

## Indoor air quality at home

### NICE guideline: methods

*NICE guideline <number>*

*Methods*

*December 2018*

*Draft for Consultation*

*Evidence reviews were developed by  
Public Health Internal Guideline  
Development team*



## **Disclaimer**

The recommendations in this guideline represent the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, professionals are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or service users. The recommendations in this guideline are not mandatory and the guideline does not override the responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient, in consultation with the patient and/or their carer or guardian.

Local commissioners and/or providers have a responsibility to enable the guideline to be applied when individual health professionals and their patients or service users wish to use it. They should do so in the context of local and national priorities for funding and developing services, and in light of their duties to have due regard to the need to eliminate unlawful discrimination, to advance equality of opportunity and to reduce health inequalities. Nothing in this guideline should be interpreted in a way that would be inconsistent with compliance with those duties.

NICE guidelines cover health and care in England. Decisions on how they apply in other UK countries are made by ministers in the [Welsh Government](#), [Scottish Government](#), and [Northern Ireland Executive](#). All NICE guidance is subject to regular review and may be updated or withdrawn.

## **Copyright**

© National Institute for Health and Care Excellence, 2018. All rights reserved.

ISBN:

# Contents

<b>Development of the guideline</b> .....	<b>5</b>
What this guideline covers.....	5
What this guideline does not cover.....	5
<b>Methods</b> .....	<b>6</b>
Developing the review questions and outcomes.....	6
Reviewing research evidence.....	6
Type of studies and inclusion/exclusion criteria.....	7
Methods of combining evidence.....	7
Data synthesis for intervention reviews.....	7
Minimal important difference (MID).....	8
Data synthesis for non-intervention reviews.....	8
Appraising the quality of evidence.....	9
Critical appraisal of individual studies.....	9
Certainty of the evidence for each outcome.....	10
Reviewing economic evidence.....	11
Inclusion and exclusion of economic studies.....	11
Appraising the quality of economic evidence.....	12
Health economic modelling.....	12
Resource impact assessment.....	13

# 1 **Development of the guideline**

## 2 **What this guideline covers**

3 This guideline covers effective ways to prevent or reduce the health impact of poor  
4 indoor air quality at home. It looks at individual or building characteristics that  
5 increase exposure to poor indoor air quality and signs and symptoms that should  
6 prompt healthcare professionals to consider exposure to poor indoor air quality in  
7 people presenting to health services. It also covers strategies for raising awareness  
8 and interventions to prevent or reduce the risks of poor indoor air quality at home.

## 9 **What this guideline does not cover**

10 This guideline does not cover areas covered by national legislation such as  
11 legislation on Radon or areas covered by other NICE guidance for example outdoor  
12 air quality, smoking: harm reduction, smoking: stopping in pregnancy and after  
13 childbirth

# 1 **Methods**

2 This guideline was developed in accordance with the process set out in ‘Developing  
3 NICE guidelines: the manual (2014)’ Last updated: October 2018. A booklet, ‘How  
4 NICE guidelines are developed: an overview for stakeholders, the public and the  
5 NHS’ is available. In instances where the guidelines manual does not provide advice,  
6 additional methods are described below. Declarations of interest were recorded  
7 according to the 2018 NICE conflicts of interest policy.

## 8 **Developing the review questions and outcomes**

9 The 4 overarching review questions (RQs) developed for this guideline were based  
10 on the key areas identified in the guideline scope. They were drafted by the NICE  
11 Public Health Internal Guideline Development team, refined and validated by the  
12 guideline committee.

13 The review questions were based on the following frameworks:

- 14 • population, intervention, comparator and outcome (PICO) for intervention reviews
- 15 • population (problem), exposure (prognostic factor), and outcome for prognostic  
16 and risk stratification reviews

17 Full literature searches, evidence tables and critical appraisal for all included studies,  
18 excluded studies and reasons for exclusion and evidence reviews were completed  
19 for all review questions.

## 20 **Reviewing research evidence**

21 The identification of evidence for evidence review in the guideline conformed to the  
22 methods set out in chapters 5 of the ‘Developing NICE Guidelines Manual’ (October  
23 2014). The purpose of the search was to identify the best available evidence to  
24 address review questions without producing an unmanageable volume of results.

25 Relevant databases and websites, listed in indoor air quality – Search strategies,  
26 were searched systematically to identify effectiveness, prognostic, risk stratification,  
27 cost effectiveness and qualitative research evidence. The principal database search  
28 strategy is listed in Indoor air quality at home – Search strategies. The strategies  
29 have been developed in MEDLINE (Ovid interface) and will be adapted, as  
30 appropriate, for use in the other sources listed in Indoor air quality at home – Search  
31 strategies taking into account their size, search functionality and subject coverage.

## 32 **Priority screening**

33 Review questions undertaken for this guideline made use of the priority screening  
34 functionality (text mining) with the EPPI-reviewer 4 systematic reviewing software.  
35 This uses a machine learning algorithm (specifically, a stochastic gradient descent  
36 (SGD) classifier) to take information on features in the titles and abstract of papers  
37 marked as being ‘includes’ or ‘excludes’ during the title and abstract screening  
38 process, and re-orders the remaining records from most likely to least likely to be an  
39 include, based on that algorithm. This re-ordering of the remaining records occurs  
40 every time 25 additional records have been screened.

1 At least 10 included and 10 excluded studies were identified during the title and  
2 abstract screening process before applying the priority screening functionality  
3 Screening on title and abstracts was only terminated after a plateau was reached and  
4 priority screening did not identify any more new includes. As research is currently  
5 ongoing as to what are the appropriate thresholds where reviewing of abstract can be  
6 stopped, we adopted the following additional steps to ensure no studies were  
7 missed.

- 8 • the included studies lists of included systematic reviews were searched to identify  
9 any papers not identified through the primary sift
- 10 • The database was also manually searched to ensure no relevant studies were  
11 missed. For example searching for key words or intervention terms.
- 12 • We double checked with the committee to ensure all studies they were aware of  
13 were captured.

#### 14 **Type of studies and inclusion/exclusion criteria**

- 15 • Cohort and case-control studies were included if they evaluated risk stratification  
16 and/or prognostic factors related to RQs 1 and 2.
- 17 • Randomised controlled trials (RCTs) were included if they evaluated interventions  
18 related to RQs 3.1, 3.1a, 3.2, 3.3 and 4.
- 19 • Health impact and economic modelling studies were included if they evaluated  
20 interventions related to RQ 3.3.

21 Systematic reviews of intervention studies were used as a source for primary studies  
22 but were not included in the evidence reviews as per protocol.

23 Papers were excluded if:

- 24 • they were not published in the English language, were not conducted in  
25 developed economies similar to the UK or not conducted from 1970<sup>1</sup> onwards
- 26 • only available as conference abstract, letter, opinion piece, review articles

#### 27 **Methods of combining evidence**

#### 28 **Data synthesis for respiratory conditions**

29 Respiratory conditions were reported differently within and across studies. Due to the  
30 myriad of respiratory conditions reported and measures used, the committee agreed  
31 that:

- 32 • Where 2 or more respiratory conditions are reported, to use the most  
33 sensitive outcome. For example, using Forced expiratory volume - 1 second  
34 (FEV1) over peak expiratory flow (PEF) or
- 35 • Where 2 or more respiratory conditions are reported, to use the one reported  
36 as the primary outcome for which the trial was powered. For example,  
37 reporting wheeze powered for study over cough

---

<sup>1</sup> The year 1970 was identified as a suitable start date as it would gather relevant, current evidence. It also pre-dates the national legislation on improving building structures and indoor air quality

## 1 **Data synthesis for intervention reviews**

2 Meta-analyses of intervention reviews were conducted with reference to the  
3 Cochrane Handbook for Systematic Reviews of Interventions (Higgins et al. 2011).

4 Data from single study was not reported in forest plots. Forest plots reported where  
5 we have pooled 2 or more studies.

## 6 **Continuous data**

7 Where different studies with continuous data measuring the same outcome but used  
8 different instruments/metrics, data were analysed using standardised mean  
9 differences

## 10 **Dichotomous data**

11 Meta-analysis of quantitative data was conducted with reference to the Cochrane  
12 Handbook for Systematic Reviews of Interventions (Higgins et al. 2011).

13 Where events rates were reported for both control and intervention arms, outcomes  
14 were pooled on either the odds ratio (OR) or relative risk (RR) scale using the  
15 Mantel–Haenszel method. Where events rates were not reported for both control and  
16 intervention arms and only the estimate of effects were reported, outcomes were  
17 pooled on the log odds scale using the inverse variance method. Fixed- and random-  
18 effects models were fitted for evidence review synthesis as appropriate.

19 Meta-analyses were performed in Cochrane Review Manager V5.3.

## 20 **Minimal important difference (MID)**

21 MIDs were not specified for this guideline so the GRADE rule of thumb (approach) for  
22 downgrading the certainty of evidence because of imprecision for dichotomous and  
23 continuous outcomes was used.

## 24 **Dichotomous outcome**

25 Outcomes were downgraded if 95% confidence interval around the pooled or best  
26 estimate of effect includes both 1) no effect and 2) appreciable benefit of 0.80 or  
27 appreciable harm of 1.25

## 28 **Continuous outcome**

29 Outcomes were downgraded if 95% confidence interval around the mean difference  
30 or pooled mean difference includes 0.5 standard deviations of the control group. For  
31 SMD, outcomes were downgraded if the upper or lower confidence limit crosses an  
32 effect size of 0.5 in either direction

## 33 **Data synthesis for non-intervention reviews**

34 Data for the non-intervention reviews were not pooled statistically (meta-analysed) as  
35 studies

- 36 • were not similar enough in terms of adjusting for the same potential confounders  
37 or variables.



- 1 • reported more than one source per pollutant
- 2 • reported more than one measure of per pollutant
- 3 The Adjusted relative effects (for example, aOR and aRR) and associated lower and
- 4 upper 95% confidence interval (CI) from each study were individually reported

## 5 **Appraising the quality of evidence**

### 6 **Critical appraisal of individual studies**

- 7 The information extracted for the critical appraisal was used in two ways
- 8 • to rate the study quality for use when summarising the quality of the studies
  - 9 included in each review and
  - 10 • as part of the GRADE assessment of the committee's confidence in the evidence
  - 11 base for each outcome

### 12 **Intervention studies**

13 Quality assessment for all included studies was conducted using the tools in  
14 Developing NICE guidelines: the manual. The quality of individual studies were  
15 assessed using the appropriate NICE quality assessment checklist for each particular  
16 study.

17 The critical appraisal of RCTs included for RQs 3.1, 3.2, 3.3 and 4 was conducted  
18 with the Cochrane risk of bias (ROB) tool. Bias was assessed as a judgment (high or  
19 low) for individual elements from seven domains (random sequence generation,  
20 allocation concealment performance, blinding of participants and personnel, blinding  
21 of outcome assessment, incomplete outcome data, selective reporting and other  
22 sources of bias). Each domain was given equal weight. Overall ROB was then  
23 assigned for each study as either 'high' or 'low' and was interpreted as follows:

24 Low overall ROB indicates low ROB for all domains or 1 high ROB for only 1 domain

25 High overall ROB indicates high ROB for 2 or more domains

### 26 **Non-intervention studies**

27 Quality assessment for all included studies was conducted using the tools in  
28 Developing NICE guidelines: the manual. The quality of individual study was  
29 assessed using the appropriate NICE quality assessment checklist for each particular  
30 study.

31 The critical appraisal of observational studies included for RQ 1 and 2 was conducted  
32 with Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised  
33 studies. Bias was assessed as a judgment (high, low or moderate) for individual  
34 elements from three domains (selection, comparability and outcome assessment).  
35 Overall ROB was then assigned for each study as either 'high' 'moderate' or 'low'.  
36 The critical appraisal of modelling studies included for RQ 4 was conducted with the  
37 Philips (Philips et.al 2004) assessment checklist for decision analytic models. This  
38 checklist included 55 items across 3 domains. The 3 domains were model structure,  
39 model data and model consistency.

## 1 Certainty of the evidence for each outcome

2 Adoption of the GRADE approach for this guideline was confirmed during protocol  
3 development. The GRADE approach for assessing certainty of evidence across  
4 outcomes was designed using intervention studies (RCTs) as the gold standard.  
5 Where RCTs start as 'high quality' and observational studies as 'low quality'. For this  
6 guideline, it was agreed that:

- 7 • The study design that best answers our review question shall start as 'high  
8 quality' as long as it was determined that RCTs are not feasible or not ethical
- 9 • Where appropriate GRADE will be modified to meet the needs of the review  
10 question.

11 For intervention studies, RCTs were considered to be of highest quality. For the risk  
12 factor studies, cohort studies were considered to be of highest quality and case  
13 control studies as next best evidence quality

## 14 GRADE methodology for intervention and non-intervention evidence

15 For the non-intervention reviews (RQs 1 and 2) cohort and case control studies were  
16 included and these started as 'high and moderate quality' respectively.

17 For the intervention reviews (RQs 3.1, 3.2, 3.3 and 4) RCTs were included and these  
18 started as 'high quality'.

19 Outcomes of the included studies were rated individually to indicate the certainty  
20 around the findings, based on assessment using GRADE methodology as outlined in  
21 Table 1

22 **Table 1: GRADE**

Criterion	Reason for downgrading or not downgrading confidence
Risk of bias	The certainty of the evidence was downgraded if there were concerns about the design or execution of the study, including concealment of allocation, blinding, loss to follow up using intervention checklists in the NICE guidelines manual (2012); For example, limitations in the study design and implementation may bias the estimates of the treatment effect. Major limitations in studies decrease the confidence in the estimate of the effect. Examples of such limitations are selection bias (often due to poor allocation concealment), performance and detection bias (often due to a lack of blinding of the patient, healthcare professional or assessor) and attrition bias (due to missing data causing systematic bias in the analysis).
Indirectness	Indirectness refers to differences in study population, intervention, comparator and outcomes between the available evidence and the review question. The certainty of the evidence was downgraded if there were concerns about the population, intervention and outcome in the included studies and how directly these variables could address the specific review question.
Inconsistency	Inconsistency refers to an unexplained heterogeneity of effect estimates between studies in the same meta-analysis. The certainty of the evidence was downgraded if there were concerns about inconsistency of effects across studies: occurring when there is variability in the treatment effect demonstrated across studies (heterogeneity). This was assessed using visual inspection
Imprecision	Using the recommended GRADE cut-off values for imprecision:

Criterion	Reason for downgrading or not downgrading confidence
	<ul style="list-style-type: none"> <li>dichotomous outcome was downgraded if the 95% confidence interval around the effect size includes appreciable benefit of 0.80 or appreciable harm of 1.25</li> <li>continuous outcome was downgraded if the 95% confidence interval around the mean difference includes 0.5 standard deviations of the control group. For standardised mean difference (SMD), outcomes were downgraded if the upper or lower confidence limit crosses an effect size of 0.5 in either direction</li> </ul>
Other issues	None

1

2

### 3 Reviewing economic evidence

4 The PHAC is required to make decisions based on the best available evidence of  
5 both general effectiveness and cost-effectiveness. Guideline recommendations  
6 should be based on the expected costs of the different options in relation to their  
7 expected benefits (that is, their 'cost-effectiveness') rather than the total  
8 implementation cost. Thus, if the evidence suggests that a strategy provides  
9 significant benefits at an acceptable cost per person treated, it should be  
10 recommended.

11 In order to assess the cost effectiveness of the key issues addressed in this  
12 guideline, the following actions were carried out:

- 13 • A systematic review of economic evidence in the literature was conducted,  
14 alongside the review of evidence on general effectiveness
- 15 • A de novo economic model was developed, in order to provide cost effectiveness  
16 evidence for a number of review questions

#### 17 Literature review

18 The systematic reviewer:

- 19 • Identified potentially relevant studies for each review question from the  
20 economic search results by reviewing titles and abstracts. Full papers were  
21 then obtained.
- 22 • Reviewed full papers against pre-specified inclusion and exclusion criteria to  
23 identify relevant studies (see below for details).
- 24 • Extracted key information about the studies' methods and results into  
25 evidence tables
- 26 • Generated summaries of the evidence in NICE economic evidence profiles

27

#### 28 Inclusion and exclusion of economic studies

29 Full economic evaluations (studies comparing costs and health consequences of  
30 alternative courses of action: cost-utility, cost-effectiveness, cost-benefit and cost-  
31 consequence analyses) and comparative costing studies that addressed the review

1 question in the relevant population were considered potentially includable as  
2 economic evidence.

3 As per 'Developing NICE Guidelines: The Manual', UK-based cost-utility studies  
4 reporting health outcomes in quality adjusted life years (QALYs) were preferred.  
5 However, due to the relatively sparse evidence for most review questions, non-UK-  
6 based cost effectiveness studies (i.e. those reporting outcomes in natural units) were  
7 also included. It was determined that such evidence may still be useful in informing  
8 the committee of the potential trade-off between costs and benefit of interventions.  
9 Similarly, cost-consequence analyses (i.e. those in which costs and benefits are  
10 reported separately) were included, as they were also determined to be potentially  
11 useful, for instance in cases where an intervention is associated with lower costs and  
12 higher benefits than the alternative.

13 Studies which only reported costs (without any consideration of health benefits) were  
14 excluded. Literature reviews, abstracts, posters, letters, editorials, comment articles,  
15 unpublished studies and studies not in English were excluded.

16 Full details can be found in the evidence review.

## 17 **Appraising the quality of economic evidence**

18 Studies that met the eligibility criteria were assessed using the quality appraisal  
19 criteria as outlined in Developing NICE guidelines (NICE 2014).

20

## 21 **Health economic modelling**

22 As well as reviewing the published economic literature for each review question, as  
23 described above, a de novo economic analysis was undertaken for relevant research  
24 questions. The following general principles were adhered to in developing the  
25 analysis:

- 26 • Methods were consistent with the NICE reference case.
- 27 • The committee was involved in the design of the model, selection of inputs  
28 and interpretation of the results.
- 29 • Where possible, model inputs were based on the systematic review of the  
30 clinical literature, supplemented with other published data sources identified  
31 by the committee as required.
- 32 • When published data were not available committee expert opinion was used  
33 to populate the model.
- 34 • Model inputs and assumptions were reported fully and transparently.
- 35 • The results were subject to sensitivity analysis and limitations were  
36 discussed.

37 Full methods for the de-novo modelling can be found in the Indoor Air Quality  
38 HE report.

39

## 1 **Resource impact assessment**

2 The resource impact team used the methods outlined in the in Assessing resource  
3 impact process manual: guidelines

4 The resource impact team worked with the guideline committee from an early stage  
5 to identify recommendations that either individually or cumulatively have a substantial  
6 impact on resources. The aim was to ensure that a recommendation does not  
7 introduce a cost pressure into the health and social care system unless the  
8 committee is convinced of the benefits and cost effectiveness of the  
9 recommendation. The team gave advice to the committee on issues related to the  
10 workforce, capacity and demand, training, facilities and educational implications of  
11 the recommendations.  
12