

## Introduction

### **Worked example: Improving energy performance of homes for health and financial benefits**

[DRAFT – 21 October 2015]

This worked example is provided to give an indication of how several of the forms provided within the Standard of Evidence for the Effectiveness of Interventions (StEv2-1) could be completed for a housing-related study.

## 1 Issue description

<b>Date</b>	2015-10-05
<b>Description of issue</b>	<p>We suspect that improving the physical quality of homes (specifically, improving the energy performance of homes) will have a number of beneficial effects, but this has not been sufficiently tested. The possible effects include:</p> <p>Improved health outcomes for occupants.  Lower energy bills for heating.  Improved ability to pay rent (due to lower expenditure on energy).</p>
<b>Who experiences the issue?</b>	<p>Any occupants of the property may experience improved health outcomes.</p> <p>Those responsible for paying bills may experience lower energy bills (typically the tenants).</p> <p>The tenants may have more money available to pay the rent.</p>
<b>Why would these improvements matter?</b>	<p>Health improvements are self-evidently beneficial.  Lower energy bills for tenants would clearly help them, and especially since many tenants have relatively constrained incomes.  Improved rental payments would matter to the organisation as the landlord (having a more reliable income stream / cashflow). It would also ultimately benefit those tenants who avoid falling into arrears, due to removing the risk of enforcement action being taken against them (which might ultimately lead to them losing their homes).</p>
<b>Who does it matter to?</b>	<p>As above, benefits may accrue to tenants and other occupants.  May also benefit the landlord, if lower energy bills translates into tenants' rent payment rate improving.</p>
<b>Current practice</b>	<p>Over recent years, all properties owned by the organisation have been brought up to the Decent Homes Standard, which includes a requirement for at least a minimum level of thermal comfort.</p>
<b>Relevance of the study</b>	<p>The organisation has a continuing programme of planned maintenance on its properties. There are many options for the types of works that could be undertaken, including other property upgrades/refurbishments or investment in building new homes.</p> <p>Identifying how effective improving energy performance is at creating improved outcomes will inform decisions about what the balance should be between different types of works.</p>

## 2 Intervention specification

<b>Date</b>	2015-10-05
<b>Brief name</b>	Improvements to energy performance of homes in Energy Efficiency Rating bands D and E to improve to band C or above.
<b>Why</b>	Homes in the better Energy Efficiency Rating (EER) bands (bands A-C) require less energy to keep warm. Improving the energy performance of homes in bands D and E to lift them to band C or above will therefore reduce the energy requirements to keep them warm. Lower energy requirements will mean that occupants with low incomes will be better able to afford to keep the home adequately warm in cold weather. Some occupants might keep the home warmer whilst spending the same amount on heating; others might keep the home at the same level of warmth whilst spending less on heating.
<b>What: Materials</b>	The measure or measures used to improve the energy performance of the homes will be determined according to the specific requirements of each home. They will include a range of insulation measures and upgrades to systems for space heating.
<b>What: Procedures</b>	The measure or measures used to improve the energy performance of the homes will be determined according to the specific requirements of each home. They will include a range of insulation measures and upgrades to systems for space heating.
<b>Who providing</b>	Appropriately skilled tradespeople will deliver the property upgrades.
<b>How</b>	Physical works to properties so will be conducted in person on site.
<b>Where</b>	At the properties. Various types of homes exist within the organisation's stock including flats, terraced houses, semi-detached and detached homes. Some are in estate locations where the organisation owns the majority of homes; others are dispersed street properties.  Homes are located in a number of areas across the midlands and south of England, with particularly high concentrations of homes in 5 local authority areas.
<b>When and how much</b>	In most cases, upgrades will be delivered as a single package of works on the property. In a small number of cases it may be necessary to deliver the work in separate stages (for example upgrading the heating system as one job and returning later to increase the insulation). In all cases, once the property has been upgraded to its final level it is assumed to remain at that level subsequently.
<b>Tailoring</b>	The measure or measures used to improve the energy performance of the homes will be determined according to the specific requirements of each home. They will include a range of insulation measures and upgrades to systems for space heating.
<b>How well (fidelity)</b>	A sample of properties will be surveyed after works to ensure installation to plan for the property.  Planned works will vary by property type and the specific needs of the property, and will be affected by the existing details of the property.

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<b>Brief name</b>	No major upgrades (control group)
<b>Why</b>	Business as usual is that some properties will get upgrades and others will not. The properties selected into the control arm will not receive major upgrades. They will still receive responsive repairs and maintenance as per standard procedures of the organisation.
<b>What: Materials</b>	No major planned upgrades to heating or insulation of properties. Upgrades may be delivered if warranted as part of a responsive repair. For example, in the event of a boiler failure that is beyond economic repair a new boiler would be installed, which may result in an energy performance improvement to the property.
<b>What: Procedures</b>	Normal repairs and maintenance are carried out where it is the landlord's repairing duty to do so. Where these relate to energy performance, if a replacement is required because an old system has failed and is beyond economic repair, it will be replaced with a suitable modern model.
<b>Who providing</b>	Appropriately skilled tradespeople deliver the repairs and maintenance service.
<b>How</b>	Physical works to properties so will be conducted in person on site.
<b>Where</b>	At the properties. Various types of homes exist within the organisation's stock including flats, terraced houses, semi-detached and detached homes. Some are in estate locations where the organisation owns the majority of homes; others are dispersed street properties.  Homes are located in a number of areas across the midlands and south of England, with particularly high concentrations of homes in 5 local authority areas.
<b>When and how much</b>	As required in response to faults and issues arising over the period.
<b>Tailoring</b>	Necessary repairs will be dependent on the design of the property, the design of the existing installation and the nature of any faults arising.
<b>How well (fidelity)</b>	A sample of repairs and maintenance works are routinely surveyed to ensure quality of works.

### 3 Outcome measure specification

<b>Outcome name</b>	UK SF-12
<b>Primary or secondary outcome?</b>	Primary
<b>Direct or surrogate?</b>	Direct
<b>Description of measure</b>	Use of the UK SF-12 health survey to measure general self-reported health.
<b>Collection procedures</b>	Telephone interview by members of the research team.
<b>Timepoint(s) of interest</b>	Baseline. Six months after intervention. Twelve months after intervention (primary timepoint). 24 months after intervention. (Equivalent spacing of timepoints for control group participants.)
<b>Minimum practically important difference</b>	{TO ADD – NEED TO CHECK VARIATION IN SF-12 SCORES}
<b>Relevance of outcome</b>	Good overall summary measure of physical and mental health that has accrued substantial evidence of validity through repeated usage. Primary timepoint selected to detect sustained effects that occur over a year post-intervention.

<b>Outcome name</b>	Energy bills
<b>Primary or secondary outcome?</b>	Secondary
<b>Direct or surrogate?</b>	Direct
<b>Description of measure</b>	Meter readings for energy supplies.
<b>Collection procedures</b>	Telephone interview by members of the research team.
<b>Timepoint(s) of interest</b>	Meter readings immediately prior to intervention, 12 months later and 24 months later. (Equivalent spacing of timepoints for control group participants.)
<b>Minimum practically important difference</b>	£50 per year difference in energy bills.
<b>Relevance of outcome</b>	Important to understand whether the intervention is delivering a significant decrease in costs to tenants. It is acknowledged that this might not be observed if tenants are instead using the same level of energy to increase the temperature in the home (but hopefully that would be picked up in the measure of improved health).

<b>Outcome name</b>	Rent arrears
<b>Primary or secondary outcome?</b>	Secondary
<b>Direct or surrogate?</b>	Direct

<b>Description of measure</b>	Data on rental accounts is routinely collected as a core function of being a landlord. Many tenants' rent account figures fluctuate due to the cycles on which their rent is paid being out of alignment with the cycles on which it is due (for example, 13 annual payments of 4 weeks' rent, when the rent is contractually due calendar monthly). For the purposes of this study we will take as the 'rent arrears' figure the best account balance in 6 week period, to account for the majority of these fluctuations. Any credit balances will be disregarded (i.e., capped as treated as zero arrears rather than as 'negative arrears'). Values will be normalised to be expressed as figure as multiple of one week's rent rather than as a £ figure.
<b>Collection procedures</b>	Rental account data is routinely collected. Data will be output from the housing management system and processed into the levels as defined above by the Business Intelligence team.
<b>Timepoint(s) of interest</b>	<p>The primary timepoint of interest is towards the end of the main heating period, the spring after the property is upgraded. This will be measured as the six weeks to the end of April.</p> <p>Properties upgraded during the main heating period (after 1 November) the primary timepoint of interest will be a year later (i.e., if the property is upgraded in December 2015, the measurement will be in Mar-April 2017, not Mar-Apr 2016).</p> <p>Follow-ups at secondary timepoints will be collected on 4 further quarterly occasions (periods to end of July, end of October, end of January, and end of April the year after the primary timepoint).</p> <p>Data will be output regarding the arrears in relation to each property in the year preceding the upgrade.</p>
<b>Minimum practically important difference</b>	<p>0.5 week's rent.</p> <p>If replicated across the stock this would amount to a substantial increase in cashflow that would be a significant improvement to the organisation.</p>
<b>Relevance of outcome</b>	<p>Improving rental collection is of direct practical importance to the organisation.</p> <p>The timepoint has been selected on the basis of being likely to be the point at which any differences are most likely to be discernible – at the end of the period when tenants are facing the greatest energy bills.</p> <p>The secondary timepoints are of interest to discern whether any impacts are maintained over time.</p>

## 4 Measurement specification

<b>Measurement name</b>	Weekly rent
<b>Description of measurement</b>	Contractual rent due for the property, expressed as a sum per week. Rents due weekly will be as stated. Rents due for periods that are multiples of a week (e.g. fortnightly) will be derived by dividing by the relevant number. Rents due per calendar month will be derived by multiplying by 12/52.
<b>Collection procedures and timing</b>	Data to be extracted from the housing management system by the Business Intelligence team.

<b>Measurement name</b>	Number of bedrooms
<b>Description of measurement</b>	Number of bedrooms as recorded on the housing management system.
<b>Collection procedures and timing</b>	Data to be extracted from the housing management system by the Business Intelligence team.

<b>Measurement name</b>	Energy Efficiency Rating band before works
<b>Description of measurement</b>	Categorical data (EER bands): D or E
<b>Collection procedures and timing</b>	Data to be extracted from the asset management system by the Business Intelligence team. Also extracted for properties in control group.

<b>Measurement name</b>	Energy Efficiency Rating band after works
<b>Description of measurement</b>	Categorical data (EER bands): A, B or C
<b>Collection procedures and timing</b>	Data to be extracted from the asset management system by the Business Intelligence team.

## 5 Causal design specification

<b>Design name</b>	Randomised controlled trial
<b>Justification for design</b>	<p>An RCT design is appropriate and practical in this instance as it will be possible to randomly decide which properties receive upgrades over the period of the trial.</p> <p>An RCT is ethical since there is uncertainty over the extent to which the energy performance upgrades result in the beneficial outcomes of interest. Furthermore, it would not be feasible with the available resources of the organisation to upgrade all of the potential properties during this period anyway, so there would inevitably be some homes upgraded and some not; consequently, randomisation is a fair and ethical basis on which to decide which homes receive the upgrades during this period. If the intervention is found to be beneficial it is likely that the programme will continue with upgrades to other properties in later years.</p>
<b>Framework (superiority, non-inferiority or equivalence)</b>	Superiority
<b>Description of planned design</b>	<p>The organisation has identified a list of properties that have an Energy Efficiency Rating in band D or E. From these a random selection will be identified to receive upgrades that will lift them to band C or above (see separate table for details of the intervention) and another random selection will be identified to be the control arm in the study in relation to the primary outcome. Those in the control arm will be placed in a waiting list to be the next set of properties to receive the upgrades should the programme continue beyond the end of the study.</p> <p>For the secondary outcome related to rent arrears (where there is no additional cost to data collection), additional statistical power will be gained by treating all homes from the identified long list that do not get the intervention as the control arm.</p>
<b>Pragmatic attitude</b>	The list of properties from which the intervention and control groups will be selected is the full list of properties in the categories that would be considered for receiving these upgrades in practice if the programme continues. The property upgrades will be delivered in the same manner and by the normal contractors who are responsible for these types of work. No additional training will be needed over the normal skills these staff have for undertaking these types of works.
<b>Equity</b>	<p>None – no particular subgroups being studied.</p> <p>However, if the intervention is proven to be effective it is likely to be beneficial in terms of health equity, since many of the organisation's tenants are from backgrounds with lower health outcomes in general.</p>

<b>Description of planned analysis</b>	<p>One-sided t-test of difference between each of the outcomes for the intervention and control groups in the study. Analysis will be conducted on an Intention-to-Treat basis.</p> <p>Subgroup analyses will be conducted on the difference between properties that start in band D and those that start in band E.</p>
<b>Assumptions</b>	<p>From experience, compliance is likely to be very high – we expect little crossover between the intervention and treatment arms.</p>
<b>Limitations of approach</b>	<p>The study will not address the (very few) properties that have EER bands of F and lower.</p> <p>In the vast majority of instances the upgrades will lift the EER bands of properties to C. The study will not distinguish between these and the few properties where the benefits ‘overshoot’ and the property ends up in band B or A. The study will not assess the effectiveness of increasing properties from band C to bands B or A.</p>

## 6 Participant recruitment approach specification

<b>Target population including location(s)</b>	<p>Social rented homes, owned and managed by one organisation.</p> <p>Various types of homes are included in the population flats, terraced houses, semi-detached and detached homes. Some are in estate locations where the organisation owns the majority of homes; others are dispersed street properties.</p> <p>Homes are located in a number of areas across the midlands and south of England, with particularly high concentrations of homes in 5 local authority areas.</p>
<b>Eligibility criteria</b>	<p>All homes owned by the organisation and with a current EER of band D or E, as recorded in the organisation's asset management system. Excludes shared ownership and leasehold properties but includes all types of rental tenure.</p>
<b>Process for recruitment</b>	<p>Properties will be identified by randomisation from the list of all eligible properties owned by the organisation.</p>
<b>Target sample size</b>	<p>TO ADD {NEED DATA ON SF-12 VARIANCE ETC.}</p>
<b>Intended recruitment schedule including date of first recruitment</b>	<p>Properties will be randomised in March 2016. Works will commence April 2016 and continue until July 2017.</p>

## 7 Record of ethical considerations

<b>Ethics committee</b>	No
<b>Ethical state of study given existing evidence base</b>	<p>Although improvements to energy efficiency of homes should be associated with being able to keep it as warm for less money (or warmer for the same money) it is not known the extent to which these improvements will happen in practice. There is equipoise.</p> <p>There is also an issue of natural delay given the rate of property upgrades the organisation is able to deliver per year. Even if it were decided to upgrade all of the homes as per the intervention it would take a period of several years before this programme could be delivered.</p>
<b>Risks to participants</b>	<p>In line with the organisation's standard approach to property works, care will be taken to minimise the impact of the intervention. Many of the upgrades will take place during warm months of the year. For those conducted in winter months, every effort is taken to ensure homes are not left without heating facilities overnight. Where this is unavoidable, portable electrical space heaters will be supplied and the tenants will be reimbursed for additional electricity usage.</p> <p>As far as possible, outcome measures are targeted on from routinely-collected to minimise inconvenience associated with obtaining data from participants. However, there will be a small data collection burden relating to seeking health outcomes data.</p>
<b>Risks to study team</b>	<p>Tradespeople implementing the intervention – the nature of the work, and consequently the risk profile will be very similar to their normal roles. These risks are routinely considered and mitigated through the standard approaches to health and safety at work adopted by the organisation.</p> <p>Most data collection will be a process of data extraction from existing databases and come at no significant risk of harm.</p> <p>Data on health outcomes will be collected directly from tenants. To minimise the risk of harm, the bulk of this will be collected in telephone interviews. Where it is necessary to visit in person the organisation's lone working policies will be followed to ensure the safety of those collecting data.</p>
<b>Participant involvement</b>	No.
<b>Participant consent</b>	<p>Consent will be sought for outcomes data relating to health and energy usage.</p> <p>Where consent is not available arrears data will still be analysed as the organisation already holds a general consent the permits analysis of this information.</p>

<b>Participant information</b>	Participants who are asked to provide health and energy usage data will be informed that a study is being conducted regarding the energy efficiency of homes to see what the impacts are. They will be informed that they are either going to receive the intervention or to be placed at the top of the list to get it next if further resources are available to continue the programme after the study.
<b>Participant payment</b>	No payments will be made.
<b>Confidentiality and personal data</b>	Data relating individuals will be anonymised and referred to by ID numbers. Personally identifiable information will only be available to the people conducting the survey. They will anonymise to ID numbers and pass outcomes data on to the analysts. Separately, the Business Intelligence team will produce all other data outputs, referenced only by ID numbers, and pass these to the analysts. The analysts will not hold any details of property addresses or tenant identities.
<b>Breaking confidentiality</b>	The survey does not ask questions directly related to risks of harm. If the respondent volunteers information that suggests that he/she is considering causing harm to self or others the person conducting the survey will pass that information on to a designated individual.
<b>Other</b>	N/A