Interventions and actions against
damp and mould

A review of case studies

Selected studies
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Case study 3

Contacts / study coordinator
Please provide contact details for the person in charge of the study.

Name: Wolfgang Lorenz
Title: Dr.-Ing.
Organization: Institute for Indoor Diagnostic
Email: wolfgang.lorenz@infid.de

Intervention title
Health complaints before and after renovation of mould damages

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?
We selected 114 cases of the year 2005, where we investigated indoor pollution in homes. We evaluated whether the ailments of the inhabitants decreased or not and if the damages were renovated or not.

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What where the results expected?
Can we see a correlation between change of complaints and
a) Household moved to new dwelling
b) kind of renovation (b1: with complete removal of the damaged materials; b2: only drying and coating the damaged materials)
c) complete (c1) or not complete (c2) renovation.
(= (c2) not complete means that not all detected damages were renovated)
d) no action
Target population groups

2. Please specify the targeted population groups:

Whole population  ( X )

Specific age groups:  Please add notes / comments behind parentheses if required

- Older people  ( )
- Adults  ( )
- Adolescents  ( )
- Children  ( )

Specific target groups:  Please add notes / comments behind parentheses if required

- Women  ( )
- Disabled people  ( )
- Other  ( ) (please specify:)

Target buildings

3. Which buildings are targeted by the intervention/initiative?

Residential buildings  ( X )
- Schools  ( )
- Child centres  ( )
- Elderly centres  ( )
- Other  ( ) (please specify:)

Geographical scale

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)?
Please inform about the geographical scale/administrative scope/region.

Germany , North-Rhine-Westphalia

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

No specific setting
**Study size**

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

*Please add notes / comments if required*

- Dwellings: 114
- Schools:
- Day centres:

- Persons: 249

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

In every dwelling at least one inhabitant suffered from health complaints and visited an environmental doctor. The doctor assumed indoor pollution as causative agent. We investigated the homes on chemical, biological and, physical indoor pollution sources. Only cases with mould damages were selected for the study.

**Target indicators of indoor environmental quality**

6. What are the pollutants or factors that were targeted by the intervention/initiative?

- Relative humidity
- Damp / moisture in building structure
- Dampness entering from outside
- Mould in / on building structures (X)
- Air exchange rate
- Thermal performance of building (insulation / heating)
- Building materials themselves

Please add to this list all other factors the intervention/initiative did target:

**Specific actions**

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative? Please describe shortly.

6 month after investigating the homes data were collected by telephone using a questionnaire.
Funding, costs and project context

8a. What was the project budget?
15.000 Euro for the evaluation of the individual cases

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

8c. What were the sources of funding?

Please add notes / comments behind parentheses if required

Private / sponsors ( X )
City / municipal ( )
National / federal ( )
EC project ( )
Other ( ) (please specify:)

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

Yes ( ) Program name:
No ( X )

Coordinator and collaborators

9a. Which institution/organization etc. coordinated the intervention/initiative?
Institute for Indoor Diagnostic

9b. Which were the collaborators?
Results

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

<table>
<thead>
<tr>
<th>a) After removal:</th>
</tr>
</thead>
<tbody>
<tr>
<td>At 87.5 % of the previous suffering people the respiratory and skin symptoms and at 73% the joint pain decreased significantly or died down completely.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>b1 and c1) After renovation of all damages with complete removing of the damaged material:</th>
</tr>
</thead>
<tbody>
<tr>
<td>At 87 % of the previous suffering people the respiratory and skin symptoms and at 47% the joint pain decreased significantly or died down completely.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>b2) After renovation of all damages without removing of the damaged material:</th>
</tr>
</thead>
<tbody>
<tr>
<td>At 39 % of the previous suffering people the respiratory and skin symptoms and at 20% the joint pain decreased significantly or died down completely.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>c 2) After renovation of only a part of the mould damages with complete removing of the damaged material:</th>
</tr>
</thead>
<tbody>
<tr>
<td>At 74 % of the previous suffering people the respiratory and skin symptoms and at 54% the joint pain decreased significantly or died down completely.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>d) Without renovation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>At 17 % of the previous suffering people the respiratory and skin symptoms and at 19% the joint pain decreased significantly or died down completely.</td>
</tr>
</tbody>
</table>

10b. Were the objectives (as provided in 1b) reached?

A significant correlation between source deposition and decrease of health complaints can be seen.
Other sources than mould damages can be excluded-
Renovation will be much more successful if the damaged materials are removed.

10c. What kind of communication activities to disseminate the results and findings have been taken?

Please add notes / comments behind parentheses if required

| Media (TV, radio, newspaper) | ( ) |
| Public meetings / fora | ( X ) 1. GHUP Conference in Bielefeld Oct 2007 |
| Internet / web sites | ( ) |
| Scientific publications | ( ) |
| Other | ( ) (please specify:) |
**Evaluation**

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

This “Evaluation-study” was not evaluated

11b. What were the main evaluation findings?

Except the phone survey, no measurements or site visits were done.

**Recommendations for policy formulation**

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

Renovation will be much more successful if the damaged materials are removed.

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

Principally yes, in practice not, because you need enough well investigated cases. It is not possible to look for mould damages (very often at hidden places) or other indoor pollution with short time trained students or assistants. To be sure that there are only mould problems in dwellings and no mould damage is overseen, the object must be investigated by an experienced professional expert for indoor diagnostic. You need a doctor for medical diagnostic and you need an indoor expert for the indoor diagnostic!

**Additional comments and experiences**

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

**Further information**

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

German abstract and tables (see additional background document that comes with this case study, Germany only)
Case study 4

Contacts / study coordinator

Please provide contact details for the person in charge of the study.

Name: Dorr G. Dearborn, PhD, MD
Title: Prof/Chairman
Organization: Dept Environmental Health Sciences, Case Western Reserve Univ, School of Medicine
Email: dxd9@case.edu

Intervention title

Cuyahoga County Urban Moisture and Mold Project

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

We examined changes in asthma morbidity in children as a result of home remediation aimed at moisture sources and reducing mold exposure.

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What where the results expected?

Construction remediation aimed at the root cause of moisture sources together with removal of visible mold resulted in a significant decrease in visible mold scores and indoor mold species as measure by dust analysis by quantitative PCR. These interventions significantly reduced symptom days and health care use for asthmatic children who live in homes with a documented mold problem compared to a parallel control group that did not receive professional remediation.
Target population groups

2. Please specify the targeted population groups:

Whole population (  )

Specific age groups: Please add notes / comments behind parentheses if required

Older people (  )
Adults (  )
Adolescents (  )
Children ( X )

Specific target groups: Please add notes / comments behind parentheses if required

Women (  )
Disabled people (  )
Other ( X ) (please specify:) moderately severe asthmatic children

Target buildings

3. Which buildings are targeted by the intervention/initiative?

Residential buildings ( X )
Schools (  )
Child centres (  )
Elderly centres (  )
Other (  ) (please specify:)

Geographical scale

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)? Please inform about the geographical scale/administrative scope/region.

COUNTY

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

URBAN; OLDER FRAME HOUSING STOCK; CITY AND INNER RING SUBURBS
**Study size**

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

*Please add notes / comments if required*

- Dwellings: 104
- Schools: 0
- Day centres: 0

Persons: 104 FAMILIES

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

| MODERATELY SEVERE ASTHMATIC CHILDREN OR FAMILIES WITH YOUNG INFANTS, ALL LIVING IN HOMES WITH VISIBLE WATER DAMAGE AND/OR MOLD |

**Target indicators of indoor environmental quality**

6. What are the pollutants or factors that were targeted by the intervention/initiative?

- Relative humidity ( )
- Damp / moisture in building structure ( X )
- Dampness entering from outside ( X )
- Mould in / on building structures ( X )
- Air exchange rate ( )
- Thermal performance of building (insulation / heating) ( )
- Building materials themselves ( )

Please add to this list all other factors the intervention/initiative did target:

| EXCLUDING INTAKE OF BASEMENT AIR FOR THE FORCED AIR HEATING SYSTEM |
Specific actions

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative? Please describe shortly.

[FROM WWW.EHW.ORG]

**Mold and Moisture Control Interventions**

*General Strategy*

- Remove moisture damaged material.
- Remove mold exposure pathways.
- Clean mold from hard surfaces.
- Stop rain water intrusion.
- Exhaust water vapor.
- Repair plumbing leaks.

*Key Specifications Developed*

- Duct cold air return directly to the furnace (repair the "Cleveland drop").
- Flash the soil to the house.
- Treat the porch like a roof.
- Eliminate sub-slab duct and heating systems.
- Disconnect and redirect downspouts.
- Reduce moisture in crawlspaces.

The interventions were tailored for the individual dwelling. This is a list of the breadth of the interventions but each house received only what was needed/appropriate for that house. The key points are that the source of the water intrusion was addressed and all visible mold was removed—making the results uniform.
# Funding, costs and project context

8a. What was the project budget?

| Overall HUD grant budget: $3.1 million |

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

| Moisture and mold remediation average unit cost: $3,148 |

8c. What were the sources of funding?

<table>
<thead>
<tr>
<th>Source</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private / sponsors</td>
<td>( )</td>
</tr>
<tr>
<td>City / municipal</td>
<td>( )</td>
</tr>
<tr>
<td>National / federal</td>
<td>( X )</td>
</tr>
<tr>
<td>EC project</td>
<td>( )</td>
</tr>
<tr>
<td>Other</td>
<td>( ) (please specify:)</td>
</tr>
</tbody>
</table>

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

<table>
<thead>
<tr>
<th>Answer</th>
<th>Program name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>( X ) US HUD HEALTHY HOMES INITIATIVE</td>
</tr>
<tr>
<td>No</td>
<td>( )</td>
</tr>
</tbody>
</table>

# Coordinator and collaborators

9a. Which institution/organization etc. coordinated the intervention/initiative?

| CUYAHOGA COUNTY DEPT OF DEVELOPMENT |

9b. Which were the collaborators?

| CUYAHOGA COUNTY BOARD OF HEALTH, CASE WESTERN RESERVE UNIVERSITY SCHOOL OF MEDICINE, ENVIRONMENTAL HEALTH WATCH, |
Results

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

OBJECTIVE: Home dampness and the presence of mold and allergens have been associated with asthma morbidity. We examined changes in asthma morbidity in children as a result of home remediation aimed at moisture sources.

DESIGN: In this prospective, randomized controlled trial, symptomatic, asthmatic children (n = 62), 2–17 years of age, living in a home with indoor mold, received an asthma intervention including an action plan, education, and individualized problem solving. The remediation group also received household repairs, including reduction of water infiltration, removal of water-damaged building materials, and heating/ventilation/air-conditioning alterations. The control group received only home cleaning information. We measured children’s total and allergen-specific serum immunoglobulin E, peripheral blood eosinophil counts, and urinary cotinine. Environmental dust samples were analyzed for dust mite, cockroach, rodent urinary protein, endotoxin, and fungi.

The follow-up period was 1 year.

RESULTS: Children in both groups showed improvement in asthma symptomatic days during the preremediation portion of the study. The remediation group had a significant decrease in symptom days (p = 0.003, as randomized; p = 0.004, intent to treat) after remodeling, whereas these parameters in the control group did not significantly change. In the postremediation period, the remediation group had a lower rate of exacerbations compared with control asthmatics (as treated: 1 of 29 vs. 11 of 33, respectively, p = 0.003; intent to treat: 28.1% and 10.0%, respectively, p = 0.11).

CONCLUSION: Construction remediation aimed at the root cause of moisture sources and combined with a medical/behavioral intervention significantly reduces symptom days and health care use for asthmatic children who live in homes with a documented mold problem.


10b. Were the objectives (as provided in 1b) reached?

yes

10c. What kind of communication activities to disseminate the results and findings have been taken?

Please add notes / comments behind parentheses if required

Media (TV, radio, newspaper)  (   )
Public meetings / fora  (   )
Internet / web sites  ( X )
Scientific publications  ( X )
Other  ( X ) EDUCATIONAL LECTURES/SEMINARS
Evaluation

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

QA/QC of 45/104 of the houses was performed approximately as year later and we are currently attempting to re-evaluate 5-7 years later.

11b. What were the main evaluation findings?

Initial evaluations- ENVIRON: Visible mold scores and quantitative analyses of settled dust for indoor mold species (qPCR) and endotoxin were all significantly decreased ~6 months after remediation. CLINICAL: Patient symptom days and clinical exacerbations (ER or Hosp) were significantly reduced for 6 months. Longer follow-up about to start. See publication for initial study details.

Recommendations for policy formulation

12a. Please highlight some of your "key experiences" and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

A major impact on improving the morbidity of asthmatic children can be attained by adequately remediating the moisture and mold in their home environments.

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

Yes—type of housing, climate, type of heating/ventilation systems,

Additional comments and experiences

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

We were surprised that our small ‘n’ study with projected low statistical power had such a dramatically significant outcome in improved morbidity.

Further information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

Case study 5

Contacts / study coordinator
Please provide contact details for the person in charge of the study.

Name: Bart Van Audenhove
Title:
Organization: Flemish Government; Department Ruimtelijke Ordening, Woonbeleid en Onroerend Erfgoed, Afdeling Woonbeleid
Email: bart.vanaudenhove@rwo.vlaanderen.be

Intervention title
Inspection of residential house quality by Flemish Government services

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?
Assessing and improving general quality of housing in Flanders (including, but not only, related to damp, mould and basic ventilation)

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What where the results expected?
No specific quantitative targets – target in 1997 (start of project) was creating an instrument to assess and enforce improvement of housing quality, without quantities proposed.
**Target population groups**

2. Please specify the targeted population groups:

**Whole population** (X)

**Specific age groups:** Please add notes / comments behind parentheses if required

- Older people ( )
- Adults ( )
- Adolescents ( )
- Children ( )

**Specific target groups:** Please add notes / comments behind parentheses if required

- Women ( )
- Disabled people ( )
- Other ( ) (please specify:)

**Target buildings**

3. Which buildings are targeted by the intervention/initiative?

- Residential buildings (X) (mainly on the rental market)
- Schools ( )
- Child centres ( )
- Elderly centres ( )
- Other ( ) (please specify:)

**Geographical scale**

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)? Please inform about the geographical scale/administrative scope/region.

Regional: Flanders (Vlaamse Gewest)

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

The whole of Flanders in general. Depends partly on cooperation of municipal services, not all participate actively. Due to secondary and practical reasons more active in big cities.
**Study size**

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

*Please add notes / comments if required*

Dwellings: between 1000-1500 houses per year get on the inventory list of dwellings for which housing deficiencies are considered relevant enough so that the remediation activities are monitored / ascertained by public authorities (but many more are inspected)

Schools:

Day centres:

Persons:

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

| Mainly complaint cases by residents (almost exclusively of rented houses) |

**Target indicators of indoor environmental quality**

6. What are the pollutants or factors that were targeted by the intervention/initiative?

| Relative humidity | ( ) |
| Damp / moisture in building structure | ( X ) |
| Dampness entering from outside | ( X ) |
| Mould in / on building structures | ( X ) |
| Air exchange rate | ( X ) (by assessing presence of basic ventilation possibilities – opening windows etc.) |
| Thermal performance of building (insulation / heating) | ( ) |
| Building materials themselves | ( ) |

Please add to this list all other factors the intervention/initiative did target:

Stability, risk of fire/explosion/CO-gases/electrocution, basic comfort (sanitary, kitchen and electrical outlets), heating, basic ventilation, light, accessibility (in general, not for disabled/elderly/…), occupation rate (dwelling adapted to how many persons, based on surface measurements)

This is done by a visual inspection and does not include measurements.

The public authorities only make the decision whether a dwelling comes on or is taken off the list, based on the inspections. There is no information on the actions taken by the dwelling owners to tackle the problems.
**Specific actions**

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative? Please describe shortly.

| Inscription of houses and putting on inventory of those that do not meet basic standards. While problems not solved, houses remain on inventory and owners can become subject to fine (see further 10a). Before being removed from inventory, the houses are checked again to assess if they meet basic requirements (a certain degree of problems is tolerated). |

**Funding, costs and project context**

8a. What was the project budget?

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

8c. What were the sources of funding?

Please add notes / comments behind parentheses if required

| Private / sponsors | ( ) |
| City / municipal   | ( ) |
| National / federal | ( ) |
| EC project         | ( ) |
| Other              | ( X ) (please specify: regional (Flanders – Vlaams Gewest)) |

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

| Yes | ( ) Program name: |
| No  | ( ) |

**Coordinator and collaborators**

9a. Which institution/organization etc. coordinated the intervention/initiative?

Flemish Government (Housing Department)

9b. Which were the collaborators?

Own services and Municipal services
Results

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

| The total number of residential houses in Flanders is about 2.200.000; of these some 30.000 are estimated to be in very bad condition. Each year some 1000-1500 houses have been put on the inventory, and about the same number (slightly less) are taken yearly off the inventory (due to quality improvement, and a small percentage for administrative reasons not related to house quality). The measures have no doubt also a preventive positive effect, and in many cases problems are resolved before the actual procedure is started. After one year on the inventory the owners are subject to a yearly, gradually increasing substantial fine, and special measures (the application of these is at this moment very limited) can be taken to make the concerned houses available on the (social) housing market |

10b. Were the objectives (as provided in 1b) reached?
Yes

10c. What kind of communication activities to disseminate the results and findings have been taken?

Please add notes / comments behind parentheses if required

- Media (TV, radio, newspaper) ( X )
- Public meetings / fora (   )
- Internet / web sites ( X )
- Scientific publications (   )
- Other (   ) (please specify:)

Evaluation

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

In 2002 an analysis has been made based on data stored in the inventory (database).

11b. What were the main evaluation findings?

| Some interesting results related to damp/mould were (analysis 2002 based on ca. 4000 dwellings on the list at that time?): |
| - Humidity was (and is) by far the main problem in houses. |
| - some 90% of houses on the inventory had some (small or big) problem related to humidity |
| - 52% of the houses on the inventory had a serious humidity problem in at least one area (roofs or walls or basements or floors) |
| - some 20% did not have sufficient possibilities for basic ventilation (e.g., no opening windows) |
| Data related to procedural aspects (period of time on inventory, etc.) is easy to retrieve from database; however the technical aspects are not directly stored and need to be processed manually. This means that additional or newer data concerning humidity/mould would need a considerable amount of work. |
**Recommendations for policy formulation**

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

The measures have no doubt also a preventive positive effect, and in many cases problems are resolved before the actual procedure is started.

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

**Additional comments and experiences**

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

These screenings are carried out on the basis of visual observations (no measurements), and lead to the filling out of a technical checklist in which every problem encountered is related to points. If the resulting total points are 15 or more, the conclusion is that the house does not meet minimal quality standards.

Mould as such is not an item for the inspection checklist, but occurrence of humidity (being basically the "cause" of mould) is on the list. We see mould as an "indication of humidity" and give points for humidity. Humidity is one of the most important parts of the technical checklist, and consequently one of the main parameters of the assessment.

Points on the checklist are given in 4 categories according to severity and extension, namely 1, 3, 9 and 15 points (more problems = higher value). This means that a house which gets 15 points for damp will already be on the inventory list for rehabilitation, even if it has no other deficiency. Damp/humidity (with or without mould) can score 1, 3 or 9 points several times in parallel in the same dwelling, so depending on where and how severe the damp problem is, the overall score can range from 1 to 60 points (see technical checklist wherever it says "VOCHT").

The maximum score of 60 points is very rare; "intermediate" cases easily get 9, 12, 15 points; severe cases should not fall below 15 points. So to get off the inventory list the humidity problem can no longer be more than light to intermediate. In practical terms, limited or local humidity problems in some rooms can still exist, but a generally "damp" house (or large parts of it) would definitely stay on the list.

Therefore, most dwellings which aim at getting off the inventory list will be likely to address damp as one of the key problems in their renovation or mitigation activities.
Further information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

The technical checklists can be downloaded here
http://www.bouwenenwonen.be/uploads/b2917_technischverslag_woningen_200815815.pdf (for houses) and here
The "manual" for the use of the technical report (in Dutch) can be downloaded here: http://www.bouwenenwonen.be/uploads/b2905_technischerichtlijnen_voor_woningkwaliteitsonderzoek103440.pdf. References to dampness, mould and ventilation on pages 63-84, 101-119 and 134. On page 1 the data of the specific laws and regulations, which can subsequently be retrieved (search by title or other data) here: http://www.ejustice.just.fgov.be/cgi/welcome.pl.
Review of interventions implemented in member states to address health hazards associated with dampness, mould and inadequate ventilation

Case study 6

**Contacts/ Study coordinator**

Please provide contact details for the person in charge of the study.

Name: Marle Kopf
Title: 
Organisation: University Bielefeld
E-mail: marle-kopf@t-online.de

**Title**

**Quality assurance and optimising indoors mould assessment and removal**

**Objective**

1a. Please give a brief description of the objective(s) of the measure/intervention (e.g., adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or dampness).
- Reducing the mould exposure of tenants and renovators during renovations.
- Extending knowledge of health-related guidelines of mould assessment and removal.

1b. Which quantitative targets were set (e.g., reducing the number of exposed dwellings by 20%)? Which results were expected?
- Determining the extent to which official recommendations were being followed by service providers with special training compared to other sanitation companies.
Target populations

2. Please specify the target populations:

**Entire population**  ( X )

**Specific age groups:**  Please add notes/comments behind the brackets if needed.

- Older people (  )
- Adults (  )
- Adolescents (  )
- Children (  )

**Specific target groups:**  Please add notes/comments behind the brackets if needed.

- Women (  )
- Disabled people (  )
- Others (  ) (please specify)

Target buildings

3. Which buildings are targeted by the measure/intervention?

**Residential buildings**  ( X )

**Schools** (  )

**Child centres** (  )

**Centres for the elderly** (  )

**Others** (  ) (please specify)

Geographical scale

4a. At which level was the measure/intervention implemented (e.g., national, provincial, municipal)? Please give the geographical scale, administrative scope or region.

State of North Rhine-Westphalia, Germany
Eastern region

4b. What is the specific setting of the measure/intervention? Does it focus on urban or rural areas? Does it involve one or more neighbourhoods, cities or states?

Focus on two cities: Bielefeld and Gütersloh
Study size

5a. How many buildings and many persons were involved in the measure/intervention? Please indicate the number of:

Please add notes/comments if needed.

Dwellings: 1 sample for case study.
One dwelling with indoors mould was chosen to conduct the case study with 29 remediation experts. For best comparability of results, all service providers inspected and assessed the same dwelling because indoors mould damage is a complex problem and differs greatly between dwellings and so does not allow a comparison of the results.

Schools:

Daycare centres:

Persons: 87; 1st step: 58; 2nd step: 29. In the first step of the study, 58 mould removal experts were surveyed by questionnaire how they removed indoors mould as part of a basic situation analysis. In the second step – a real situation of choosing a qualified service provider – 29 sanitation companies offering indoors mould removal services were interviewed separately during on-site inspection of a building with indoors mould damage. One third of the spot sample comprised painters (n=9) with training based on the official guidelines, compared to 10 other painters and 10 building conservation experts without special educational training.

5b. How were the buildings selected (e.g., random selection, complaints, etc.)?

The building was selected out of cases of complaints at the consumers’ association. The following criteria should have been followed:
- Visible mould over an area of 0.5 m² (not only small spots).
- The mould should not be in living rooms or bedrooms but rather in basements, storage areas, etc. because the study should not lead to needless exposure and health risks for the occupants
- The occupants must have agreed to provide their home for the 29 inspections.
- The cause of the damage should preferably not be too easy to find out.
Target indicators of indoors environment quality

6. Which pollutants or factors were targeted by the measure/intervention?

- Relative humidity: (X)
- Dampness/moisture in the building structure: (X)
- Dampness entering from outside: (X)
- Mould in/on the building structures: (X)
- Air exchange rate: (X)
- Thermal performance of building (insulation/heating): (X)
- Building materials themselves: (X)

Please list all other factors targeted by the measure/intervention:

Assessment and removal of mould damage includes all the factors listed above plus chemicals used for disinfection.

Specific measures

7. Please give a short description of the measures or campaigns undertaken as part of the measure/intervention.

Step 1: Survey by questionnaire analysing the situation to evaluate compliance with health-related guidelines for assessment and removal of indoors dampness and mould, followed by educational training for qualified renovations in a group of professional sanitation companies as part of quality assurance.

Step 2: Evaluating the effect of educational training on compliance with health-related guidelines compared to service providers who did not receive it.

In this case study, the intervention is considered the training of craftsmen involved in repair work (painters), the evaluation referring to compliance with health-related guidelines as an effect of training.
**Funding, costs and context of the project**

8a. What was the budget for the project?

The first one was a low-budget project. Today, the regular budget is about 4,000-5,000 € for the education course, paid for by the course participants.

8b. Can you give the unit cost (e.g., dwelling, school, person)?

The costs per participant enrolled in the education course today is 700-800 €

8c. Which were the sources of funding?

Please add notes/comments behind the brackets if needed.

- Private sponsors (  )
- City/municipal funds (  )
- National/federal funds (  )
- EU project (  )
- Other ( X ) (please specify: association of the professional guilds)

8d. Was the measure/intervention part of a national programme, campaign, etc.?

- Yes (  ) Name of the programme:
- No ( X )

**Coordination and partners**

9a. Which institution, organisation, etc. coordinated the measure/intervention?

Professional organisation of painters in North Rhine-Westphalia (Bielefeld, Germany).

9b. Please list the partners, if any.

Federal Occupational Safety Organisation of the Building Industry North Rhine-Westphalia, Consumer Association North Rhine-Westphalia in Bielefeld and the University of Bielefeld.
Results

10a. Briefly describe the main results of the measure/intervention (e.g., reduction in symptoms or exposure, improvement in health, fewer complaints).

15 service providers/painters attended a three-day educational training course on the theory and practice of measuring, assessing and removing indoors mould according to official guidelines. At the end of the course, an oral and written test was given by a federal occupational safety organisation.

10b. Were the objectives outlined in point 1b reached?

Yes.

10c. How were the results and findings of the study reported?

Please add notes/comments behind the brackets if needed.

Media (TV, radio, newspapers) ( X )
Public meetings/forums ( X )
Internet/websites ( X )
Scientific publications ( X )
Others ( ) (please specify:)

Evaluation

11a. Was the intervention/initiative evaluated? If so, how? (Measuring pollutants and ventilation, giving the occupants a medical examination, using a control group, etc.)

The painters who took part in the intervention or received educational training on indoors mould removal were evaluated. The painters who received training were compared to a control group of 10 other painters and 10 building conservation experts who did not by having all of them inspect the same building indoors mould separately. They assessed the mould damage, explained how they would remove it, which safety measures they would use, etc.

A semi-quantitative analysis of the performance of service providers was done during on-site inspection of mould damage in the building used for the case study: Both a partially standardised interview and a participating observation were covertly conducted.
11b. Which were the main findings of this evaluation?

Health-related guidelines are not followed at all when renovations are undertaken. Qualified service providers complied more with official health-related guidelines than did others. They did more and better dampness surveys, but did not find the right causes of dampness as often. Also, health assessment and employment protection were better when done by qualified painters, but not object protection, and particularly the manner and scope of the removal of mould-contaminated material. Still, compliance with guidelines even by qualified companies remains unsatisfactory. The deficits found pose health risks for both tenants and renovators because there is a higher concentration of mould in the air during sanitation. Even where mould was confined to a basement, the service providers did not explain this, and so it must be assumed that they would renovate living quarters no differently.

An important result was found in the control group: The health assessment done by the indoors mould by the building conservation experts was significant higher than that done by the painters. All building conservation experts greatly overestimated the potential health risks posed by mould in the home, whereas the painters in the control group consistently underestimated the risks. Renovation cost estimates therefore differed widely between these two groups. The trained painters were more in line with the current knowledge on health assessment of indoors mould, but still tended to overestimate costs somewhat.

Recommendations for policy formulation

12a. Please highlight some of your key experiences which might be helpful to others interested in implementing similar measures/interventions.

Guidelines and education by themselves are helpful but not enough to make sure that the recommendations are implemented. The causes of this remain to be determined. The quality of occupational health and consumer protection still needs to be optimised, and more transparency is needed for contractors. The entire public and professional risk communication of indoors mould must be brought up to date with current knowledge. Even if service providers are given comprehensive education (including an examination), more quality assurance is needed to ensure that theory is implemented in practice. Also, educational training must be updated regularly. National professional renovation associations, different professions and organisations together with local quality assurance associations can help optimise the quality assurance of assessment and renovation of indoors mould.

12b. Could this measure/intervention be readily transferred to other cities, regions or countries? Which factors need to be considered here?

It can readily be transferred to other organisations, but the factors listed under 12a should be kept in mind. Needless to say, the measure/intervention should be conducted professionally. Course instructors need to be highly skilled. Costs of the training for the course participants should be kept as low as possible.
Additional comments

Please add any comments or notes which could be helpful but were not covered by the questions above.

Additional information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

The evaluation will be published at the Indoors Air 2008 in Copenhagen (Denmark).
Case study 7

Contacts / study coordinator

Please provide contact details for the person in charge of the study.

Name: Jonathan Wilson
Title: Deputy Director
Organization: National Center for Healthy Housing
Email: jwilson@nchh.org

The National Center for Healthy Housing (NCHH) was a producer and main distributor of a video offering guidance on proper flood clean-up. The video was developed by the Little Sisters of the Assumption (LSA) Family Health Service, Inc. (New York, NY – contact: Ray Lopez) and Microecologies, Inc. (New York, NY – contact: Bill Sothern) after extensive field work in New Orleans in the fall of 2005. The guidance on the video was further supported by a three dwelling unit field study conducted by Columbia University (NY, NY - Ginger Chew, PI), Tulane University (New Orleans, LA) and NCHH with field support from Enterprise Community Partners (Columbia, MD) and Neighborhood Housing Services of New Orleans. Results from the field study are reported in Environmental Health Perspectives 114:1883–1889 (December 2006).

Intervention title

| Mold Clean-up Guidance for New Orleans Area Residents Affected by Hurricane Katrina – a DVD |
Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

By distributing a video to families and volunteers in the New Orleans area of Louisiana, USA following Hurricane Katrina (2005), provide guidance on how to clean-up homes so to:

- Reduce exposure to mold generated by flooding
- Reduce respiratory problems of residents working in flooded homes
- Reduce exposure to other environmental toxins including flood-borne bacteria, lead, and hazardous household chemicals

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What where the results expected?

- Provide educational video to at least 3,000 people including residents and volunteers to reduce their near-term and long-term exposure to mold

Target population groups

2. Please specify the targeted population groups:

Whole population (X) in New Orleans, Louisiana area (2005-2006)

Specific age groups: Please add notes / comments behind parentheses if required

- Older people ( )
- Adults ( )
- Adolescents ( )
- Children ( )

Specific target groups: Please add notes / comments behind parentheses if required

- Women ( )
- Disabled people ( )
- Other ( ) (please specify:)

30
**Target buildings**

3. Which buildings are targeted by the intervention/initiative?

- **Residential buildings** (X) Targeted toward the wood-framed homes on raised piers or on concrete slabs the characterize the New Orleans housing stock.

- **Schools** ( )
- **Child centres** ( )
- **Elderly centres** ( )
- **Other** ( ) (please specify:)

**Geographical scale**

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)? Please inform about the geographical scale/administrative scope/region.

Locally in New Orleans, Louisiana and the surrounding communities (2005-2006)

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

The intervention focuses on flood clean-up and mold control for homes in an urban area affected by multiple days of flooding.

**Study size**

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

- **Dwellings:**
- **Schools:**
- **Day centres:**

Persons: At least 3,000 persons educated

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

Residents were provided the videos for free. NCHH and LSA Family Health Services conducted outreach via the media, community partners and health department contacts. DVDs were mailed to partners for distribution locally and were available for download via our website (centerforhealthyhousing.org).
Target indicators of indoor environmental quality

6. What are the pollutants or factors that were targeted by the intervention/initiative?

| Relative humidity | (   ) |
| Damp / moisture in building structure | (X) |
| Dampness entering from outside | (   ) |
| Mould in / on building structures | (X) |
| Air exchange rate | (   ) |
| Thermal performance of building (insulation / heating) | (   ) |
| Building materials themselves | (X) |

Please add to this list all other factors the intervention/initiative did target:

- Lead, asbestos, bacterial toxins

Specific actions

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative? Please describe shortly.

As part of the video production process, Ray Lopez of LSA Family Health Service and Bill Sothern of Microecologies spent time in New Orleans post-Katrina testing homes for mold and refining methods to remove the mold and other hazards from homes. Concurrently, NCHH partnered with Columbia University and Tulane University to test mold-clean-up protocols in three homes in the Gentilly neighbourhood of New Orleans. The combined wisdom of this work resulted in the final production of the flood clean-up video.

Post-production, NCHH and LSA Family Health Services notified local housing organizations, volunteer agencies and health departments of the availability of the DVD. DVDs were shipped to these organizations in quantities of 25-500 for free distribution to local residents and volunteers. The DVD is also available on-line on the NCHH website for free download.

Funding, costs and project context

8a. What was the project budget?

$37,000 US

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

$12/DVD distributed; Further distribution would be at a lower marginal cost.
8c. What were the sources of funding?

Private / sponsors (X) Enterprise Community Partners from Robert Wood Johnson Foundation; Arnold P. Gold Foundation grant through Columbia University

City / municipal ( )

National / federal (X) US Housing and Urban Development Grant through Mt Sinai School of Medicine

EC project ( )

Other ( ) (please specify:)

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

Yes ( ) Program name:

No (X)

Coordinator and collaborators

9a. Which institution/organization etc. coordinated the intervention/initiative?

Little Sisters of the Assumption Family Health Service and National Center for Healthy Housing

9b. Which were the collaborators?

Microecologies, Enterprise Community Partners, Columbia University, Tulane University, Neighborhood Housing Services of New Orleans
Results

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

The partners successfully distributed the DVDs and received positive feedback from the public.

10b. Were the objectives (as provided in 1b) reached?

Yes

10c. What kind of communication activities to disseminate the results and findings have been taken?

Please add notes / comments behind parentheses if required

- Media (TV, radio, newspaper) (X) Local media in New Orleans
- Public meetings / fora (X) Local meetings by partners
- Internet / web sites (X) Outreach on centerforhealthyhousing.org
- Scientific publications (X) Environmental Health Perspectives
- Other ( ) (please specify:)

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Evaluation

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

The partners did not evaluate the impact of the video distribution itself. A total of 3009 DVD copies have so far been distributed and the website version was downloaded 1041 times. Feedback from volunteers and tenant or housing organizations indicates that the information is helpful in considering how to address mold and the proper precautions to take before intervening in the homes. The partners heard that the video was especially useful as a training tool for volunteers preparing to clean out flooded homes.

Regarding evaluation, many of the techniques promoted in the video were tested by Columbia University/NCHH and their partners prior to completion of the video.

11b. What were the main evaluation findings?

The three-home case study demonstrated that by using the flood clean-up protocols similar to those documented in the video, total mold spore counts could be significantly reduced in homes that endured one to six feet of flooding for up to two weeks. We also have reports from some homes where the protocols were not followed that the airborne mold spore counts were 10 or more times higher after clean-up than homes where the protocols were followed. The case study emphasized the importance of personal respiratory protection and adequate drying of homes before rebuilding.

The protocol follows a basic four step process that should be applied to all flood clean-up activities:

1. Remove all water-damaged housing components from the home as soon as possible after the flood waters have subsided and the home is safe for re-entry. Replaceable components and other objects should be thrown out including water-damaged appliances. Other valued components should be properly cleaned and stored.

2. After the wood frame is allowed to dry to a moisture content <15%, dry brush and vacuum the wood surfaces with a HEPA filter vacuum to remove dirt and mold. Wet wash hard surfaces with a household detergent. Household bleach may be needed in areas contaminated by bacteria. All surfaces should be vacuumed after cleaning.

3. Apply a borate solution to wood surfaces to prevent regrowth of mold. Allow time for the wood frame to fully dry (<15% moisture content) before restoration. When possible, mechanical dehumidification should be used to aid the drying process.

4. In areas of the home prone to moisture and mold such as crawl spaces, a mold-resistant coating may be applied before the restoration process begins. During restoration, mold resistant wallboard should be installed in showers, water closets or other likely to be subject to water damage.
Recommendations for policy formulation

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

Through strong partnerships, empirically tested protocols can be documented on film and provided to residents and volunteers so they may safely restore flooded homes.

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

The protocols documented on this video are very relevant for homes that have experienced substantial flooding, especially over a prolonged period. Other US state health departments have used the videos to help families in the aftermath of river flooding.

Additional comments and experiences

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

Further information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

The video can be downloaded from:
A companion flood clean-up guide is available:
The case study that helped support the video can be found at:
Review of interventions implemented in member states to address health hazards associated with dampness, mould and inadequate ventilation

Case study 8

Contacts / study coordinator
Please provide contact details for the person in charge of the study.

Name: Herbarth, Olf
Title: Univ.-Prof. Dr.
Organization: Faculty of Medicine, University of Leipzig
Email: olf.herbarth@medizin.uni-leipzig.de

Intervention title

<table>
<thead>
<tr>
<th>Type of Study</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cross sectional study:</td>
<td>KIGA - Kindergarten children, with the same design studies in Argentina (KIGA-ARG)</td>
</tr>
<tr>
<td>repeated cross sectional study:</td>
<td>LISS - school starters and 8 and 14 years old children (with similar design studies in Mexico)</td>
</tr>
<tr>
<td>cohort studies:</td>
<td>LARS - high risk children for allergic disorders</td>
</tr>
<tr>
<td></td>
<td>LISA - population based study started with newborns</td>
</tr>
<tr>
<td></td>
<td>(multicenter study: here Leipzig part)</td>
</tr>
<tr>
<td></td>
<td>LiNA – population based study started with pregnancy (state: recruiting phase)</td>
</tr>
</tbody>
</table>
Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

<table>
<thead>
<tr>
<th>Objective</th>
<th>Effect of indoor exposure on health disorders</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• focused on allergic disorders, airway diseases, infections</td>
</tr>
<tr>
<td></td>
<td>• including detailed medical check up and questionnaires</td>
</tr>
<tr>
<td></td>
<td>• search for exposure and effect pattern</td>
</tr>
<tr>
<td></td>
<td>• detection of health relevant exposure scenarios focused on indoor allergens (including mould), mVOC and VOC</td>
</tr>
<tr>
<td></td>
<td>• investigation about the interaction between mould (and mould derived products) and other exposures on health</td>
</tr>
<tr>
<td></td>
<td>• effect of refurbishment, redecoration etc. on indoor air quality and health effects focused on the question at what time in life a high indoor VOC (linked with redecoration activities) has the most important influence on triggering allergic disorders:</td>
</tr>
<tr>
<td></td>
<td>3 sources are of special interest: painting, wall to wall carpet and new furniture</td>
</tr>
<tr>
<td></td>
<td>The interesting time window was around birth and the first years of life</td>
</tr>
</tbody>
</table>

The specific questions worked with depend on the study mentioned in the box “intervention title”

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What were the results expected?

<table>
<thead>
<tr>
<th>Target population groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole population ( )</td>
</tr>
<tr>
<td>Specific age groups:</td>
</tr>
<tr>
<td>Older people ( )</td>
</tr>
<tr>
<td>Adults ( )</td>
</tr>
<tr>
<td>Adolescents ( )</td>
</tr>
<tr>
<td>Children ( x )</td>
</tr>
<tr>
<td>Specific target groups:</td>
</tr>
<tr>
<td>Women ( )</td>
</tr>
<tr>
<td>Disabled people ( )</td>
</tr>
<tr>
<td>Other ( x ) (please specify: children)</td>
</tr>
</tbody>
</table>
**Target buildings**

3. Which buildings are targeted by the intervention/initiative?

Please add notes / comments behind parentheses if required

- Residential buildings (x)
- Schools ( )
- Child centres (x)
- Elderly centres ( )
- Other ( ) (please specify:)

**Geographical scale**

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)? Please inform about the geographical scale/administrative scope/region.

- Municipal

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

- Urban areas (in some studies rural areas too)

**Study size**

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

Please add notes / comments if required

- Dwellings: approx. 3000
- Schools:
- Day centres: approx: 50

- Persons: approx. 6200

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

- Complaints caused by mould (suspicion); visit of the outpatients clinic of environmental medicine or of the public health office.
**Target indicators of indoor environmental quality**

6. What are the pollutants or factors that were targeted by the intervention/initiative?

<table>
<thead>
<tr>
<th>Factor</th>
<th>Targeted</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative humidity</td>
<td>( x )</td>
<td>(partially)</td>
</tr>
<tr>
<td>Damp / moisture in building structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dampness entering from outside</td>
<td>( x )</td>
<td>(by questionnaires)</td>
</tr>
<tr>
<td>Mould in / on building structures</td>
<td>( x )</td>
<td></td>
</tr>
<tr>
<td>Air exchange rate</td>
<td>( x )</td>
<td>(partially)</td>
</tr>
<tr>
<td>Thermal performance of building (insulation / heating)</td>
<td>( x )</td>
<td>(by questionnaires)</td>
</tr>
<tr>
<td>Building materials themselves</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please add to this list all other factors the intervention/initiative did target:

- Indoor air quality additional characterised by VOC and mVOC; other allergens than mould

**Specific actions**

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative?

- It is not a “poor” intervention study!!!

At every time point of investigation (around birth, after 7 weeks, 0.5 years old 1 year old and at every birth day until the 6th, 10th or 14th (dependent on the study) medical check up and measurements in the apartments have been done.

The VOCs and mVOC were measured using passive (4 weeks) and active sampling methods. The mould was measured using sampling devices (and agar plates).

The aim was to find out changing in load depending on activities like redecoration and sometimes mould removal and associated health effects.
Funding, costs and project context

8a. What was the project budget?
approx. 1.4 Mio € (partially not included costs for personal; would be paid in part by institutional budget)

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

8c. What were the sources of funding?

Please add notes / comments behind parentheses if required
- Private / sponsors (  )
- City / municipal (  )
- National / federal ( x )
- EC project (  )
- Other (  ) (please specify:)

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?
Yes (  ) Program name:
No ( x )

Coordinator and collaborators

9a. Which institution/organization etc. coordinated the intervention/initiative?
dependent on study, as a rule Centre for Environmental Medicine

9b. Which were the collaborators?
Public health offices, partners from the University (clinics and institutes), HGF-Centre for Environmental Research - UFZ Leipzig, GSF Munich, UNAM Mexico, Universidad de Mendoza and La Plate Argentina, ...
**Results**

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

sensitive time window is between the end of pregnancy (?) and the first year of life intervention leads to improvement of health, reduction of frequency of symptoms

10b. Were the objectives (as provided in 1b) reached?

yes

10c. What kind of communication activities to disseminate the results and findings have been taken?

*Please add notes / comments behind parentheses if required*

- Media (TV, radio, newspaper) (x ) presentations together with the results of other studies
- Public meetings / fora (x ) sometimes together with the chiefs of the Kindergartens, the parents and fora with members of the town council
- Internet / web sites (x )
- Scientific publications (x )
- Other (x ) (please specify: brochures and leaflets for parents and Kindergarten teachers)

**Evaluation**

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

Yes; SOPs for medical examination, control groups and quality assurance of the measurements by participation at proficiency tests; validated questionnaires

11b. What were the main evaluation findings?

The main finding was:

It exists a strong link between redecoration activities around birth and (outbreak of) atopic diseases in later life. The risk to fall ill was approx. 2 times higher in case of renovation activities around birth compared with the controls (no redecoration activities) (see box further information Herbarth et al. 2006)

Best associations between description of health disorders in questionnaires and medical check up outcomes; the same between questionnaire data and exposure measurements; optimizing studies
Recommendations for policy formulation

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

- support by local public health offices is necessary
- show the participants the link between the exposure and the health effects
- give advices for preventive measures

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

yes / considering micro climate

Additional comments and experiences

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

Further information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

Selection of papers with respect to the topic:


<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Title</th>
<th>Journal</th>
<th>Volume</th>
<th>Page Numbers</th>
<th>Year</th>
</tr>
</thead>
</table>
Review of interventions implemented in member states to address health hazards associated with dampness, mould and inadequate ventilation

Case study 10

Contacts / study coordinator

Please provide contact details for the person in charge of the study.

Name: Ulla Haverinen-Shaughnessy
Title: Senior Researcher
Organization: National Public Health Institute
Email: ulla.haverinen@ktl.fi

Intervention title

| Monitoring success of remediation: case 5 (old age home) |

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

| Monitoring effects of remediation on building, microbial concentrations and occupant health |

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What where the results expected?

| Significant differences in microbial concentrations and occurrence of health symptoms as compared to the situation before remediation |
Target population groups

2. Please specify the targeted population groups:

Whole population  

Specific age groups:  Please add notes / comments behind parentheses if required

- Older people  
- Adults  ( ) old age home personnel  
- Adolescents  
- Children  

Specific target groups:  Please add notes / comments behind parentheses if required

- Women  
- Disabled people  
- Other  ( ) (please specify:)  elderly people were not directly included in the health monitoring, but personnel expressed concerns about their health during the remediation

Target buildings

3. Which buildings are targeted by the intervention/initiative?

- Residential buildings  
- Schools  
- Child centres  
- Elderly centres  ( x )  
- Other  ( ) (please specify:)

Geographical scale

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)?  
Please inform about the geographical scale/administrative scope/region.

- Municipal

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

- One city, rural location
**Study size**

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

*Please add notes / comments if required*

Dwellings:
Schools:
Day centres:

Persons: 41 (personnel)

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

Cases were selected by an engineering consultant called upon estimating dampness related problems in the buildings. Recruited for the research project were cases with sufficiently large occupancy (to allow health effect studies / group level estimation of effects) with suspected dampness related indoor air quality problems. The selected cases had to be able to ensure / commit themselves to completion of the recommended remediation tasks within a reasonable time and were willing to participate in the “extra” monitoring program.

**Target indicators of indoor environmental quality**

6. What are the pollutants or factors that were targeted by the intervention/initiative?

Relative humidity (  )
Damp / moisture in building structure ( x )
Dampness entering from outside ( x )
Mould in / on building structures ( x )
Air exchange rate (  )
Thermal performance of building (insulation / heating) (  )
Building materials themselves (  )

Please add to this list all other factors the intervention/initiative did target:
**Specific actions**

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative? Please describe shortly.

Remediation actions included renewal of roofing, improving drainage system, remediation of balconies, and renewal of damaged ceiling tiles.

**Funding, costs and project context**

8a. What was the project budget?

Not known at this point (I will try to collect this information for the meeting).

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

8c. What were the sources of funding?

Please add notes / comments behind parentheses if required

- Private / sponsors (  )
- City / municipal ( x )
- National / federal ( x )
- EC project (  )
- Other (  ) (please specify:)

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

Yes ( x ) Program name: Finnish Research Programme of Environmental Health (SYTTY)

No (  )

**Coordinator and collaborators**

9a. Which institution/organization etc. coordinated the intervention/initiative?

National Public Health Institute, Finland

9b. Which were the collaborators?

Consulting Engineers Mikko Vahanen Ltd, City of Porvoo
**Results**

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

Technical investigations and remediation only included roof and balcony (n=40) structures and related leakages. This case illustrates results from a large-scale, yet partial, remediation and follow-up program, as other possible damage sites (but roofing/ceiling and balconies) within the building were not included in the process, i.e. there could be moisture damage / mould contamination in other parts of the building, which was not considered during the course of the study.

Based on technical monitoring, it was concluded that the remediation work was successful, but other damage could still exist in the building.

10b. Were the objectives (as provided in 1b) reached?

Partial improvement was detected in both microbial status of the building and health of the occupants.

10c. What kind of communication activities to disseminate the results and findings have been taken?

Please add notes / comments behind parentheses if required

- Media (TV, radio, newspaper) ( )
- Public meetings / fora ( x )
- Internet / web sites ( )
- Scientific publications ( x )
- Other ( ) (please specify:)

**Evaluation**

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

Technical follow-up included visual inspection and interviewing occupants.
Microbial follow-up included air, surface and material samples (see Table 1).
Health effect studies included use of questionnaires.

Table 1. Results from air samples. *Highlighted text indicate possible microbial sources in the building*
<table>
<thead>
<tr>
<th>Sampling Date</th>
<th>Results</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/99 n=22 (before remediation)</td>
<td></td>
<td>- Elevated concentration and indicator microbes observed (1/22) - Low concentrations of indicator microbes observed (11/22) - Low concentrations and no indicator microbes observed (10/22)</td>
</tr>
<tr>
<td>8/00</td>
<td>n = 23</td>
<td>- Elevated concentration (2/23) - Several indicator microbial species observed (21/23)</td>
</tr>
<tr>
<td>2/01</td>
<td>n = 16</td>
<td>- Low concentrations of indicator microbes observed (10/17) - Low concentrations and no indicator microbes observed (6/16)</td>
</tr>
<tr>
<td>8/00</td>
<td>Results indicate possible abnormal microbial sources in the building</td>
<td></td>
</tr>
<tr>
<td>2/01</td>
<td>Results give “slight” indication of possible abnormal microbial sources in the building</td>
<td></td>
</tr>
</tbody>
</table>

11b. What were the main evaluation findings?

After remediation, water leakage through roof and balcony structures had stopped, and no more *Stachybotrys* spp. fungi was observed in the indoor air samples. However, low concentrations of other indicator microbes were still observed. Occupants reported significantly less nasal symptoms, hoarseness, sore throat, and eye symptoms. Symptoms association with work decreased significantly in facial eczema and cough. The prevalence of sinusitis was significantly decreased.

**Recommendations for policy formulation**

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

Partial/selective remediation may not solve IAQ problems within the whole building. However, even if a holistic approach is highly recommended, it appears that partial measures can, at least in some cases, contribute to improved microbial status of buildings and occupant health.

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

This case particularly illustrates the questions of sufficient extension of the repair, effects of partial repairs, “normal” or “acceptable” levels of damage, concentrations of microbes, prevalence of symptoms etc. The general advice for building owners who wish to solve moisture related problems in buildings is to repair the damage, including both eliminating the original cause of moisture accumulation, and replacing damaged materials. However, these principles can not be strictly followed in every case. There is often a need to prioritize the repairs or seek for a compromise that may not satisfy all the parties involved. Which criteria should be used when making such decisions?
Additional comments and experiences

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

Further information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

Review of interventions implemented in member states to address health hazards associated with dampness, mould and inadequate ventilation

Case study 11

Contacts / study coordinator

Please provide contact details for the person in charge of the study.

Name: Ulla Haverinen-Shaughnessy
Title: Senior Researcher
Organization: National Public Health Institute
Email: ulla.haverinen@ktl.fi

Intervention title

Estimating effects of moisture damage repairs on students' health

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

Estimating effects of remediation on students' health

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What where the results expected?

To estimate differences in students' health status on the group level (cross-sectional) and individual level (longitudinally) before and after remediation
Target population groups

2. Please specify the targeted population groups:

Whole population (  )

Specific age groups: Please add notes / comments behind parentheses if required

   Older people (  )
   Adults (  )
   Adolescents ( x )
   Children (  )

Specific target groups: Please add notes / comments behind parentheses if required

   Women (  )
   Disabled people (  )
   Other ( x ) (please specify:) upper secondary and high school students

Target buildings

3. Which buildings are targeted by the intervention/initiative?

   Residential buildings (  )
   Schools ( x )
   Child centres (  )
   Elderly centres (  )
   Other (  ) (please specify:)

Geographical scale

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)?

Please inform about the geographical scale/administrative scope/region.

Municipal

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

One city
**Study size**

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

*Please add notes / comments if required*

- Dwellings:

- Schools: 1

- Day centres:

- Persons: ~250 students each year

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

Long history of dampness/mould problems. The school had contacted KTL in order to get help in solving their persistent IAQ problems. At that time (mid 1990’s) the dampness/mould issues were not widely recognized in Finland and KTL had just started looking into school buildings (their previous studies were focused on dwellings). They started cooperation with Tampere University of Technology in a Ministry of Education funded program that involved three other cases – the first ones in Finland I believe. Nobody really knew what would be the best way to address these issues, so our main goal was to develop a multidisciplinary approach in solving excess moisture related problems, including experts from technical, microbiological and health point of view.

**Target indicators of indoor environmental quality**

6. What are the pollutants or factors that were targeted by the intervention/initiative?

- Relative humidity
- Damp / moisture in building structure (x)
- Dampness entering from outside (x)
- Mould in / on building structures (x)
- Air exchange rate
- Thermal performance of building (insulation / heating)
- Building materials themselves

Please add to this list all other factors the intervention/initiative did target:
Specific actions

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative? Please describe shortly.

Remediation actions included better control of rising damp, i.e. improvements in drainage and rainwater sewer systems, as well as in water barriers of basement walls, in order to ensure drying of ground floor and wall structures; replacement of moisture prone materials improperly used in locations subjected to high moisture loads; improved-ventilation in crawl spaces; and replacement of all damaged material. Areas where damage was observed were left unused and were kept isolated to avoid air exchange between the damaged areas and other areas before and during the repairs. Some repairs were using dust containment techniques similar to asbestos abatement. An extensive cleaning after the removal of damaged materials included wiping of all surfaces and disinfecting materials prone to microbial contamination.

Funding, costs and project context

8a. What was the project budget?

2-3 million euros

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

8c. What were the sources of funding?

Private / sponsors ( )
City / municipal ( x )
National / federal ( x )
EC project ( )
Other ( ) (please specify:)

Please add notes / comments behind parentheses if required

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

Yes ( ) Program name:
No ( x )
Coordinator and collaborators

9a. Which institution/organization etc. coordinated the intervention/initiative?
National Public Health Institute

9b. Which were the collaborators?
Tampere University of Technology

Results

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

Abstract (For further information, see the original article)
Health symptom questionnaire responses were collected from upper secondary and high school students (n=245) before comprehensive repairs of moisture damage in the school. The questionnaire study was repeated 1 year (n=227), 3 years (n=256), and 5 years (n=233) after the repairs. The data were analyzed both in cross-sectional design including all respondents, and longitudinally including paired observations of those individuals who had responded both before and after the repairs. In addition, the effect of intervention on health symptoms was analyzed using generalized estimating equations (GEEs), taking into account within-subject correlation between repeated measurements. Compared to the situation before the repairs, the situation after the repairs was significantly improved in most of the 20 symptoms studied among the cross-sectional study populations. However, improvement was not so clear in the paired analysis and GEE analysis among the students who responded to three repeated questionnaires. The results indicate that the repairs succeeded in the sense that new cases of symptomatic students were no longer expected. However, the reversibility of symptoms among the group of exposed individuals may need to be considered separately.

10b. Were the objectives (as provided in 1b) reached?
Yes

10c. What kind of communication activities to disseminate the results and findings have been taken?

Please add notes / comments behind parentheses if required

- Media (TV, radio, newspaper) ( )
- Public meetings / fora ( x )
- Internet / web sites ( )
- Scientific publications ( x )
- Other ( ) (please specify: )
**Evaluation**

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

Yes. Follow-up actions included measurement of moisture contents of structures/materials, crawl-space ventilation, ground water level.

Microbial follow-up included air, surface and material samples.

Health effect studies included use of questionnaires.

11b. What were the main evaluation findings?

Both technical and microbial follow-up measurements made one year after the repairs (Haverinen et al. 1999), and partially repeated three years after the repairs (unpublished data) suggested that the repairs were satisfactory and microbial contaminant levels were reduced. However, it is quite impossible to say what was the cause (among the several possible causes) that had contributed most to the poor IAQ, and what was the most effective repair measure taken with respect to exposure to moulds.

At the end of the intervention period, the prevalence of symptoms among students had decreased on the group level. Not so clear reduction on the individual level (see table 1). Among the cross-sectional study populations, odds ratios (ORs) adjusted for age, gender, smoking, home location, and having pets, suggested significantly decreased risks altogether for 16 symptoms in the first follow-up, 16 symptoms in the second follow-up, and 14 symptoms in the third follow-up studies. Reported occurrence of sinusitis, nocturnal cough, eye symptoms and asthma decreased over the study period 1996-2001, demonstrating a continuously decreasing prevalence over time. A decreasing trend was seen in nine symptoms when looking at the three years period 1996-1999, including nasal bleeding and cough symptoms.

Among the 49 students who had participated in three questionnaires significantly decreased ORs were observed for need of antibiotics (first and second follow-up), cough with phlegm (second follow-up), nocturnal cough (first follow-up), and asthma (second follow-up), whereas the OR for fatigue was significantly increased (second follow-up). The trend was decreasing in nine and increasing in three symptoms over the study period 1996-1999. These results were adjusted for age, gender and smoking.
Table 1. Adjusted ORs\(^1\) for the effect of intervention on symptoms at the end of spring semester.

<table>
<thead>
<tr>
<th>Health symptom</th>
<th>Whole population(^2)</th>
<th>49 students(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-96(^4)  -97  -99  -01</td>
<td>-96(^4)  -97  -99</td>
</tr>
<tr>
<td>Sinusitis</td>
<td>1.0  0.58*  0.53*  0.49*</td>
<td>1.0  0.52  0.30</td>
</tr>
<tr>
<td>Doctor visits</td>
<td>1.0  0.66*  0.45***  0.66</td>
<td>1.0  0.59  0.22</td>
</tr>
<tr>
<td>Need of antibiotics</td>
<td>1.0  0.63*  0.37***  0.48**</td>
<td>1.0  0.34*  0.07*</td>
</tr>
<tr>
<td>Blocked nose</td>
<td>1.0  0.38***  0.42***  0.41***</td>
<td>1.0  0.42  0.40</td>
</tr>
<tr>
<td>Rhinitis</td>
<td>1.0  0.40***  0.50***  0.48***</td>
<td>1.0  0.64  1.11</td>
</tr>
<tr>
<td>Sore throat</td>
<td>1.0  0.42***  0.62**  0.67*</td>
<td>1.0  0.56  0.44</td>
</tr>
<tr>
<td>Hoarseness</td>
<td>1.0  0.46***  0.56**  0.42*</td>
<td>1.0  0.51  0.88</td>
</tr>
<tr>
<td>Nasal bleeding</td>
<td>1.0  0.82  0.55*  0.60</td>
<td>1.0  2.81  1.25</td>
</tr>
<tr>
<td>Cough without phlegm</td>
<td>1.0  0.64*  0.53**  0.64*</td>
<td>1.0  0.99  0.88</td>
</tr>
<tr>
<td>Cough with phlegm</td>
<td>1.0  0.61*  0.53***  0.57**</td>
<td>1.0  0.67  0.16*</td>
</tr>
<tr>
<td>Dyspnea/ wheezing</td>
<td>1.0  0.56*  0.59*  0.83</td>
<td>1.0  1.73  3.01</td>
</tr>
<tr>
<td>Nocturnal cough</td>
<td>1.0  0.61*  0.52**  0.50**</td>
<td>1.0  0.26*  0.14</td>
</tr>
<tr>
<td>Eye symptoms</td>
<td>1.0  0.52***  0.48***  0.43***</td>
<td>1.0  0.66  1.41</td>
</tr>
<tr>
<td>Fever</td>
<td>1.0  0.91  0.91  0.70</td>
<td>1.0  2.13  3.97</td>
</tr>
<tr>
<td>Fatigue</td>
<td>1.0  0.38***  0.62*  0.59*</td>
<td>1.0  0.47  16.5*</td>
</tr>
<tr>
<td>Headache</td>
<td>1.0  0.50***  0.62**  0.58**</td>
<td>1.0  0.64  1.79</td>
</tr>
<tr>
<td>Difficulties in concentration</td>
<td>1.0  0.30***  0.35***  0.36***</td>
<td>1.0  0.57  1.19</td>
</tr>
<tr>
<td>Muscular pain</td>
<td>1.0  0.52***  0.99  0.89</td>
<td>1.0  0.99  1.77</td>
</tr>
<tr>
<td>Arthralgia</td>
<td>1.0  0.65  0.99  0.65</td>
<td>1.0  1.86  3.88</td>
</tr>
<tr>
<td>Asthma</td>
<td>1.0  0.73  0.57  0.43*</td>
<td>1.0  0.49  0.09*</td>
</tr>
</tbody>
</table>

\(^1\) Assessed using GEEs; \(^2\) Adjusted for age, gender, smoking, home location and having pets; \(^3\) Adjusted for age, gender and smoking; \(^4\) Repairs completed in 1996 (after 1996 survey); * \(p<0.05\) ** \(p<0.01\) *** \(p<0.001\)
**Recommendations for policy formulation**

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

| Individual level (longitudinal) assessment among students is challenging (student population changes over time) |

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

| Yes. For more comprehensive results, it is best to combine technical, microbial and health effect assessment. (In this case all these aspects were included although the paper focused on health effect assessment as the final end point.) From technical point of view it would be interesting to collect similar data from different types of remediation (in this case the problems were mostly related to the ground floor structures and caused by rising damp or surface water penetration, which are often widespread, affect on large areas, and are difficult to solve). |

**Additional comments and experiences**

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

**Further information**

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

Case study 13

Contacts / study coordinator

Please provide contact details for the person in charge of the study.

Name: Assoc. Prof. Rachel Becker
Title: Head, Physical Performance of Buildings Division, NBRI
Organization: Technion – Israel Institute of Technology
Email: becker@tx.technion.ac.il

Intervention title

Introduction of a new Thermal Insulation Standard in the country in 1985

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

The objective of the intervention was reducing the risk of surface condensation in buildings, and consequently the risk for mould growth. Until 1985 Israel had no obligatory requirements for thermal insulation and even a 20 cm concrete wall (U=3.85 W/m²K) complied with the regulations. In the early 1970's there was a general improvement in the standard of living in Israel and expectations of people from their dwellings grew. At that time public awareness has been raised to the fact that there is a moisture and mould problem of in many Israeli dwellings, mainly of low to medium income societal sectors, and that thermal insulation requirements must be mandated to solve it. The National Building Research Institute was sponsored by the Ministry of Construction and Housing to lead an objective survey in order to study the extent of the problem. The consequences of the survey were a general recognition that adequate minimal thermal insulation requirements should be established and enforced in Israeli dwellings. The new Standard SI 1045 has been finalized, approved and became obligatory by adoption into the building regulations in 1985. Results of the first survey (1982-3), which included older non insulated buildings, and a follow up survey after the new standard has been implemented (1991-97) are given in item 10a below.
1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What where the results expected?

The objective was to generally reduce the risk for surface condensation in bedrooms and living rooms in regular size dwellings under normal use conditions. To achieve this target theoretical analysis, including a multitude of calculations, has been carried out, checking various scenarios. Steady-state characteristic climatic conditions and "standard" occupancy conditions composed of two persons per room (in 2 to 3 bedroom dwellings with a bedroom floor area of 8 to 10 m²) were used to investigate the required thermal insulation levels for the elimination of surface condensation with the assumption of a 0.5 to 1.0 air change rate per hour (ACH). For non-porous interior finishes a safety margin of 0.5°C-1.0°C above dew point was used. The levels of minimal thermal insulation that suit the entire set of feasible scenarios were then introduced as a proposal for the new thermal insulation standard. The final outcome was a result of the Standardization Committee's deliberations, which included additional considerations, such as construction habits and availability of technological solutions.

Target population groups

2. Please specify the targeted population groups:

Whole population (X)

Specific age groups: Please add notes / comments behind parentheses if required

- Older people ( )
- Adults ( )
- Adolescents ( )
- Children ( )

Specific target groups: Please add notes / comments behind parentheses if required

- Women ( )
- Disabled people ( )
- Other ( ) (please specify:)

Target buildings

3. Which buildings are targeted by the intervention/initiative?

Residential buildings (X)
- Schools ( )
- Child centres ( )
- Elderly centres ( )
- Other ( ) (please specify:)

Please add notes / comments behind parentheses if required
**Geographical scale**

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)?
   Please inform about the geographical scale/administrative scope/region.

   The Israeli Standards are National Standards and apply throughout the country. There are 4 climatic zones, and surface condensation prevention affected thermal insulation levels in three of them (The coastal region, the interior plane, and the mountainous region).

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

   As mentioned before, the Standard applies throughout the country. The surveys in buildings before and after implementing the new standard were conducted in the moderate-climate region (the coastal region) that is also the mostly populated region and the most humid region as well. Smaller scale surveys (“before” only) were conducted also in Jerusalem, which is in the mountainous region.

**Study size**

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

   Please add notes / comments if required

   Dwellings: The intervention affects all dwellings built since 1985. The survey before the intervention involved some 200 dwellings in the coastal region and 50 in Jerusalem. The one after implementing it involved only 100 in the coastal region.

   Schools:

   Day centres:

   Persons:

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

   The change in the Standard created a change in the building market that lead to improved building products and to an improved insulation level in the new buildings. The level of thermal insulation of walls used to be minimal (U\( \geq 2.78 \) W/m²K) and there was no thermal insulation on roofs (U=3.27 W/m²K).

   The new standard required some improved minimal insulation levels (for walls: U<1.15-1.78 W/m²K depending on the climatic region, for roofs: U<1.05-1.55 W/m²K).

   As mentioned above, the new Standard became effective in 1985, but covers only new construction.

   No requirements for improving thermal insulation were imposed on existing buildings.
**Target indicators of indoor environmental quality**

6. What are the pollutants or factors that were targeted by the intervention/initiative?

<table>
<thead>
<tr>
<th>Pollutant / Factor</th>
<th>Targeted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative humidity</td>
<td>( )</td>
</tr>
<tr>
<td>Damp / moisture in building structure</td>
<td>( x )</td>
</tr>
<tr>
<td>Dampness entering from outside</td>
<td>( )</td>
</tr>
<tr>
<td>Mould in / on building structures</td>
<td>( x )</td>
</tr>
<tr>
<td>Air exchange rate</td>
<td>( )</td>
</tr>
<tr>
<td>Thermal performance of building (insulation / heating)</td>
<td>( x )</td>
</tr>
<tr>
<td>Building materials themselves</td>
<td>( )</td>
</tr>
</tbody>
</table>

Please add to this list all other factors the intervention/initiative did target:

- Decreasing the risk for visible surface condensation and surface mould growth.

**Specific actions**

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative?  
   Please describe shortly.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>In addition to the before and after surveys described in item 10a below, the following activities took place:</td>
<td></td>
</tr>
<tr>
<td>1) Raising public awareness to the new standard. Main actions were taken by the Ministry of Construction and Housing that required strict adherence to the new standard in all its publicly subsidized new housing projects and by the Ministry of Energy who provided free of charge advisory assistance to engineers and architects who designed new buildings.</td>
<td></td>
</tr>
<tr>
<td>2) Providing a lee period of six years until its implementation and enforcement by the Building Regulations in order to enable the gradual development of adequate technical solutions by the local industry.</td>
<td></td>
</tr>
<tr>
<td>3) Promoting industries to initiate production of new materials and building components that can meet the new standard.</td>
<td></td>
</tr>
<tr>
<td>4) Preparation (by the National Building Research Institute) of a Design Guide and Manual of Solutions that meet the new standard. This project was initiated and supported by the Ministry of Construction and Housing.</td>
<td></td>
</tr>
</tbody>
</table>
Funding, costs and project context

8a. What was the project budget?
There was no specific budget allocation. But it can be estimated that the two Ministries spent no more than $500,000 altogether in order to assist the market to respond to the new standard. In addition, the cost of all the surveys that were conducted (before and after) was, using today's prices, approximately $150,000.

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

8c. What were the sources of funding?

Please add notes / comments behind parentheses if required

Private / sponsors ( )
City / municipal ( )
National / federal ( X)
EC project ( )
Other ( ) (please specify:)

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

Yes ( X) Program name: No specific name was given to the described process.
No ( )

Coordinator and collaborators

9a. Which institution/organization etc. coordinated the intervention/initiative?

NBRI (National Building Research Institute) raised the need to solve the problem, showed its extent by means of the various surveys, and prepared the suggested solutions, which included first and foremost the introduction of an obligatory standard for thermal insulation of residential buildings. Other findings from the surveys included the possible proneness of PVAc paints to fast mould growth, and lead to further research and consequently to additional recommendations, as described in another case study description form.

The main players in promoting the preparation of the new thermal insulation standard were the Ministry of construction & Housing and the Ministry of Energy.

NBRI supplied the knowledge base and assisted the industry in developing its solutions.
9b. Which were the collaborators?

Local industries of hollow-core blocks and Autoclaved Aerated blocks (improved block products and solutions for the thermal bridges), local industry for plastering materials (development of external thermal plaster), and local industry of polystyrene boards (to be used on flat roofs).

Results

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

With the advent in the standard of living in the early 1970's it became known that there are many law suits due to surface mould growth in dwellings. A survey, sponsored by The Ministry of Construction and Housing, was conducted in the early 1980's by the National Building Research Institute (NBRI) in 200 randomly chosen dwellings in the low to medium income sector in the coastal region. The survey indicated that only 45.5% of the dwellings had no condensation-related mould growth. 19% had severe mould growth attributed to surface condensation. 29.5% had observed surface moisture due to condensation. Similar results were obtained in a smaller survey (50 dwellings) in Jerusalem.

Detailed results of the first survey are given in the Appendix placed at the end of this form. In 1985 a new Thermal Insulation Standard, SI 1045, came into effect, requiring a thermal insulation level that caused an actual change in the construction materials and components (introduction into the market of new thermally improved blocks, thermal plaster, and roof insulation).

Several years after implementing the new standard, as the new products entered the market and became the new conventional way of construction, a survey in 100 dwellings in similar neighbourhoods (same socio-economic level), but built according to the new standard, was conducted. The preliminary stage of the follow-up survey started in 1991-2 and its main part was conducted in 1996-7. The level of condensation-related mould growth has reduced to less than 30% and severe mould growth related to surface condensation was reduced to less than 9%, appearing only in northern dwellings with an insulation level almost equal to the new minimum. It should be noted that the new standard does not require controlled ventilation, but has a requirement for energy efficiency that can be met only if relatively tight windows are used (leading to an air change rate of ~1 per hour or less). Despite this additional change, in construction tightness, the level of condensation and mould growth seems to be well controlled and the impression in the country is that the number of law suits due to surface mould growth has diminished dramatically.
10b. Were the objectives (as provided in 1b) reached?

The objectives were reached in non-northern dwellings, and mainly in those with insulation levels above the minimal requirements. In northern dwellings it was reached only partially. As northern dwellings do not enjoy sunshine in winter, it is usually more difficult to heat them, and the basic assumption that indoor temperature in winter is always above 18°C may not be consistently met. Momentary measurements in the preliminary sub sample of 17 dwellings of the follow-up survey indicated that there were seven dwellings with an indoor temperature below 17°C, and one was even below 16°C. Moreover, the interior surface temperature of northern walls is also smaller than that of other walls (in two cases it was as low as 14.5°C). Under such conditions the risk for indoor surface condensation is increased. This may indicate that it would be beneficial to use larger levels of thermal insulation in the walls of northern dwellings, but for technical reasons such recommendations are not accepted by standardization committees. Moreover, since the general number of law suits due to mouldy conditions has decreased, builders do not regard this problem a threat any longer, and whenever a call for imposing more stringent thermal insulation requirements comes from energy conscious professionals, builders oppose it.

10c. What kind of communication activities to disseminate the results and findings have been taken?

Please add notes / comments behind parentheses if required

- Media (TV, radio, newspaper) (   )
- Public meetings / fora ( X) Conferences
- Internet / web sites (   )
- Scientific publications ( X)
- Other ( X) Assisting the market (engineers, architects, industry) in providing the proper solutions and making the change in construction habits.

Evaluation

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

The link to health has not been established or measured. However, the follow up survey indicated, as mentioned above in 10a, that severe mould problems diminished substantially, from 19% to less than 9%.

11b. What were the main evaluation findings?

As mentioned before – a reduction in observed condensation and mould growth on wall and ceiling surfaces in dwellings.
Recommendations for policy formulation

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

When a new Standard is written its implementation should be accompanied by devoting public financial resources and academic manpower for assisting the industry to respond adequately.

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

Minimal thermal insulation, including at thermal bridges, must be enforced in all humid regions in all countries. The level of the requirements should depend on the type and level of problem the country is facing. Another factor is the level of governmental influence on the market forces.

Additional comments and experiences

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

The changes in the thermal insulation requirements have been opposed by the builders. They claimed that the change will be too costly and therefore is not needed, and that the main problem can be solved "by simply opening the windows". Despite the positive impacts on surface condensation and on energy saving, some builders still claim that the standard should be withdrawn from the regulations. Only the introduction of a strict Building Energy Code has the chance to improve the levels of implemented thermal insulation so that surface condensation, and hence mould growth, will be totally eliminated.

Our building regulations and standards still have to be improved in order to address prevention of poor indoor air quality, mainly for the cases that extremely air tight windows are used. This topic has not been handled at all, despite the observed overall tendency to improve window air tightness that may lead to poorer indoor air quality.
### Further information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

<table>
<thead>
<tr>
<th>Papers In English:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>and pp 495-505.</td>
<td></td>
</tr>
<tr>
<td>Reports in Hebrew:</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix: Data analysis of 1983 Survey

#### Table 1. Frequency of occurrence (%) of mould growth levels vs various factors in the first survey

<table>
<thead>
<tr>
<th>Type of sub-sample</th>
<th>Size of sub-sample</th>
<th>Frequency of occurrence of mould growth of class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>NM</td>
</tr>
<tr>
<td>Total sample</td>
<td>200</td>
<td>54.5</td>
</tr>
</tbody>
</table>

#### Location of dwelling
- Exterior bottom storey: 51, 60.8, 15.7, 23.5
- Exterior intermediate storey: 46, 69.6, 17.4, 13.0
- Exterior top storey: 63, 36.5, 39.7, 23.8
- Interior any storey: 40, 57.5, 30.0, 12.5

#### Orientation of dwelling
- Northern: 100, 47.0, 25.0, 28.0
- Southern: 72, 63.9, 29.2, 6.9

#### Size of dwelling
- 3 Rooms (64-76 m²): 113, 51.3, 30.1, 18.6
- 4 Rooms (76-95 m²): 73, 53.4, 23.3, 23.3

#### Occupancy density
- ≤1 Person/room: 92, 67.4, 22.8, 9.8
- >1 Person/room: 108, 43.5, 29.6, 26.9

#### Heating habits
- No heating at all: 41, 51.2, 29.3, 19.5
- 'Dry' heating: 63, 55.6, 25.4, 19.0
- 'Wet' heating: 96, 55.2, 26.0, 18.8

#### Ventilation habits
- No ventilation: 41, 43.9, 36.6, 19.5
- Daytime ventilation: 159, 57.2, 24.0, 18.8

#### Cooking habits
- Daytime + ventilated kitchen: 116, 62.9, 21.6, 15.5
- Others: 84, 42.9, 33.3, 23.8

#### Hand laundry habits
- Daytime + ventilated bathroom: 147, 59.9, 22.5, 17.7
- Others: 53, 39.6, 37.7, 22.7

#### Wall coverings
- Whitewash: 31, 77.4, 16.1, 6.5
- Emulsion paints: 93, 59.2, 20.4, 20.4
- PVC. wallpaper: 75, 40.0, 38.7, 21.3
Case study 15

Contacts / study coordinator

Please provide contact details for the person in charge of the study.

Name: Tadj Oreszczyn
Title: Professor
Organization: The Bartlett School of Graduate Studies, University College London
Email: t.oreszczyn@ucl.ac.uk

Intervention title

Warm Front energy efficiency scheme

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

The Warm Front scheme aims to improve the health of low-income households living in cold dwellings by increasing the indoor temperature through the installation of draught stripping, insulation and gas central heating system.

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What were the results expected?

The Warm Front scheme aims to alleviate poverty, slow climate change and enhance population health. Each dwelling receiving the assistance is expected to save annually about 194 British Pounds in fuel cost and 10GJ in energy use.
Target population groups

2. Please specify the targeted population groups:

Whole population  (  )

Specific age groups:  Please add notes / comments behind parentheses if required

   Older people  ( X )
   Adults  (  )
   Adolescents  (  )
   Children  ( X )

Specific target groups:  Please add notes / comments behind parentheses if required

   Women  (  )
   Disabled people  (  )
   Other  ( x ) (please specify:) The scheme aims to target those who are most susceptible to the health effects of being fuel poor, i.e. low incomes, poor housing and elderly or with young children.

Target buildings

3. Which buildings are targeted by the intervention/initiative?

   Residential buildings  ( X )
   Schools  (  )
   Child centres  (  )
   Elderly centres  (  )
   Other  (  ) (please specify:)

Geographical scale

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)? Please inform about the geographical scale/administrative scope/region.

The Warm Front scheme is designed to tackle fuel poverty in England.

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

Any homeowners in England receiving income benefits and with a household member aged below 16 or above 60 can qualify under the scheme.
Study size

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

Please add notes / comments if required

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwellings</td>
<td>3100 dwellings</td>
<td>1060</td>
<td>2040</td>
</tr>
<tr>
<td>Schools</td>
<td>none</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day centres</td>
<td>none</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persons</td>
<td>2900 dwellings</td>
<td>850</td>
<td>2050</td>
</tr>
</tbody>
</table>

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

Any homeowners in England living in dwellings with poor energy efficiency i.e. missing insulation and inefficient heating system, and receiving income benefits and with a household member aged below 16 or above 60.

Target indicators of indoor environmental quality

6. What are the pollutants or factors that were targeted by the intervention/initiative?

Relative humidity (X)
Damp / moisture in building structure (X)
Dampness entering from outside ( )
Mould in / on building structures (X)
Air exchange rate (X)
Thermal performance of building (insulation / heating) (X)
Building materials themselves ( )

Please add to this list all other factors the intervention/initiative did target:
Indoor air temperature, thermal comfort
Specific actions

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative?
   Please describe shortly.

| Draught stripping around windows and doors, cavity wall insulation, loft insulation, gas convection heating system, gas central heating system. The package of measures was specific to each property and so different properties received different measures. Insulation of basement ceilings and double glazing was not part of the package |

The Health Impact Evaluation of Warm Front study was initiated in 2002 to investigate the impact of the Warm Front scheme on occupant health, thermal comfort, indoor environment and energy consumption. 3200 dwellings were originally targeted to collect household and property data was collected from 2500 dwellings.

Funding, costs and project context

8a. What was the project budget?
| Excess of 800 million British Pounds from 2005 to 2008. Since the launch of the Warm Front program in 2000, 1.1 million dwellings were targeted by 2005. |

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?
| Households with an elderly member: max. 2,500 Pounds per dwelling |
| Households with a member under the age of 16: max. 1,500 Pounds per dwelling |

Up to a maximum expenditure of these amounts per property. So the package of measures was selected that could be achieved within this cost.

8c. What were the sources of funding?

Please add notes / comments behind parentheses if required

| Private / sponsors |
| City / municipal |
| National / federal | ( X ) Warm Front scheme |
| EC project |
| Other | ( ) (please specify:) |

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

| Yes | ( X ) Program name: Warm Front |
| No | ( ) |
Coordinator and collaborators

9a. Which institution/organization etc. coordinated the intervention/initiative?
The Warm Front energy efficiency scheme is administered by the eaga group which is the UK’s leading provider of residential energy efficiency solutions

9b. Which were the collaborators?

Results

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).
The Warm Front scheme was beneficial in increasing the indoor temperature and thermal comfort with the householders feeling most comfortable at 19.0°C. The expected decrease in air infiltration rate was not observed due to increase associated with plumbing work when installing the gas central heating system (Although holes were sealed when draught stripping was introduced, holes were also introduced when the heating system was installed).
Relative humidity and mould was also found to decrease following the Warm Front. Fewer households reported difficulty with paying fuel bill after Warm Front although no decrease in overall fuel consumption was observed.
Warm Front intervention appears to have a direct positive impact on mental health and, via higher temperatures, greater thermal comfort and lower stress, an indirect impact on most dimensions of self-reported health. The principal route to health gain is via the alleviation of fuel poverty. Better health was linked to lower utilization of health care services.

10b. Were the objectives (as provided in 1b) reached?
See above

10c. What kind of communication activities to disseminate the results and findings have been taken?
Please add notes / comments behind parentheses if required

Media (TV, radio, newspaper) (   )
Public meetings / fora (   )
Internet / web sites (   )
Scientific publications ( X)
Other (   ) (please specify:)

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Evaluation

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

The evaluation work was carried out under the Health Impact Evaluation of Warm Front study by the consortium of 1. Centre for Regional Economic and Social Research at Sheffield Hallam University, 2. London School of Hygiene & Tropical Medicine and 3. the Bartlett School of Graduate Studies at University College London.

Property and household condition data were collected from 2500 dwellings by trained surveyors. The environmental data (temperature, relative humidity) was monitored at half-hourly interval for two to three week period in 1600 dwellings. Thermal comfort diary was recorded by householders from 2400 dwellings; air infiltration rate was tested in 200 dwellings.

11b. What were the main evaluation findings?

The main mould and relative humidity findings are that the interventions reduced the relative humidity and mould growth primarily because of the increased internal temperature as a result of the interventions, see table 3 below, also a relationship between mould and relative humidity was determined see and Figure 1 below. For detailed explanation of these tables and figures the reader is referred to the original source.


Which can be downloaded from http://eprints.ucl.ac.uk/2098/

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Type of intervention</th>
<th>Living room (n=601)</th>
<th>Bedroom (n=640)</th>
<th>Odds ratios (95% CI) for mould severity index &gt;1 relative to baseline group (n=2,155)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area, year, deprivation, household size (model 1)</td>
<td>Pre-intervention</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Insulation only†</td>
<td>-1.12 (-3.01, 0.78)</td>
<td>-2.88 (-5.13, -0.64)</td>
<td>0.64 (0.41, 1.00)</td>
</tr>
<tr>
<td></td>
<td>Heating only‡</td>
<td>-2.63 (-4.16, -0.80)</td>
<td>-5.84 (-8.04, -3.64)</td>
<td>0.47 (0.20, 0.75)</td>
</tr>
<tr>
<td></td>
<td>Heating + insulation</td>
<td>-3.41 (-4.94, -1.89)</td>
<td>-7.62 (-9.44, -5.80)</td>
<td>0.55 (0.38, 0.81)</td>
</tr>
<tr>
<td>Model 1 + SAP rating (model 2)</td>
<td>Pre-intervention</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Insulation only</td>
<td>-0.51 (-2.43, 1.41)</td>
<td>-2.22 (-4.49, 0.05)</td>
<td>0.69 (0.44, 1.08)</td>
</tr>
<tr>
<td></td>
<td>Heating only</td>
<td>-1.22 (-3.22, 0.79)</td>
<td>-4.02 (-6.43, -1.61)</td>
<td>0.66 (0.40, 1.10)</td>
</tr>
<tr>
<td></td>
<td>Heating + insulation</td>
<td>-1.93 (-3.71, -0.15)</td>
<td>-5.63 (-7.75, -3.52)</td>
<td>0.81 (0.53, 1.24)</td>
</tr>
</tbody>
</table>

* all results based on the subset of records with complete data for area, year, index of multiple deprivation, household size, SAP energy efficiency rating
† loft insulation or cavity wall insulation or loft and cavity wall insulation
‡ gas central heating system
Figure 1. Relationship between mould and standardized relative humidity: (A) living room standardized RH, (B) bedroom standardized RH. Graphs show predicted values (solid line) and 95% confidence intervals (dashed).
Recommendations for policy formulation

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

1. Good quality control should accompany the installation of gas central heating system as a retrofit measure if increased air infiltration rate following the work is to be avoided.
2. The installation of a gas central heating system should be accompanied by the removal of the old inefficient heating system in order to avoid their combined use which can comprise the potential energy saving from the efficient heating system.
3. Surveys for the evaluation study should be carried out with the least number of visits possible in order to avoid drop out among the survey participants.

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

The Warm Front scheme is designed to improve the dwelling thermal comfort condition in winter by increasing the indoor temperature. This scheme is therefore effective in regions that experience cold winters.
The scheme’s main energy efficiency intervention measures are cavity wall insulation, loft insulation and gas central heating system. These require the presence of loft space, cavity wall space and the mains gas supply.

Additional comments and experiences

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

Further information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.


Case study 16

Contacts / study coordinator

Please provide contact details for the person in charge of the study.

Name: Gunnel Emenius
Title: EHO, Phd environmental medicine
Organization: Occupational and Environmental medicine, Stockholm County Council/
Department of Public Health Sciences, Karolinska Institutet
Email: gunnel.emenius@sll.se, gunnel.emenius@ki.se

Intervention title

Mechanical ventilation protects one-storey single-dwelling houses against increased air humidity,
domestic mite allergens and indoor pollutants in a cold climatic region

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates,
reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

The aim of this project was to investigate the ventilation rate in houses with different ventilation
systems in relation to indoor air humidity, domestic mite allergen levels and volatile organic
compounds (VOC).

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)?
What were the results expected?

The impact of various ventilation systems on indoor exposures, such as:
- homes having a ventilation rate <0.5 air changes per hour (ACH) (minimum in buildings
equipped with mechanical ventilation systems, according to the Swedish building code)
- reduction of homes with indoor humidity promoting mite growth
- reduction of homes with house dust mites
- impact on indoor volatile organic compounds (VOC)
Target population groups

2. Please specify the targeted population groups:

Whole population  ( x )

Specific age groups: Please add notes / comments behind parentheses if required

- Older people  ( )
- Adults  ( )
- Adolescents  ( )
- Children  ( )

Specific target groups: Please add notes / comments behind parentheses if required

- Women  ( )
- Disabled people  ( )
- Other  ( x ) (susceptible individuals (allergic diseases). However, individuals suffering from allergic diseases were excluded from the study, with the purpose that no other allergen avoidance measures – than change of ventilation system – had been undertaken.

Target buildings

3. Which buildings are targeted by the intervention/initiative?

Residential buildings  ( x )
- Schools  ( )
- Child centres  ( )
- Elderly centres  ( )
- Other  ( ) (please specify:)


**Geographical scale**

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)? Please inform about the geographical scale/administrative scope/region.

| The result of the study was implemented on national and municipal level (primarily within Stockholm County Council) as well as individual level |

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

| Primarily this study focus on indoor climate in single family homes as, in Sweden, those buildings are at higher risk of having increased indoor humidity levels that promote mite growth compared with multi-unit buildings |

**Study size**

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

*Please add notes / comments if required*

- Dwellings: 59 single family-houses
- Schools: 0
- Day centres: 0

- Persons: (59/ No focus on individuals)

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

| The criteria were:
| - family size ≥ 2 persons; same family in the house since the original first study
| - renovation by ventilation system only
| - no allergen avoidance measures undertaken.
| - the same mattress/bed that was originally vacuumed in the first study should be present in the house and in use. |
Target indicators of indoor environmental quality

6. What are the pollutants or factors that were targeted by the intervention/initiative?

- Relative humidity (x)
- Damp/moisture in building structure (x)
- Dampness entering from outside ( )
- Mould in/on building structures ( )
- Air exchange rate (x)
- Thermal performance of building (insulation/heating) ( )
- Building materials themselves ( )

Please add to this list all other factors the intervention/initiative did target:

- Mite growth (x)
- Volatile Organic Compounds (VOC) (x)

Specific actions

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative? Please describe shortly.

Installation of mechanical ventilation systems in originally naturally ventilated homes, as a single measure

Funding, costs and project context

8a. What was the project budget?

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

(private financed by each house owner)

8c. What were the sources of funding?

Please add notes/comments behind parentheses if required

<table>
<thead>
<tr>
<th>Source</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private / sponsors</td>
<td>( )</td>
</tr>
<tr>
<td>City / municipal</td>
<td>( )</td>
</tr>
<tr>
<td>National / federal</td>
<td>(x)</td>
</tr>
<tr>
<td>EC project</td>
<td>( )</td>
</tr>
<tr>
<td>Other</td>
<td>( )</td>
</tr>
</tbody>
</table>
8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

Yes   (   ) Program name:
No   ( x )

Coordinator and collaborators

9a. Which institution/organization etc. coordinated the intervention/initiative?
Dept of environmental health, Stockholm County Council/ Karolinska Institutet, Inst of Environmental Medicine

9b. Which were the collaborators?
Former Swedish Institute for Building Research and Chemik lab AB, Norrtälje, Sweden

Results

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

- Poor ventilation, i.e. an air exchange rate per hour (ACH) < 0.5 correlated strongly with original natural ventilation. The ACH was below 0.5 in only five of the 22 houses with mechanical ventilation compared with 24 of the 29 houses with natural ventilation (OR=0.06, 95% CI, 0.01–0.2)
- ACH ≥ 0.5 significantly reduced the risk of an Absolute Indoor Humidity (AIH) > 7 g/kg None of the 23 houses with an ACH ≥ 5 had an AIH ≥ 7 g/kg air compared with 10 out of 36 houses with an ACH < 0.5 (P < 0.01)
- None of the 23 homes with an ACH ≤ 0.5 exhibited concentrations of mite allergen ≥ 0.5 mg/g of dust compared with 12 (33%) out of those 36 with an ACH below this level (P=0.03)
- Subsequently, levels of mite allergen in mattress dust were significantly lower in houses with mechanical ventilation compared with those with natural ventilation with medians of 0.02 mg/g (0.0–1.5) and 0.07 mg/g (0.0–15.2), respectively (P=0.04)
- The mechanically ventilated homes had significantly lower concentrations of VOC compared with the naturally ventilated houses; P < 0.0001, however
- petrol gases could be detected in houses where a garage – used for parking cars (i.e. not rebuilt and used for other purposes)

10b. Were the objectives (as provided in 1b) reached?

-YES, in cold climatic regions, mechanical ventilation in, have the potential to lower the exposure both according to indoor humidity, mite growth and indoor air pollutants (VOC), particularly in single-family houses built after 1960 compared with naturally ventilated houses
10c. What kind of communication activities to disseminate the results and findings have been taken?

*Please add notes / comments behind parentheses if required*

Media (TV, radio, newspaper) ( x )
Public meetings / fora ( x )
Internet / web sites ( x )
Scientific publications ( x )
Other ( x ) (information meetings/education; municipalities etc.)

**Evaluation**

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

Yes, measurement of ventilation rate, indoor humidity and temperature, mite growth and VOC

11b. What were the main evaluation findings?

In cold climatic regions, mechanical ventilation in residential homes has the potential to lower the exposure to indoor humidity, mite growth and indoor air pollutants (VOC), particularly in single-family houses built after 1960 compared with naturally ventilated houses.

We did not evaluate the direct relation between ventilation rate/system and mould damages or mould spores in this study, but it seems fairly well documented that high indoor humidity, and especially a high indoor vapour contribution, as a result of poor ventilation and high indoor moisture production, may increase the risk of condensation on surfaces as well as within the building construction, with a subsequent risk of microbial growth. This later phenomenon (condensation within the construction), as a result of leaking of warm and humid air through the insulation in light weight constructions without a sufficient air tightness, etc.

**Recommendations for policy formulation**

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

In times of energy saving measures, it is also very important to take into consideration the effects on indoor air quality and the risk of adverse health effects on susceptible individuals, especially children and people suffering from allergic diseases.

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

Yes, but likely primarily in cold climatic regions.
Additional comments and experiences

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

Further information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

Strictly, this is not a prevention study per se. We did collect data two years apart (mite growth and momentary measured indoor temperature and humidity), however, both those time sequences are AFTER retrofitting of the ventilation systems.

What we did in the second part of the study was to complete the information of exposure with “long term” (two weeks) measurements of indoor ventilation, humidity and temperature as well as chemical measurements (VOC; tenax) to receive objective data on the impact of various ventilation systems on indoor exposures.

In this, we used the homes having the original naturally ventilation system as a control group for the group of houses having a new installed mechanical ventilation system.

Except for the ventilation systems, all hoses had a similar design, and were located within a small geographic area.

All hoses were originally constructed with a natural ventilation system, thereafter some of the houses had been retrofitted and a mechanically ventilation system installed, primarily with the aim of lowering indoor Radon exposure (however not measured in our study).
Review of interventions implemented in member states to address health hazards associated with dampness, mould and inadequate ventilation

Case study 17

Contacts / study coordinator

Please provide contact details for the person in charge of the study.

Name: Ian Matthews  
Title: Professor  
Organization: Dept Primary Care and Public Health, Cardiff University  
Email: matthewsip@cf.ac.uk

Intervention title

The effects of mould eradication from homes of asthmatics – a randomised controlled trial.

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

To remove visible mould and reduce humidity levels through improved ventilation and to study the effects these procedures have on asthma symptoms.

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What where the results expected?

To measure peak expiratory flow rate (PEFR) and asthma symptoms. No specific targets were set for humidity reductions as this was a preliminary study to assess the efficacy of our methodology.
**Target population groups**

2. Please specify the targeted population groups:

**Whole population**

( )

**Specific age groups:** Please add notes / comments behind parentheses if required

- Older people ( )
- Adults ( X )
- Adolescents ( X )
- Children ( X )

**Specific target groups:** Please add notes / comments behind parentheses if required

- Women ( )
- Disabled people ( )
- Other ( X ) (please specify:) Asthma sufferers

**Target buildings**

3. Which buildings are targeted by the intervention/initiative?

**Residential buildings** ( X )

**Schools** ( )

**Child centres** ( )

**Elderly centres** ( )

**Other** ( ) (please specify:)

**Geographical scale**

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)? Please inform about the geographical scale/administrative scope/region.

The intervention targeted the region of south east Wales including the City of Cardiff. Approximately 40km x 60km (25miles x 35miles).

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

The study targeted asthmatics in all settings within the region of south Wales. This included city, rural and urban dwellings covering all socioeconomic backgrounds. The participants were identified through patient asthma registers of General Practitioners.
Study size

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

Please add notes / comments if required

Dwellings: 81 Intervention homes, 83 Control homes
Schools:
Day centres:

Persons: 115 Intervention participants (44 males, 71 females), 117 Control participants (49 males, 68 females).

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

Homes were randomised through serially numbered and sealed envelopes which were stratified by built form (detached and semi-detached, terraced houses and flats).

Target indicators of indoor environmental quality

6. What are the pollutants or factors that were targeted by the intervention/initiative?

Relative humidity ( X )
Damp / moisture in building structure ( X )
Dampness entering from outside ( )
Mould in / on building structures ( X )
Air exchange rate ( X )
Thermal performance of building (insulation / heating) ( )
Building materials themselves ( )

Please add to this list all other factors the intervention/initiative did target:

Room temperatures, house dust mites, ergosterol in air samples (= indoor mould sampling) and outdoor mould sampling.
We believed that some of the moulds were only growing in an indoor situation, so we identified both moulds indoors and outdoors and compared them. Penicillium was the most abundant fungi indoors and Cladosporium was the most abundant outdoors. There were some varieties that only grew in one of the environments but the four most common moulds were found in both (Aspergillus, Penicillium, Alternaria and Cladosporium). We also wanted to compare those patients who had allergy to moulds and pollens so we needed to know when these organic materials were abundant outdoors.
Specific actions

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative? Please describe shortly.

The moulds were present on most window frames to some degree but most occurred in cold rooms on walls and ceilings isolated from ventilation. Corners of rooms both high (ceiling) and low were common areas of growth. Outside walls, i.e. the building envelope, including attic rooms were also dominant areas of growth. Significant areas of mould were found in single storey flats and bungalows, again probably indicative of minimal ventilation. We compared our study with a postal study of 55,000 homes run by the Welsh School of Architecture here at Cardiff University and found a very close correlation. We compared built form and the number of storeys and found that 23% of single storey dwellings had mould, 14% of two storey and 33% of three storey, indicating the positive benefits of the stack effect (heat rises and is replaced by colder air thus providing some natural ventilation. The high value of 3 storey homes can be explained through the contact of moist warm air from the lower floors with cold, uninsulated surfaces in the attic rooms resulting in condensation forming and later moulds. These findings have not been published.

Mould removal: We did not want to disturb the moulds and introduce them to the air so we used a three part aqueous system; the first surface treatment consisted of an aqueous solution of sodium dichlorophen plus detergent wash to eliminate the surface moulds. After drying this was followed by an aqueous solution of Dialkyl dimethylammonium chloride plus polymer emulsions to penetrate the substrate and kill the roots. Finally a liquid fungicide was left with the participants to add to paint or wallpaper paste to minimise any future regrowth.

Installation of a positive input ventilation (PIV) unit in the attic or kitchen and bathroom exhaust units if deemed necessary.

Water vapour in outdoor air can vary from lows around 1g/kg to highs of 15g/kg (that is 1 gram of water vapour per kg of dry air). These values are much lower than those found indoors due to occupant activities including bathing, cooking and washing which add considerable moisture to the occupied interior space. (It has been difficult to persuade some people that when it is pouring rain outdoors that the actual moisture content of the air is still much lower than that indoors.) It is the warm moist air that helps the moulds grow. It was our belief that we could reduce the indoor moisture content by introducing fresh, filtered air from the outdoors on a continuous basis to the interior of the homes because the moisture content outdoors is lower. A positive input ventilation (PIV) unit has a small fan which pulls outdoor air through a filter and emits it into the hall or kitchen space. It is inexpensive to run (~£4/yr) much more effective than an extraction fan at lowering the whole house moisture content although extraction fans are useful in confined areas of high moisture content (bathrooms and kitchens). This method works best on homes that have open windows, doors or vents or functioning chimneys and/or older properties that have a somewhat leaky build.

Funding, costs and project context

8a. What was the project budget?

£220,000

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

The PIVs cost ~£250 each including installation. Each mould eradication kit cost £20.
8c. What were the sources of funding?

*Please add notes / comments behind parentheses if required*

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Notes</th>
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<tbody>
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<td>City / municipal</td>
<td>(   )</td>
</tr>
<tr>
<td>National / federal</td>
<td>( X ) Medical Research Council and the Wales Office of Research and Development (WORD)</td>
</tr>
<tr>
<td>EC project</td>
<td>(   )</td>
</tr>
<tr>
<td>Other</td>
<td>(   ) (please specify:)</td>
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</table>

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

<table>
<thead>
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<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>Yes</td>
<td>(   ) Program name:</td>
</tr>
<tr>
<td>No</td>
<td>( X )</td>
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</tbody>
</table>

**Coordinator and collaborators**

9a. Which institution/organization etc. coordinated the intervention/initiative?

<table>
<thead>
<tr>
<th>Institution/organization</th>
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<tbody>
<tr>
<td>College of Medicine, Cardiff University</td>
</tr>
</tbody>
</table>

9b. Which were the collaborators?

<table>
<thead>
<tr>
<th>Collaborators</th>
</tr>
</thead>
<tbody>
<tr>
<td>General practitioners in south Wales, Neath and Port Talbot County Borough Council as part of the Housing and Neighbourhoods and Health project (HANAH).</td>
</tr>
</tbody>
</table>
**Results**

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

PEFR variability declined in both groups, with no significant differences between them. Both groups were measured between 4 and 6 weeks after intervention then again at 6 months and 12 months from the first visit date.

The intervention and control groups were compared and indicated improvement in wheeze, rhinitis and rhinoconjunctivitis and a reduction in medication use within the intervention group. There was a small but significant reduction in atmospheric humidity.

10b. Were the objectives (as provided in 1b) reached?

PEFR showed no significant change between the groups.

Humidity levels were reduced in the intervention homes but we had anticipated a greater reduction than we observed.

10c. What kind of communication activities to disseminate the results and findings have been taken?

*Please add notes / comments behind parentheses if required*

- Media (TV, radio, newspaper) (X)
- Public meetings / fora ( )
- Internet / web sites ( )
- Scientific publications (X)
- Other (X) (please specify:) conference presentations

**Evaluation**

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

At 6 months, significantly more of the intervention group showed a net improvement in wheeze affecting activities (a difference of 25% between groups, 95% CI: 3, 47; p=0.028), perceived improvement of breathing (52%, 95% CI: 30, 74; p<0.0001) and perceived reduction in medication use (59%, 95% CI: 35, 81; p<0.0001). By 12 months the intervention group showed significantly greater reductions than the control group in preventer and reliever use, and more improvement for rhinitis (24%, 95% CI: 9, 39; p=0.001) and rhinoconjunctivitis (20%, 95% CI: 5, 36; p=0.009).

At 12 months from baseline the median RH, standardised to external conditions of 5°C and 80% RH, had increased by 1.1% in the control homes and decreased by 4.6% in the intervention homes for the same internal temperature, an overall difference of ~6%.

11b. What were the main evaluation findings?

There is a beneficial effect of eradicating moulds from homes.
Recommendations for policy formulation

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

Many participants admitted to having condensation but actually they had mould. Local council employees had told some of the participants that the black surface substance was not mould and they had nothing to worry about. Education then, is important with photos and detailed explanations and descriptions. People were embarrassed to admit they have mouldy surfaces which may have hindered us finding more participants.

Diaries of the participants’ daily medication use including bronchodilators, and FEV1 or FEVR could be very useful. The PEFR did not show any changes in either group. Teenagers were poor at keeping records. Digital diaries and measuring units that can record or transfer data without an in-home visit or other novel measuring devices may be helpful.

Such a study requires participant numbers in the several hundreds to thousands to show some significance, especially if taking measurements within many house types and builds.

RAST tests and allergy testing would be helpful.

B-D-glucans may be a better biomarker of the quantities of mould than the ergosterol was.

There is some benefit to installing PIVs. Moulds did return in 40% of the intervention homes but not in the areas that had been treated and in much smaller quantities. Many times this occurred behind or on furniture as well as in lower corners of walls and ceilings where ventilation is limited.

High quality quiet fans in bathrooms would be very beneficial as many participants did not use them or had them disconnected because they perceived they were losing a lot of heat from the units or they were too noisy.

Many home owners again never opened any windows during the winter months for fear of it costing too much in heating loses. They would benefit from whole home ventilation.

We removed mould and installed PIV units simultaneously so we could not say which intervention was helpful or whether both were.

There is no standardised system of recording humidity, which needs to be addressed. Many authors use differing names to describe the humidity (Humidity Ratio, Moisture Content, Mixing Ratio, or Specific Humidity) which are actually similar measurements (dimensionless though often recorded as grams of moisture per kilogram of air). There is little use in recording Relative Humidity unless the temperatures are known as the RH values can vary wildly with temperature. Use of a psychrometric chart is worth considering.

Low temperatures in the homes (fuel poverty) may have exacerbated the condensation conditions of the homes. Records of temperature and humidity need to be recorded in many rooms and on different floors to get a good picture of the house conditions (including living room, kitchen, bathroom and bedrooms).

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

Yes. Built form needs considering as well as the climatic variability of the areas being investigated. Regions with cold, dry winters can have a significant effect on knocking back moulds which may have started growing during the damper summer months.
**Additional comments and experiences**

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

Different forms of heating and ventilation need promoting especially if the system is not familiar to the local population or building trades. Education and marketing are needed to introduce the ideas to a population. Insulation both internal, external and roof forms need considering in addition to ventilation; a fairly inexpensive option, it would have considerable benefit in some areas. Support from local councils could be helpful with adequate education. These local employees bring considerable local knowledge to any project. There is some benefit to installing PIVs though full house and/or heated systems could be more effective. Solar input ventilation as well as air and water heat pump systems are worth considering.

**Further information**

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.


Other papers pending.
Review of interventions implemented in member states to address health hazards associated with dampness, mould and inadequate ventilation

Case study 19

Contacts / study coordinator

Please provide contact details for the person in charge of the study.

Name: Matthias Braubach
Title: Technical Officer
Organization: WHO
Email: mbr@eccebonn.euro.who.int

Intervention title

| Intervention study of housing rehabilitation / thermal insulation in multi-family apartment blocks |

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

Main objective was to assess the impact of thermal insulation changes on the indoor environments, and then, to the extent possible, evaluate the effects on residents’ health.

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)?

No quantitative targets were set. The study was a natural experiment, monitoring the effects of housing interventions undertaken by a housing agency. Therefore, no control on the interventions was exerted and thus no targets could be set.
Target population groups

2. Please specify the targeted population groups:

Whole population  ( x )

Specific age groups:  Please add notes / comments behind parentheses if required

Older people  ( )
Adults  ( )
Adolescents  ( )
Children  ( )

Specific target groups:  Please add notes / comments behind parentheses if required

Women  ( )
Disabled people  ( )
Other  ( ) (please specify:)

Target buildings

3. Which buildings are targeted by the intervention/initiative?

Residential buildings  ( x )
Schools  ( )
Child centres  ( )
Elderly centres  ( )
Other  ( ) (please specify:)

Geographical scale

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)? Please inform about the geographical scale/administrative scope/region.

Municipal level - city of Frankfurt, various locations throughout the city

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

Urban areas, but in different neighbourhoods
Study size

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

*Please add notes / comments if required*

Dwellings: 374 (Intervention group: 212 dwellings; Control group: 162 dwellings)
Schools:
Day centres:

Persons: 610 (Intervention group: 355 persons; Control group: 255 persons)

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

<table>
<thead>
<tr>
<th>The selection was done in a rather pragmatic way and considered:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Buildings being renovated in summer/ fall 2006 for the intervention group</td>
</tr>
<tr>
<td>2) Buildings not planned for renovation before 2009 for the control group</td>
</tr>
<tr>
<td>3) Buildings had to be spatially accessible and close, i.e. there had to be clusters of renovation sites so that the field survey was logistically feasible (we ended up with four main areas)</td>
</tr>
<tr>
<td>4) Control buildings had to be comparable with intervention buildings, as much as possible from the same neighbourhood / same construction year</td>
</tr>
</tbody>
</table>

The requirements lead to a reduced sample, as quite a few of the buildings that were to be rehabilitated did not match the requirements or were of specific nature so that numbers would be too little or no matching control buildings were found.

Target indicators of indoor environmental quality

6. What are the pollutants or factors that were targeted by the intervention/initiative?

<table>
<thead>
<tr>
<th>Relative humidity</th>
<th>( x ) indirectly (monitoring)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damp / moisture in building structure</td>
<td>( x ) indirectly (monitoring)</td>
</tr>
<tr>
<td>Dampness entering from outside</td>
<td>( )</td>
</tr>
<tr>
<td>Mould in / on building structures</td>
<td>( x ) indirectly (monitoring)</td>
</tr>
<tr>
<td>Air exchange rate</td>
<td>( x ) indirectly (monitoring)</td>
</tr>
<tr>
<td>Thermal performance of building (insulation / heating)</td>
<td>( x ) objective of rehabilitation</td>
</tr>
<tr>
<td>Building materials themselves</td>
<td>( )</td>
</tr>
</tbody>
</table>

Please add to this list all other factors the intervention/initiative did target:

Although the renovations did not directly aim to improve specific conditions, the monitoring project covered a variety of housing conditions such as noise, pests, temperature, sanitation, safety, etc.
Specific actions

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative? Please describe shortly.

The housing agency carried out a large-scale rehabilitation that had as a main component the improvement of thermal insulation, but also targeted general building improvements.

For thermal insulation and thermal comfort, actions included:

1) Thermal insulation of facades, building roof and ceiling of basement;
2) Replacement of single-glazed with double-glazed insulation windows (if not yet recently done);
3) Exchange of dwelling doors to the staircase;
4) Exchange of heating system in some dwellings

<table>
<thead>
<tr>
<th>Type of Intervention</th>
<th>Intervention group (56% of surveyed dwellings)</th>
<th>Control group* (44% of surveyed dwellings)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New windows in all rooms</td>
<td>29%</td>
<td>1.9%</td>
</tr>
<tr>
<td>New windows in some rooms</td>
<td>33.6%</td>
<td>3.8%</td>
</tr>
<tr>
<td>Change of heating system</td>
<td>32.1%</td>
<td>1%</td>
</tr>
<tr>
<td>Insulation of façade</td>
<td>86.3%</td>
<td>0%</td>
</tr>
<tr>
<td>Insulation of floor</td>
<td>64.9%**</td>
<td>0%</td>
</tr>
<tr>
<td>Insulation of basement ceiling</td>
<td>51.9%**</td>
<td>0%</td>
</tr>
<tr>
<td>New dwelling door</td>
<td>18.3%</td>
<td>0%</td>
</tr>
</tbody>
</table>

*In some dwellings, the housing company did necessary changes and renovations works if obsolete dwelling elements (such as windows etc.) had to be repaired or exchanged.

**These results are affected by various households in the same house reporting that their building roof or basement ceiling was repaired. In total, only 19.7% of all surveyed dwellings are located right under the roof.

Other work included:
- painting of staircase;
- exchange of water and electricity systems;
- building refurbishment (kitchen, bathroom)
- improvement of surrounding spaces;
- installation of intercom systems
- etc.
**Funding, costs and project context**

8a. What was the project budget?

No information

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

No information

8c. What were the sources of funding?

Please add notes / comments behind parentheses if required

- Private / sponsors (   )
- City / municipal ( x ) the housing agency is carried by the city of Frankfurt and carried all costs for rehabilitation as well as monitoring.
- National / federal (   )
- EC project (   )
- Other (   ) (please specify:)

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

Yes (   ) Program name:

No ( x )

**Coordinator and collaborators**

9a. Which institution/organization etc. coordinated the intervention/initiative?

ABG housing agency Frankfurt

9b. Which were the collaborators?

None.
The monitoring project was carried out by the WHO Housing programme on behalf of the ABG. VOC and house dust / NO measurements were sponsored by external agencies as part of the monitoring.
### Results

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

The main results indicate that the residents of intervention dwellings report better thermal comfort. Data shows that indoor temperatures were higher in intervention dwellings, and relative humidity was slightly reduced compared to control dwellings.

For visible mould growth, very little change was found. However, this may be normal as the follow-up study in spring 2007 was just held a few months after the intervention and the winter 2006/2007 was relatively warm.

For health effects, there is little change for health perception (although it improves for intervention dwellings residents and deteriorates for control dwelling residents). For several disease (asthma, cold, bronchitis), the prevalence increased for residents of control dwellings while there was no change or a slight decrease for intervention dwelling residents. Stronger results were found for the number of acute respiratory diseases during the last 3 months (i.e. the winter time), which clearly increased for the control dwelling residents and decreased for intervention dwelling residents.

NB – all health data is indicative only due to the small sample size

<table>
<thead>
<tr>
<th>10b. Were the objectives (as provided in 1b) reached?</th>
</tr>
</thead>
</table>

| 10c. What kind of communication activities to disseminate the results and findings have been taken? |

Please add notes / comments behind parentheses if required

- Media (TV, radio, newspaper) (   )
- Public meetings / fora ( x ) done for 2006, 2007 results to come
- Internet / web sites ( x ) final report to be published
- Scientific publications ( x ) to come
- Other (   ) (please specify:)
Evaluation

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

The monitoring project covered the measurement of

- Peak Flow
- NO in exhaled air
- Prevalence of selected diseases
- Data on indoor °C and relative humidity for 189 dwellings
- Dust samples for 102 dwellings
- VOC measurements for 22 dwellings
- Measurement of inside and outside wall temperature and humidity for bedrooms and living rooms for all dwellings

11b. What were the main evaluation findings?

See last pages of the template for a selection of results.

Recommendations for policy formulation

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

Based on the results it seems that thermal insulation (or: increased thermal comfort in general, including reduced temperature differences in building structures as well) has a supportive impact on damp, condensation and mould due to the increase of temperature and the reduction of humidity and condensation.

However, this result is an average of all cases. Increases of humidity have also been found in intervention and/or warmer dwellings, indicating that residential behaviour is the decisive aspect while building variables provide the overall framework.

The hypothesis that tighter dwellings accumulate moisture and thus are more mould-prone could not be confirmed in this study. However, any housing rehabilitation project including thermal insulation needs to strongly consider the impact of reduced ventilation on indoor conditions and identify adequate solutions.

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

In fact, thermal insulation projects are being implemented in all countries with large-scale projects already. It is a priority in the building sector. From health perspective, extremely little evidence on the positive or negative impacts are available. Health actors need to be more aware of the relevance of these process on indoor conditions.
**Additional comments and experiences**

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

<table>
<thead>
<tr>
<th>Additional comments and experiences</th>
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**Further information**

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

<table>
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<tr>
<th>Further information</th>
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<tbody>
<tr>
<td>The report of the follow-up study after building interventions is currently being finalized.</td>
</tr>
</tbody>
</table>
Selection of results

*Extracted from:*
Braubach, Heinen and Dame (2008): Preliminary results of the WHO Frankfurt housing intervention project.
WHO Regional Office for Europe, Copenhagen.

Median Temperature 2006/2007  

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention group</td>
<td>20.62</td>
<td>21.47</td>
<td>0.85</td>
</tr>
<tr>
<td>Control group</td>
<td>20.9</td>
<td>21.19</td>
<td>0.29</td>
</tr>
<tr>
<td>Difference</td>
<td>0.28</td>
<td>-0.28</td>
<td></td>
</tr>
</tbody>
</table>

Change of median indoor temperature between 2006 and 2007  

Median Relative Humidity levels, 2006/2007  

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>Difference</th>
</tr>
</thead>
</table>
**Change of median relative humidity**

<table>
<thead>
<tr>
<th></th>
<th>Intervention group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention group</td>
<td>34.56%</td>
<td>33.84%</td>
</tr>
<tr>
<td>Control group</td>
<td>40.70%</td>
<td>41.18%</td>
</tr>
<tr>
<td>Difference</td>
<td>-0.72%</td>
<td>0.48%</td>
</tr>
</tbody>
</table>

**Change of mould occurrence**

- **n=234**

<table>
<thead>
<tr>
<th></th>
<th>Intervention group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease of mould</td>
<td>16.7%</td>
<td>8.3%</td>
</tr>
<tr>
<td>No change</td>
<td>83.3%</td>
<td>83.3%</td>
</tr>
<tr>
<td>Increase of mould</td>
<td>0.0%</td>
<td>8.3%</td>
</tr>
</tbody>
</table>

**Relation of change of median Relative Humidity and mould**

<table>
<thead>
<tr>
<th></th>
<th>Decrease of RH</th>
<th>Increase of RH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease of mould</td>
<td>No change</td>
<td>Increase of mould</td>
</tr>
<tr>
<td>Intervention group (n=24)</td>
<td>16.7%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Control group (n=12)</td>
<td>8.3%</td>
<td>8.3%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Decrease of RH</th>
<th>Increase of RH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease of mould</td>
<td>No change</td>
<td>Increase of mould</td>
</tr>
<tr>
<td>Intervention group (n=48)</td>
<td>6.3%</td>
<td>12.5%</td>
</tr>
<tr>
<td>Control group (n=39)</td>
<td>10.3%</td>
<td>2.6%</td>
</tr>
</tbody>
</table>
Change of temperature of inside and outside facing walls in bedrooms and living rooms, in °C

<table>
<thead>
<tr>
<th></th>
<th>Living room walls</th>
<th>Bedroom walls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>inside</td>
<td>outside</td>
</tr>
<tr>
<td>2006 Intervention</td>
<td>19</td>
<td>16.55</td>
</tr>
<tr>
<td>2007 Intervention</td>
<td>19.8</td>
<td>18.8</td>
</tr>
<tr>
<td>Difference</td>
<td>0.8</td>
<td>2.25</td>
</tr>
<tr>
<td>2006 Control</td>
<td>19.5</td>
<td>17.3</td>
</tr>
<tr>
<td>2007 Control</td>
<td>19.3</td>
<td>17.3</td>
</tr>
<tr>
<td>Difference</td>
<td>-0.2</td>
<td>0</td>
</tr>
</tbody>
</table>

Increase by insulation

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2.25</td>
<td>1.55</td>
</tr>
<tr>
<td></td>
<td>2.35</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Temperature measured on the inside of these walls, measurement data given are means of the minimum temperatures identified for respective wall)

Change of health perception in 2007

![Change of health perception in 2007](image)

Decrease and increase of diseases after the housing interventions

<table>
<thead>
<tr>
<th></th>
<th>Occurrence of cold</th>
<th>Occurrence of asthma</th>
<th>Occurrence of acute bronchitis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Decrease</td>
<td>Increase</td>
<td>Decrease</td>
</tr>
<tr>
<td>Intervention group</td>
<td>20,0%</td>
<td>18,6%</td>
<td>3,6%</td>
</tr>
<tr>
<td>(n=220)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td>11,6%</td>
<td>16,1%</td>
<td>1,3%</td>
</tr>
<tr>
<td>(n=155)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Case study 20

Contacts / study coordinator

Please provide contact details for the person in charge of the study.

Name: Denis CHARPIN
Title: Head of the pneumonology & allergy department, Marseille University, France
Organisations: Assistance publique- Hôpitaux de Marseille- Faculté de Médecine
Email: denis-andre.charpin@ap-hm.fr

Intervention title

Housing & health counselling: Preliminary results of a new medical referral system in France

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

Allergen and irritant avoidance is a first line recommendation in the management of respiratory allergic diseases. Because it is difficult or disturbing to implement, we have set up a housing environmental service providing advices to family following an indoor environmental assessment.

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What where the results expected?

We aimed at evaluating changes in housing conditions following professional identification of housing-related health hazards. It did not consider the medical impact of such changes but indicated what type of action is taken or not taken by private residents to follow up on recommendations on home interventions, based on housing inspections initiated by medical diagnosis.
Target population groups

2. Please specify the targeted population groups:

Whole population ( ) Intervention was not targeted on human health

Specific age groups: Please add notes / comments behind parentheses if required
- Older people ( )
- Adults ( )
- Adolescents ( )
- Children ( )

Specific target groups: Please add notes / comments behind parentheses if required
- Women ( )
- Disabled people ( )
- Other ( ) (please specify:)

Target buildings

3. Which buildings are targeted by the intervention/initiative?

Residential buildings ( x )
- Schools ( )
- Child centres ( )
- Elderly centres ( )
- Other ( ) (please specify:)

Geographical scale

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)?
Please inform about the geographical scale/administrative scope/region.

Provincial

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

The patient’s attending physician can ask for a housing environmental check-up when he (she) feels that the patient’s condition could be related to housing conditions
Study size

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

*Please add notes / comments if required*

Dwellings: 650
Schools:
Day centres:

Persons:

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

<table>
<thead>
<tr>
<th>Complaints by the doctors, or by the residents complaining to the doctor who then assumes there could be a link to the dwelling</th>
</tr>
</thead>
</table>

Target indicators of indoor environmental quality

6. What are the pollutants or factors that were targeted by the intervention/initiative?

<table>
<thead>
<tr>
<th>Relative humidity</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Damp / moisture in building structure</td>
<td>x</td>
</tr>
<tr>
<td>Dampness entering from outside</td>
<td></td>
</tr>
<tr>
<td>Mould in / on building structures</td>
<td>x</td>
</tr>
<tr>
<td>Air exchange rate</td>
<td></td>
</tr>
<tr>
<td>Thermal performance of building (insulation / heating)</td>
<td></td>
</tr>
<tr>
<td>Building materials themselves</td>
<td>x</td>
</tr>
</tbody>
</table>

Please add to this list all other factors the intervention/initiative did target:

Furniture, equipment, VOCs- also non respiratory health hazards such as domestic accidents or lead poisoning
Specific actions

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative?
   Please describe shortly.

<table>
<thead>
<tr>
<th>Questionnaire about housing conditions and identified defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>A structure house inspection.</td>
</tr>
<tr>
<td>Sampling for house-dust mite allergen semi-quantification,</td>
</tr>
<tr>
<td>mold identification, measurement of ambient and wall</td>
</tr>
<tr>
<td>temperature and relative humidity, and measurement of</td>
</tr>
<tr>
<td>indoor pollutants (VOCs)</td>
</tr>
</tbody>
</table>

(Note: in this case study, the intervention is considered the visit of the inspection team to the dwelling, the outcome of which is the implementation of recommended renovation and mitigation actions)

Funding, costs and project context

8a. What was the project budget?

   Around 200,000 euros

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

   300 euros

8c. What were the sources of funding?

   Please add notes / comments behind parentheses if required

   Private / sponsors (  )
   City / municipal ( x )
   National / federal ( x )
   EC project (  )
   Other (  ) (please specify:)

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

   Yes (  ) Program name:
   No ( x )
Coordinator and collaborators

9a. Which institution/organization etc. coordinated the intervention/initiative?
A private initiative from hospital and private physicians

9b. Which were the collaborators?
Technicians in the field of microbiology, health hazards, architecture

Results

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).
Substantial repairs, including carpentry, wall floors and ceiling repairs, mold decontamination and plumbing had been performed in 59.4% of those houses after the inspection visit.

10b. Were the objectives (as provided in 1b) reached?
Results to be confirmed by an on-site study

10c. What kind of communication activities to disseminate the results and findings have been taken?

Please add notes / comments behind parentheses if required

Media (TV, radio, newspaper) ( x )
Public meetings / fora ( x )
Internet / web sites ( x )
Scientific publications ( x )
Other ( ) (please specify:)

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Evaluation

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

Yes, by a telephone survey.

11b. What were the main evaluation findings?

Substantial repairs have been performed but there are not any data that show the effectiveness of repairs and especially of the mould removal. The service only suggest to residents to carry out mould removal but then did not control or assess the work done.

The main results are listed on the table below:

Table 2
Listing of works performed in the house following our visit (n=328 dwellings, as published in 2007)

<table>
<thead>
<tr>
<th>Works</th>
<th>Number of occurrences</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masonry</td>
<td>36</td>
<td>22.0</td>
</tr>
<tr>
<td>Ventilation (opening/creating airing-</td>
<td>26</td>
<td>15.9</td>
</tr>
<tr>
<td>mechanical ventilation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improving sanitation</td>
<td>24</td>
<td>14.6</td>
</tr>
<tr>
<td>Painting/paper-wall</td>
<td>17</td>
<td>10.4</td>
</tr>
<tr>
<td>Insulation</td>
<td>13</td>
<td>7.9</td>
</tr>
<tr>
<td>Plumbing</td>
<td>2</td>
<td>1.2</td>
</tr>
<tr>
<td>Other</td>
<td>20</td>
<td>12.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>164</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

More details can be taken from the background document published in Environmental Research, 2007

The efficacy of the environmental evaluation was assessed by the family member who rated if his (her) health status worsened, remained unchanged or improved following the changes implemented. One third of families stated that the health complain disappeared, whereas 50% said it improved. However, it is difficult to associate these findings with specific renovation work undertaken so this data cannot serve as a direct evaluation of individual interventions, and only indicates the general health relevance of renovation and repair work.
**Recommendations for policy formulation**

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

| The intervention need to be targeted on several health hazards. Thus the staff has to get an overall assessment of indoor health hazards. It would be nice to perform the assessment and remediation of health hazards through the same team and at the same time. If appropriate, we asked why repairs suggested were not performed. The answered given were: problem disappeared (7.1%), moving (14.1%), no available time (15.7%), no available money (7.1%), advice given not convincing (15.8%), change too difficult to perform (7.1%), lack of care (4%), other reasons (17.3%) and did not remember (7.8%). These pragmatic barriers to home improvement need to be considered in policy-making. |

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

| This initiative can be transferred to other cities, provided the service is funded and the physicians and the public are repeatedly advised about it. Another strategy is to have compulsory indoor hazards identification when selling or renting a flat or a house, paid by the owner. |

**Additional comments and experiences**

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

| A cost-benefit analysis of this intervention should be performed. |

**Further information**

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

Case study 21

Contacts / study coordinator
Please provide contact details for the person in charge of the study.

Name: BLADT Sandrine
Title: Coordinator CRIPI
Organization: Brussels Environment – BIME (Brussels Institute for the Management of the Environment)
Email: sbl@ibgebim.be

Intervention title
Green ambulance in the Brussels-Capital Region

The Green ambulance is called upon medical prescription in order to provide an environmental diagnosis of a dwelling where the physician suspects that the health problems are related to indoor exposure (moulds and other biological factors, chemicals pollutants, ...). The Green ambulance collects samples systematically in all the rooms and searches for pollutants (biological and chemical). It gives advises to improve the indoor quality of the dwelling. Based on the results a report is sent to the physician, advices are given to the patient and 12-18 months later the health improvement is assessed.

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

Identification of Indoor Air Pollutants (biological and chemical) in order to provide advises to reduce related health symptoms. The overall objectives are to reduce health problems linked to indoor exposure. Mould and dampness are one of the major problems in Brussels housing. The objective is to provide an environmental diagnosis in support of the medical diagnosis and further on prevent unhealthy situations in residential buildings. The given advises rank from natural ventilation and ventilation rates, cleaning of the moulds patches, to close access to a contaminated room.
1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What were the results expected?

The general target is the health improvement of the Brussels inhabitants. We provide 150 enquiries per year in support of medical prescription. The service exists since 2000 and more than 700 visits were done up to December 2006. Dampness and moulds are observed in the majority of the dwellings. In 43% of the dwellings mould was present as spores even though no spot had been observed, in 20% of the dwelling spots are larger than 3m². The objective after the environmental diagnosis is to provide advises in order to remediate those situations and eventually improve the health of the inhabitants of those dwellings.

### Target population groups

2. Please specify the targeted population groups:

<table>
<thead>
<tr>
<th>Whole population</th>
<th>(X)</th>
<th>(all the age-groups are concerned but an analysis of the age-groups in the medical prescriptions shows a major demand for children, they account for 30% of the demands and to a lesser extent older people is a second age-group accounting for 12% of the demands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific age groups:</td>
<td></td>
<td>Please add notes / comments behind parentheses if required</td>
</tr>
<tr>
<td>Older people</td>
<td>(X)</td>
<td>(12% of the interventions aim for patients older than 65)</td>
</tr>
<tr>
<td>Adults</td>
<td>(X)</td>
<td></td>
</tr>
<tr>
<td>Adolescents</td>
<td>(X)</td>
<td></td>
</tr>
<tr>
<td>Children</td>
<td>(X)</td>
<td>(30% of the interventions are for children under 6 years old, upon that result we have extended the area of environmental diagnosis to nurseries and day-care centres. The project is still in a pilot phase but it follows the same principles)</td>
</tr>
<tr>
<td>Specific target groups:</td>
<td></td>
<td>Please add notes / comments behind parentheses if required</td>
</tr>
<tr>
<td>Women</td>
<td>( )</td>
<td></td>
</tr>
<tr>
<td>Disabled people</td>
<td>( )</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>(X)</td>
<td>(please specify: the service is only accessible with a medical request, therefore only with persons with health problems)</td>
</tr>
</tbody>
</table>
Target buildings

3. Which buildings are targeted by the intervention/initiative?

Please add notes / comments behind parentheses if required

- Residential buildings (X)
- Schools ( )
- Child centres (X) (since 2006: pilot project on indoor air quality in the child centres on a voluntary basis – 10 child centres have been studied in 2006-2007, the protocol includes dampness and moulds, chemical pollutants and extends to hygiene of soil and surfaces)
- Elderly centres ( )
- Other ( ) (please specify:)

Geographical scale

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)? Please inform about the geographical scale/administrative scope/region.

The Green Ambulance is a Regional initiative (Ministry of Environment) and its intervention is limited to the Brussels-Capital Region territory.

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

We cover the 19 local authorities of the Brussels Region, therefore essentially urban situation.


**Study size**

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

*Please add notes / comments if required*

- **Dwellings:** +/- 150/year
- **Schools:**
- **Day centres:** since 2006 10 day care centres
- **Persons:** 1 unhealthy person/dwelling, therefore +/- 150 / year

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

The selection of the dwellings is the result of the mechanism for the intervention of the Green ambulance. It requests a medical prescription. In conclusions, the analysed dwellings correspond to dwellings where lives a person with health problems whose doctor suspects that the indoor environment is a source for its/hers health problems.

**Target indicators of indoor environmental quality**

6. What are the pollutants or factors that were targeted by the intervention/initiative?

- Relative humidity
- Damp / moisture in building structure
- Dampness entering from outside
- Mould in / on building structures
- Air exchange rate
- Thermal performance of building (insulation / heating)
- Building materials themselves

Please add to this list all other factors the intervention/initiative did target:

- Chemical compounds (VOCs – Formaldehyde – pesticides - PM) in the air
- Lead in paints
- House dust mites in mattress
### Specific actions

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative? Please describe shortly.

In function of the results of analysis, recommendations in terms of behaviour and cleaning are given to the occupant. Specific actions at the level of ventilation and conception of the building should emerge from the global results obtained.

The various actions recommended include advises on how to ventilate, behaviour linked to cooking, cleaning and washing activities; correct use of heating and ventilation systems and the identification of problems related to the building and its conception. The most often given advices concern ventilation and opening of windows to remove the humidity from the indoor air.

When the patient's health improvement is assessed 12 to 18 months later, questions are asked on which advices were implemented and which have not been. Concerning the later, further questions are asked to know reasons. The situation is often due to the status of the patient (renter and not owner), conflicts with the owner who does not want to solve or fix the problems (leakages, roof, windows that cannot be opened) or eventually financial reasons. Health is an important enough reason to act either completely or not at all. Health improvement is assessed by the physician who often when the health is improved does not see the patient until another problem appears. The assessment given by the patient on its/her health improvement cannot be evaluated, it is improved a lot, somehow or not. Degree's of compliance are not integrated, it is compliance or not compliance.
Funding, costs and project context

8a. What was the project budget?
+/- 80000€ / year (cost in personal, sampling and analysis in laboratory)

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?
Around 500€ for chemical and biological sampling and analysis per dwelling

8c. What were the sources of funding?

Please add notes / comments behind parentheses if required

Private / sponsors (   )
City / municipal (   )
National / federal (   )
EC project (   )
Other (X) (please specify: Regional: Brussels Region – environment)

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?
Yes (   ) Program name:
No (X) (it is a regional program focusing on indoor pollution including scientific and technical knowledge, intervention in dwellings under medical prescription, call centre and home visits for anxious inhabitants, tools for professionals and information for the population)

Coordinator and collaborators

9a. Which institution/organization etc. coordinated the intervention/initiative?
Brussels Environment – BIME: Brussels institute for the management of the environment (the Brussels regional administration for environment)

9b. Which were the collaborators?
Institute of Public Health (section of Mycology) and FARES (Fonds des Affections Respiratoires)
Results

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

An evaluation of the health improvement done 12-18 months after advises had been received shows that 57% of the physicians declare a real improvement of their patient’s health. The same evaluation give a more positive picture form the inhabitants, 80 % of the patients feel an improvement of their health (net or light). Some of them moved and saw them symptoms disappearing. Others stay in the same situation and no improvement is perceptible. In several cases the given advises had not been implemented by the inhabitants (30% of the enquiries).

Mould is a problem in many dwellings. In 43%, spores were identified in air samples but there was no stain. In 20% the observed stains were larger than 3m². After identification and upon the given advises to remove the stains (washing stains) and prevent their coming-back (ventilation and fixing leakages), symptoms had disappeared and health had improved within 12 to 18 months. The success rate depends on the compliance to the advice.

10b. Were the objectives (as provided in 1b) reached?

Yes in the majority of the cases

10c. What kind of communication activities to disseminate the results and findings have been taken?

Please add notes / comments behind parentheses if required

- Media (TV, radio, newspaper) (   )
- Public meetings / fora (   )
- Internet / web sites (X)
- Scientific publications (X) (scientific meetings and posters mainly)
- Other (X) (please specify: specific meetings of health professionals, training and long-life learning sessions)
Evaluation

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

A questionnaire is sent to every patient and every doctor to evaluate the health improvement of the patient. At the same time an evaluation of the service is made. It raises the question of adequacy to their demands and efficiency.

11b. What were the main evaluation findings?

The service is declared useful for the medical diagnosis and it complement medical remediation. Some difficulties are shown in the implementation of the given recommendations (costs of the cleaning and purification, change of behaviour is difficult, problems between renter and owner, ...). There is a need for more social support in a healthy housing.

Recommendations for policy formulation

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

It is difficult to make change the habits of people in a short time, but small advice which patient can easily operate can already help.

The lessons learned are of 3 aspects (behaviour in housing, ventilation and building conception). The aspects linked to behaviour require human energy and only small reachable advises have been proven accessible. We have a study undergoing on how to accompany changes in behaviour about a healthy housing.

The aspect linked to ventilation is very important. The coming regulations on energy performances and rational use of energy should benefit from experiences such as a Green ambulance and should integrate health as an overall objective.

The aspect linked to building conception should benefit also from the observations made by the Green ambulance and integrate objectives on health in their regulations and actions.

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

Yes

One would need a laboratory structure to analyse moulds, other biological pollutants and chemical pollutants
One would need to develop a collaboration with a social structure
The lack of knowledge on indoor environment and health by medical professionals is a constraint to overcome
Additional comments and experiences

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

Further information on demand – please contact project coordinator by phone or mail

Further information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

The results of this project could be consulted on the website www.ibgebim.be

“Rapport sur l'Etat de l'Environnement bruxellois 2006” in French and Flemish
Case study 22

Contacts / study coordinator

Please provide contact details for the person in charge of the study.

Name: Philippa Howden-Chapman
Title: Professor
Organization: Housing and Health Research Programme, Department of Public Health, University of Otago, Wellington,
Email: philippa.howden-chapman@otago.ac.nz

Intervention title

Housing, Insulation and Health Study

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

The objective was to decrease respiratory symptoms during winter through increasing the indoor temperature in the houses during winter.

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What where the results expected?

The anticipated results were a decrease in respiratory symptoms. As part of the study we also measured temperature and RH in a subset of houses, and took dust samples to evaluate the amount of mould in an overlapping subset of the houses.
Target population groups

2. Please specify the targeted population groups:

Whole population ( X )

Specific age groups: Please add notes / comments behind parentheses if required

- Older people ( )
- Adults ( )
- Adolescents ( )
- Children ( )

Specific target groups: Please add notes / comments behind parentheses if required

- Women ( )
- Disabled people ( )
- Other ( ) (please specify:)

Target buildings

3. Which buildings are targeted by the intervention/initiative?

- Residential buildings ( X )
- Schools ( )
- Child centres ( )
- Elderly centres ( )
- Other ( ) (please specify:)

Geographical scale

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)? Please inform about the geographical scale/administrative scope/region.

It was a national study, conducted in 7 regional settings. The settings were both rural and urban and covered a considerable North/South range. The rural settings had a variety of subclimates and some covered considerable areas.

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

see above
Study size

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

Please add notes / comments if required

Dwellings: 1400 with approximately 5000 residents
Schools:
Day centres:

Persons:

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

Dwellings had to have minimal or no ceiling insulation, and access to the ceiling space. Residents of the dwellings had to expect to stay for 2 years, and have report having had a respiratory illness the previous winter. Recruitment was through community organisation and by application.

Target indicators of indoor environmental quality

6. What are the pollutants or factors that were targeted by the intervention/initiative?

Relative humidity (X)
Damp / moisture in building structure ( )
Dampness entering from outside ( X )
Mould in / on building structures ( X ) through dust sampling
Air exchange rate ( )
Thermal performance of building (insulation / heating) ( X )
Building materials themselves ( )

Please add to this list all other factors the intervention/initiative did target:
The primary target was the thermal performance. Measurement included mould, temperature and humidity on a subset of dwellings.
Specific actions

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative? Please describe shortly.

Ceiling insulation in the dwellings. Draught stopping around doors and windows (if appropriate). Underfloor insulation (if appropriate and the underfloor could be reached safely), underfloor polythene to reduce rising damp.

Facade/wall insulation was not done. It wasn’t done because it isn’t part of the standard retrofit package, and it’s probably not part of that due to both the cost/time and the difficulty of auditing if it has been done satisfactorily.

Funding, costs and project context

8a. What was the project budget?

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

8c. What were the sources of funding?

Please add notes / comments behind parentheses if required

Private / sponsors (X) solid energy, MARIA, ORION
City / municipal (X) Hutt Mana Energy Trust (now Hutt Mana Charitable Trust), Environment Canterbury, Christchurch City Council, Eastern Bay Energy Trust,
National / federal (X) Health Research Council, Ministry of Health, Housing New Zealand, Energy Efficiency Conservation Authority,
EC project ( )
Other ( ) (please specify:)

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

Yes ( ) Program name:
No ( )

The initiative took advantage of a natural experiment (the subsidizing of retrofitting insulation into housing) that was taking place in the community, and used that funding stream but wasn’t explicitly part of the programme.
Coordinator and collaborators

9a. Which institution/organization etc. coordinated the intervention/initiative?
University of Otago, Wellington

9b. Which were the collaborators?

Results

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

A standard retrofit insulation package was associated with a small increase in bedroom winter temperatures (0.5°C) and decreased relative humidity (−2.3%) despite energy consumption in insulated houses being 81% of that in uninsulated houses, adjusted for baseline measures. The time per day in which bedroom temperatures were <10°C was reduced by 1.7 hours by insulation. These changes were associated with reduced odds in the insulated homes of fair or poor self-rated health (OR 0.50, 95% CI 0.38 to 0.68), self-reported wheezing in the last three months (OR 0.57, 0.47 to 0.70), self-reported children having had a day off school (adjusted OR 0.49, 0.31 to 0.80), and adults reporting having had a day off work (aOR 0.62, 0.46 to 0.83). GP visits were less often reported by occupants of insulated homes (aOR 0.73, 0.62 to 0.87). Hospital admissions for respiratory conditions were also reduced (aOR 0.53, 0.22 to 1.29) though not statistically significantly (p=0.16).

A secondary evaluation of the mould data suggests that dwellings that received more draft-stopping measures may have been more likely to have a greater amount of mould – but the analysis is ongoing.

10b. Were the objectives (as provided in 1b) reached?
Yes

10c. What kind of communication activities to disseminate the results and findings have been taken?

Please add notes / comments behind parentheses if required

Media (TV, radio, newspaper) (X)
Public meetings / fora (X)
Internet / web sites (X)
Scientific publications (X)
Other (X) (please specify:) conferences
**Evaluation**

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

<table>
<thead>
<tr>
<th>The whole study is an evaluation of the standard insulation measures that were being retrofitted into New Zealand homes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The study was a randomised controlled trial. After recruitment and answering questionnaires for the first winter (2001), the participants were divided into control and intervention groups (separately for each area). The intervention group was insulated over the summer of 2001/2002, and the same measurements were repeated the following winter (subsample of dwellings with temperature and RH measured; and overlapping subsample with dust samples taken at the end of winter) and questionnaires for the dwellings and their residents. The control group was then insulated over the summer of 2002/2003</td>
</tr>
</tbody>
</table>

11b. What were the main evaluation findings?

<table>
<thead>
<tr>
<th>The intervention was successful. There appeared to be a triple bottom line effect of improved health, reduced energy consumption and improved living conditions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The secondary analysis specific to the mould data dust suggest some cautions probably in relation to the air-tightness of the buildings.</td>
</tr>
</tbody>
</table>

**Recommendations for policy formulation**

12a. Please highlight some of your "key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

- Need to monitor quality of workmanship
- Need to raise a lot of money to carry out the intervention – but that brought a reward of similar magnitude
- Good benefit/cost ratio.

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

| Yes. Most of the dwellings in this study were stand-alone weatherboard houses. Regions and countries that have many apartments would face different challenges, as would those where most of the dwellings already have some form of insulation. |

**Additional comments and experiences**

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.
Further information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.


Case study 24

Contacts/Study coordinator

Please provide contact details for the person in charge of the study.

Name: Marle Kopf
Title: 
Organisation: Consumer Association North Rhine Westfalia Germany
E-mail: bielefeld.umwelt@vz-nrw.de

Title

Pilot project: Supporting solutions for mould problems. Interdisciplinary consulting and mediation service for dampness and mould in rented homes.

Objective

1a. Please give a brief description of the objective(s) of the measure/intervention (e.g., adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or dampness).

The various problems which tenants and landlords face with indoors mould lead to prolonged exposure and insufficient renovation, with definite health risks for the occupants. The assessment of dampness and mould in buildings requires a variety of experts: building conservation experts, microbiologists, lawyers, hygienists and/or environmental health professionals. There is a great need of assistance with indoor mould, especially with finding the causes of dampness in rented homes and taking proper remedial action. Regarding the effects of dampness and mould in buildings, neither landlords nor tenants are willing to take responsibility for the damage. This causes lengthy but mostly useless and unnecessary lawsuits. This project provides an interdisciplinary consulting and mediation (icm) service for settling disputes about dampness and mould in rented homes out of court.
1b. Which quantitative targets were set (e.g., reducing the number of exposed dwellings by 20%)? Which results were expected?

First, a pilot study (8-10 cases) was done to gain experience with the new service. It was expected to yield:

1. help with the mould problem;
2. identifying and eliminating the causes of dampness with as little input as possible;
3. develop a solution acceptable to both sides (landlord/tenants); and
4. quick intervention and information on how to solve the mould problem.

After evaluating the pilot study and optimising the concept, the icm service has been regularly offered in the community since 2006.

Target populations

2. Please specify the target populations:

**Entire population**  (X)

**Specific age groups:**  
- Older people ( )
- Adults ( )
- Adolescents ( )
- Children ( )

**Specific target groups:**  
- Women ( )
- Disabled people ( )
- Others (X) (please specify: landlords, tenants)

Target buildings

3. Which buildings are targeted by the measure/intervention?

**Residential buildings**  (X)
- Schools ( )
- Child centres ( )
- Centres for the elderly ( )
- Others ( ) (please specify: )
Geographical scale

4a. At which level was the measure/intervention implemented (e.g., national, provincial, municipal)? Please give the geographical scale, administrative scope or region.

The project was developed and conducted in Bielefeld, a city in North Rhine-Westphalia (northern Germany) with 330,000 inhabitants.

4b. What is the specific setting of the measure/intervention? Does it focus on urban or rural areas? Does it involve one or more neighbourhoods, cities or states?

The icm service is offered to all residents within the city limits, especially tenants of low socioeconomic status. This project is part of a local network against mould problem in buildings.

Study size

5a. How many buildings and many persons were involved in the measure/intervention? Please indicate the number of:

Please add notes/comments if needed.

Dwellings: 8 for the pilot study, total of 31 (since implementation of icm 2006?)
Schools:
Daycare centres:

Persons: 20 for the pilot study, total of 45-55 (since implementation of icm 2006)

5b. How were the buildings selected (e.g., random selection, complaints, etc.)?

The icm service was available for cases reaching the consumer association in this region or cooperation partners (see 9a and 9b).
Target indicators of indoors environment quality

6. Which pollutants or factors were targeted by the measure/intervention?

Relative humidity       ( X )
Dampness/moisture in the building structure   ( X )
Dampness entering from outside    (   )
Mould in/on the building structures    ( X )
Air exchange rate          ( X )
Thermal performance of building (insulation/heating)   ( X )
Building materials themselves   ( X )

Please list all other factors targeted by measure/intervention:

Specific measures

7. Please give a short description of the measures or campaigns undertaken as part of the measure/intervention.

The proceedings in each case include at least three steps:
1. Joint analysis of the situation on “neutral” ground (at the consumers’ associations office).
2. Visit the dwelling; assessment by a building inspector; measure temperature and humidity of indoors air, wall surface, building construction; etc.
3. Where needed, long-term measurements of indoors air were done, other experts called in for assessment, cost estimates were received and discussed.
4. In the final meeting, a report of opportunities for solutions was given. In a joint discussion, solutions were chosen by the parties and set down on record.

Every step was conducted with both parties and all partners (see points 9a, 9b).

In addition to the icm service, the local network started different initiatives; e.g., an information campaign with public relations, lectures, exhibitions, symposia for experts and other PR events.

In this case study, the intervention is considered to be the active involvement of icm services in solving the problem. The result and evaluation refer to the assessing the contribution of the icm service to settling conflict cases by a compromise agreeable to both sides.

Funding, costs and context of the project

8a. What was the budget for the project?

This was a low-budget project without other funding. The service costs 50.00 € per tenant and landlord. This revenue is used for new measuring instruments or fliers.
8b. Can you give the unit cost (e.g., dwelling, school, person)?

| During the pilot study, each case took 3-4 hours. By now on-site inspection takes 1 hour at the most plus the time required to travel there and a short record. |

8c. Which were the sources of funding?

Please add notes/comments behind the brackets if needed.

- Private sponsors (   )
- City/municipal funds (   )
- National/federal funds (   )
- EC project (   )
- Other ( X ) (please specify: The local network of the coordinator and partners (see 9a and 9c) who worked on project.)

8d. Was the measure/intervention part of a national programme, campaign, etc.?

- Yes (   ) Name of the programme:
- No ( X )

Coordinator and partners

9a. Which institution, organisation, etc. coordinated the measure/intervention?

The local environmental health consulting branch of the consumers’ association is in charge of coordinating the local network and part of the icm service.

9b. Please list the partners, if any.

The local partners were:
- the tenants’ association (Mieterbund);
- the real estate owners’ association (Haus & Grund); and
- the municipal housing company and a building expert.

Together with the coordinator, all four organisations form the icm consulting group. Both tenants and landlords were given representation. The icm service may call in other experts if needed.
Results

10a. Briefly describe the main results of the measure/intervention (e.g., reduction in symptoms or exposure, improvement in health, fewer complaints).

Valuable experience was gained from the pilot study. The routine developed is useful for handling complicate cases and reduce the duration of service time. All participants and the icm service group were satisfied with the service except for the tenants in one case. Likewise, except for the aforementioned case, the causes of dampness were always found and a solution for eliminating them which was acceptable for both landlords and tenants. In 50% of the cases, dampness and mould were due mainly to the construction of the building, in 25% of cases both the building and the tenants contributed to it, and respectively 12.5% was caused exclusively by the tenants or no results were found. Today, the icm service is an important community service and other organisations and communities are adopting this model for tackling indoors mould problems.

10b. Were the objectives outlined in point 1b reached?

Yes. Although target no. 4 was not reached during the pilot study, it is now in regular service (see point 11b below).

10c. How were the results and findings of the study reported?

Please add notes/comments behind the brackets if needed.

- Media (TV, radio, newspapers) (X )
- Public meetings/forums (X )
- Internet/websites ( )
- Scientific publications (X )
- Others (X ) (please specify: newsletters of the organisations involved)
Evaluation

11a. Was the intervention/initiative evaluated? If so, how? (Measuring pollutants and ventilation, giving the occupants a medical examination, using a control group, etc.)

The pilot study was evaluated by the Bielefeld University School of Public Health, Dept. of Environmental Health. Project targets like prevention of health problems for the occupants and indoor mould were not measurable during the short time of the pilot study. If solving mould problems means lasting effects, these can only be assessed on a long term scale. The evaluation therefore assessed only the main results, acceptance of service and optimising the project concepts because this was a pioneer project, and hence had no previous experience to fall back on.

11b. Which were the main findings of this evaluation?

Please see 10a for the main results and acceptance by the participants. How far each of the goals was reached in the pilot study is shown in the table below (aim: >60% required for two out of three questions):

<table>
<thead>
<tr>
<th>Target aims</th>
<th>Goals reached?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Supporting people with mould problems</td>
<td>Yes</td>
</tr>
<tr>
<td>Overall satisfaction with icm</td>
<td>100%</td>
</tr>
<tr>
<td>Icm service was useful</td>
<td>62%</td>
</tr>
<tr>
<td>Icm service was essential</td>
<td>67%</td>
</tr>
<tr>
<td>2: Qualified elimination of the causes</td>
<td>Yes</td>
</tr>
<tr>
<td>Causes were found</td>
<td>88%</td>
</tr>
<tr>
<td>Satisfaction with results</td>
<td>77%</td>
</tr>
<tr>
<td>Reasons of the causes understood</td>
<td>77%</td>
</tr>
<tr>
<td>With as little information as possible</td>
<td>Yes</td>
</tr>
<tr>
<td>Mixture of the service group sufficient</td>
<td>85%</td>
</tr>
<tr>
<td>Participants did not want another expert</td>
<td>63%</td>
</tr>
<tr>
<td>Analysis was sufficient</td>
<td>50%</td>
</tr>
<tr>
<td>3: Problems solved for both sides</td>
<td>Yes</td>
</tr>
<tr>
<td>Satisfaction/recommendations conducted</td>
<td>63%</td>
</tr>
<tr>
<td>Elimination of the causes understood</td>
<td>77%</td>
</tr>
<tr>
<td>Fair balance between tenants and landlords</td>
<td>70%</td>
</tr>
<tr>
<td>Lawsuit avoided</td>
<td>not measurable</td>
</tr>
<tr>
<td>4: Quick and qualified remediation</td>
<td>No</td>
</tr>
<tr>
<td>Within 3 months</td>
<td>50%</td>
</tr>
<tr>
<td>Qualified (following official guidelines)</td>
<td>13%</td>
</tr>
</tbody>
</table>
Recommendations for policy formulation

12a. Please highlight some of your key experiences which might be helpful to others interested in implementing similar measures/interventions.

In order to reduce health risks posed by indoors mould, tenants and landlords should be given special offers for quick, easy and inexpensive intervention in case of indoors mould to limit the duration of exposure. Policies should focus on a combined collective pragmatic solution of the problem, with mediation instead of lawsuits. Landlords should be given more information about simple but important types of building insulation, such as the ceiling of the top floor or basement, as well as information about financial aid from the government. There is a great need for information about what tenants can do to avoid indoors mould. Hygrometer and mould monitors as advertising gifts are helpful in tenant information campaigns. All together, better and more detailed information on the risks of indoors mould is needed. Information about indoors mould and estimation methods need to be adapted. Also, the most important condition of this intervention model is a constructive local network, fairness between the partners, qualified and experienced professionals in the network, and a creative and realistical appreciation of the complex situations involving indoors mould.

12b. Could this measure/intervention be readily transferred to other cities, regions or countries? Which factors need to be considered here?

This model is readily transferrable to other communities if a good network is in place (see 12a).

Additional comments

Please add any comments or notes which could be helpful but were not covered by the questions above.

Additional information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

All pertaining reports and publications are in German.
Case study 25

Contacts / study coordinator

Please provide contact details for the person in charge of the study.

Name: Elena Piecková
Title: MPH, PhD.
Organization: Slovak Medical University
Email: elena.pieckova@szu.sk

Intervention title

The relation between indoor fungal contamination of buildings, surrounding environment and household characteristics.

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

Reducing exposure to indoor moulds in dwellings in Slovakia due to “healthy household style”.

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What where the results expected?

Public dissemination of knowledge "how to use my flat properly" and how to avoid objectively identified factors increasing indoor dampness and moulds, i. e. to create and sustain “healthy” dwelling/school”, in a medium-term (5 yrs after the projects’ ends) outcome, approx. one third’s reduction of affected dwellings’ numbers could be expected.
To sustain this information campaign with evidence, measurements were undertaken to show that healthy and unhealthy lifestyles (related to heating and ventilation) can impact on damp and mould conditions in dwellings.
**Target population groups**

2. Please specify the targeted population groups:

**Whole population**  (X)

**Specific age groups:** Please add notes / comments behind parentheses if required

- Older people  ( )
- Adults  ( )
- Adolescents  (X)
- Children  (X)

**Specific target groups:** Please add notes / comments behind parentheses if required

- Women  ( )
- Disabled people  ( )
- Other  ( ) (please specify:)

**Target buildings**

3. Which buildings are targeted by the intervention/initiative?

**Residential buildings**  (X)

**Schools**  (X)

**Child centres**  ( )

**Elderly centres**  ( )

**Other**  ( ) (please specify:)

**Geographical scale**

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)?

Please inform about the geographical scale/administrative scope/region.

National level in Slovakia: mountian area (the High Tatras foot-hills, city of Poprad; Central Slovakia, town of Hodruša-Hámre), hilly area (Central Slovakia, village of Lehota pod Vtáčnikom, town of Lučenec), flat area (Western Slovakia, city of Bratislava, towns of Komárno, Šurany, Hurbanovo; Eastern Slovakia, city of Košice).

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

The initiatives took place in both – urban and rural areas, in several villages, towns and cities as well, and were focused on apartment houses and schools built from concrete panels (prefabs).
Study size

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

Please add notes / comments if required

- Dwellings: 148
- Schools: 3
- Day centres: -

Persons: approx. 560

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

Complaint cases (damp, indoor moulds repeatedly) + control (“healthy”) buildings of the same construction type in the same area. The same measurements (as named below) were performed in both types of the buildings to materialize the statistic significance of results obtained.

Target indicators of indoor environmental quality

6. What are the pollutants or factors that were targeted by the intervention/initiative?

- Relative humidity (X)
- Damp / moisture in building structure (X)
- Dampness entering from outside (X)
- Mould in / on building structures (X)
- Air exchange rate ( )
- Thermal performance of building (insulation / heating) (X)
- Building materials themselves (X)

Please add to this list all other factors the intervention/initiative did target:

Construction type, indoor temperature, incl. dew point and surface temperature, household style (ventilation, cleaning regimen, internal sources of dampness, incl. pets, laundry drying, cooking, etc., furnishing, economic status, subjective health conditions – respiratory illnesses, discomfort etc.)
Specific actions

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative? Please describe shortly.

<table>
<thead>
<tr>
<th>Specific actions</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective measurements of thermal-moist parameters given before, questionnaires with occupants behavioural elements named, statistical evaluation of the results, comparing the two groups of dwelling. The results may help to further develop the information campaign to provide residents with adequate information on right behaviour. However, the project did not compare groups of residents that received, and not received the information on behaviour, and only compares dwellings in which healthy and unhealthy lifestyles of families are assumed.</td>
<td></td>
</tr>
</tbody>
</table>

Funding, costs and project context

8a. What was the project budget?

| 1) | 3,871,000 SKK |

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

| 1) | approx. 6,600 SKK per dwelling |

8c. What were the sources of funding?

Please add notes / comments behind parentheses if required

<table>
<thead>
<tr>
<th>Source</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private / sponsors</td>
<td>( )</td>
</tr>
<tr>
<td>City / municipal</td>
<td>( )</td>
</tr>
<tr>
<td>National / federal</td>
<td>( X )</td>
</tr>
<tr>
<td>EC project</td>
<td>(X) (please specify:)</td>
</tr>
<tr>
<td>Other</td>
<td>( )</td>
</tr>
</tbody>
</table>

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( X )</td>
</tr>
</tbody>
</table>

Coordinator and collaborators

9a. Which institution/organization etc. coordinated the intervention/initiative?

| Slovak Medical University, Bratislava |

9b. Which were the collaborators?

| VVUPS – NOVA, Research and Development Institute of Building Construction, Ltd., Bratislava |
**Results**

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

Very early results (half a year after the information campaign on proper occupants’ behavior) include a reduction of complaints about indoor dampness/moulds (it should be verified statistically further) in dwellings. Actually, “informing the public with adequate information leads to reduced problem cases” is what we hope for, but it’s very short time to make final conclusions at this moment.

10b. Were the objectives (as provided in 1b) reached?

Yes, the informative campaign is still going on.

10c. What kind of communication activities to disseminate the results and findings have been taken?

Please add notes / comments behind parentheses if required

- Media (TV, radio, newspaper) ( X )
- Public meetings / fora (   )
- Internet / web sites ( X )
- Scientific publications ( X )
- Other ( X ) (please specify: information leaflets with easy-to-read and to remember results’ summaries for the public)

**Evaluation**

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

In the course of the studies, control groups of the same kind of dwellings – in terms of construction type – were used to materialize measurements’ results. Statistical analysis of the relationships of indoor fungal contamination vs. thermal-moist conditions, household characteristics, construction defects is in process. Control dwellings are “healthy” ones, although they’re the same as mouldy ones from the technical point of view, but their inhabitants mostly behave differently, in terms of heating/ventilation modes of their spaces, their cleaning/maintenance, indoor moisture sources – laundry drying, kitchen/bath exhausts, over-occupied rooms etc. These parameters seem to affect indoor moulds even more potentially than construction/insulation failures. Thus, the target is to educate people from mouldy houses to change their approach to their indoor environment to make it healthier.
11b. What were the main evaluation findings?

Preliminarily, recommendations on proper ventilation mode and household style (minimal internal moisture sources, proper cleaning and maintenance) are relevant to be disseminated to the public.

Healthy and sick dwellings were selected first from the point of damp and mouldy indoor conditions. From statistical evaluation it’s become apparent that people in healthy (control) houses behave differently from the sick ones’ inhabitants. To help them reduce mouldy environment, the mentioned info campaign has started. To assess if the campaign helps or not (though early positive responses – decreased complaints – are coming (but e.g. this very mild winter should be considered either)), it’ll be necessary to conduct objective measurements of biological/thermal-moist conditions at least next three seasons/years (as it was performed in the finished study).

Recommendations for policy formulation

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

People should be informed clearly and objectively about possible consequences (ill health, economic losses) of their mouldy housing, the measurements needed to perform scientific analysis of their complaints, the results obtained, thus, they should be motivated to change present state by interventions recommended. Building managers should collaborate as well. However, as the project compared dwellings in which adequate and inadequate behaviours already existed in the past, there is no evaluation of the degree to which an information campaign can improve the residential behaviour and whether this improvement does lead to measurable reduction of exposure.

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

Yes. Specificities of the work with different people and the typical style of housing and households in the region/country should be taken into account while planning and realizing any intervention.

Additional comments and experiences

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

Studies’ results are also going to be applied to national legislation on indoor pollution of dwellings and public buildings.
Further information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.


Case study 26

Contacts / study coordinator
Please provide contact details for the person in charge of the study.

Name: Herbarth, Olf
Title: Univ.-Prof. Dr.
Organization: Faculty of Medicine, University of Leipzig
Email: olf.herbarth@medizin.uni-leipzig.de

Intervention title
LEIPI - Leipzig Intervention Study about Mould associated Disorders

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

Effect of measures of removing mould on health disorders
- focused on allergic disorders, air way diseases and indoor associated syndromes like sick building syndrome, chronic fatigue syndrome an so on
- changing of physiological and biochemical parameters during the intervention period (duration of the intervention time: 1 year)

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)?
What were the results expected?

Number of exposed dwellings at the beginning of the study
Number of exposed families after 1 year, divided in measures during the intervention period:
- no measures
- changing dwellings
- removing mould using a) specialists or b) (own) redecoration activities
  improvement of health vs. reducing of indoor load (mould)
Target population groups

2. Please specify the targeted population groups:

Whole population  ( x )

Specific age groups:  Please add notes / comments behind parentheses if required

Older people  ( )
Adults  ( x )
Adolescents  ( )
Children  ( x )

Specific target groups:  Please add notes / comments behind parentheses if required

Women  ( )
Disabled people  ( )
Other  ( x ) (please specify: children)

Target buildings

3. Which buildings are targeted by the intervention/initiative?

Residential buildings  ( x )
Schools  ( )
Child centres  ( )
Elderly centres  ( )
Other  ( ) (please specify:)

Geographical scale

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)?
Please inform about the geographical scale/administrative scope/region.

municipal

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

Urban areas
Study size

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

Please add notes / comments if required

Dwellings: approx. 550
Schools:
Day centres:

Persons: approx. 500

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

Complaints caused by mould (suspicion); visit of the outpatients clinic of environmental medicine or of the public health office

Target indicators of indoor environmental quality

6. What are the pollutants or factors that were targeted by the intervention/initiative?

Relative humidity (x) (partially)
Damp / moisture in building structure (x)
Dampness entering from outside (x) (by questionnaires)
Mould in / on building structures (x)
Air exchange rate (x) (partially)
Thermal performance of building (insulation / heating) (x) (by questionnaires)
Building materials themselves (x)

Please add to this list all other factors the intervention/initiative did target:
Indoor air quality additional characterised by VOC
Specific actions

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative? Please describe shortly.

After the first contact with the outpatients ambulance measurements were taken in the apartments of the patients/study participants. Dependent on the results the patients get all information about the load. Top priority was to avoid further load by mould.

The patients / study participants get some advice about potential possibilities to reduce/remove the load referring to the "mould remediation guide" ("Schimmelpilzsanierungs-Leitfaden"). No measure was prescribed on grounds of legal problems!

The evaluation afterward showed that the following measures have been done by the patients / study participants or owners of the apartments:

Removing mould:
- contract of a specialised company (service) and removing mould using this service
- measures by the patient / study participant itself (using anti mould chemicals) and/or redecoration activity
- change the apartment (moving out)
- or doing nothing (ignore of load)

Remark:
The used measures in detail (e.g. the used chemicals etc.) are not known

Funding, costs and project context

8a. What was the project budget?

Approx. 250000 € (not included costs for personal; would be paid by institutional budget)

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

Approx 500 € per participant without the costs for intervention measures

8c. What were the sources of funding?

Private / sponsors ( )
City / municipal ( )
National / federal ( x )
EC project ( )
Other ( ) (please specify: )

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

Yes ( )
No ( x )
Coordinator and collaborators

9a. Which institution/organization etc. coordinated the intervention/initiative?
Centre for Environmental Medicine

9b. Which were the collaborators?
Public health office of the city, partners from the University (clinics and institutes), Institute for Environmental Medicine Erfurt, HGF-Centre for Environmental Research - UFZ Leipzig, University of Colonia

Results

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).
Intervention (both redecoration and changing flat) lead to improvement of health, reduction of frequency of symptoms

10b. Were the objectives (as provided in 1b) reached?
yes

10c. What kind of communication activities to disseminate the results and findings have been taken?

Please add notes / comments behind parentheses if required

| Media (TV, radio, newspaper) | x |
| Public meetings / fora |  |
| Internet / web sites |  |
| Scientific publications | x |
| Other |  | (please specify:)|
Evaluation

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

Medical check up of the participants; measurements of the indoor air quality; both 2 times, first time after the first contact of the patient / study participant with the outpatients clinic and second after one year (as the rule after the realization of the removing of mould). For that reason the patient / study participant was ask to come to the clinic and/or study office

Yes; SOPs for medical examination, control groups and quality assurance of the measurements by participation at proficiency tests

11b. What were the main evaluation findings?

For all patients / study participants who have taken any measure (remediation or moving out) the load caused by mould was lower than before or not further detectable.

Considering means, the following results have been obtained (please note that the here presented results are results for the time being!!!):

The typical indoor mould spores have been decreased: Penicillium reduction by approx. 30% and Aspergillus reduction by approx. 70%

In line with the decrease of the load the symptoms were reduced. This effect was observed considering non specific symptoms like headaches or fatigue as well as specific symptoms concerning respiratory tract (like irritations, itching nose, cough), epidermis and eyes (such as irritations, dry eyes, skin rash). All in all the number / frequency of affected persons was decreased by around 15 to 30%.

Together with the symptoms also changes of laboratory parameters have been observed (as a rule an improvement), for example specific IgE, IgG. The improvement in case of symptoms was more pronounced than in the laboratory parameters.

Recommendations for policy formulation

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

- support by local public health offices is necessary
- show the participants the link between the exposure and the health effects
- take the health problems seriously

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?
Additional comments and experiences

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

Further information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

<table>
<thead>
<tr>
<th>Selection - first results published in:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(full) study will be published within theses and papers in 2008 and 2009</td>
</tr>
</tbody>
</table>
Review of interventions implemented in member states to address health hazards associated with dampness, mould and inadequate ventilation

Case study 28

Contacts / study coordinator

Please provide contact details for the person in charge of the study.

Name: Ulla Haverinen-Shaughnessy
Title: Senior Researcher
Organization: National Public Health Institute
Email: ulla.haverinen@ktl.fi

Intervention title

Monitoring success of remediation: case 7 (row house complex)

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?

Monitoring effects of remediation on buildings, microbial concentrations and occupant health

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What where the results expected?

Significant differences in microbial concentrations and occurrence of health symptoms as compared to the situation before remediation
Target population groups

2. Please specify the targeted population groups:

Whole population  (x) (all who lived in the buildings targeted)

Specific age groups: Please add notes / comments behind parentheses if required

- Older people  ( )
- Adults  ( )
- Adolescents  ( )
- Children  ( )

Specific target groups: Please add notes / comments behind parentheses if required

- Women  ( )
- Disabled people  ( )
- Other  ( ) (please specify:)

Target buildings

3. Which buildings are targeted by the intervention/initiative?

Residential buildings  (x)
- Schools  ( )
- Child centres  ( )
- Elderly centres  ( )
- Other  ( ) (please specify:)

Geographical scale

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)? Please inform about the geographical scale/administrative scope/region.

City

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

city, urban, one neighbourhood
**Study size**

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

*Please add notes / comments if required*

- Dwellings: 51 apartments
- Schools:
- Day centres:

Persons: 145

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

This case was brought up to the research group’s attention by the city representatives, who wanted to develop an objective approach to handle occupants’ complaints about their residences with dampness related problems. The case fulfilled criteria set for a parallel research project, and was therefore included in the study. Included in the research project were cases with sufficiently large occupancy (to allow health effect studies / group level estimation of effects) with suspected dampness related indoor air quality problems. The selected cases had to be able to ensure / commit themselves to completion of the recommended remediation tasks within a reasonable time and were willing to participate in the “extra” monitoring program.

**Target indicators of indoor environmental quality**

6. What are the pollutants or factors that were targeted by the intervention/initiative?

- Relative humidity
- Damp / moisture in building structure
- Dampness entering from outside
- Mould in / on building structures
- Air exchange rate
- Thermal performance of building (insulation / heating)
- Building materials themselves

Please add to this list all other factors the intervention/initiative did target:
Specific actions

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative? Please describe shortly.

Remediation actions improving ventilation and drainage, drying wet materials and improving moisture protection in bathrooms.

Funding, costs and project context

8a. What was the project budget?

Not known at this point (I will try to collect this information for the meeting).

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

Please add notes / comments behind parentheses if required

Private / sponsors ( )
City / municipal ( x )
National / federal ( )
EC project ( )
Other ( ) (please specify:)

8c. What were the sources of funding?

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

Yes ( x ) Program name: Finnish Research Programme of Environmental Health (SYTTY)
No ( )

Coordinator and collaborators

9a. Which institution/organization etc. coordinated the intervention/initiative?

National Public Health Institute, Finland

9b. Which were the collaborators?

Savonia Polytechnic, City of Kuopio
Results

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

Technical monitoring indicated improved and more controlled ventilation. However, some of the floor structures still had elevated moisture contents. Occupant reports and complaints of poor IAQ had diminished. We concluded that the remediation had improved building conditions, but further microbial and health effect studies may be required for more definite conclusions.

10b. Were the objectives (as provided in 1b) reached?

Not thoroughly monitored.

10c. What kind of communication activities to disseminate the results and findings have been taken?

Please add notes / comments behind parentheses if required

Media (TV, radio, newspaper) (  )
Public meetings / fora ( x )
Internet / web sites (  )
Scientific publications ( x )
Other (  ) (please specify:)

Evaluation

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

Only technical evaluation was done within the course of the study. Technical follow-up included visual inspections, air flow measurements, and moisture measurements. A thermal camera was utilized.
Microbial and health effect studies were done later on, but the results have not been analyzed collectively due to the research project ending.

11b. What were the main evaluation findings?

Partial improvement was detected.
Recommendations for policy formulation

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

Pilot remediation (within a large building complex) may help in developing working remediation specs and procedures.

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

This case particularly illustrates the importance of commitment of different parties participating in the process, and suggests more successful remediation, concrete results, and better documentation of the success to be expected if the follow-up measures are extended to cover the whole duration of the process (and further on, taken as a part of continuous maintenance practices of the buildings) rather than limited to the post-remediation monitoring. Also it was noted in this study that in a small portion of the apartments, the occupants seemed to become so sensitized to the building condition than sufficient level of improvement was not achieved at a reasonable cost. The city decided to appoint a new apartment for these families.

Additional comments and experiences

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

Further information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.

Case study 29

Contacts / study coordinator
Please provide contact details for the person in charge of the study.

Name: Ulla Haverinen-Shaughnessy
Title: Senior Researcher
Organization: National Public Health Institute
Email: ulla.haverinen@ktl.fi

Intervention title
Monitoring success of remediation: case 3 (school building)

Objective

1a. Please describe shortly the objective(s) of the intervention (e.g. adjusting ventilation rates, reducing asthma symptoms, reducing exposure to mould and/or damp, etc.)?
Monitoring effects of remediation on building, microbial concentrations and occupant health during 3-year course of the study

1b. What quantitative targets were set (like: reduction of number of exposed dwellings by 20%)? What where the results expected?
Significant differences in microbial concentrations and occurrence of health symptoms as compared to the situation before any remediation measures were taken
**Target population groups**

2. Please specify the targeted population groups:

**Whole population**

Please add notes / comments behind parentheses if required

**Specific age groups:**

- Older people
- Adults (x) teachers
- Adolescents
- Children (x) elementary school students

**Specific target groups:**

- Women
- Disabled people
- Other (please specify:)

**Target buildings**

3. Which buildings are targeted by the intervention/initiative?

**Residential buildings**

Please add notes / comments behind parentheses if required

**Schools**

- (x)

**Child centres**

- ( )

**Elderly centres**

- ( )

**Other**

- ( ) (please specify:)

**Geographical scale**

4a. At what level was the intervention/initiative implemented (e.g. national, provincial, municipal)?

Please inform about the geographical scale/administrative scope/region.

Municipal

4b. What is the specific setting in which the intervention/initiative takes place? Does it focus on urban or rural areas? Does it take place in one or more neighbourhoods, cities, states etc.?

City, urban
Study size

5a. How many buildings and how many persons were involved in the intervention/initiative? Please indicate the number of:

Please add notes / comments if required

Dwellings:
Schools: 1
Day centres:

Persons: ~25 teachers, 250 students

5b. What was the selection procedure of the buildings taking part in the intervention/initiative (e.g. random selection, complaint cases, etc.)

Cases were selected by an engineering consultant called upon estimating dampness related problems in the buildings. Recruited for the research project were cases with sufficiently large occupancy (to allow health effect studies / group level estimation of effects) with suspected dampness related indoor air quality problems. The selected cases had to be able to ensure / commit themselves to completion of the recommended remediation tasks within a reasonable time and were willing to participate in the “extra” monitoring program.

Target indicators of indoor environmental quality

6. What are the pollutants or factors that were targeted by the intervention/initiative?

Relative humidity (x)
Damp / moisture in building structure (x)
Dampness entering from outside (x)
Mould in / on building structures (x)
Air exchange rate (x)
Thermal performance of building (insulation / heating) ( )
Building materials themselves (x)

Please add to this list all other factors the intervention/initiative did target:
Specific actions

7. What actions, measures or campaigns were undertaken as part of the intervention/initiative? Please describe shortly.

Remediation actions included improving ventilation system and renewal of roofing, sealing air leakages, repair of windows, improving drainage, and remediation of wooden ground floor structures.

Funding, costs and project context

8a. What was the project budget?
Not known at this point (I will try to collect this information for the meeting).

8b. If possible, can you give the unit cost per intervention unit (per dwelling, per school, per person, etc.)?

Please add notes / comments behind parentheses if required

8c. What were the sources of funding?

Private / sponsors ( )
City / municipal ( x )
National / federal ( x )
EC project ( )
Other ( ) (please specify:)

8d. Was the intervention/initiative etc. part of a national programme, campaign etc.?

Yes ( x ) Program name: Finnish Research Programme of Environmental Health (SYTTY)
No ( )

Coordinator and collaborators

9a. Which institution/organization etc. coordinated the intervention/initiative?
National Public Health Institute, Finland

9b. Which were the collaborators?
Consulting Engineers Mikko Vahanen Ltd, City of Helsinki
Results

10a. Please describe shortly the main results of the intervention/initiative (e.g. reduction in symptoms or exposure, improvement of health, reduction of complaints etc.).

The remediation plans were inclusive of all repairs necessary, but the repairs could not be implemented immediately due to budgetary constrains. Therefore, repairs were extended over a 3-year time span. Based on technical monitoring, it was concluded that the remediation of this building was partially successful.

10b. Were the objectives (as provided in 1b) reached?
Not conclusively

10c. What kind of communication activities to disseminate the results and findings have been taken?

Please add notes / comments behind parentheses if required

Media (TV, radio, newspaper) (   )
Public meetings / fora (   )
Internet / web sites (   )
Scientific publications (   )
Other (   ) (please specify:)


Evaluation

11a. Has the intervention/initiative been evaluated? If yes, how? (Measurement of pollutants, ventilation measurement, medical examination of occupants, existence of control group etc.)

Technical follow-up included visual inspection and interviewing occupants approximately 6 months after completion of the remediation process. Most of the problematic sites were improved, but some of the issues still remained (e.g. ventilation system was only partially renewed).

Microbial follow-up included air, surface and material samples (Table 1). Health effect studies included use of questionnaires.

| Table 1. Results from air samples. |
| Text in italics indicates possible microbial sources in the building |

<table>
<thead>
<tr>
<th>sampling date</th>
<th>n=13 (before remediation)</th>
<th>6/00 n = 17 (partial remediation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/99</td>
<td>Elevated concentration and indicator microbes observed (3/13)</td>
<td>Elevated concentration and indicator microbes observed (1/17)</td>
</tr>
<tr>
<td></td>
<td>Several indicator microbial species observed (1/13)</td>
<td>Several indicator microbial species observed (4/17)</td>
</tr>
<tr>
<td></td>
<td>Low concentrations of indicator microbes observed (4/13)</td>
<td>Low concentrations of indicator microbes observed (6/17)</td>
</tr>
<tr>
<td></td>
<td>Low concentrations and no indicator microbes observed (5/13)</td>
<td>Low concentrations and no indicator microbes observed (6/17)</td>
</tr>
<tr>
<td>3/01</td>
<td>Elevated concentration and indicator microbes observed (4/17)</td>
<td>Low concentrations of indicator microbes observed (2/16)</td>
</tr>
<tr>
<td></td>
<td>Low concentrations of indicator microbes observed (2/16)</td>
<td>Low concentrations and no indicator microbes observed (12/16)</td>
</tr>
<tr>
<td>12/01</td>
<td>Elevated concentration and indicator microbes observed (5/15)</td>
<td>Low concentrations of indicator microbes observed (5/15)</td>
</tr>
<tr>
<td></td>
<td>Low concentrations of indicator microbes observed (5/15)</td>
<td>Low concentrations and no indicator microbes observed (5/5)</td>
</tr>
</tbody>
</table>

11b. What were the main evaluation findings?

From technical point of view, the remediation was considered partially successful (many improvements detected). Throughout the 3-year follow-up period, large spatial and temporal variation was observed in the airborne microbial concentrations. Hence no conclusion could be drawn based on these results. Occupant health status remained similar or even deteriorated during the remediation process. Therefore, the remediation did not have positive effects on occupant health.
Recommendations for policy formulation

12a. Please highlight some of your “key experiences” and lessons learned with implementing the intervention/initiative that others interested in implementing a similar intervention should know of.

Extended duration of the remediation process could create additional stress among the occupants, and affect perceived health.

12b. Could this intervention/initiative be easily transferred to other cities, regions or countries? What factors need to be considered?

Yes, but monitoring success of remediation is complex, and it often takes a long time (= years) to complete one case study. It is also challenging to control all variables (if any) in these types of assessments, also considering the time perspective.

Additional comments and experiences

Please give further comments on the intervention/initiative that could be relevant but have not been asked above.

Further information

Please give references to project-related documents and/or attach the relevant report or publications when sending back this template.