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# HEALS

**Health and Environment-wide Associations  
based on Large population Surveys**

*FP7-ENV-2013- 603946*

<http://www.heals-eu.eu/>

## **Deliverable 9.1 – Practical sensor-based Exposure monitoring protocol for use in WP17**

**WP 9 Exposome monitoring throughout lifetime – Constructing the  
exposome**


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## 1 Introduction

### 1.1 Background and rationale

The Health and Environment-wide Associations based on Large population Surveys (HEALS) project is funded under the European Union's Seventh Programme (grant agreement No. 603946). It aims to characterize the human exposome, which is defined as the totality of exposures from conception onwards. This is a broad concept, and HEALS will approach its study using various methods to examine the exogenous and endogenous exposures and modifiable risk factors that predispose a person to disease. The project will employ various “-omics” technologies to examine internal biomarkers and relate these to environmentally mediated disease using bioinformatics. Additionally, the study will test the use of new sensor technologies in collecting exposure information. The HEALS approach will be applied in several existing cohort studies of various chronic disease outcomes and also in a prospective birth cohort study, of both twin and singleton births, in several European countries (EXHES study).

Work package 9 (WP9) of HEALS will conduct a pilot study to test an exposure assessment protocol for the EXHES study. This document describes the pilot study for WP9. The objective of the pilot study is to develop a protocol for measuring external environmental exposures and related factors using a non-targeted, data driven approach. This approach is a characteristic of exposome studies, where investigators gather data with the aim to do exploratory analyses to discover associations that lead to further, more targeted hypothesis driven research. Since the exposome is meant to include exposures and factors that influence exposures, a methodology for measuring the external exposome must therefore include many things, including numerous pollutant concentrations in air, water, food, etc. Other aspects of the environment that can influence health and exposure will also be included, such as personal activity, location, diet, and demographic and socioeconomic factors. The HEALS WP9 protocol is being developed with the expectation that it can be applied at various life stages of a person.

The HEALS project will take advantage of the “internet-of-things” concept, by integrating wireless and mobile devices, including wearable sensors, into the data collection methodology and development of a data platform for gathering and storing information. In the last few years, microelectronic sensors and smartphone apps have allowed the general public to monitor various aspects of their environment, behaviours, and health. These “do-it-

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yourself” technologies also provide new opportunities for research, including the potential for data to be collected for longer periods of time, with greater ease, and less cost than conventional research methods. Another novel aspect of this methodology is that much of the data collection will be self-administered by the subject, rather than administered by research staff. The subject will be using online programs or mobile apps to answer questions and obtain data from their wearable and other connected devices. This will allow both the researchers and subjects to get real-time information. In addition, conventional exposure assessment methods will be used where sensors are not able to reliably collect information.

This document describes the protocol for the WP9 pilot study. The entire protocol will be trialed using a known associate before it is applied to the general public. After this trial, 50 families with young children will be recruited in each of 3 areas (Edinburgh, Utrecht/Delft, and Thessaloniki/Athens). A sampling campaign will be conducted in each city by the local HEALS partner institute. A data collection platform is developed by HEALS partner TNO, in the Netherlands. Data collected will be analysed and published and lessons learned will be used to create a protocol for EXHES.

## 2 Objectives


The key objectives of this pilot study of the external exposome are to:

1. Collect data on external environmental exposure and exposure determinants to children and their primary caretakers in 3 centers across Europe.
2. Demonstrate feasibility of using new sensor and mobile technologies in collecting exposure data.
3. Analyse the data gathered in this study to characterize exposures to families of small children in several different European cities.
4. Provide data that can be used in piloting agent based (or related) exposure modeling.
5. Use lessons learned from the pilot to finalize a protocol for the HEALS cohort study.

## 3 Study design

This study will require participation of households with small children (aged  $\leq 3$  years at the time of recruitment). The study aims to characterize children’s exposure by measuring the



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place(s) that they spend the most time in (assumed to be the home) and by examining the exposure of their primary caretaker or guardian. It is assumed that the exposure of their guardian will be closely related to the child's exposure. In addition, if the guardian is a parent, the parent's exposure and health likely affects the child's exposure and health status. Therefore, this study will focus on assessing the exposure of the guardian and the child.

Each city (or city cluster) will recruit 50 households with a young child ( $\leq 3$  years old). This protocol will be followed by each city (cluster), and translated as necessary. For each household, one adult (the primary caretaker for the child in the study) and one child will be enrolled into the study. If there is more than one child  $\leq 3$  years old in the household, the family will be asked if the youngest may be enrolled. If they do not wish to enroll the youngest, they may select another of their children for study participation.

The study will include both at home and personal monitoring for 5 to 7 days, including a weekend. The types of information to be collected include exposure monitoring devices, smart phone apps and questionnaires and are indicated in Chapter 5. Two home visits will take place – once at the beginning of the data collection period and once at the end, with a phone call check-in around the middle of the period. During the monitoring period volunteers can contact fieldworkers, if needed.

Some of the data collected will be viewable by the subject during the monitoring period, as they will be measured using do-it-yourself devices. Some of the data will need to be sent to a laboratory for analysis. These may be used for exposomic-type non-targeted analyses, or will be analysed for specific classes of chemicals (e.g. metals, endocrine disrupters, etc.). These will be analysed as resources permit and may be done at a later date.


## 4 Study population

### 4.1 Subject base


Each center will be responsible for recruiting 50 households with a child  $\leq 3$  years of age. At least one adult caretaker and one child will be enrolled as study subjects.

### 4.2 Inclusion criteria

These are the criteria for a household to participate in our study.

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- Household must have at least 1 adult and child, and the adult should be the guardian
- Child in study should be  $\leq 3$  years old.
- Subjects must give voluntary informed consent for themselves, the household, and child(ren)
- Subjects and other household members must be willing and able to have sampling equipment in home and accept fieldworkers to survey their home, and place data collection devices in the home.
- Subjects must be willing to carry around personal monitors and perform any functions required to maintain or record data from them
- Subjects must be willing to use the HEALS electronic portal for data gathering and answer any questionnaires requested of them
- Subjects must be willing to share anonymised data on food intake with external parties Fatsecret (food intake app provider), Fitbit device and app, Moves app, Netatmo device and app and Wireless tag.
- Subjects must be willing to share anonymised data from Fatsecret, Fitbit, Moves, Netatmo, and Wireless Tag with the HEALS portal, developed by TNO
- Subjects must be willing to accept use of all anonymised data, including publication, and the confidential use and storage of all data by study partners (list found in Appendix 1)
- Subjects should own a Smartphone with Bluetooth that runs either iOS 7 or Android 4.0 and up.
- Subjects must have a desktop or laptop with internet access and wireless connection at home and allow use of this connection for study devices
- Subjects should live in the Edinburgh area

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- Language:

### 4.3 Exclusion criteria

If potential subjects meet any of the following criteria they will be excluded from the study.

- Does not have children below 3 years of age
- Restrictions on ability to have study devices at home or other locations (such as work)
- Not willing to perform study procedures or share data as listed in Section 4.2
- Live outside the study area
- Not speak English
- If the study researcher or field worker deems that the subject is not functionally capable of giving informed consent.


### 4.4 Sample size

This is a pilot study and we are most interested in exploring the feasibility of using the methods described to measure exposures in households. Since this study is exploratory in nature, and there are resource constraints on the number of households we can collect information from, we have limited the sample size to 50 households per study centre.

## 5 Treatment of subjects

### 5.1 Investigational treatment


In this study, the subjects will be asked to allow fieldworkers to survey their home, place data collection devices in the home, and use do-it-yourself monitoring devices during a period of 5-7 days. The exposure assessment monitoring devices and questionnaires are summarized in Table 1 and described in more detail below. Each subject and household will be given a non-identifying username, email address, and password for the study. These will be used to set up accounts on the devices listed below. For any apps where information can be shared with other users in the community, privacy settings will be set to the most restricted viewing.

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The personal monitors will be carried by the guardian. If the child is regularly cared for by another person than the guardian (e.g. during the workday), the guardian will still carry any personal monitors, but we will ask the guardian to provide information on the child's whereabouts during the time when they are being cared for by another.

Table 1: Overview of exposure assessment monitoring devices and questionnaires

<b>Exposure</b>	<b>Personal</b>	<b>Household</b>	<b>Comments</b>
Activity (day and night)	<a href="#">Fitbit</a>  <a href="#">(sign in required)</a>	N/A	Personal sensor
Location	Moves app (sign in required)	N/A	Moves download provides data on location and transport type
Air temperature – indoors		<a href="#">Netatmo</a>  <a href="#">(sign in required)</a>	Child's room, main living area
Air temperature – outdoors		Meteorological data	Download from external data source and applied to geographical location
Humidity – indoors		Netatmo	Child's room, main living area
Humidity – outdoors		Meteorological data (e.g. <a href="http://www.wunderground.com">www.wunderground.com</a> )	Download from external data source and applied to geographical location

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Exposure	Personal	Household	Comments
CO2 – indoors	N/A	Netatmo	Child's room, main living area
Noise	WideNoise Plus app and Noise meter app	Netatmo	Netatmo sensor placed in child's room. WideNoise Plus app used by adult to capture and characterize noise at various times.
Light – indoors		Mini light data logger	Child's room, guardian's room
Particulate matter		Dylos DC1700	Placed in main living area
VOCs		Passam passive badge samplers	Child's room, main living area
NO2		Passam passive badge samplers	Child's room, main living area
O3		Passam passive badge samplers	Child's room, main living area
UV	Satellite data	N/A	Will be modeled based on location activity data and outdoor levels
Dietary data (including water and other drinks)	Fatsecret	N/A	Personal diet log filled in online or on mobile device for both the parent and the child
Allergens	N/A	Dustfall on filter	Child's room, main living area

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Exposure	Personal	Household	Comments
Dust	N/A	Dust from vacuum cleaner	
Consumer products		Phone barcode scanning app  Wireless tags	Cleaning products and personal care
Water		Kitchen tap sample  Public water supply info	Sample taken by the fieldworker
Building/area characteristics			Fieldworker will conduct survey. Some questions will be answered by the parent
SES			Administered to parent

### 5.1.1 Home survey

The fieldworkers will ask permission to walk around inside and outside the home and record data about the building and environment which will be used in better understanding how the home and immediate outdoor environment might affect environmental exposures. The fieldworkers will fill out two surveys regarding the dwelling structure and occupant activities (Appendix 2 and 3). They will also ask which is the main living area, i.e. the room where occupants spend most of their time. This will be one of the rooms in which we place monitoring devices.


### 5.1.2 In-home data collection devices

#### Netatmo

The Netatmo (Figure 1: Netatmo) is a home environment sensing device with modules. One module will be placed in a child's bedroom and the other in the room where the child spends a lot of time.



**Figure 1: Netatmo**

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Each Netatmo module measures temperature, humidity, and carbon dioxide, with one module also measuring noise (in dB), which will be placed in the child's bedroom. The Netatmo needs to be connected to the household Wi-Fi. The data collected by the Netatmo modules will be sent to the main module, which will send the data to the user's online account, which will be set up using the anonymous username and email address that the study assigns. The subjects can see the data collected via the online account or they may download the app on their smartphone. The Netatmo will be synced to the HEALS portal.

### Dylos

The Dylos (Figure 2: Dylos) is a particle monitor which measures the number of particles in the air around the instrument in real time (e.g. every minute). It logs this data and can be downloaded later onto a computer using the company's software. This device is not connected to the internet or a wireless device. This will be placed in the main living area.



**Figure 2: Dylos**

### Passive sampler for volatile organic compounds, nitrogen dioxide, and ozone



Passive sampling tubes (Figure 3: Passive air sampler) will be used for sampling gases and volatile organic compounds in the air. These are relatively small tubes which make no noise and absorb gases for analysis in a laboratory. These would be placed in the bedrooms and main living area of the home. These will be sent for analysis at a commercial laboratory.


**Figure 3: Passive air sampler**

### Passive sampler for dust

A cardboard folder will be placed in the child's bedroom with electrostatic sheets that will collect dust as it settles out of the air. This will be used to quantify allergens in the air and dust.

### Vacuum Dust

The fieldworkers will also ask if the household uses a vacuum cleaner and if they may collect the contents of the vacuum cleaner (i.e. the vacuum bag or contents of the canister).

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## Water

A water sample will be taken from the kitchen tap for analysis of various contaminants. Questions about water consumption will also be asked.

## Wireless tag

Wireless tags are used for detecting motion. We will put these on the cleaning products that the household reports using the most often. These will be taped in a waterproof plastic bag to the container of the cleaning product. When the product is used or moved the sensor will report that it has moved and the time at which the movement occurred. We can use this information to model potential exposures to substances that may be in the product.

## Light logger

A small data logger that measures light levels will be placed in the bedrooms. Data will be downloaded at the end of the study.

### 5.1.3 Personal collection devices/apps

#### Fitbit



**Figure 5: Fitbit**

The Fitbit Flex is a personal activity monitor. It can measure the number of steps a person takes and, using the person's height, weight, and age, estimates energy expenditure. It can also be used to estimate sleep efficiency. This Fitbit is worn on the wrist (Figure 4: Fitbit) and uses Bluetooth to sync with a smartphone or computer. Steps, energy expenditure, and sleep efficiency can be seen on the web or smartphone app. The Fitbit will be synced to the HEALS portal. The Fitbit should be worn at all times by the caretaker, unless there is a reason it needs to be removed (e.g. charging, need to go through security, swimming). It can also be worn while sleeping.


#### Moves

The Moves app can be downloaded to a person's smartphone (Figure 5: Moves app). This app tracks a person's location, activity (as steps), and can estimate the mode of transport being used. The data can then be



**Figure 4: Moves app**

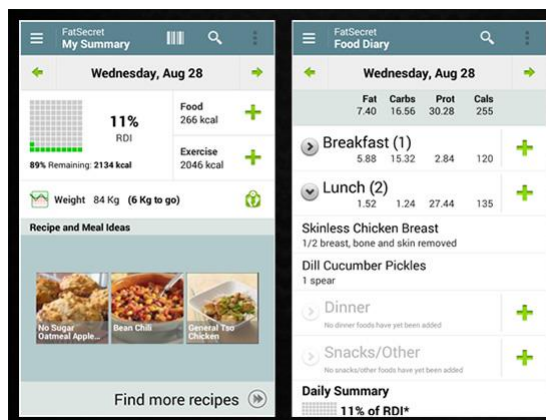


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downloaded from the website. The subject will be asked to label locations, if they are not already labeled in the app, such as “home,” “work,” etc. The app can be run in a battery saving mode if battery drain is a concern. Moves will be synced to the HEALS portal. The subject (i.e. guardian) will be asked to carry their phone with them at all times, except when it is not feasible (e.g. while sleeping, in the shower).

### Fatsecret app

Fatsecret provides a food intake application that is available as a Smartphone application or can be accessed via a web browser. Caretakers report their daily food intake as well as the child’s daily food intake during the day, immediately after consumption (see Figure 6: Fatsecret app). Subjects will be asked to record as many food intake events as they can remember. They will receive reminder emails throughout the study. Fatsecret accounts will be set up for the caretaker as well as the child.



**Figure 6: Fatsecret app**


The data of this application is synchronized to the HEALS portal using the Fatsecret API. This allows for collecting the number of calories, fat, saturated fat, carbohydrates, proteins, etc.

### Redlaser scanning app

Subjects will be asked to download the Redlaser app on their smartphones. This app scans barcodes of household products and links them with product databases to identify the product. The subject will be instructed to scan the products that they use each day and save them to a separate list for each day. The lists will then be emailed to the researchers.

### WideNoise Plus

50% of the subjects will be asked to download the WideNoise Plus app on their smartphones. This app takes a noise sample and asks the person to characterize the type of noise (e.g. office, traffic), and to rate the noise on a scale based on how much they like or dislike it.

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## Noise Meter

50% of the subjects will be asked to download the Noise Meter (JINASYS) on their Android smartphones. This app takes a noise sample for a longer period compare to the WideNoise Plus app and provides more detailed information. However, no information is collected about the type of noise and the personal rating of the noise.

## HEALS Portal

The HEALS portal is an online ‘personal data portal’ on which data from multiple devices can be uploaded or synchronized (see Figure 7). Participants have the opportunity to see all the data in one portal while it allows researchers to collect the encoded data for data analysis. Data from wireless devices and apps will be uploaded to the HEALS portal automatically. Subjects are free to check their data as often as they wish

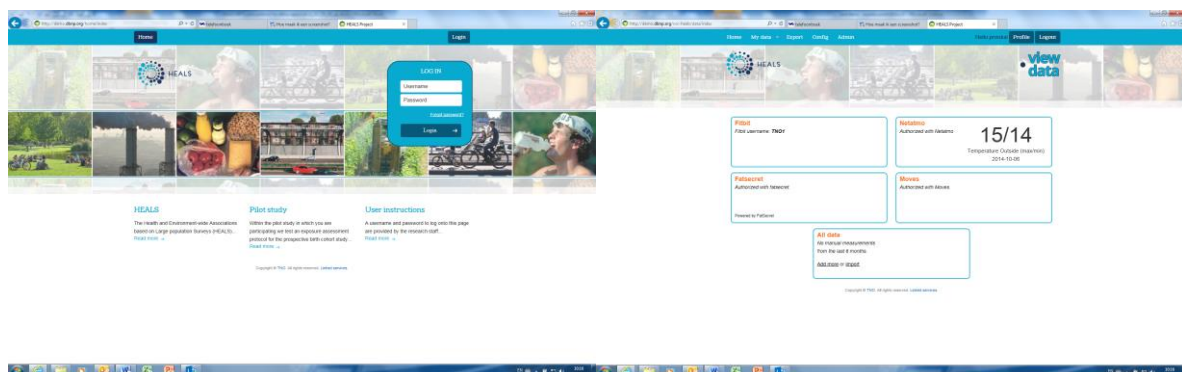



Figure 7: Screenshots of the HEALS portal login screen and data upload and viewing screen

### 5.1.4 Questionnaires

The subjects will also be asked a set of questions by the fieldworkers, including information about the housing characteristics and household (Appendix 2 and 3), demographics and socio-economics (Appendix 4) and noise (Appendix 5). Questions that are asked by the fieldworkers will be recorded preferably by tablet, for later upload into a database, or by paper, if the tablet option is not working. The subjects will also be asked to answer a questionnaire about their experience with the study at the end (Appendix 6). The text of all questions can be found in the appendices.

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## 5.2 Supply and privacy of do-it-yourself devices

At the first home visit, the subjects will receive the devices required for the study. Also, all guardians will be provided with two email accounts that are anonymized and created especially for study purposes with corresponding passwords. One account for the guardian will be linked to an account on the HEALS portal and an account on the Netatmo, Wireless tag, Fitbit, Moves, Fatsecret, and RedLaser. In addition an additional account for the child will be linked to Fatsecret. This account will be linked to the HEALS account of the guardian, who will keep track of the child's diet. The fieldworker will distribute the email accounts via sealed envelopes to the participants and keep track of which number is allocated to which subject.

The data will thus automatically be linked to the subject number. All subject data will be aggregated in an encoded manner in the HEALS portal.

## 5.3 Compliance to study protocol


The measuring devices will be handed out to the participants at the first home visit. Compliance to the study protocol can be checked in HEALS portal by the presence of data from linked devices. Reminder emails will be sent periodically during the study period to remind the subject to, e.g. fill in their diet log, take noise samples, charge and sync their Fitbit, check their Moves app, etc. A mid-study call from a fieldworker to confirm the final home visit will also serve as a reminder to comply with the protocol and provide an opportunity for the study subject to ask questions.

# 6 Methods

## 6.1 Study parameters/endpoints

The exposome approach is a non-targeted, agnostic approach to data gathering and analysis. Thus, there are many endpoints. The study's primary endpoints will be the exposure related data collected. These may also be used in further studies to estimate personal exposures for adults and children. Data collected include:

- Time-activity-location patterns
- Indoor air and environmental quality parameters
- Socio-economic information

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Study variables that will be used as potential predictors include the questionnaire data on building characteristics and occupant behavior.

Additionally, the study will evaluate the potential of do-it-yourself devices for measuring exposure parameters by subjects. Given the 5-7 day monitoring period, we will evaluate the percent completeness of the real-time measurements per day and over the entire 5-7 days.

Usability of the devices will be assessed with a questionnaire on user-experience with do-it-yourself devices at the end of the study (Appendix 6). This questionnaire will encompass questions on how often the devices are used, the context in which the device is used, the satisfaction of the user with the device, the effects of the device on user behaviour, the ease of use and the problems encountered. We will encourage participants to report any problems or issues encountered on the HEALS portal during the study period.

## 6.2 Randomisation, blinding, treatment condition

Not applicable.


## 6.3 Study procedures

### 6.3.1 Subject contact

If a person has expressed interest in this study during the recruitment process (see Appendix 7, a research staff member will contact the person by phone and/or e-mail and provide an explanation of the study (see Appendix 8 for draft scripts). If the person agrees to participate, the staff member will set up an appointment for the first visit and reserve a date and time for the second visit. Names of subjects will not be stored with their phone numbers on mobile or other phones. A copy of the participant information sheet and consent form (Appendix 9) will be sent to the participant in advance of the first visit, so that they will have time to read it and think about it in advance.

### 6.3.2 First visit

The research staff will provide the subject(s) with another copy of the subject information sheet (Appendix 9) and explain each part of the sheet to the subject, who will then be given an opportunity to review the sheet and ask questions. The subject will have to consent for themselves and their child to be in the study. Once they have signed the consent checklist, the fieldworkers will conduct a survey of the home (Appendix 2), administer questionnaires

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(Appendix 3, 4, 5) to the adult subject, set up measurement equipment in the home, and set up and provide instructions to the adult subject about using the personal measurement devices and apps. The fieldworkers will set up all devices and will ask the subject for permission to link to their home wireless internet connection for the Netatmo and Wireless tags. They will also help the subject set up the apps on the subject's smartphone. The fieldworkers will go through all the procedures for use of the do-it-yourself devices, apps, and websites with the adult. The field staff will log relevant consumer products according to the consumer product protocol (Appendix 10) and, for the cleaning products identified as the most frequently used by the subject, will place a Wireless Tag on the product. The subject will receive a folder with instructions (see Appendix 11), their anonymized study username, email, and password, and who to contact in case of questions or an emergency. They will also confirm the date and time of the next visit. This visit is expected to take approximately 2 hours.

### 6.3.3 During the study

The subject will be provided with a phone number to call in case of questions or problems with the equipment. The fieldworkers will call the adult subject mid-way through the sampling period to see if the subject has any questions, to remind them to use their devices, and to confirm the date/time of the second visit. The subject will also receive notifications on their phone periodically (not more often than once a day) to remind them to use their devices. Any data that is linked to the HEALS portal will be monitored by the fieldworkers and research staff, and if there are any questions regarding this information, the subject will either be contacted during the study or will be asked during the second visit, depending on the nature of the issue. We estimate that each day the participant would take 15-30 minutes on activities, such as recording their diet, syncing their Fitbit, taking a noise sample. It will vary by participant and day but we do not anticipate more than 15-30 minutes/day.

### 6.3.4 Second visit

During the second visit, which will be scheduled between 5 and 7 days later, the fieldworkers will log and remove all in-home measurement devices and take back the personal monitoring devices. The vacuum and water samples will be taken at this visit. The fieldworkers will ask if the subject had any problems and go over any issues that may have arisen during the study, including questions about the data from the HEALS portal that the research staff may have. Additionally, the fieldworkers will administer a questionnaire to the subject about their

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experience with the study and use of the devices as well as some additional questions on the noise experience (Appendix 6). This visit will take about 1.5 hours.

## 6.4 Withdrawal of subjects

Subjects can leave the study at any time for any reason if they wish to do so without any consequences. If the subject wishes to leave the study, they may do so by contacting either the fieldworker, who will communicate this to the principal investigator, or the investigator directly. The investigator can decide to withdraw a subject from the study for urgent medical reasons.

Subjects may be withdrawn from the study by the principal investigator if they do not comply with the rules and regulations of the study.

## 6.5 Replacement of subjects after withdrawal

If we are able to recruit another household within the study period and resources permit, we will enroll a replacement household into the study to replace possible drop-outs.


## 6.6 Follow-up of subjects after withdrawal

Subjects will not be followed up after withdrawal.

# 7 Risks

## 7.1 Risks to staff

A copy of the risk assessment for this project can be found in Appendix 12. A Safe Working in the Community protocol is in Appendix 13. Fieldworkers will be required to acknowledge that they have read and understood the material in these documents. Staff will also be required to familiarize themselves with IOM's Health and Safety Manual. Staff will be trained as to proper installation, use, and take-down of the study devices, how to deal with incidents, and how to interact with subjects. There will be 2 fieldworkers for each visit, and they will both be supplied with a mobile phone and will be instructed to let the principal investigator and their line manager know before a visit where they are going, the time they are anticipated to be there, the time they leave, and to notify the investigator and line manager when they arrive at the home, when they leave, and when they return back to the office or

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home from a visit by phone or text. Any incidents should be reported accordingly. Any incidents will be reported to the Occupational Health and Safety Adviser, the staff member's line manager, and the principal investigator.

## 7.2 Risks to participants

The devices used pose low risk of harm. Any electronic devices to be plugged in will be tested according to IOM's Guidance Notice on portable appliance testing prior to deployment in the field. The fieldworkers will need to take precautions that any devices placed in the home or worn by the adult caretaker will pose minimal threat of harm to the household members and children. This includes instructing the adult subject to be watchful of the devices, especially in the presence of children, so that they are not accidentally misused. The fieldworker will place measurement devices, with consultation from the adult subject, in areas where a child cannot easily access the devices.


All equipment will be checked at IOM upon return from the field and prior to use in the field. If any problems are noted in the field, the fieldworkers are instructed to not use the device and use either a backup or to bring another functional device later, if possible.

The subjects will be instructed to report any incidents involving study equipment or procedures as soon as possible to study staff. If a study device is accidentally broken by the subject, they will not be required to make any payment or replace the device. Any other incidents that may adversely affect the subject during the study or the subject's ability to comply with study procedures should also be reported to IOM.

## 8 Safety reporting

The investigator will inform the subjects and the reviewing ethics committee of any issue that is deemed by the investigator to pose danger to the subjects and for which the disadvantages of participation may be significantly greater than was foreseen in the research proposal. The study will be suspended pending further review by the ethics committee, except insofar as suspension would jeopardise the subjects' health. All subjects will be kept informed by the investigator.



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## 8.1 AEs, SAEs

### 8.1.1 Adverse events (AEs)

Adverse events are defined as any undesirable experience occurring to a subject during the study, whether or not considered related to the experiment. All adverse events reported spontaneously by the subject or observed by the investigator or study staff will be recorded and will be dealt with as deemed appropriate for the situation by the investigator. This includes reporting to the ethics committee and any emergency actions needed.

### 8.1.2 Serious adverse events (SAEs)

A serious adverse event is any untoward medical occurrence or effect that:

- results in death;
- is life threatening (at the time of the event);
- requires hospitalisation or prolongation of existing inpatients' hospitalisation;
- results in persistent or significant disability or incapacity;
- is a congenital anomaly or birth defect;
- Any other important medical event that may not result in death, be life threatening, or require hospitalization, may be considered a serious adverse experience when, based upon appropriate medical judgement, the event may jeopardize the subject or may require an intervention to prevent one of the outcomes listed above.


The investigator will report the SAEs to the accredited ethics committee that approved the protocol, as soon as possible, and no later than 15 days after the investigator has first knowledge of the serious adverse events.

SAEs that result in death or are life threatening should be reported expedited. The expedited reporting will occur not later than 7 days after the responsible investigator has first knowledge of the adverse event. This is for a preliminary report with another 8 days for completion of the report.

## 8.2 Follow-up of adverse events

All AEs will be followed until they have abated, or until a stable situation has been reached.



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## 9 Data Analysis

The datasets will be checked on missing and duplicate data, on the range of the data and on correct read in and calculations of the variables. All transformations, calculations and changes (if any) in datasets will be controlled and recorded.

### 9.1 Missing values


The decision of how to deal with missing values will depend on the randomness of missing and the number of missing data. Decisions will be described in any reports. If the decision is to impute missing data, this will be done only after the first step of data analysis, in which the percentage of missing data is assessed.

### 9.2 Primary study parameters

The purpose of this study is to demonstrate a methodology for a non-targeted collection of data to characterise the external exposome and to use this methodology in collecting exposure data in different countries. Thus the primary study parameters are those that relate to exposure data.

The agnostic exposome approach includes planned and exploratory data analyses. Planned analyses include:

- Estimating adult and child personal exposure to air pollutants by combining location and activity data, and data on air pollution in different microenvironments (e.g. at home, at work, etc.). Air pollution data will come from both measurements done in this study and from other monitoring sources such as local air quality monitoring stations, and air quality models.
- Estimating UV exposure from location data collected in study and outdoor UV erythemal dose data from satellite data and models
- Estimate noise exposure
- Analyse dietary intake of various foods and, where available, model intake of contaminants using food contaminant databases

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- Analyse the relationship between household variables, such as cleaning activity, product use, etc. on home environmental contaminant levels
- Compare exposure data between countries in study.
- Use data to parameterize and/or validate simulation models.

The feasibility of the methods employed will be assessed based on completeness of data, reported compliance, and reported experiences by the subjects.

The end-of-study assessment questionnaire will be summarized descriptively.

## 10 Ethical considerations

### 10.1 Regulation statement

The study will be conducted in compliance with the protocol and all amendments to the protocol. The protocol and any changes to the protocol effecting the design, rationale or objectives of the study, or the burden of or health risks for the volunteers will only be implemented after written approval of the ethics committee of the School of Life Sciences of Heriot-Watt University.


The study will be conducted according to:

1. The current revision of the World Medical Association Declaration of Helsinki. 64th WMA General Assembly, Fortaleza, Brazil, October 2013. Note of clarification on paragraph 29 added by the WMA General Assembly, Washington, 2002. Note of clarification on paragraph 30 added by the WMA General Assembly, Tokyo 2004;4. The current national regulations.

### 10.2 Recruitment of subjects

Each centre will develop its own recruitment plan.

*IOM Edinburgh recruitment plan.* We plan to recruit potential subjects in several ways. We will approach nurseries, charities or other groups that sponsor activities for parents and children, about recruiting through them by posting informational posters and providing information leaflets to the children's parents (see Appendix 7 and 813 for leaflet and

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recruitment letter). We will also advertise through parent-child online sites and local magazines and via word-of-mouth. In cases where we send leaflets and letters by post or via a nursery or other group, a postage-paid reply form will be provided for parents to send back to IOM. In all cases, the recruitment materials will include a telephone number and email at IOM for interested people to contact. The researcher will contact the potential subject via telephone and/or email. If the researcher cannot reach the subject the first time, he/she will make 3 more attempts and then stop contacting the person. If the potential subject says they do not wish to participate, no further attempt to contact the person will be made.

### 10.3 Information and consent

Subjects will be given a subject information leaflet (Appendix 9) explaining the study's aims and objectives. The test procedures will be explained to each subject and each will be given an opportunity to ask questions prior to them providing consent for themselves, their household, and child to participate on the study by means of a signed Subject Consent Form (also in Appendix 9). Subjects will also be asked to consent to terms and conditions of the devices used for data collection. For devices and apps which require a log in and password, the study staff will provide subjects with an anonymised email address and username.


Subjects will be informed that they are allowed to withdraw at any time and without explanation.

### 10.4 Objection by minors or incapacitated subjects

Any minors in this study will be below the age of 3 years. Consent will be given by the child's official guardian. Personal exposure devices will be worn by the caretakers, not the children. Some exposure assessment equipment will be placed in the child's bedroom.

### 10.5 Benefits and risks assessment, group relatedness

There are no special risks for participation in this study. The included devices are commercially available and do not pose any health risks. This study does not include an intervention.

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## 10.6 Compensation for injury

IOM maintains public liability insurance for claims in respect of personal injury to or death of any person or damage to any property of up to £10,000,000 arising out of or in connection with the study and caused or contributed to by any negligence, omission or default by IOM.

## 10.7 Incentives

Each household will be provided with compensation in the form of a gift voucher for £35 and will be the same for all subjects.

# 11 Administrative aspects, monitoring and publications


## 11.1 Data Management and Security

Data collected under this project will be subject to compliance with the Data Protection Act 1998.

All researchers will be trained in the ethics of human subject research and in the appropriate information governance. Subject names and contact information will be kept in a separate file, linked with the person's ID code for the study. This will be kept encrypted on a password protected computer. Only personnel authorized by the study will have access to this and any other files containing private information. Any paper documents with subject information will be kept in a locked cabinet, and only study personnel will have access to the keys.

A data management system will be used to securely store and share data via the internet, ensuring that only authorized HEALS personnel have access. The stored data will be encrypted. Any data to ultimately be made public will be adequately de-identified. No potentially identifying data will be revealed in any public data or data publication.

Data collected using do-it-yourself devices will be uploaded to an online portal using an anonymous account. After a subject is included in the study, he/she will be provided with an envelope including a login for an email account (which is linked to the subject number) and a password. Prior to the start of the study, for each subject number an account is created for Fatsecret (food intake application), Fitbit (activity monitor), Moves (Smartphone app), Netatmo, Wireless Tags and the HEALS portal. The email account will be linked to these accounts. Data from these applications will be synchronized to the HEALS portal via an

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Application Protocol Interface (API). The portal is hosted on a server, constantly monitored and maintained by TNO. For authorisation we use the Spring Security framework, which is responsible for the control of passwords (encrypted and decrypted) and the relevant different users (e.g. subject, fieldworker, administrator etc.) Furthermore, the subject data and personal information will be stored in two different and separate databases. All links implemented into the portal work with the OAuth authentication, which is a part of Spring Security. Spring Security is a long-established framework with a large support. All providers (Netatmo, Fitbit, Fatsecret, Moves) will be linked to the HEALS portal work with this platform.

Subjects have to enter some data manually on their account in the HEALS portal. Data from all other devices will be uploaded to the HEALS portal automatically.

Only anonymized data can be downloaded from the HEALS portal for subsequent tabulation and statistical analysis. Subjects and households will be assigned a unique identification code that does not include any identifying information. Information such as address and phone number will be kept in a separate, encrypted database and will not be linked to subject data in analyses.


The documentation of this study consists of the study protocol, correspondence, report, raw data, source documents or authenticated copies of these.

For privacy reasons, documents containing data of individual subjects will be identified only by their pre-entry or entry number.

Information with personal identifiers will be retained for the timescale set out by the IOM's Research Procedures (which would normally be 5 years after the publication of reports on the subject, unless a longer timescale is required by the sponsoring organization). Anonymous matched data may be retained for future research, but without any link to personal identifiers (e.g. date of birth converted to age at last birthday, etc.).

## 11.2 Device and sample management

Electronic and do-it-yourself devices will be re-used throughout the study. In all cases, data will be downloaded and removed from the device before re-use in another household and for another subject. Do-it-yourself devices will be reset for use with a new user and password, and the past user's information will not be available to the next user. Each device will be assigned a unique ID, which will be linked with any identifiers, such as a serial number, for

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the device, and will not be changed during the study. This will allow researchers to track any issues that may come up with certain devices. The device ID used for each household/subject will be recorded and entered into a database.

Passive air and dust samplers that are set out by the fieldworkers on the first visit and the vacuum dust contents will be logged with a unique sample ID, which will be linked to the household ID. These will be associated with a chain of custody form, that will be filled out by each person handling the samples, and which will be kept with the samples. These forms will only use household and sample ID numbers for identification. The location and status of samples throughout their life cycle (i.e. from laboratory to home, back to laboratory, to any further analysis) will be logged in a database. Any associated measurements or treatments of the sample will also be logged in this database. If the sample is sent outside of the IOM for analysis, courier tracking will be used, and appropriate transit conditions will be used (e.g. use of a cooling box or other method for storage, next day delivery, etc.). Recipients will be required to sign and send the original of the chain of custody form back to the IOM, keeping a copy. All transactions will be logged in the sample database.

### 11.3 Monitoring and quality assurance

Audits of the data collection and processing procedures will be taken throughout the project. For example:

- An audit of the data collection process employed by the fieldworkers will be carried out at regular project meetings, both within the IOM and between study centers.
- Most of the data collected will not be manually entered. Research staff will be responsible for checking that data is uploaded to the HEALS portal during the collection period for each household and to the database during and after the collection period.
- Any manually entered data will be checked for completeness of entry and compared to the paper questionnaire and data logs by someone who did not enter the data.
- All devices will be tested at the institute before use in the field. Tests will include co-location, reliability for the sampling time, and comparison with a reference instrument, if available.

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- Approximately 10% of passive air samples will be co-located duplicates and 10% will be blank.

## 11.4 Annual and end-of-study progress reports

If required the sponsor/investigator will submit a summary of the progress of the trial to the ethics committee once a year. Information will be provided on the date of inclusion of the first subject, numbers of subjects included and numbers of subjects that have completed the trial, serious adverse events/ serious adverse reactions, other problems, and amendments.

## 11.5 Public disclosure and publication policy


Public disclosure may include:

- Summarized study results issued on the study or institutional website;
- Oral or poster presentation at conferences, symposia or other public meetings;
- Full publication in peer-reviewed scientific journals.

In any case only encoded data will be used and no reference to any information leading to the identification of the participant subjects will be disclosed.

## 11.6 Report back to study subjects


The study subjects will be able to view their data on the do-it-yourself devices. As this is a demonstration project, some of the collected samples (e.g. dust) may be stored and analysed at a later date. The subjects will be given the option of receiving reports of data from air and dust samples, if these are analysed within 5 years of study completion. Within 6 months of data collection the study participants will receive an overview of their results that are available at that time.

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## Appendix 1: HEALS Partners

#	Organisation Name	Short name	Country	Principal Investigator
1	<a href="#">UNIVERSITE PIERRE ET MARIE CURIE PARIS 6</a>	UPMC	France	Dr. Isabella Annesi-Maesano
2	<a href="#">ARISTOTLE UNIVERSITY OF THESSALONIKI</a>	AUTH	Greece	Prof. Dimosthenis Sarigiannis
3	<a href="#">INSTITUTE OF OCCUPATIONAL MEDICINE</a>	IOM	UK	Dr. John Cherrie
4	<a href="#">UNIVERSITAET STUTTGART</a>	USTUTT	Germany	Prof. Dr. Rainer Friedrich
5	<a href="#">INSTITUT JOZEF STEFAN</a>	JSI	Slovenia	Prof. dr. Milena Horvat
6	<a href="#">UNIVERSITE PARIS DESCARTES</a>	UPD	France	Prof. Robert Barouki
7	<a href="#">UNIVERSITY OF BRISTOL</a>	UNIVBRIS	UK	Prof Clive Sabel
8	<a href="#">ISTITUTO SUPERIORE DI SANITA</a>	ISS	Italy	Dr. Gemma Calamandrei
9	<a href="#">LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN</a>	LMU	Germany	Dr. med. Stephan Böse-O'Reilly
10	<a href="#">INSTYTUT MEDYCYNY PRACY NOFERA</a>	NIOM	Poland	Prof. Wojciech Hanke
11	<a href="#">TEKNOLOGIAN TUTKIMUSKESKUS</a>	VTT	Finland	Dr. Sami Nousiainen
12	<a href="#">THE UNIVERSITY OF MANCHESTER</a>	UM	UK	Dr. AC Povey




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13	<a href="#">NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK</a>	TNO	Netherlands	Dr. Rob Stierum
14	<a href="#">THE SECRETARY OF STATE FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS</a>	FERA	UK	Dr. Adrian Charlton
15	<a href="#">AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS</a>	CSIC	Spain	Prof. Joan O. Grimalt
16	<a href="#">UNIVERSITY OF WESTERN MACEDONIA</a>	UOWM	Greece	Prof. John Bartzis
17	<a href="#">FUNDACIO PRIVADA PARC CIENTIFIC DE BARCELONA</a>	CERETOX	Spain	Dr. Miquel Borràs
18	<a href="#">INSTITUTO DE ENGENHARIA MECANICA</a>	IDMEC-FEUP	Portugal	Prof. Eduardo de Oliveira Fernandes
19	<a href="#">OIKON DOO INSTITUT ZA PRIMIJENJENU EKOLOGIJU</a>	OIKON	Croatia	Dr. Zdravko Spiric
20	<a href="#">CONSIGLIO NAZIONALE DELLE RICERCHE</a>	CNR	Italy	Prof. Giovanni Viegi
21	<a href="#">UNIVERSIDADE DO PORTO</a>	FMUP	Portugal	Prof. Elisabete Ramos
22	<a href="#">NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS"</a>	NCSR	Greece	Dr. Leondios Leondiadis
23	<a href="#">UNIVERSITAT ROVIRA I VIRGILI</a>	URV	Spain	Prof. Marta Schuhmacher
24	<a href="#">KLINIKUM DER UNIVERSITAET REGENSBURG</a>	UKR	Germany	Prof. Michael Kabesch
25	<a href="#">SERVICXS BV</a>	SXS	Netherlands	Prof. Dr. B.

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#	Organisation Name	Short name	Country	Principal Investigator
				Janssen
26	<a href="#">KING'S COLLEGE LONDON</a>	KCL	US	Prof. Tim Spector
27	<a href="#">NASJONALT FOLKEHELSEINSTITUTT</a>	NIPH	Norway	Dr. Jennifer Harris
28	<a href="#">SYDDANSK UNIVERSITET</a>	SDU	Denmark	Prof. Kaare Christensen
29	<a href="#">THE REGENTS OF THE UNIVERSITY OF CALIFORNIA</a>	UC	USA	Prof. Michael Jerrett

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## Appendix 2: Household observational questionnaire

# HEALS Pilot Study

## OBSERVATIONAL QUESTIONNAIRE (to be completed by field staff)

\*\*\*\*\*

HOUSEHOLD ID: \_\_\_\_\_


NAME OF FIELD WORKER: \_\_\_\_\_

DATE OF OBSERVATION: \_\_\_\_\_

TIME OBSERVATION BEGAN: \_\_\_\_\_

TIME OBSERVATION ENDED: \_\_\_\_\_

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## SECTION A. EXTERIOR OF DWELLING OBSERVATIONS

1. (1A-J) Are there any nearby (within 200 m) potential sources of pollution?  
(check all that apply)

- a) ☐ 1= None
- b) ☐ 1= Car parking close to building
- c) ☐ 1= Attached garage
- d) ☐ 1= Highway
- e) ☐ 1= Busy road
- f) ☐ 1= Low-traffic road
- g) ☐ 1= Power plant
- h) ☐ 1= Industry
- i) ☐ 1= Agricultural sources
- j) ☐ 1= Other (*Specify:* \_\_\_\_\_)

2. Where is the building situated?

- ☐ 1 = Industrial area
- ☐ 2 = Mixed industrial/residential area
- ☐ 3 = Commercial area
- ☐ 4 = Mixed commercial/residential area
- ☐ 5 = City centre
- ☐ 6 = Town with no or small gardens
- ☐ 7 = Village in rural area
- ☐ 8 = Rural area with no or few other homes nearby

3. What is the kind of dwelling?


- ☐ 1 = Free standing house
- ☐ 2 = two attached houses
- ☐ 3 = multiple houses attached (row/terrace)
- ☐ 4 = Multi-unit building (apartment)
- ☐ 5 = Other (*Specify:* \_\_\_\_\_)

4. On which floor (storey) do you live?

\_\_\_\_\_

5. On what type of road is the dwelling located?

- ☐ 1 = Asphalt
- ☐ 2 = Concrete
- ☐ 3 = Gravel
- ☐ 4 = Unpaved, dirt
- ☐ 5 = Mixed (describe with proportions) \_\_\_\_\_
- ☐ 6 = Other \_\_\_\_\_

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6. What type of foundation does the dwelling have?

☐1 = Cinderblocks

☐2 = Slab

☐3 = Crawl space

☐4 = Full basement

☐5 = Other \_\_\_\_\_

☐888 = Don't know

7. Is there any peeling/crumbling paint on exterior components of the home or nearby buildings/structures?

☐0= No

☐1= Yes

8. Are there solar shading devices present?

☐0= No

☐1= Yes

9. Is there any visible algae/fungi/moss on the outdoor walls?

☐0= No

☐1= Yes


## SECTION B. INTERIOR OF DWELLING OBSERVATIONS

10. Does the living room have windows looking out on:  
PLEASE CHECK ONE ANSWER PER ITEM.


	0 = No	1 = yes
a. a major road (>50km/h)		
b. a minor road (<50km/h)		
c. a railway track		
d. a park/forest		

11. Does the bedroom have windows looking out on:  
PLEASE CHECK ONE ANSWER PER ITEM.

	0 = No	1 = yes
a. a major road (>50km/h)		
b. a minor road (<50km/h)		
c. a railway		

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track		
d. a park/forest		


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12. How is the house ventilated? (**Interviewer:** Check all that are applicable)

- ☐ a Windows
- ☐ b Exhaust only
- ☐ c Supply and exhaust devices
- ☐ d Air conditioning cabinets
- ☐ e Other (*Specify:* \_\_\_\_\_)
- ☐ 888 = Don't know
- ☐ 999 = Refused

13. What is the total area in m<sup>2</sup> of the home? \_\_\_\_\_ m<sup>2</sup>

14. In the space below, sketch the interior layout of the house (each floor), noting where each room is located. Label each room as A, B, C, etc. and use these same letters to reference the answers to question 15.

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*Interviewer: In the next section, please answer the following set of questions for each room.*

*Room reference label from diagram: \_\_\_\_\_*

12A. Room type: \_\_\_\_\_ (e.g. living room, bedroom, kitchen, etc)

12A\_1a. \_\_\_\_\_ Room height (m)

12A\_1b. \_\_\_\_\_ Room width (m)

12A\_1c. \_\_\_\_\_ Room length (m)


12A\_2. Floor type (check all that apply):

	Type	0 = No	1 = Yes
12A_2a.	Stone/tile		
12A_2b.	Wall-to-wall Carpet		
12A_2c.	Other textile carpet		
12A_2d.	Wood		
12A_2e.	Linoleum		
12A_2f.	Concrete		
12A_2g.	Vinyl/PVC		
12A_2h.	Other (Specify: _____)		
12A_2i.	888 = Don't know		

12A\_3. Wall type (check all that apply):

	Type	0 = No	1 = Yes
12A_3a.	Wallpaper		
12A_3b.	Paint		
12A_3c.	Wood/sealed cork		
12A_3d.	Porous fabric (incl. textiles)		
12A_3e.	Stone/tile		
12A_3f.	Exposed concrete		
12A_3g.	Plaster		
12A_3h.	Other (Specify: _____)		
12A_3i.	888 = Don't know		




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12A\_4. Ceiling type (check all that apply):

	Type	0 = No	1 = Yes
12A_4a.	Exposed concrete		
12A_4b.	Plaster		
12A_4c.	Paint		
12A_4d.	Synthetic		
12A_4e.	Mineral fibre tile		
12A_4f.	Wood fibre tile		
12A_4h.	Other (Specify: _____)		
12A_4i.	888 = Don't know		

<p>12A_5. How often is the floor cleaned?</p> <p><input type="checkbox"/> 1=Never</p> <p><input type="checkbox"/> 2=Less than once a year</p> <p><input type="checkbox"/> 3=At least once a year</p> <p><input type="checkbox"/> 4=At least once every few months</p> <p><input type="checkbox"/> 5=At least once a month</p> <p><input type="checkbox"/> 6=At least once a week</p> <p><input type="checkbox"/> 888=Don't know</p> <p><input type="checkbox"/> 999=Refused</p>	<p>What type of cleaning do you apply? (check all that apply)</p> <p>12A_5a. <input type="checkbox"/> Vacuum</p> <p>12A_5b. <input type="checkbox"/> Wet washing with a mop</p> <p>12A_5c. <input type="checkbox"/> Dry sweeping with a cloth</p> <p>12A_5d. <input type="checkbox"/> Dry sweeping with a broom</p> <p>12A_5e <input type="checkbox"/> Other (Specify: _____)</p> <p><input type="checkbox"/> 777 = Not applicable</p> <p><input type="checkbox"/> 888 = Don't know</p> <p><input type="checkbox"/> 999 = Refused</p>
<p>12A_6. How often are the other surfaces cleaned?</p> <p><input type="checkbox"/> 1=Never</p> <p><input type="checkbox"/> 2=Less than once a year</p> <p><input type="checkbox"/> 3=At least once a year</p> <p><input type="checkbox"/> 4=At least once every few months</p> <p><input type="checkbox"/> 5=At least once a month</p> <p><input type="checkbox"/> 6=At least once a week</p> <p><input type="checkbox"/> 888=Don't know</p> <p><input type="checkbox"/> 999=Refused</p>	<p>What type of cleaning do you apply? (check all that apply)</p> <p>12A_6a. <input type="checkbox"/> Dry dusting using a cloth or feather duster</p> <p>12A_6b. <input type="checkbox"/> Wiped down with a damp cloth or spray with cleaner</p> <p>12A_6c. <input type="checkbox"/> Vacuum</p> <p>12A_6d. <input type="checkbox"/> Other (Specify: _____)</p> <p><input type="checkbox"/> 777 = Not applicable</p> <p><input type="checkbox"/> 888 = Don't know</p>

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12A\_7. Do you see any damp spots?

☐0=No ☐1=Yes

If yes, 12A\_7a (*Specify:* \_\_\_\_\_)

12A\_8. Is there any visible mold?

☐0=No ☐1=Yes

If yes, 12A\_8a (*Specify:* \_\_\_\_\_)

12A\_9. Are there window coverings such as blinds or curtains?

☐0=No ☐1=Yes

If yes, 12A\_9a (*Specify:* \_\_\_\_\_)

12A\_10. How many windows are there? \_\_\_\_\_ (number of windows)

12A\_11. What kind of glazing do the windows have?

☐1=Single ☐2=Double ☐3=Other (*Specify:* \_\_\_\_\_)


12A\_12. Is there condensation on the windows?

☐1=No

☐2=Yes, outside

☐3=Yes, inside

☐4=Yes, between glazing

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## Appendix 3: Household questionnaire

# HEALS Pilot Study

## HOUSEHOLD QUESTIONNAIRE (to be completed by field staff)

\*\*\*\*\*

HOUSEHOLD ID: \_\_\_\_\_


NAME OF FIELD WORKER: \_\_\_\_\_

DATE OF OBSERVATION: \_\_\_\_\_

TIME OBSERVATION BEGAN: \_\_\_\_\_

TIME OBSERVATION ENDED: \_\_\_\_\_

\*\*\*\*\*

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## SECTION A. HOUSING CHARACTERISTICS

*[Interviewer say: First I will ask you a few general questions about your home].*

1. How many years have you lived in your current home? \_\_\_\_\_(number of years)  
☐ 888 = Don't know      ☐ 999 = Refused
2. How old is your current home? \_\_\_\_\_(number of years)  
☐ 89 = Don't know   ☐ 99 = Refused
3. Have there been any renovations made to this home since you have been living here?  
☐ 0 = No  
☐ 1 = Yes  
☐ 89 = Don't know  
☐ 99 = Refused


*[Interviewer: Ask #4-5 if response to #3 was "Yes". Otherwise mark "Not applicable"]*

<p>4. In what year(s) was/were renovations made to the home?  _____</p> <p><input type="checkbox"/> 777 = Not applicable    <input type="checkbox"/> 888 = Don't know    <input type="checkbox"/> 999 = Refused</p> <p>5. What kinds of renovations have been made to the home? (Check all that apply)</p> <ul style="list-style-type: none"> <li>a) <input type="checkbox"/> 1 = Wall painting/new wallpaper</li> <li>b) <input type="checkbox"/> 1 = Ceiling</li> <li>c) <input type="checkbox"/> 1 =Floor repair/polishing/varnishing</li> <li>d) <input type="checkbox"/> 1 =Water/sewage system repair</li> <li>e) <input type="checkbox"/> 1 =Window or door repair/replacement</li> <li>f) <input type="checkbox"/> 1 =Insulation repair/replacement</li> <li>g) <input type="checkbox"/> 1 =Wall construction/removing</li> <li>h) <input type="checkbox"/> 1 =Heating/cooling system</li> <li>i) <input type="checkbox"/> 1 = Building an extension to home</li> <li>j) <input type="checkbox"/> 1 = Other (please specify: _____)</li> <li>k) <input type="checkbox"/> 1 = None</li> <li>l) <input type="checkbox"/> 777 = Not applicable</li> <li>m) <input type="checkbox"/> 888 = Don't know</li> <li>n) <input type="checkbox"/> 999 = Refused</li> </ul>
---

6. Has there ever been any water damage in your home?  
☐ 0 = No    ☐ 1 = Yes

*[Interviewer: if answer to 6 is "yes", ask 7 and 8]*

7. If yes, where?
  - a) ☐ 1 = bathroom
  - b) ☐ 1 = child's bedroom

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- c) ☐ 1 = living room  
d) ☐ 1 = kitchen  
e) ☐ 1 = in other rooms

8. When? \_\_\_\_\_ month \_\_\_\_\_ year

9. Please describe the source of your drinking water and cooking water. If the source is tap water, please describe whether and how it is treated?


	<b>Drinking</b>	<b>Cooking</b>
a. Source	<input type="checkbox"/> 1 = Tap <input type="checkbox"/> 2 = Bottled <input type="checkbox"/> 3 = Other (Specify: _____) <input type="checkbox"/> 89 = Don't know <input type="checkbox"/> 99 = Refused	<input type="checkbox"/> 1 = Tap <input type="checkbox"/> 2 = Bottled <input type="checkbox"/> 3 = Other (Specify: _____) <input type="checkbox"/> 89 = Don't know <input type="checkbox"/> 99 = Refused
b. If treated, how?	<input type="checkbox"/> 1 = Activated carbon (countertop pitcher such as Brita filter, faucet filter, or under-the-sink) <input type="checkbox"/> 2 = Water softener <input type="checkbox"/> 3 = Distiller (countertop pitcher, whole-house, or point-of-entry unit) <input type="checkbox"/> 4 = Reverse osmosis (under the sink) <input type="checkbox"/> 5 = Ultraviolet disinfection (under the sink) <input type="checkbox"/> 6 = Other (Specify: _____) <input type="checkbox"/> 777 = Not applicable <input type="checkbox"/> 888 = Don't know <input type="checkbox"/> 999 = Refused	<input type="checkbox"/> 1 = Activated carbon (countertop pitcher such as Brita filter, faucet filter, or under-the-sink) <input type="checkbox"/> 2 = Water softener <input type="checkbox"/> 3 = Distiller (countertop pitcher, whole-house, or point-of-entry unit) <input type="checkbox"/> 4 = Reverse osmosis (under the sink) <input type="checkbox"/> 5 = Ultraviolet disinfection (under the sink) <input type="checkbox"/> 6 = Other (Specify: _____) <input type="checkbox"/> 777 = Not applicable <input type="checkbox"/> 888 = Don't know <input type="checkbox"/> 999 = Refused

10. Are there any smokers in the household? Please tick any which apply.

- ☐ 1 = none  
☐ 2 = father  
☐ 3 = mother  
☐ 4 = siblings  
☐ 5 = somebody else, Who? \_\_\_\_\_

11. How many cigarettes per day are smoked indoors in your home? (eg. father 3, mother 2, sister 5 = 10 cigarettes in all)

- ☐ 1 = none  
☐ 2 = 1-5 cigarettes  
☐ 3 = 6-10 cigarettes

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- ☐ 4 = 11-15 cigarettes
- ☐ 5 = 16-20 cigarettes
- ☐ 6 = 21-30 cigarettes
- ☐ 7 = more than 30 cigarettes

12. If there are smokers in the family, do you usually smoke

- ☐ 1 = usually, indoors
- ☐ 2 = usually outdoors (e.g. on the balcony)
- ☐ 3 = always outdoors, including visitors

13. Do you currently have pets? Please tick any which apply.

- ☐ 1 = no
- ☐ 2 = dog
- ☐ 3 = cat
- ☐ 4 = hamster
- ☐ 5 = guinea pig
- ☐ 6 = mice
- ☐ 7 = gerbils
- ☐ 8 = birds
- ☐ 9 = fish
- ☐ 10 = other animals, which? \_\_\_\_\_

## SECTION B. IN-HOME ROUTINES

*[Interviewer say: Next, I will ask you about some of your household routines]*

14. During what months do you generally cool your home using air conditioning equipment? (Check all that apply)


- a) ☐ 1 = January-March
- b) ☐ 1 = April-June
- c) ☐ 1 = July-September
- d) ☐ 1 = October-December

15. During what months do you generally heat your home? (Check all that apply)


- a) ☐ 1 = January-March
- b) ☐ 1 = April-June
- c) ☐ 1 = July-September
- d) ☐ 1 = October-December

16. What is the main heating system in your residence?

- a) ☐ 1 = Central heating with radiators
- b) ☐ 1 = Electrical heating
- c) ☐ 1 = Under floor heating
- d) ☐ 1 = Heating in the ceiling
- e) ☐ 1 = Air circulating heating system

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- f) ☐ 1 = Fireplaces or ovens  
 g) ☐ 1 = Other (*Specify:* \_\_\_\_\_ )  
 h) ☐ 888 = Don't know

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17. What fuel do you use to heat your home? (Check all that apply)

- a) ☐ 1 = Electricity
- b) ☐ 1 = Gas
- c) ☐ 1 = Liquid fuel
- d) ☐ 1 = Wood burning stove/ fireplace
- e) ☐ 1 = Other (*Specify:* \_\_\_\_\_ )
- f) ☐ 888 = Don't know

18. When the weather permits, how often do you open windows or doors for several hours a day?

- ☐ 1 = Never
- ☐ 2 = Less than once a month
- ☐ 3 = About one to three times a month
- ☐ 4 = About once a week
- ☐ 5 = Several times a week
- ☐ 6 = Every day
- ☐ 888 = Don't know

19. Do you usually sleep with your window open?

- a) during summertime ☐ 0 = no ☐ 1 = yes
- b) during wintertime ☐ 0 = no ☐ 1 = yes

20. What type of material are your sofas and armchairs? (Check all that apply)

- a) ☐ 1 =Leather
- b) ☐ 1 =Upholstered with fabric cloth
- c) ☐ 1 =Upholstered with vinyl material
- d) ☐ 1 =Other (*Specify:* \_\_\_\_\_ )
- e) 777 = Not applicable
- f) 888 = Don't know

21. Which best describes your family's habit regarding wearing shoes in the home?

- ☐ 1 = Shoes are taken off prior to entering the home
- ☐ 2 = Shoes are taken off right away after entering the home
- ☐ 3 = Shoes are taken off prior to entering certain rooms
- ☐ 4 = Shoes are not routinely taken off while in the home
- ☐ 888 = Don't know ☐ 999 = Refused

22. What kind of stove do you use in cooking? Please tick any which apply.


- ☐ 1 = electrical stove
- ☐ 2 = gas cooking
- ☐ 5 = something else, \_\_\_\_\_

23. Do you have a ventilation hood above the stove?

- ☐ 0 = No ☐ 1 = Yes

[Interviewer: if answer to 23 is "yes", ask 24]



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24. If you answered YES, do you use the hood when cooking?


- ☐ 1 = regularly  
☐ 2 = every now and then  
☐ 3 = seldom or never

25. How many hours per day is the whole family away from home on a typical weekday?

- ☐ 1 = 0-4 hours per day  
☐ 2 = 5-10 hours per day  
☐ 3 = 10-16 hours per day  
☐ 4 = Greater than 16 hours  
☐ 888 = Don't know      ☐ 999 = Refused

26. How many hours per day is the whole family away from home on a typical weekend day?

- ☐ 1 = 0-4 hours per day  
☐ 2 = 5-10 hours per day  
☐ 3 = 10-16 hours per day  
☐ 4 = Greater than 16 hours  
☐ 888 = Don't know      ☐ 999 = Refused

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## Appendix 4: Socioeconomic status questionnaire

# HEALS Pilot Study

## SOCIOECONOMIC STATUS QUESTIONNAIRE (to be completed by field staff)

\*\*\*\*\*

HOUSEHOLD ID: \_\_\_\_\_


NAME OF FIELD WORKER: \_\_\_\_\_

DATE OF OBSERVATION: \_\_\_\_\_

TIME OBSERVATION BEGAN: \_\_\_\_\_

TIME OBSERVATION ENDED: \_\_\_\_\_

\*\*\*\*\*

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Reference period: \_\_/201\_\_

Respondent ID.....

## SECTION A. HOUSEHOLD QUESTIONS

27. Please tell us about everybody in your household? [If age not known, please give best estimate] The main earner is the household member who usually earns the most money

Relationship to you e.g. son/daughter/husband/lodger/parent	Female	Male	Age	Main earner
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>

28. Do you have any children who do not currently live in your household?  
No ☐ Yes ☐ Please give ages :  
\_\_\_\_\_

29. Are you?  
Married ☐ Single ☐ Separated ☐ Divorced ☐ Widowed ☐

30. Are you?  
Living with the child's father ☐ Living with another partner ☐  
Not living with a partner ☐

31. If you are living with a spouse/partner, what year did you start living together? \_ \_ \_ \_

32. Does your child's father support your child financially nowadays?  
Regularly ☐ Sometimes ☐ Never ☐

WP9	Security:
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<b>Author(s):</b> Loh, M et al.	<b>Version:</b> 1
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5 to 7 nights a week ☐ 3 to 4 nights a week ☐  
 1 to 2 nights a week or 1 night per fortnight ☐  
 at least once a fortnight but not overnight ☐  
 less than once a fortnight and not overnight ☐  
 less than once a fortnight and does stay overnight (e.g. during holidays) ☐  
 does not see father ☐

Mother ☐    Father ☐    Mother's partner ☐    Grandparent ☐    Other ☐

Yes ☐ Sometimes ☐ No ☐


## SECTION B. FAMILY BACKGROUND

1. Please tell us about the ethnicity of yourself and your child's father (even if he is not living with you)

a) Ethnic group			b) Religion			c) Place of birth		
	You	Father		You	Father		You	Father
White (Scottish/British)	<input type="checkbox"/>	<input type="checkbox"/>	No religion	<input type="checkbox"/>	<input type="checkbox"/>	Scotland	<input type="checkbox"/>	<input type="checkbox"/>
White (other) ( <i>write in below</i> )	<input type="checkbox"/>	<input type="checkbox"/>	Buddhism	<input type="checkbox"/>	<input type="checkbox"/>	Rest of UK	<input type="checkbox"/>	<input type="checkbox"/>
Mixed ( <i>write in below</i> )	<input type="checkbox"/>	<input type="checkbox"/>	Christian	<input type="checkbox"/>	<input type="checkbox"/>	Republic of Ireland	<input type="checkbox"/>	<input type="checkbox"/>
Arab	<input type="checkbox"/>	<input type="checkbox"/>	Hinduism	<input type="checkbox"/>	<input type="checkbox"/>	Poland	<input type="checkbox"/>	<input type="checkbox"/>
Asian (Pakistani, Indian, Bangladeshi)	<input type="checkbox"/>	<input type="checkbox"/>	Jewish	<input type="checkbox"/>	<input type="checkbox"/>	India	<input type="checkbox"/>	<input type="checkbox"/>
Asian (Chinese, Japanese, Korean)	<input type="checkbox"/>	<input type="checkbox"/>	Muslim	<input type="checkbox"/>	<input type="checkbox"/>	Pakistan	<input type="checkbox"/>	<input type="checkbox"/>
Asian (other) ( <i>write in below</i> )	<input type="checkbox"/>	<input type="checkbox"/>	Sikh	<input type="checkbox"/>	<input type="checkbox"/>	Germany	<input type="checkbox"/>	<input type="checkbox"/>
Black (African, Caribbean etc)	<input type="checkbox"/>	<input type="checkbox"/>	Other	<input type="checkbox"/>	<input type="checkbox"/>	<i>Other (write in below)</i>	<input type="checkbox"/>	<input type="checkbox"/>
Other ( <i>write in below</i> )	<input type="checkbox"/>	<input type="checkbox"/>						

Yes (bought new within the last 6 months) ☐

Yes (but not bought new within the last 6 months) ☐

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No - cannot afford a car ☐

No - other reason ☐

3. How often is the car used, in hours, for?

	<b>Weekday</b>	<b>Weekend</b>
Yourself		
Father		
Main earner (if different)		

4. How often does your child/children travel in this car, in hours? Please list in same order as question 1 in Section A


<b>Age of child</b>	<b>Weekday</b>	<b>Weekend</b>

5. What are your GROSS household (before tax) annual earnings in the last 12 MONTHS? £\_\_\_\_\_

6. What is the highest level of successfully completed education for:


	<b>You</b>	<b>Father</b>	<b>Main earner (if different)</b>
None	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
School/sixth form college	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vocational/apprenticeship	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (write in)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. What is the current economic activity of:

	<b>You</b>	<b>Father</b>	<b>Main earner (if different)</b>
Working for pay or profit (including unpaid work for a family business or holding; an apprenticeship or paid traineeship; currently on maternity, parental, sick leave or holidays)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pupil, student, further training, unpaid work experience	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
In retirement (including early retirement)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Permanently sick or disabled	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Caring for home and/or family (unpaid)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Unemployed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (write in) 	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. If you are currently working, how long have you been at your current job?

\_\_\_\_\_


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9. If you are not currently working, how long have you not been working?

\_\_\_\_\_


## SECTION C. OCCUPATION QUESTIONS

1. Please tell us about the current (or most recent) job of yourself, your child's father and main earner (if different)

	<b>Yourself</b>	<b>Child's father</b>	<b>Main earner (if different)</b>
Does not work (if no one applicable works go to section E)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Job title			
Full time or part time?			
Main job tasks			
Main activity of the employer/business			
Tick box if self employed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Number of supervisees/ employees			
Number of people in company			
Number of hours usually worked per week?			
Usual transport to work (please tick the one for each person) ____			
Work mainly at or from home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A car or van	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Train	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Motorcycle, scooter or moped	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bicycle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
On foot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other means of transport	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Don't know		<input type="checkbox"/>	<input type="checkbox"/>

## SECTION D. HISTORIC DATA

We would like to know what sort of pollution and chemicals you have been exposed to so we would like you to tell us about where you and your child's father have lived and worked throughout your lives

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1. Please list previous addresses – please be as precise as you can recall but if you do not know the address please give the name of the village/town and country

a) Yourself


From (month and year)	To (month and year)	Address (as much information as known)

b) Child's father


From (month and year)	To (month and year)	Address (as much information as known)

c) Your parent (s) (child's grandparents)

Parent (s)	From (month and year)	To (month and year)	Address

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d) Child's father's parent (s) (child's grandparents)

<b>Parent (s)</b>	<b>From (month and year)</b>	<b>To (month and year)</b>	<b>Address</b>


2. Please list your employment history

a) Yourself

<b>From (month and year)</b>	<b>To (month and year)</b>	<b>Occupation</b>	<b>Address (if known)</b>	<b>Indoor or Outdoor Job?</b>	
				<b>Largely Indoor</b>	<b>Largely Outdoor</b>

b) Child's father

<b>From (month and year)</b>	<b>To (month and year)</b>	<b>Occupation</b>	<b>Address (if known)</b>	<b>Indoor or Outdoor Job?</b>	
				<b>Largely Indoor</b>	<b>Largely Outdoor</b>


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c) Main earner (if different)

From (month and year)	To (month and year)	Occupation	Address (if known)	Indoor or Outdoor Job?	
				Largely Indoor	Largely Outdoor


d). Your parents (child's grandparents)

Parent	From (month and year)	To (month and year)	Address
Mother			
Father			

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e) Child's father's parents (child's grandparents)

<b>Parent</b>	<b>From (month and year)</b>	<b>To (month and year)</b>	<b>Address</b>
Mother			
Father			

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## Appendix 5: Noise questions (1<sup>st</sup> visit)

# HEALS Pilot Study

## NOISE QUESTIONNAIRE (to be completed by field staff)

\*\*\*\*\*

HOUSEHOLD ID: \_\_\_\_\_


NAME OF FIELD WORKER: \_\_\_\_\_

DATE OF OBSERVATION: \_\_\_\_\_

TIME OBSERVATION BEGAN: \_\_\_\_\_

TIME OBSERVATION ENDED: \_\_\_\_\_

\*\*\*\*\*

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	<b>WP9</b>	<b>Security:</b>	
	<b>Author(s):</b> Loh, M et al.	<b>Version:</b> 1	61/107

1. Thinking about the past week, when at home, what number from 0 to 10 best shows how bothered, annoyed or disturbed you were by noise from the sources mentioned below?

*The scale ranging from 0 to 10 indicates how much noise bothers, disturbs or annoys you when you are here at home. If you are not at all annoyed choose 0, if you are extremely annoyed choose 10, if you are somewhere in between choose a number between 0 and 10. If you do not notice any noise from a source, please indicate this in the first column "don't notice".*

PLEASE CHECK ONE ANSWER PER ITEM.

	don't notice	not at all annoying											extremely annoying
		0	1	2	3	4	5	6	7	8	9	10	
road traffic													
railway													
other, namely .....													

- 2 During the past week, how often did noise from road traffic/railway:

	(almost) never	some times	often
prevent you from falling asleep?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
wake you up?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
impair your sleep quality?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

a) If you answered *sometimes* or *often*, how disturbing or annoying would you say this is?

	a bit	rather	very
prevent you from falling asleep?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
wake you up?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
impair your sleep quality?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- 3 Did you sleep with your window open during the past week?

☐ No ☐ Part of the time ☐ Most of the time

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**Complete this question only if you regularly walk ore cycle in transit:**

- 4 Thinking about the past week, when in transit walking or cycling, what number from 0 to 10 best shows how bothered, annoyed or disturbed you were by noise from the sources mentioned below?

PLEASE CHECK ONE ANSWER PER ITEM.

[illegible]

***Complete this question only if you regularly use public transport:***


- 5 Thinking about the past week, when using public transport, what number from 0 to 10 best shows how bothered, annoyed or disturbed you were by noise from the sources mentioned below?

PLEASE CHECK ONE ANSWER PER ITEM.

[illegible]

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[illegible]

 <b>HEALS</b>  FP7-ENV-2013-603946	D9.1- Practicable sensor-based exposure monitoring protocol for use in WP17		
	<b>WP9</b>	<b>Security:</b>	
	<b>Author(s):</b> Loh, M et al.	<b>Version:</b> 1	64/107

## Appendix 6: Evaluation

# HEALS Pilot Study

## EVALUATION QUESTIONNAIRE (to be completed by field staff)

\*\*\*\*\*

HOUSEHOLD ID: \_\_\_\_\_

NAME OF FIELD WORKER: \_\_\_\_\_


DATE OF OBSERVATION: \_\_\_\_\_

TIME OBSERVATION BEGAN: \_\_\_\_\_

TIME OBSERVATION ENDED: \_\_\_\_\_

\*\*\*\*\*




 <b>HEALS</b>  FP7-ENV-2013-603946	D9.1- Practicable sensor-based exposure monitoring protocol for use in WP17		
	<b>WP9</b>	<b>Security:</b>	
	<b>Author(s):</b> Loh, M et al.	<b>Version:</b> 1	65/107

## SECTION A. PARTICIPANT EXPERIENCES


How satisfied are you with this study overall?	<input type="checkbox"/> very satisfied <input type="checkbox"/> satisfied <input type="checkbox"/> Neutral <input type="checkbox"/> dissatisfied <input type="checkbox"/> very dissatisfied									
Did you experience participating in this study as pleasant or unpleasant?	<input type="checkbox"/> very pleasant <input type="checkbox"/> pleasant <input type="checkbox"/> Neutral <input type="checkbox"/> Unpleasant <input type="checkbox"/> very unpleasant									
Did participating in this study meet your expectations?	<input type="checkbox"/> yes, very <input type="checkbox"/> No, partially <input type="checkbox"/> No not at all									
Can you explain your answer to the last question?	..... ..... .....									
<b>How satisfied are you about this study on the following topics:</b> (rate 1 (very unsatisfied) – 10 (very satisfied))										
	1	2	3	4	5	6	7	8	9	10
a. The organization of the study	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. The provided information by the fieldworkers about the relevance of the study	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. The provided information (guidance) by the fieldworkers about logistics (e.g. use of the devices)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. The asked work from you as a volunteer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. The duration of the study	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>What went well, about...?</b>										
a. The organization of the study										
b. The provided information by the fieldworkers about the relevance of the study										
c. The provided information (guidance) by the fieldworkers about logistics (e.g. use of the devices)										
d. The asked work from you as a volunteer										
e. The duration of the study										

[illegible]

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Please rate your satisfaction with the devices in and around your house (1-10):										
	1	2	3	4	5	6	7	8	9	10
Netatmo	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dylos DC1700	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Passive badge samplers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To what extent do you think the devices are user friendly in and around your house (1-10):										
	1	2	3	4	5	6	7	8	9	10
Netatmo	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Dylos DC1700	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Passive badge samplers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Use of devices	
<p>Did you use the devices during the entire study period?</p> <p>If not, which devices did you not use during the entire study period?</p> <p>Please explain why you did not use these devices?</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p> <input type="checkbox"/> Fitbit  <input type="checkbox"/> Moves  <input type="checkbox"/> Netatmo  <input type="checkbox"/> Dylos DC1700  <input type="checkbox"/> Passive badge samplers  <input type="checkbox"/> Barcode scanner  <input type="checkbox"/> Noise </p> <p>.....</p> <p>.....</p>
<p>How often did you wear the following devices: (Please estimate in percentages)</p>	<p>Fitbit <input type="text"/></p> <p>Your phone <input type="text"/></p>
<p>Are there any devices that you would like to keep using after the study? (multiple choices possible)</p> <p>Please explain?</p>	<p> <input type="checkbox"/> Fitbit  <input type="checkbox"/> Moves  <input type="checkbox"/> Netatmo  <input type="checkbox"/> Dylos DC1700  <input type="checkbox"/> Passive badge samplers  <input type="checkbox"/> Barcode scanner  <input type="checkbox"/> Noise </p> <p>.....</p> <p>.....</p>

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## SECTION B. NOISE QUESTIONS

1. Thinking about the past week, when at home, what number from 0 to 10 best shows how bothered, annoyed or disturbed you were by noise from the sources mentioned below?

*The scale ranging from 0 to 10 indicates how much noise bothers, disturbs or annoys you when you are here at home. If you are not at all annoyed choose 0, if you are extremely annoyed choose 10, if you are somewhere in between choose a number between 0 and 10. If you do not notice any noise from a source, please indicate this in the first column "don't notice".*

PLEASE CHECK ONE ANSWER PER ITEM.

	don't notice	not at all annoying											extremely annoying
		0	1	2	3	4	5	6	7	8	9	10	
road traffic													
railway													
other, namely .....													

- 2 During the past week, how often did noise from road traffic/railway:

	(almost) never	some times	often
prevent you from falling asleep?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
wake you up?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
impair your sleep quality?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

a) If you answered *sometimes or often*, how disturbing or annoying would you say this is?

	a bit	rather	very
prevent you from falling asleep?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
wake you up?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
impair your sleep quality?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- 3 Did you sleep with your window open during the past week?

☐ No ☐ Part of the time ☐ Most of the time

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***Complete this question only if you regularly walk ore cycle in transit:***

- 4 Thinking about the past week, when in transit walking or cycling, what number from 0 to 10 best shows how bothered, annoyed or disturbed you were by noise from the sources mentioned below?

PLEASE CHECK ONE ANSWER PER ITEM.

[illegible]

***Complete this question only if you regularly use public transport:***


- 5 Thinking about the past week, when using public transport, what number from 0 to 10 best shows how bothered, annoyed or disturbed you were by noise from the sources mentioned below?

PLEASE CHECK ONE ANSWER PER ITEM.

[illegible]

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[illegible]

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## Appendix 7: Recruitment Flyer



### What are we studying?

Researchers from the Institute of Occupational Medicine (IOM) are studying exposures of parents and children to environmental hazards, including air pollution, chemicals, and noise, which are found both outdoors and indoors. Researchers are developing methods to measure and record these exposures and would like to determine whether these methods can be used in future studies of health impacts of the environment.



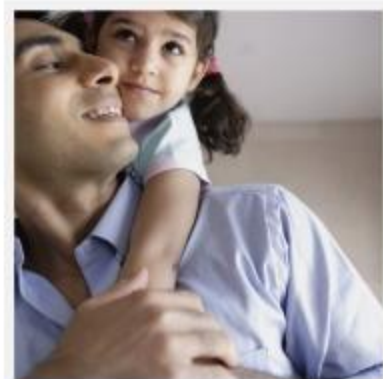
### Who can participate?

Households with at least one child that is no older than 3 years old and who live in the Edinburgh area.

### What is involved?

You would have different types of measurement devices to measure the environmental quality set up inside your home for a week.

During this time you would be asked to use your smartphone to answer questions and record data about your surroundings, the food you and your child eat, your activities, and where you go.



### What will you receive for participating in the study?

Each household will receive a gift card upon completion of the home visits.

### How will my privacy be protected?

You will be given a code for identification, and your name and identity will not be released at any point during the study, analysis, or presentation of any study results.

### How can I obtain more information?

Contact:

**Dr. Miranda Loh, Senior Scientist**


0131 449 8084 (office),

07818 426 602 (mobile),

[miranda.loh@iom-world.org](mailto:miranda.loh@iom-world.org)



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## Appendix 8: Initial Phone Call Script

**Household ID:** \_\_\_\_\_ [Fill out upon call completion]

**Parent/Guardian Name:** \_\_\_\_\_

**Time of phone call/contact:** \_\_\_\_: \_\_\_\_ ☐AM ☐PM

**Phone #/type:** \_\_\_\_\_

**How they hear about HEALS?** \_\_\_\_\_

### INTRODUCTION

**A: Hello, my name is \_\_\_\_\_. I work for \_\_\_\_\_. I'd like to speak to you about your interest in the HEALS study, which is a study of the effects of the environment on health; are you an adult or someone at least 18 years old in your house available to talk at this time?**

*If NO, May I speak with an adult that is at least 18 years old in your house?*


*If YES, continue with script at B below with the adult.*

*If NO, When is the best time to call back? [record date/time on Household Tracking Form and go to **Call Conclusion**]*

*[If 'Is this a telemarketing call?'*

**No, we're contacting you about a scientific study being conducted by \_\_\_\_\_. You or someone in your household had previously contacted us suggesting you were interested in participating in the study.]**



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**B: You or someone else in your home had contacted us with interest in the HEALS environmental exposure study. Are you still interested in participating in the study?**

*If NO, Alright. Please let me know if you'd like more information about the study or change your mind about participating in the future. Have a great day. [record date/time on the Home Data Sheet and go to Call Conclusion]*

*If YES, continue with script at C below.*

*[If 'Could you tell me more about the study?']*

**Certainly, we are conducting a pilot study to develop a method to measure a wide range of environmental exposures in households with young children. You would be helping us determine if these methods are feasible for use in future studies on health and the environment. We would place several types of monitors in your home and ask you questions about your home and home activities, to help us characterize the indoor environment of your home. We would also ask you, or another person who has primary responsibility for caring for your child, to answer various questions about your and your child's food and beverage intake, locations throughout the day, and other activities. We would also ask you questions about your family demographics. This study will also take place in several other cities in Europe.]**

**C: All of this information will help us determine whether we can use these methods in future studies of health and the environment, and will allow us to characterize some aspects of adult and child exposures to environmental factors. Keep in mind your family's information and identities would be confidential and never released. Finally, as compensation for your time, all participating households would receive a gift card. Do you have any other questions about the study?**


*If NO, continue with call at D.*


*If person has more questions, answer questions. When done, ask again,*

**Do you need more time to decide whether or not you're interested in participating?**

*If YES, say, OK, maybe you could call me back when you decide? Again, my name is \_\_\_\_\_ and you can call me at \_\_\_\_\_. If you prefer, I can call you back – please let me know a good time to do this.*

*If NO, continue with call at D*

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**Alright, would you like to participate?**

*If YES, continue with call at D*

*If NO, go to Call Conclusion*

**Great! Before we continue, I'd like to ask you a few questions to determine whether your family is eligible for the study:**

- 1. What is your street address?** [Mark as needed]

\_\_\_\_\_

- 2. How many children do you have less than or 3 years old living in your home?** \_\_\_\_\_ [Mark as needed]

- 3. Do you have an iPhone or Android phone?**

☐Yes ☐No [Check one]

- 4. [Interviewer: ask only if answer to #3 is Yes] What version of the operating system is the phone?**


\_\_\_\_\_

- 5. Do you have a laptop or desktop at home?**

☐Yes ☐No [Check one]

- 6. Do you have a wireless internet connection at home?**

☐Yes ☐No [Check one]

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- 7. Would you be willing to use your phone and home wireless connection for the study? We will ask you to download study-related apps to your phone and use them, and to allow certain study devices to be linked to the internet via your wireless connection. The study staff will help you set these up.**

☐Yes ☐No [Check one]

**OK, thanks for answering all those questions.**

*If family is eligible (must have answered YES to all the questions above),continue with script*

**If family is NOT eligible, say Unfortunately you are not eligible for the study at this time because**

\_\_\_\_\_ [note eligibility criteria(s) they do not meet]


**Would you like to be considered in the future if our eligibility requirements change and you meet them? ☐Yes ☐No [Check one]**

*If YES,* say **Great, we will be sure to contact you if you meet future eligibility requirements. Have a nice day and thank you for your time.**

*If NO,* say **OK, thank you very much for your time, have a great day.**

**Great, you're eligible to participate in the study. I would now like to schedule 2 home visits with you. During home visit #1, we will explain the study in more detail, provide you an informed consent form, do a survey of your home, administer a questionnaire to you, set up the study materials and provide you with directions as to what we would like you to do. This visit will take about 2 hours. During home visit #2, we will ask to take samples from your vacuum cleaner and water, administer final questionnaires to you and remove the study equipment. Home visit #2 will take about 1 hour. The two visits should be about one week apart. I'd like to schedule the visits at this time. When are you available for the home visits?**

[Fill out the following form for both visits]

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Date	Time
HV #1: ____ / ____ / ____	____ : ____ <input type="checkbox"/> AM <input type="checkbox"/> PM
HV #2: ____ / ____ / ____	____ : ____ <input type="checkbox"/> AM <input type="checkbox"/> PM

**Great, in order to be properly prepared for sampling, could you please tell me the age and date of birth of the children 3 years old or younger.**

[Fill out the following table.]

Child	Age	DOB	Gender	Notes
#1			<input type="checkbox"/> M <input type="checkbox"/> F <input type="checkbox"/> Other	
#2			<input type="checkbox"/> M <input type="checkbox"/> F <input type="checkbox"/> Other	
#3			<input type="checkbox"/> M <input type="checkbox"/> F <input type="checkbox"/> Other	
#4			<input type="checkbox"/> M <input type="checkbox"/> F <input type="checkbox"/> Other	
#5			<input type="checkbox"/> M <input type="checkbox"/> F <input type="checkbox"/> Other	

**We'd also like to collect dust from your vacuum during the first home visit.**

**Do you have a vacuum?** ☐Yes ☐No [Check one]


*If NO, say **OK, thank you for letting me know. Continue with script at E.***

*If YES, say **Does your vacuum have a bag or is it bagless?** ☐ Bag or ☐ Bagless [Check one]*

**May we take your bag/ contents of the vacuum?** ☐ Yes ☐ No [Check one]

*If YES, say **Great, thanks for giving us this sample.***

*If NO, say **OK, thanks for letting me know.***

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**OK, we'll see you for home visit #1 on:**

\_\_\_\_ / \_\_\_\_ / \_\_\_\_ at \_\_\_\_ : \_\_\_\_ ☐AM ☐PM. We will

call you the day before to confirm the appointment. If you need to change the appointment time or date, please let me know as soon as possible. Also, don't hesitate to call with any questions you might have. My phone number is \_\_\_\_\_.

**May we have your mailing address so we can mail you the consent form before Home Visit #1?**

\_\_\_\_\_  
\_\_\_\_\_


**Do you have any other questions?**

*If YES, answer questions and continue with script*

*If NO, continue with script*

## **CALL CONCLUSION**

Again, my name is \_\_\_\_\_, you can contact me toll free at \_\_\_\_\_. Thanks very much for your time and have a nice day/evening. [Complete recording of all data from call and transfer appropriate data to Home Date Sheet]

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## Appendix 9: Participant information sheet and consent form

### 1. INTRODUCTION

You are invited to take part in a research study. Before you decide whether you wish to participate, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information.

### 2. BACKGROUND

A person's environment can be an important influence on their health. The environment includes many things that you encounter in your everyday life, for example:

- Whether you live or work in a city or countryside;
- Chemicals, bacteria, viruses, or allergens which you may come into contact with from food, water, air, or dust;
- Noise from your surroundings

The study we are asking you to participate in is a pilot study that is part of a large project called the Health and Environment-wide Associations based on Large Population Surveys (HEALS) project ([www.heals-eu.eu](http://www.heals-eu.eu)). HEALS is designed to investigate how the environment might affect health. One of the questions that HEALS is investigating is how the environment that surrounds a young child and their family might affect the child's health now and in the future. This pilot study will focus on methods for describing a child's environment.


We are not conducting a health study at this time, and will only collect information related to environmental exposures to you and your child.

### 3. WHO IS ORGANISING AND FUNDING THE RESEARCH

This research is being funded by the European Research Commission. The Institute of Occupational Medicine (IOM) in Edinburgh is one of the organisations collaborating in this study. Details of the other partners are provided at the project website ([www.heals-eu.eu](http://www.heals-eu.eu)).

### 4. DO I HAVE TO TAKE PART?

It is up to you to decide. This form will provide you with information about what will happen if you decide to participate. The study investigators will discuss this information with you and you will have the opportunity to ask questions. If you do decide to participate, we will ask you to sign a consent form that confirms you are

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willing to participate, and that you are willing to allow us to gather information related to your child's environment. You are also free to withdraw from the study at any time and without giving reasons.

## 5. WHERE WILL THE STUDY TAKE PLACE?

The study will mainly take place in your home, although you will also be asked about other places you and your child spend time in. This may include your workplace and/or the child's nursery or day care.

## 6. WHAT WILL HAPPEN IF I TAKE PART?

Two fieldworkers will come to your home to perform the study. There will be two visits to your home: one at the beginning and one at the end. The first visit is estimated to take approximately 2 hours and the second visit will take about an hour and a half.


At the first visit, a fieldworker will do a survey of your home and ask you questions regarding various aspects of your home and your household activities. A fieldworker will set up several small devices in your home and take some dust and water samples. At the second visit, 5-7 days later, fieldworkers will visit you again to remove the various devices, collect the contents of your vacuum and some tap water, and to ask you a few final questions.

*Devices placed in your home for the week:*

- The Netatmo consists of two small, noiseless devices, roughly the size of a cardboard toilet paper roll or slightly bigger, that will measure the indoor climate. These will be placed in the child and adult bedrooms.
- Wireless tags are a couple of square (about 5cm x 5cm) wireless tags that we will place on commonly used cleaning products, which will also be associated with a small tag manager that is slightly larger (5cm x 5cm x 2cm). Both the indoor climate and wireless tags will need to be connected to your wireless internet connection – we will ask you to personally enter your wifi password to set up the equipment. You do not need to give your password to the fieldworker or any other study staff.
- There will be 3-4 small noiseless samplers that measure the air quality, which are about 10cm long. These will be placed in the child and adult bedrooms and in a common area, which is most often used by the family.
- The Dylos is a device with a small fan that measures tiny particles in the air, which is about 18cm x 12 cm x 8 cm. This will be placed in a common area, which is used most often by the family.
- We will also place some electrostatic sheets in a folder (about the size of two A4 papers) in the home to collect allergens from the air. These will not make any noise. They will be placed in the child and adult bedroom.

*Personal activity devices*



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We will ask you to record information about some of your activities during the week using a personal activity tracker and your smartphone. We expect that the amount of time each day you will use interacting with the applications in total should be about 15-30 minutes for a day.

- You will be asked to wear a Fitbit Flex on your wrist to record the number of steps you take.
- You will be asked to download the Moves mobile phone app that uses the location feature on your phone to record where you are and how you get there (e.g. by car, walk, etc.).
- We will ask you to record the foods you eat either on your phone or online using the Fatsecret app.
- We will ask you to take noise measurements using the WideNoise app on your phone.
- We will also ask you to scan the barcodes of you use for home cleaning and personal care for yourself and your child.


*Samples taken from your home:*

- The fieldworker will ask to take a 50 mL sample of water from your kitchen tap. This may be analysed for various chemicals.
- The fieldworker will ask for either the bag from your vacuum (Hoover) or the contents of the canister if you do not have a bag. This may be analysed for various chemicals.

## 7. BENEFITS AND RISKS OF TAKING PART

There is no known health risk or benefit from taking part in the study and using the various devices. Some of the in-home monitors may produce some noise. The study staff will take efforts to place the devices so that they will interfere as little as possible with your everyday life. You may find it difficult to remember to record all the information we ask you to do. If you have any concerns with any of the devices or doing any of the activities during the study, please contact the study staff at any time. In the event that a device is accidentally damaged, you will not be responsible for replacement and we will not ask for any monetary compensation. If a device is damaged or stops working, however, we do ask that you inform us as soon as possible.

In this study, we will ask you to download apps to your mobile phone and to use them to collect data. You may also be asked to access apps or online programs. As with all online and wireless technology, there is a potential for an unauthorised user to access this data. You will be responsible for ensuring that your computer and mobile phone is up-to-date with regards to security (i.e., has virus protection software). The study investigators are not responsible for the security of your personal computing or mobile devices.

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We will ask you to indicate that you will assist the study staff by indicating where they should set up equipment that would remain in the home so that that it is least likely to pose a risk of injury or damage. You will be asked for your approval of the set-up of the equipment with regards to safety in your household.

You will be able to see some of the data collected while you are in the study, via the mobile apps and websites, which may be of interest and a benefit to you. Your participation in our study will help guide the measurement of environmental exposures in future studies.

After we have completed monitoring, we will provide a gift card with a value of £35 to you to thank you for participating in our study.

## **8. WHAT WILL HAPPEN TO THE INFORMATION COLLECTED?**


Researchers will be able to access the data and information about you collected by the devices and apps used in the study. Your name and contact information will not be used. You will be given a username, email, and password related to your study account, assigned by the study which is not related to your name. This data will be downloaded from the website by researchers. The data will not include any identifiers and will be kept anonymous for analysis. Any location information collected will not be published and will only be seen by study researchers. Results of the analyses may be presented at conferences and published in a peer reviewed journal with persons and their location being anonymized.

Please be aware that for some of the devices, your data is stored in the internet cloud and is also accessible to the company that developed the product. They may use this data within the bounds of their privacy policy. You will need to agree to the terms and conditions specific to each product before you participate in the study.

Part of the principle of this study is to gather a wide range of information, some of which may be analysed later on to explore new ideas about how people interact with their environment. This means that some samples we take may not be analysed immediately. Please indicate to the study staff if you are willing to have your information stored and analysed in the future.

## **9. WILL MY TAKING PART IN THE STUDY BE CONFIDENTIAL?**

Yes. All participants' data that is acquired by IOM will be stored securely and confidentially and any identifiable information collected about an individual will only be available to authorised study personnel. Other institutions involved in the study may have access to your data, but in an anonymous format. We will not identify you or show any potentially identifying information in any documents we produce. The data collected by the Fitbit, Moves, Netatmo, Fatsecret, WideNoise, Wireless tags, and Redlaser will also be accessible to the companies that sell these products, and are subject to their privacy policies. The usernames that we provide for using these products will not contain any personal information. Any of the data

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uploaded to the HEALS portal be treated in accordance with European Union data protection regulations and the Data Protection Act 1984.

## 10. WHO HAS REVIEWED THE STUDY?


This study has been reviewed by the Ethics Committee of the School of Life Sciences at the Heriot-Watt University in Edinburgh.

## 11. CONTACTS FOR FURTHER INFORMATION

If you require any further information or have any questions then please contact:

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Institute of Occupational Medicine  
Research Avenue North, Riccarton  
Edinburgh EH14 4AP  
UK

Direct line: 0131 449 8052; Mobile: 07818 426602; Email: [miranda.loh@iom-world.org](mailto:miranda.loh@iom-world.org)

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## CONSENT FORM

### Pilot study to evaluate the planned approach for activity and location tracking

**Please read the following:**

**Please tick box**

1. I have read and the researcher has explained to me the information in the Participant Information Sheet relating to this project.

☐

2. I have had the opportunity to ask questions that have been answered to my satisfaction.

☐

3. I understand that I have the right to withdraw from the study, or part of the study, at any time without reason.

☐

4. I understand that my personal information will remain confidential. Any information from the project that is published or presented will be anonymous.

☐

5. I agree to volunteer as a participant for the study, and give my full consent to my participation in this study, and will cooperate with the instructions given to me by the research staff.

☐

6. I agree to allow my child (name: \_\_\_\_\_) to be a participant in the study, and will provide the information relating to my child that is requested by the research staff.

☐

7. I agree to allow the dust and water samples taken to be stored for future analyses. (please circle one)

**Yes**

**No**

8. Do you need a copy of this consent form? (please circle one)

**Yes**

**No**


*Please print your name, date and include your signature in the spaces provided below.*

\_\_\_\_\_  
**Name of Participant**

\_\_\_\_\_  
**Date**

\_\_\_\_\_  
**Signature**

*I confirm that I have explained to the volunteer named above, the nature and purpose of the study.*

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\_\_\_\_\_


***Name of Researcher***

\_\_\_\_\_

***Date***

\_\_\_\_\_

***Signature***

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## Appendix 10: Consumer products protocol



# HEALS

Health and Environment-wide Associations  
based on Large population Surveys

FP7-ENV-2013- 603946

<http://www.heals-eu.eu/>

## Pilot Protocol

## Consumer Products


### Version 1

Lead beneficiary:

Date:

Nature:


Dissemination level:

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## 1 Introduction

Consumer products are a potential source of exposure to many different chemicals. Characterizing people's use of these products is therefore an important part of studying the exposome. Prior studies used questionnaires to ascertain the types of products that people use in the home. The SUPERB study (Hertz-Picciotto et al., 2010) used bar code scanners to record products in the home, weighed products at the beginning and end of the study period, used an accelerometer (the Actigraph), and used questionnaires to estimate how much of certain products were used. In HEALS, we will examine whether it is feasible to have the participant collect their product use data via a commercially available shopping app, the Redlaser, which allows them to scan the barcode of a product and automatically links the UPC code to a product database. Additionally, we will use a wireless tag attached to a select number of products, which will detect movement of the product to estimate how much the product is used during the study period. This data can be used to estimate exposure to chemicals in the product.

## 2 Equipment

The following instruments are selected for noise measurements during the pilot:

- Wireless Tags
- Wireless Tag manager
- Ethernet cables of various lengths
- Multiple outlet surge protection strip
- Wi-Fi router and internet access.
- Small Ziploc bags
- The participant own phone (or study phone if available) with the following specifications:
  - iPhone: iPhone 4 or higher
  - Android: 4.0 minimum required with access to Google Play
- Redlaser app downloaded to participant's phone
- Dummy email account (prepared by the fieldworkers).

## 3 Procedure – prior to the study


### 3.1 Redlaser app

No need to set up prior to field.

### 3.2 Wireless tag setup

The Wireless Tag manager will need to be set up with the participant's home wireless router. Ask if you may do this. You will need to be able to plug it in to an electric socket as well, so



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use a multiple socket surge protector if needed. Plug in the Ethernet cable to the tag manager and the router.

The Wireless Tag is installed as described in the installation instructions via <http://wirelesstag.net/iosapp.html> for an iOS device and <http://wirelesstag.net/webapp.html> for Android or web applications. Fieldworkers will set up the device using one of these methods. For IOM, ensure that you have downloaded the Wireless Tag app from the App Store.

Ensure that each Wireless Tag is labeled with its permanent label – this should not change throughout the study. The label should be “A”, “B”, “C”, etc. The tag IDs online should be labeled using the household ID followed by 1, 2, 3, etc. Record on the Wireless Tag datasheet. Prior to going to the field ensure that the past participant’s information has been deleted.

## 4 Procedure – during the study

Prior to beginning the study the participant should be asked to sign the consent form. Participants should also be made aware that the researchers will be able to access their data stored on the internet, however their names are not included and anonymised.

### 4.1 Redlaser app

Ask the participant to download the Redlaser app to their phone. Demonstrate its use and ask the participant to scan several items to a list and text it to your (field staff) phone. Once they are able to do this ask them to scan the items that they use most often and text the information to you.

Inform the participant that sometimes the barcode scanned may not link to a product, or may link to the wrong product. If that occurs, they should note this down on their comment sheet so that we can search for the barcodes online.

### 4.2 Wireless tags


Ask the participant which cleaning products they use the most often (preferably at least once a week). Ask them to scan the products to the list. The fieldworker should also scan the product. Ask if you may attach a motion detector to the product. Place Tag into small plastic bag and close. Attach a Tag to each bottle in a place where it will not likely interfere with the use of the product using tape (masking tape or electrical tape). Tell the participant to use the product as they normally would and not to move the tape.

The Wireless Tag is installed as described in the installation instructions via <http://wirelesstag.net/iosapp.html> for an iOS device and <http://wirelesstag.net/webapp.html> for Android or web applications.

Directions for iOS (for IOM, this will likely be the way it is done).

At the Login Screen, tap “Create New Account”. Fill in the serial number from the Tag Manager. Use the household ID, login email and password that is assigned to the household.

Once you are logged in, tap the “+” in the upper right corner of the screen. Tap “Search New Wireless Tags”. When a tag is found, assign it a name on the next screen – this should be

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the tag label. Write down the tag label and the product that it is associated with on the Tag data sheet.

Associate each tag in the household to the account. In the Options screen for motion detection (tap gear icon at bottom right of tag list). Set the sensitivity of each tag to 50%. Set the response time to medium. Set door/gate mode to off. Do not enable notify @Motion start/stop. Set “send email” to on, and have it send an email to the anonymized email address for this participant. Set all other notifications to off. The tag should not beep or make any other noise.

Once all tags are associated, the settings finished, and the tags are attached to the products, arm the sensors. You can arm them individually or all together (to do the latter tap the keypad icon on the bottom of the tag list screen).

### 4.3 Reminders


The fieldworkers should remind the participants in their mid-study contact to make sure they are recording the products used with Redlaser.

## 5 Procedure – end of the study

Fieldworker(s) collect the equipment during the final visit.

Before disconnecting the Wireless Tag manager, ensure that the data from the motion sensor has been downloaded as a .csv file. Back at the institute, ensure that the wireless tag data is deleted from the account after ensuring that the .csv file has been downloaded to the secure server.

Ask the participant if they have emailed all product lists to the researcher. Tell them that they may remove the app if they wish from their phone. If they wish to do so, ask them if they need help, and offer to help them remove the app.


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## Appendix 11: Instructions to Participants of the HEALS Pilot Study

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## THANK YOU FOR PARTICIPATING IN OUR STUDY!

These instructions are to help you while the study is going on. If you need any further help or have questions about anything related to the study please contact the study staff.

### 1 Moves

Have a look at your Moves app periodically. You can also review your Moves history by tapping on the icon and selecting which day you wish to view. To help us out, please code the location of “home”, “work” and other commonly visited locations. This can be done after visiting a place for the first time by tapping on the location in the Moves log, which takes the user to a map with a label (usually “unknown place”). The user can then tap on the edit icon (a pencil) and write in the location names (e.g. “home” or some other place, see Figure 1). The phone should be carried with you each day, either in a pocket or in a bag etc. Please make sure it is kept charged.

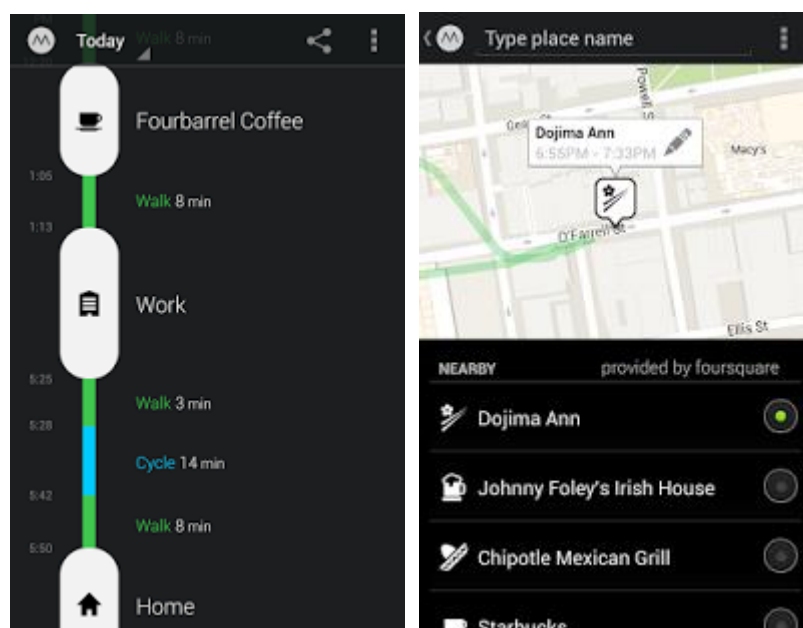



Figure 7: Labelling locations in Moves

### 2 Fitbit

You will be given a Fitbit Flex with a wristband that fits comfortably around your wrist. It should not be too tight or too loose. Your Fitbit will sync using Bluetooth with your smartphone.

The fieldworker will show you how to use the Fitbit and help you set it up on your phone and/or computer. The Fitbit should be fully charged when you receive it, but we would like you to charge it after 3-4 days, to ensure that it does not run out of battery. When you log in to your Fitbit account, there should be an icon that tells you how much charge is left in the battery.

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You should sync your Fitbit at least once during the study. Whenever you log into Fitbit.com or use the Fitbit app on your phone, it should sync. You may sync and check your Fitbit information as much as you like. At the final visit, the fieldworker will ask you to do a final sync of your Fitbit.

We will provide you with a username and password to use during the study. Please do not change these. These do not specifically identify you, which is why we use these instead of asking you to use your personal email.

For sleep logging, before going to sleep the Fitbit should be tapped until it vibrates and 2 lights are shown. After awaking in the morning the Fitbit should be tapped until it vibrates and all 5 LED lights flash. Sleep may also be logged by the user after syncing with the phone or computer manually by entering the time of going to bed and awaking. If sleep logging does not work, we recommend that the user just log sleep manually.

All equipment must be returned to the fieldworker at the end of the study period.

## 2.1 How to charge the Fitbit

1. Connect charger to computer or other power source via USB dock.
2. Insert tracker into slot until it snaps securely in (arrow on tracker should be visible through back window of charger. The lights should flash. If 5 lights flash then your tracker is fully charged.
3. One charge lasts about 5 days. The Fitbit will send an email notification if the battery is getting low. Please charge the Fitbit in the middle of the study (e.g. after 3 or 4 days), which is best done during a period of inactivity or overnight.


## 2.2 Viewing your information

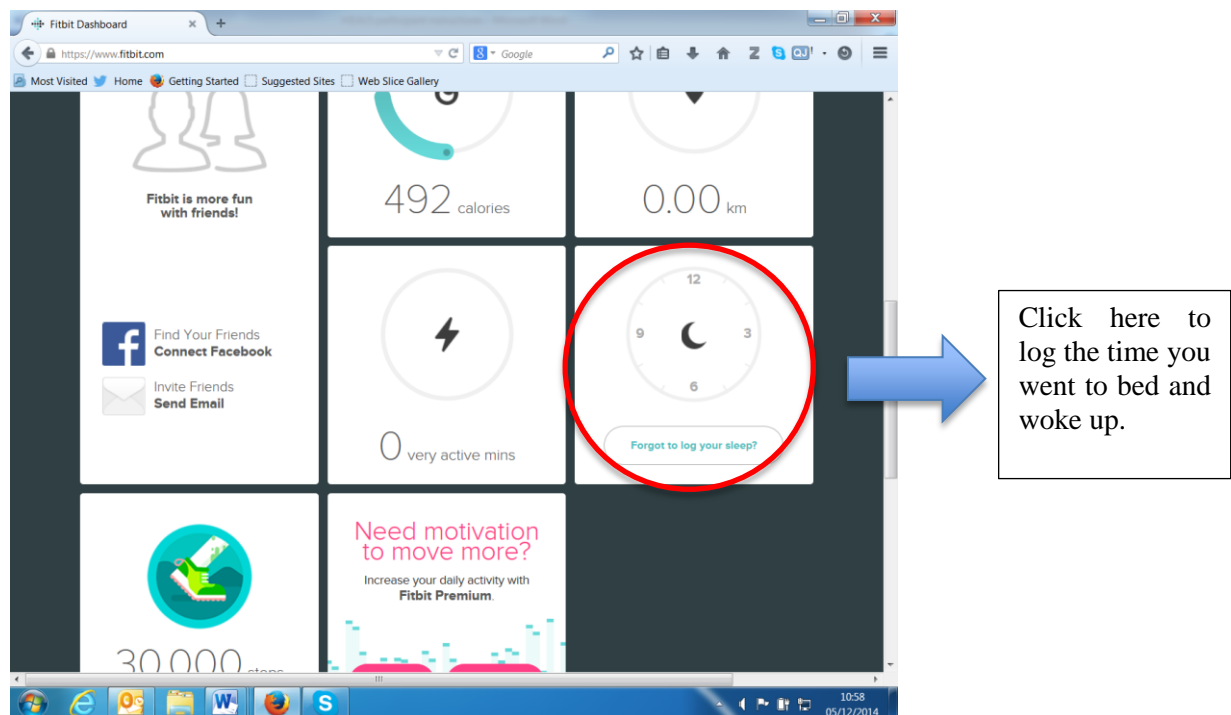
If you have the Fitbit app on your phone, you can just open it.

If you wish to view your account online, you can either view it through [www.fitbit.com](http://www.fitbit.com) and log in using the username and password that you were provided by the fieldworker, or you can log in to your HEALS portal and view your Fitbit account there.

## 2.3 Sleep logging

For sleep logging, before going to sleep the Fitbit should be tapped until it vibrates and 2 lights are shown. After awaking in the morning the Fitbit should be tapped until it vibrates and all 5 LED lights flash. Sleep may also be logged by the user after syncing with the phone or computer manually by entering the time of going to bed and awaking. If sleep logging does not work, we recommend that the user just log sleep manually.

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**Figure 8: Fitbit dashboard**

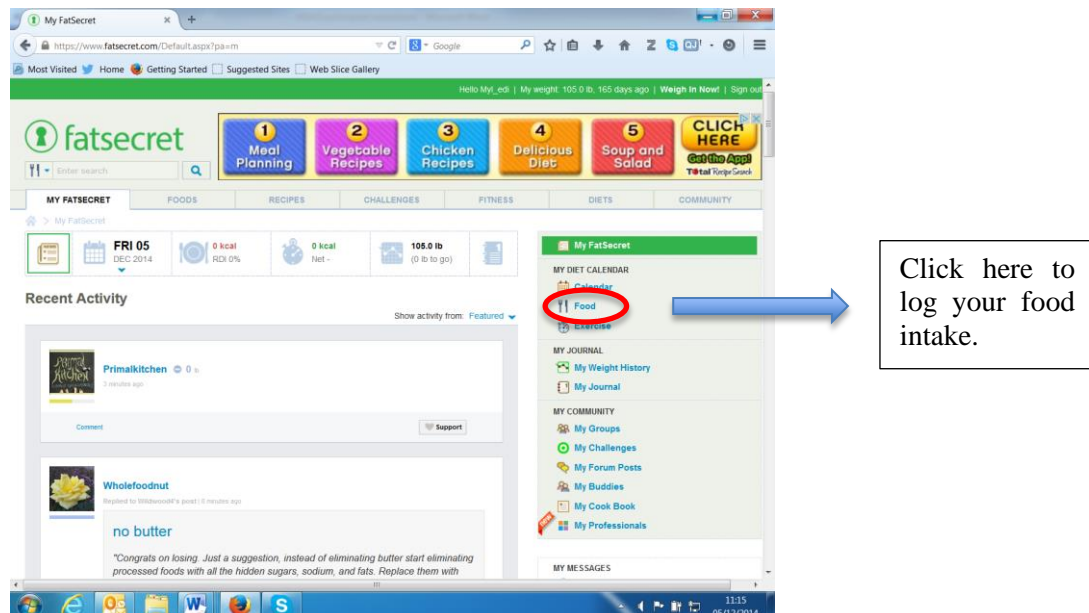
### 3 Fatsecret

#### 3.1 Entering information

To log your diet data, you can either use your phone or access your account online. If you use your phone, once you log in the first time you do not need to log in again unless you log out of account.

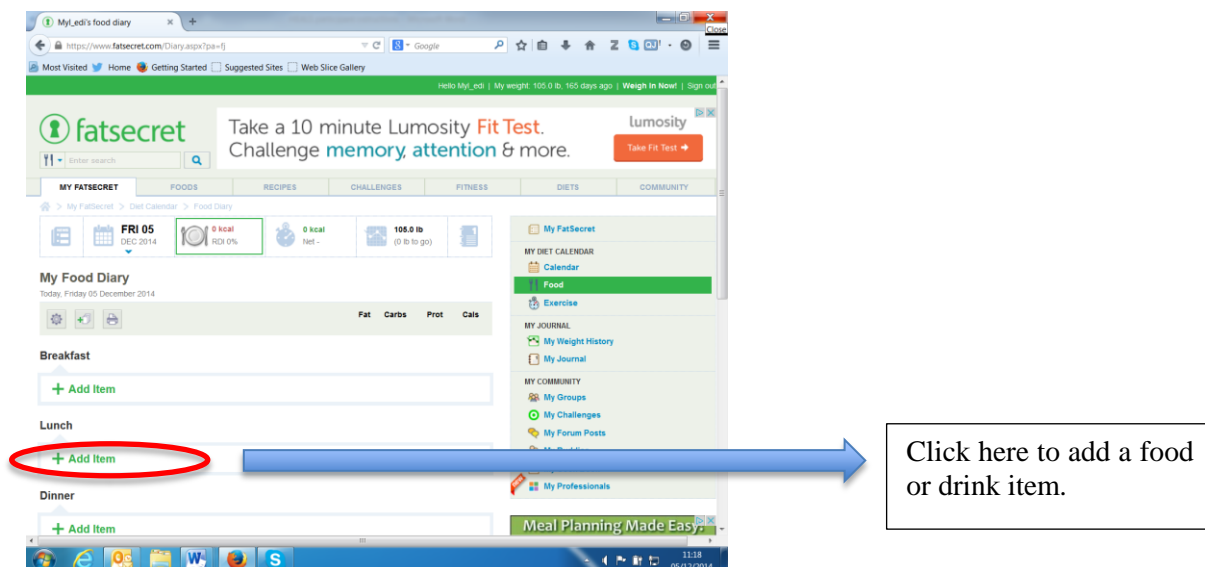
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### 3.1.1 Online use



**Figure 9: Fatsecret screen after logging in**


After you have logged online, you will see the screen in Figure 3. Click on the “Food” icon on the right menu bar, which will take you to the screen in Figure 4.



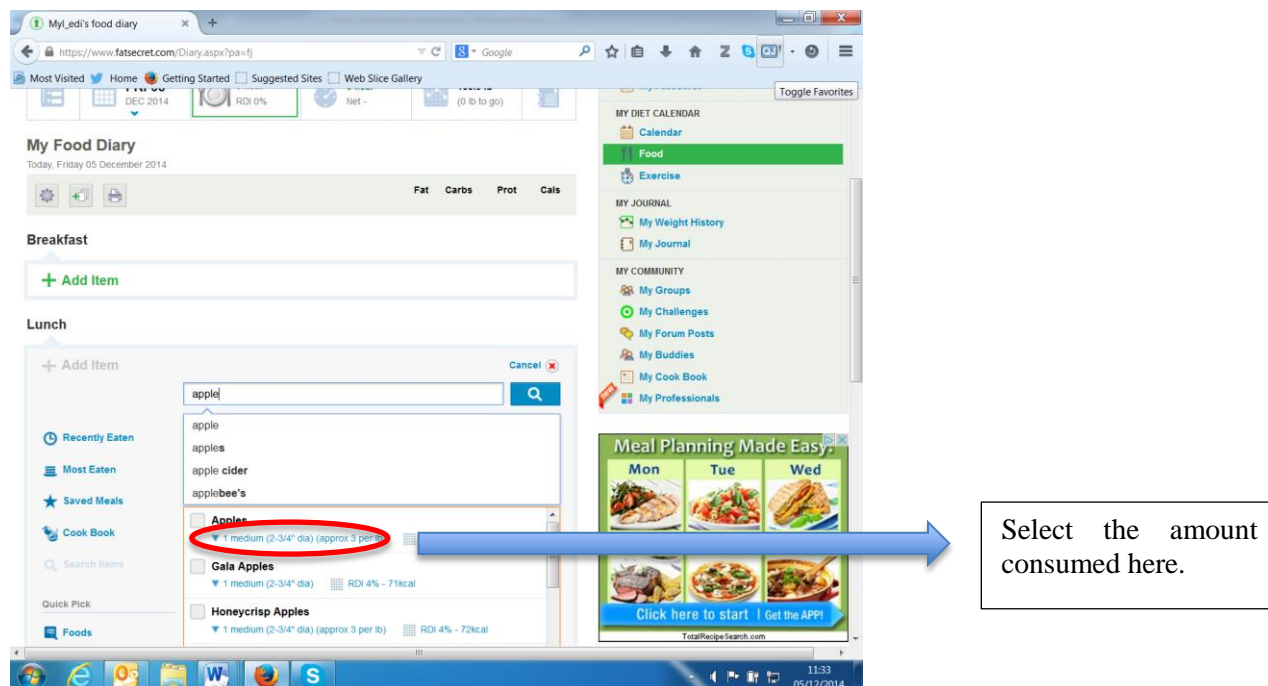
**Figure 10: Food diary screen**

Once you are on the screen in Figure 4, click on the “+ Add Item” labels for each meal to record the type and amount of food you ate. Please include the amount of water and other beverages you drank and snacks.



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When you click on “+ Add Item” you will have the opportunity to search for a food or beverage. If you find the item you are looking for, then choose the amount that you ate or drank from the dropdown menu. You can adjust the default amount provided. If you have a hard time estimating how much you ate or drank, just enter your best guess.



**Figure 11: Food search**

If you cannot find an item then click on “+ Add new food” and it will ask you if you want to add the item you searched for to the list.

### 3.1.2 Using the phone app


When the Fatsecret app is set up on your phone, the fieldworker will help you log in. Once you are logged in you should not have to do so again. Using the app, you can add a food by tapping on the “+” sign next to “Food”. You can search for a food item, or you can click on “Barcode” on the bottom right corner to scan the barcode of a food item. If the item scanned is in the database, it will automatically come up and you can choose the amount eaten. When scanning, you will need to use your phone camera and make sure the barcode is centered around the red line on the screen.

## 4 WideNoise Plus

A new noise sample is asked for the following situations:

- For every fixed and regularly attended location (e.g. work place, supermarket) which is visited during the measurement period (period at location > 15 minutes). Try to measure during a “characteristic noise level” which is representing the general noise level at this location.
- During a transit period regular in daily living (e.g. walking, cycling, public transport), but not driving Try to measure during a “characteristic noise level” which is



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representing the general noise level at this location. Please stand still during a measurement for a transit period, as movement may disturb the measurement and to shield the sensor from wind.

Collecting a new noise sample comprises the following steps (see also picture below):

1. Take noise sample (extend the sampling if needed)
2. Guess the noise level with the slider bar (this step is optional)
3. Qualify the noise sample by answering four questions for determining your perception of the noise sample you just sampled.
4. Add a tag to the noise sample. Please describe the source of the noise (e.g. traffic noise, playing children), and the location and try to be as detailed as possible.
5. Send the report (it will take a few seconds for transferring).




## 5 Noise Meter (JINASYS)

A new noise sample is asked for the following situations:

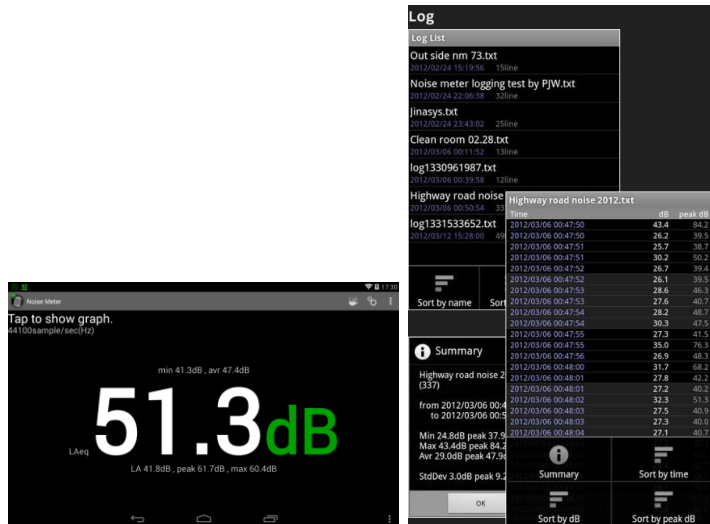
- For every fixed and regularly attended location (e.g. work place, supermarket) which is visited during the measurement period (period at location > 15 minutes). Try to measure during a “characteristic noise level” which is representing the general noise level at this location.
- During a transit period regular in daily living (e.g. walking, cycling, public transport), but not driving. Try to measure during a “characteristic noise level” which is representing the general noise level at this location. Please stand still during a measurement for a transit period, as movement may disturb the measurement and to shield the sensor from wind.

Collecting a new noise sample comprises the following steps (see also picture below):

1. Take noise sample (preferably 30 sec)

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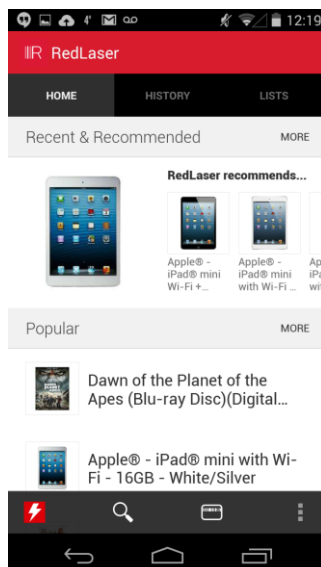
2. Save the noise sample. Please describe the source of the noise (e.g. traffic noise, playing children), and the location and try to be as detailed as possible.
3. Send the report (it will take a few seconds for transferring).




## 6 Redlaser app

You should have a list for the HEALS study that you created in your Redlaser app with the help of a field worker. Please scan the personal care products (e.g. shampoo, body lotion, body wash, hair products etc) that you use on a regular basis. This means items that you use more than once a week. Please also scan the cleaning products (e.g. multi-purpose cleaner, glass cleaner, bathroom cleaner, etc) that you use on a regular basis. This means items that you use more than once a month.

Android directions:

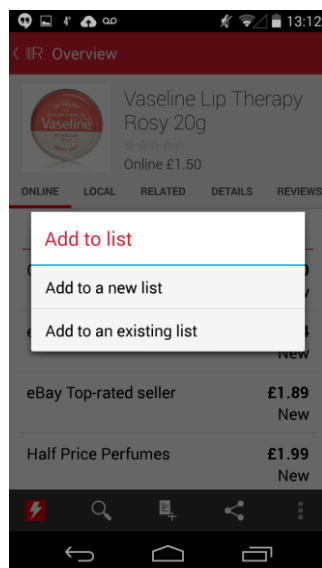
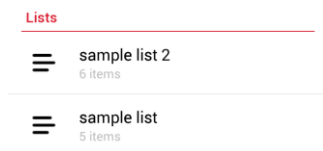


1. Home screen: When you open the RedLaser app you should see a screen like this. To access your lists, tap on the grey word "Lists." To scan, tap on the lightning bolt icon in the lower left corner.

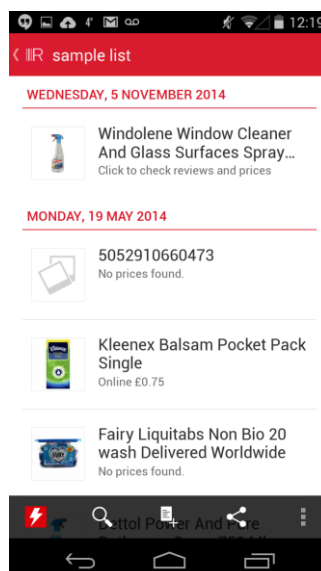
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2. After you tap on “Lists” you should see a screen like this. Select your HEALS list. You can scan a product from this screen by tapping on the lightning bolt icon on the bottom left corner.



3. After you scan a product, you can add it to the HEALS list by tapping on the middle icon on the bottom – it looks like a paper with a plus sign on the bottom right corner. After you tap this, you will see the screen below. Tap “add to existing list” and add it to your HEALS list.



4. Your sample list should look something like this.

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## 7 HEALS portal

A username and password to log onto this page are provided by the research staff. Once logged on you will see the apps and devices that are linked. You can log out after each session by pressing the button in the top right corner.


### First time users

First set up accounts for all apps and devices using study specific usernames and passwords that cannot be linked to you. The research staff will provide these usernames and passwords and will help you set up the accounts.

To give this portal permission to access the collected data, please click on each device and follow the instructions.

### Uploading and viewing of data

Please click on each device and then click on the 'update' button. All collected data will be automatically added to the database and you will see a graph with the most recent data.

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## Appendix 12: Risk Assessment

### THE INSTITUTE OF OCCUPATIONAL MEDICINE

#### LOOK AHEAD RISK ASSESSMENT FORM –IOM 2009


**Company:** IOM

**Date:** 16 January 2015


**Activity:** HEALS pilot project home visit

**The following general procedures must be observed:**


- A. All work to be carried out in accordance with this risk assessment and the safe working in the community policy.
- B. All research study staff to read and understand the risk assessment and this should form part of the ongoing liaison and review by the research team.
- C. Staff must work in accordance with the risk assessment and agreed program of work and report unsafe departures from this.
- D. In instances where IOM staff has concerns for their health and safety they should report immediately to the project leader
- E. **All research staff must review this risk assessment and update as necessary upon arrival at house.**

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Task No.	Task description	Potential hazard	Hazard H/M/L	Precautions	Final risk H/M/L	On site tick box
1	Driving to and from homes	Risk of getting lost  Risk of accident	<b>M</b>  <b>M</b>	Have route printed out in advance from internet based route planner. Use sat. nav. devices where available and safe to do so.  Follow GN 5 Rules for staff driving on business: <a href="http://intranet/general/files/Driving_at_Work_Policy.pdf">http://intranet/general/files/Driving_at_Work_Policy.pdf</a>  Schedule visits to take place (i.e. arrival at the home) between the hours of 8-6pm.	L  L	
2	Visiting homes	Risk of injury, intimidation  Slips/trips/falls  Animals – risk of scratching, biting	<b>L</b>  <b>M</b>  <b>M</b>	Follow “Safe working in the community” protocol. Ensure you are not left alone with a child in the home and make sure you keep a distance from any purses, bags, or valuable items, in case of false accusations. Most visits will be done with a partner, but if you are to go alone, ensure that you inform a “buddy” and line manager where you will be going, the time you will be gone, and when you leave and return to IOM/home from the visit.  Wear appropriate footwear. Observe surroundings.  Avoid contact with pets. Avoid entering an area where a pet is present without the owner. Ask owner to confine pet or keep to an area where there is no pet.	L  L  L	


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Task No.	Task description	Potential hazard	Hazard H/M/L	Precautions	Final risk H/M/L	On site tick box
3	Handling of house dust sample from participant's vacuum cleaner	Inhalation of dust	<b>M</b>	Staff should have an N95 respirator with them. Staff should use their judgement as to whether use of respirator while collecting dust from the participant's vacuum is necessary.	L	
		Dermal exposure	<b>M</b>	Wear disposable gloves when handling vacuum bag or canister. Wash hands afterwards or clean using hand wipes	L	
4	Electrical shorts	Electrical shock  Fire	<b>M</b>  <b>M</b>	Ensure item has been tested before use as per <a href="http://intranet/general/files/GN17_-_Portable_Appliance_Testing.pdf">http://intranet/general/files/GN17 - _Portable_Appliance_Testing.pdf</a> All equipment (including extension leads) should be checked for any potential hazards such as frayed wire or damage before use. Use a surge protector for any devices that are running continuously. Visually inspect socket that the device is to be connected to. If there is any doubt about its suitability, ask to use another one. Include a label on device advising that device should not be touched.	L  L	

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Task No.	Task description	Potential hazard	Hazard H/M/L	Precautions	Final risk H/M/L	On site tick box
<b>NOTES: DAILY RISK ASSESSMENTS TO BE COMPLETED BY OPERATIVES</b>						
				Date:	Reviewed by IOM:	
ACCIDENT POTENTIAL: <b>H= HIGH RISK, M= MEDIUM RISK, L= LOW RISK</b> IF <b>FINAL RISK</b> IS <b>NOT LOW, (L)</b> THE TASK <b>CANNOT BE CARRIED OUT</b> WITHOUT FURTHER CONTROLS in place ALL STAFF SHOULD MAKE USE OF : Version 9 of the IOM H+S Policy available on-line <a href="http://intranet/general/files/Health_and_Safety_Manual.pdf">http://intranet/general/files/Health_and_Safety_Manual.pdf</a> Additional Considerations: <b>Assessor</b> <b>Miranda Loh</b> ..... <b>Signature</b> ..... <b>Date:</b> <b>Authorised by</b> ..... <b>Signature</b> ..... <b>Date:...</b> / Report all accidents/incidents immediately to your Line Manager on the new OR1 Form.						



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## Appendix 13: Policy for Safe Working in the Community


Researchers should be aware that the number one priority during any project activity is their personal safety. They should understand that when there is any doubt that the environment they are in, or intending to enter, is safe that they should withdraw immediately.

### MOBILE TELEPHONES

All researchers working in the community will be issued with mobile phones specifically for use on this project. The researcher **MUST NOT** communicate their personal telephone number to any individuals contacted or recruited as part of the study. The researcher's mobile phone should be carried at all times during project business. This should be charged and switched on at all times.

### PROCEDURE

1. Details of all visits within the community by the fieldworkers should be logged with the project manager.
2. When visiting homes, researchers should be aware of possible sensitivities regarding their project. Behaviour should be appropriate and non-confrontational. The researcher should avoid hostile situations and remove themselves from the situation as quickly as possible. ***All incidents where the researcher has been concerned about their safety should be reported as soon as possible to the project leader.***
3. The researchers' mobile phone should be carried at all times. This should be charged and switched on at all times.
4. Without exception fieldworkers should make sure that the project leader knows, for each day of field work, where they are going, who they are meeting, when the visit will start and the anticipated end time [Note: The 'completion time' should be the time that the researcher believes that they will have returned to somewhere safe. It should not be the time of leaving the farm or home.] The project manager should be informed of the day/time of visit as soon as it is scheduled and informed of any changes as they occur.
5. At the arranged completion time for each visit, the project manager will phone or text the fieldworker to confirm that there were no problems. If the project leader fails to make contact the presumption will be that there has been an incident of some kind

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and this must not be ignored. In these circumstances the ‘buddy’ community researcher will undertake the procedure detailed in Annex 1.

6. If fieldworkers arrive at a site and finds that their mobile phone is out of signal they should ring the project manager on a land line to let them know that they may be uncontactable and, if necessary, revise the ‘completion time’ to take account of journey time to an area where they will be back in signal. Similarly, when the programme of visits is taking longer than anticipated the fieldworkers should make sure that they phone the project manager in advance to re-arrange the ‘completion time’.

7. If during field work the fieldworkers feel in need of assistance they should either contact the emergency services directly or where this is not possible they should contact the project manager. A secret code word (‘hygrometer’ e.g. ‘I think I’ve left the hygrometer in the office.’) can be used as a panic signal. See Annex I.

## **ANNEX I:**


### **Prior to visit**

Inform project manager of: Date, start time and expected ‘completion time’ of visit. Place of visit (address, postcode and phone number) and main contact name at household.

### **Phone buddy procedure**

The fieldworkers must phone or text the project manager researcher at the arranged completion time and confirm that there are no problems. If the fieldworkers fail to make the call at the prearranged time, the presumption must be that there has been an incident and this must not be ignored. The project manager must take the following action in the order stated:

1. Call both fieldworkers’ mobile numbers. If no answer then wait 10 minutes and call number again.
2. If no answer, call the main contact and ask to speak to the fieldworkers. If they are not there ask if they arrived at all and if so what time they left the premises. Also, they must explain to the contact that they are concerned about the fieldworkers and should ask them to check their premises to see if they really are not there. They should also ask about any unusual events that may have occurred during the time when the contact was due to be there.
3. If still no contact is made, the project leader should then be contacted and informed of the situation. Call the fieldworkers’ phones a third time.

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4. If still unable to speak to at least one fieldworker then call the police on the local nonemergency number. Explain the situation giving details of the address (including postcode plus times of start/finish of visit); the name of the fieldworker(s) and a description of that person.

**Procedure where researcher phones and asks for immediate help or uses the emergency panic code word ‘hygrometer’**

1. Call the police on 999.
2. Explain the situation giving details of the address (including postcode plus times of start/finish of visit); the name of the fieldworker and a description of that person.

**Maintenance**

If the researcher is aware of a technical problem with the phone reception or battery life, this must be brought to the attention of the project manager who will provide a replacement phone

**Audits**

Periodically, the project manager will audit the system to check that the procedures are being followed properly and any improvements that are suggested will be considered and incorporated into the documented procedure.