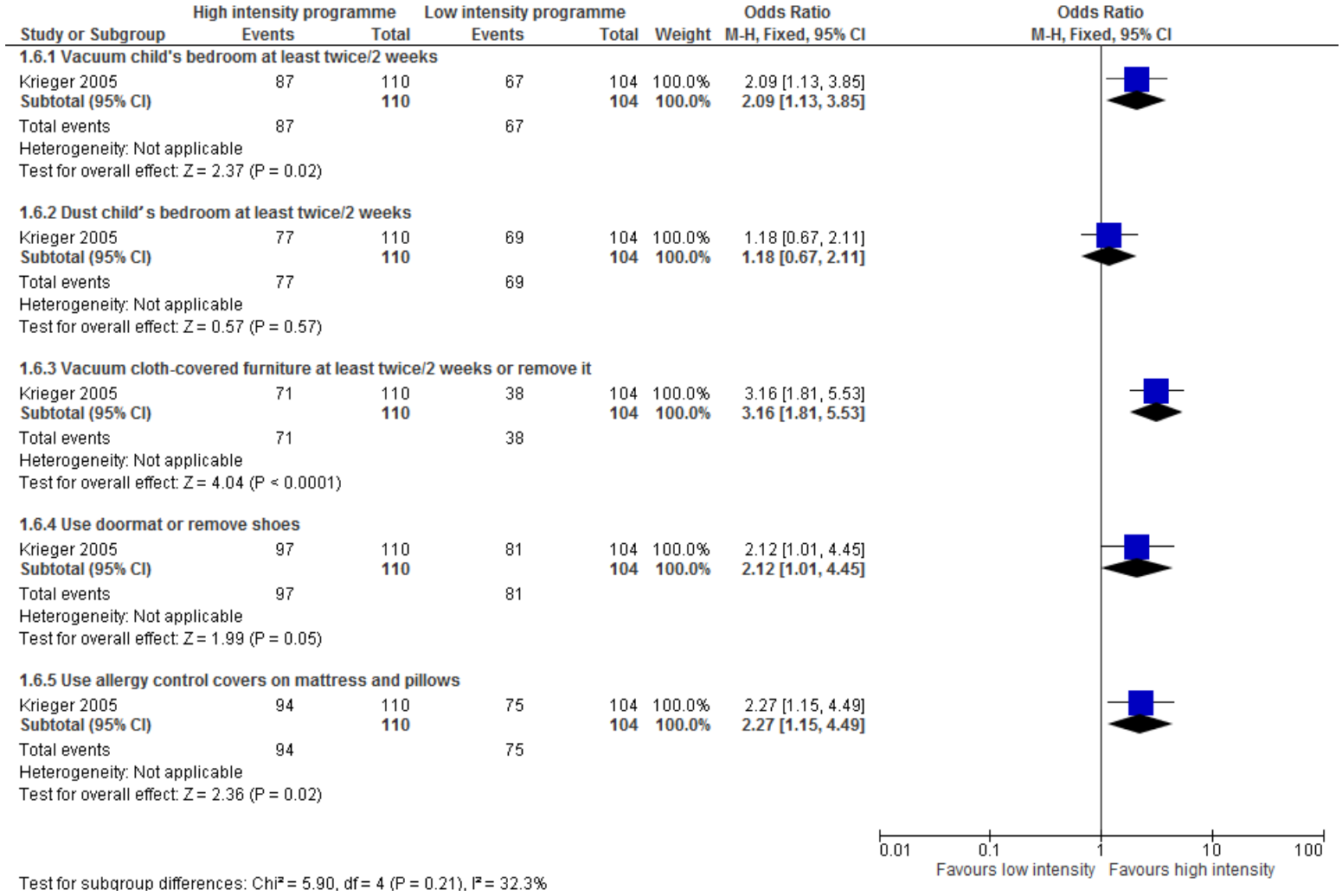
E.1.1 Risk specific self-efficacy scores



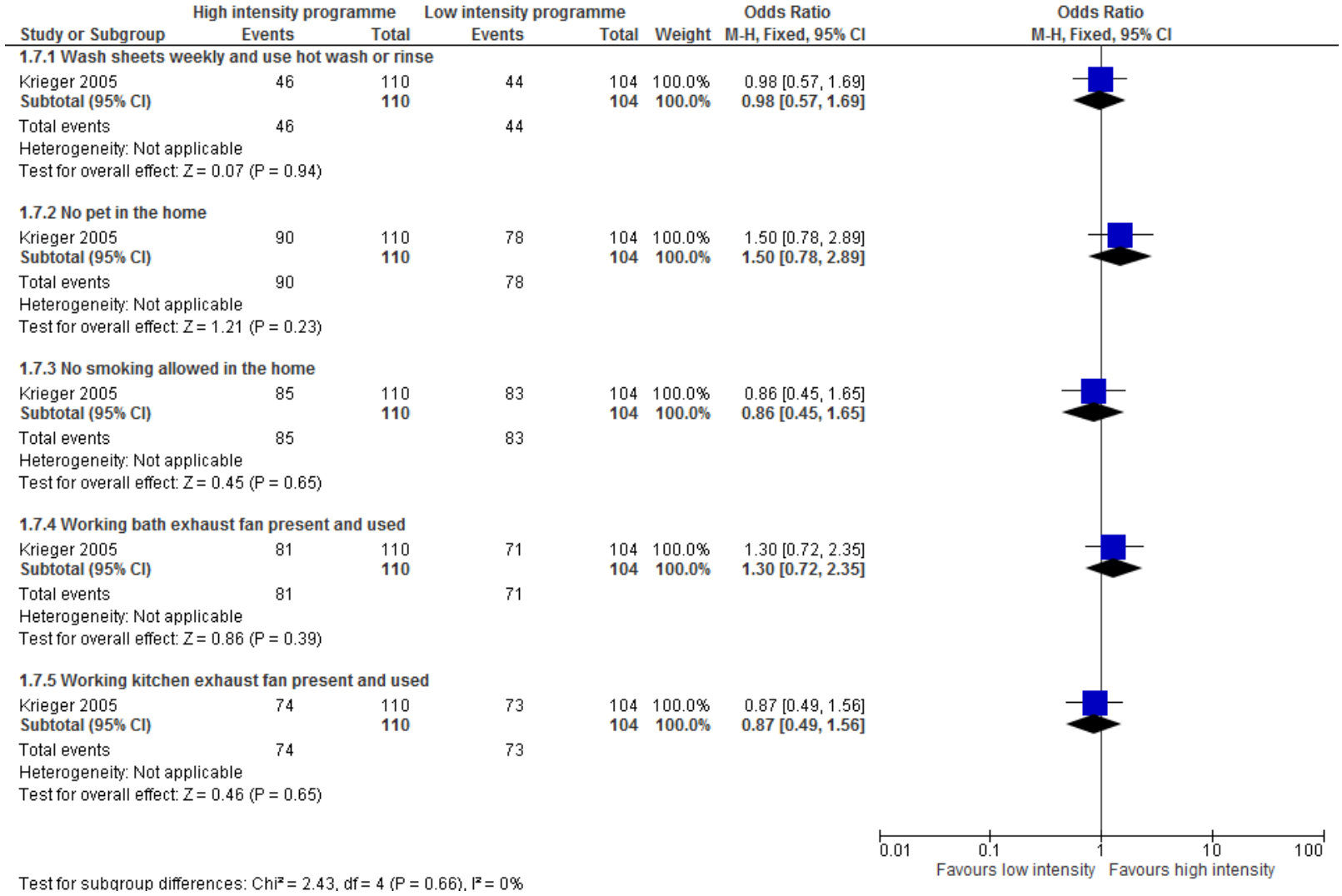
E.1.2 Risk specific precaution adoption



E.1.3 Trigger reduction behaviours



E.1.4 Trigger reduction behaviours (Continued)



Appendix F: GRADE profiles

F.1 Intensive awareness strategies: Tailored information for raising awareness for poor indoor air quality at home

Quality assessment							No of participants		Effect		Quality
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Intervention	Control	Relative (95% CI)	Absolute	
General self-efficacy scores (follow-up 3 months; measured with: Bandura's Guide for Constructing Self-Efficacy Scales (range 0 – 100); Better indicated by higher values)											
Butterfield 2011	randomised trials	very serious[1]	no serious inconsistency[2]	no serious indirectness[3]	no serious imprecision[4]	none	119	116	-	MD 9.2 higher (7.98 to 10.42 higher)	LOW
Risk specific self-efficacy scores - Carbon monoxide (CO) (follow-up 3 months; measured with: Bandura's Guide for Constructing Self-Efficacy Scales (range 0 – 100; Better indicated by lower values)											
Butterfield 2011	randomised trials	very serious[1]	no serious inconsistency[2]	no serious indirectness[3]	no serious imprecision[5]	none	119	116	-	MD 9 higher (4.76 to 13.24 higher)	LOW
Risk specific self-efficacy scores - Water contaminants (includes trace amount of VOCs) (follow-up 3 months; measured with: Bandura's Guide for Constructing Self-Efficacy Scales (range 0 – 100); Better indicated by higher values)											

Quality assessment							No of participants		Effect		Quality
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Intervention**	**Control**	**Relative (95% CI)**	**Absolute**	
Butterfield 2011	randomised trials	very serious[1]	no serious inconsistency[2]	no serious indirectness[3]	serious[6]	none	119	116	-	MD 8.4 higher (4.13 to 12.67 higher)	VERY LOW
Risk specific self-efficacy scores - In wall humidity (proxy for mould/mildew risk) (follow-up 3 months; measured with: Bandura's Guide for Constructing Self-Efficacy Scales (range 0 – 100); Better indicated by higher values)											
Butterfield 2011	randomised trials	very serious[1]	no serious inconsistency[2]	no serious indirectness[3]	serious[7]	none	119	116	-	MD 8.8 higher (4.83 to 12.77 higher)	VERY LOW
General precaution adoption (follow-up 3 months; assessed with: Weinstein's Precaution Adoption Process Model)											
Butterfield 2011	randomised trials	very serious[1]	no serious inconsistency[2]	no serious indirectness[3]	no serious imprecision[8]	none	83/119	44/116	OR 3.77 (2.19 to 6.49)	318 more per 1000 (from 193 more to 419 more)	LOW
Risk specific precaution adoption - Carbon monoxide (CO) (follow-up 3 months; assessed with: Weinstein's Precaution Adoption Process Model)											
Butterfield 2011	randomised trials	very serious[1]	no serious inconsistency[2]	no serious indirectness[3]	no serious imprecision[8]	none	61/119	35/116	OR 2.43 (1.43 to 4.16)	210 more per 1000 (from 80 more to 341 more)	LOW

Quality assessment							No of participants		Effect		Quality
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Intervention**	**Control**	**Relative (95% CI)**	**Absolute**	
Risk specific precaution adoption - Water contaminants (includes trace amount of VOCs) (follow-up 3 months; assessed with: Weinstein's Precaution Adoption Process Model)											
Butterfield 2011	randomised trials	very serious[1]	no serious inconsistency[2]	no serious indirectness[3]	serious[9]	none	71/119	53/116	OR 1.76 (1.05 to 2.95)	140 more per 1000 (from 12 more to 256 more)	VERY LOW
Risk specific precaution adoption - In wall humidity (proxy for mould/mildew risk) (follow-up 3 months; assessed with: Weinstein's Precaution Adoption Process Model)											
Butterfield 2011	randomised trials	very serious[1]	no serious inconsistency[2]	no serious indirectness[3]	no serious imprecision[8]	none	74/119	46/116	OR 2.5 (1.48 to 4.23)	225 more per 1000 (from 96 more to 339 more)	LOW
Urgent health services use (follow-up 12 months; assessed with: Urgent health service use for breathing problems)											
Krieger 2005	randomised trials	very serious[11]	no serious inconsistency[2]	no serious indirectness[3]	no serious imprecision[8]	none	Baseline 26/110 Exit 9/110	Baseline 21/104 Exit 17/104	OR 0.38 (0.16, 0.89)	-	VERY LOW
Urgent health services use (follow-up 12 months; assessed with: Urgent health service use for breathing problems)											

Quality assessment							No of participants		Effect		Quality
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Intervention**	**Control**	**Relative (95% CI)**	**Absolute**	
Persky 2009	randomised trials	very serious[1]	no serious inconsistency[2]	no serious indirectness[3]	very serious imprecision[10]	none	-	-	OR 0.94 (0.58, 1.51)	-	VERY LOW
Any respiratory symptom (follow-up 12 months)											
Persky 2009	randomised trials	very serious[1]	no serious inconsistency[2]	no serious indirectness[3]	very serious[10]	none	-	-	OR 0.69 (0.30 to 1.98)	-	VERY LOW
Trigger reduction behaviours - Vacuum child's bedroom at least twice/2 weeks (follow-up 12 months)											
Krieger 2005	randomised trials	serious[11]	no serious inconsistency[2]	no serious indirectness[3]	serious[9]	none	Baseline 70/110 Exit 87/110	Baseline 65/104 Exit 67/104	OR 2.09 (1.13 to 3.85)	147 more per 1000 (from 27 more to 230 more)	LOW
Trigger reduction behaviour - Dust child's bedroom at least twice/2weeks (follow-up 12 months)											
Krieger 2005	randomised trials	serious[11]	no serious inconsistency[2]	no serious indirectness[3]	very serious[10]	none	Baseline 70/110 Exit 77/110	Baseline 65/104 Exit 69/104	OR 1.18 (0.67 to 2.11)	36 more per 1000 (from 94 fewer to 143 more)	VERY LOW

Quality assessment							No of participants		Effect		Quality
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Intervention**	**Control**	**Relative (95% CI)**	**Absolute**	
Trigger reduction behaviours - Vacuum cloth-covered furniture at least twice/2 weeks or remove it (follow-up 12 months)											
Krieger 2005	randomised trials	serious[11]	no serious inconsistency[2]	no serious indirectness[3]	no serious imprecision[8]	none	Baseline 39/110 Exit 71/110	Baseline 27/104 Exit 38/104	OR 3.16 (1.81 to 5.53)	280 more per 1000 (from 145 more to 396 more)	MODERATE
Trigger reduction behaviours - Use doormat or remove shoes (follow-up 12 months)											
Krieger 2005	randomised trials	serious[11]	no serious inconsistency[2]	no serious indirectness[3]	serious[9]	none	Baseline 74/110 Exit 97/110	Baseline 73/104 Exit 81/104	OR 2.12 (1.01 to 4.45)	103 more per 1000 (from 2 more to 161 more)	LOW
Trigger reduction behaviours - Use allergy control covers on mattress and pillows (follow-up 12 months)											
Krieger 2005	randomised trials	serious[11]	no serious inconsistency[2]	no serious indirectness[3]	serious[9]	none	Baseline 6/110	Baseline 8/104	OR 2.27 (1.15 to 4.49)	133 more per 1000 (from 27	LOW

Quality assessment							No of participants		Effect		Quality
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Intervention	Control	Relative (95% CI)	Absolute	
							Exit 94/110	Exit 75/104		more to 200 more)	
Trigger reduction behaviours - Wash sheets weekly and use hot wash or rinse (follow-up 12 months)											
Krieger 2005	randomised trials	serious[11]	no serious inconsistency[2]	no serious indirectness[3]	very serious[10]	none	Baseline 52/110 Exit 46/110	Baseline 44/104 Base 44/104	OR 0.98 (0.57 to 1.69)	5 fewer per 1000 (from 128 fewer to 130 more)	VERY LOW
Trigger reduction behaviours - No pet in the home (follow-up 12 months)											
Krieger 2005	randomised trials	serious[11]	no serious inconsistency[2]	no serious indirectness[3]	very serious[10]	none	Baseline 90/110 Exit 90/110	Baseline 81/104 Exit 78/104	OR 1.5 (0.78 to 2.89)	68 more per 1000 (from 49 fewer to 147 more)	VERY LOW

Quality assessment							No of participants		Effect		Quality
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Intervention**	**Control**	**Relative (95% CI)**	**Absolute**	
Trigger reduction behaviours - No smoking allowed in the home (follow-up 12 months)											
Krieger 2005	randomised trials	serious[11]	no serious inconsistency[2]	no serious indirectness[3]	very serious[10]	none	Baseline 88/110 Exit 85/110	Baseline 79/104 Exit 83/104	OR 0.86 (0.45 to 1.65)	25 fewer per 1000 (from 158 fewer to 69 more)	VERY LOW
Trigger reduction behaviours - Working bath exhaust fan present and used (follow-up 12 months)											
Krieger 2005	randomised trials	serious[11]	no serious inconsistency[2]	no serious indirectness[3]	very serious[10]	none	Baseline 61/110 Exit 81/110	Baseline 71/104 Exit 71/104	OR 1.3 (0.72 to 2.35)	54 more per 1000 (from 75 fewer to 152 more)	VERY LOW
Trigger reduction behaviours - Working kitchen exhaust fan present and used (follow-up 12 months)											

Quality assessment							No of participants		Effect		Quality
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Intervention**	**Control**	**Relative (95% CI)**	**Absolute**	
Krieger 2005	randomised trials	serious[11]	no serious inconsistency[2]	no serious indirectness[3]	very serious[10]	none	Baseline 78/110 Exit 74/110	Baseline 57/104 Exit 73/104	OR 0.87 (0.49 to 1.56)	30 fewer per 1000 (from 166 fewer to 84 more)	VERY LOW
Asthma diagnosis (follow-up 12 months; assessed with: Physician diagnosed asthma)											
Persky 2009	randomised trials	very serious[1]	no serious inconsistency[2]	no serious indirectness[3]	serious[12]	none	-	-	OR 0.45 (0.25 to 0.81)	-	VERY LOW
Eczema diagnosis (follow-up 12 months; assessed with: Physician diagnosed eczema)											
Persky 2009	randomised trials	very serious[1]	no serious inconsistency[2]	no serious indirectness[3]	very serious[10]	none	-	-	OR 1.15 (0.44 to 2.99)	-	VERY LOW

[1] Downgraded for lack of randomisation, allocation concealment and blinding
[2] Not applicable as a single study
[3] Not downgraded as study met eligibility criteria as per protocol
[4] Not downgraded as confidence interval does not include 3.2 in either direction (calculated from 0.5 SD of the control group)
[5] Downgraded once as lower confidence interval crosses 9.55 (calculated from 0.5 SD of the control group)
[6] Downgraded once as lower confidence interval crosses 9.45 (calculated from 0.5 SD of the control group)
[7] Downgraded once as lower confidence interval crosses 8.35 (calculated from 0.5 SD of the control group)
[8] Not downgraded as confidence interval excludes appreciable harm and benefit

[9] Downgraded once as confidence interval includes appreciable harm (1.25)
[10] Downgraded twice as confidence interval includes appreciable benefit (0.8) and appreciable harm (1.25)
[11] Downgraded for lack of blinding of outcome assessment and high attrition (22%) rate
[12] Downgraded once as confidence interval includes appreciable benefit (0.8)

Appendix G: Health economic evidence study selection

Please see cost-effectiveness review

Appendix H: Health economic evidence tables

Please see cost-effectiveness review

Appendix I: Health economic evidence profiles

Please see cost-effectiveness review

Appendix J: Health economic analysis

Please see cost-effectiveness review

Appendix K: Excluded studies

K.1 Public health studies

Bibliography	Reason for exclusion
1. Ashley J M, Hodgson A, Sharma S, and Nisker J. (2015). Pregnant women's navigation of information on everyday household chemicals: Phthalates as a case study. BMC Pregnancy and Childbirth, 15(1), pp.312. Qualitative	Qualitative study concerned with Phthalates as a case study and not on pollutants specified in the protocol
2. Biksey T, Zickmund S, and Wu F. (2011). Disparities in risk communication: A pilot study of asthmatic children, their parents, and home environments. Journal of the National Medical Association, 103(5), pp.388-391.	Qualitative study concerned with health care (information) disparities in ethnic minority (African Americans) and not on strategies for raising awareness of the risks of poor indoor air quality at home
3. Kjellman B, and Pettersson R. (1983). The problem of furred pets in childhood atopic disease. Failure of an information program. Allergy, 38(1), pp.65-73.	Not RCT. Questionnaire based study concerned with furred pets and asthma prevalence
4. Huss K, Squire E N, Jr, Carpenter G B et.al. (1992) Effective education of adults with asthma who are allergic to dust mites. The Journal of allergy and clinical immunology 89(4), 836-43	Intervention not applicable to UK setting

K.2 Economic studies

Please see cost-effectiveness review

Appendix L: Research recommendations

L.1.1 Effective strategies for raising awareness

What are the effective and cost-effective strategies for raising awareness of the health risks of damp and mould in the home?

Population	Adults and children
Intervention	Verbal information Written information
Comparison	No information
Outcomes	Respiratory health outcomes Allergic health outcomes Cardiac health outcomes Pregnancy related health outcomes Health related quality of life
Study design	Randomised controlled trial
Time frame	At least 1 year

Rationale: the majority of the evidence focus on strategies to raise awareness on homes with identified problem relating to poor indoor quality. Evidence on the benefits and harms of awareness raising for damp and mould would improve knowledge in this area. Educative strategies tailored to homes with damp and mould could include the following content

- Health risks associated with damp and mould
- How to identify damp and mould, including the detection of microbial VOCs'
- How to reduce exposure
- how to prevent future occurrence and
- whose responsibility it is to implement changes to homes (for social and private tenants)