PROTOCOL

An evaluation of a multifaceted intervention to reduce antimicrobial prescribing in care home residents [**RE**ducing **A**ntimicrobials in **C**are **H**omes (REACH)]: a non-randomised feasibility study and process evaluation.

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1. BACKGROUND

Care homes (with or without nursing) provide care for older people who can no longer live independently. The most frequent acute health care intervention which care home residents receive is prescribing of medication (Hughes and Tunney, 2013). There are serious concerns about the quality of prescribing generally, for care home residents, and antimicrobial prescribing in particular (Hughes and Tunney, 2013). This has important implications for individual residents, and may have broader public health considerations due to the development of antimicrobial resistance (AMR). A number of prescribing decisions (not just antimicrobials) for care home residents may be made by telephone, (Schweizer *et al.,* 2005), and this can lead to medicines management problems, with erratic review of medicines and prescribing errors. A more 'whole-systems' approach, involving education, diagnosis, treatment and feedback, may help improve practice.

We have previously shown that Northern Ireland (NI) care homes with nursing have the highest levels of, and greatest variation in, antimicrobial prescribing compared to facilities in 20 other European countries/jurisdictions (McClean *et al.,* 2011). England was ranked fourth in terms of overall prescribing (McClean *et al.,* 2011). Similar findings were reported for residential homes (those facilities which are not required to have qualified nursing staff) (McClean *et al.,* 2012). Indeed, antimicrobial prescribing in care homes is seen as a global problem, contributing to increasing resistance (Hughes and Tunney, 2013). This has been recognised by a report entitled 'Infections and Antimicrobial Resistance' from the Chief Medical Officer (CMO) in England on AMR (Davies, 2013). The ageing population and the requirements for high quality long-term care are important considerations for the National Health Service (NHS) (Sackley *et al.,* 2009), and have been recognised in the CMO's Report (Davies, 2013), the UK Five Year AMR Strategy (Department of Health, 2013), and in the earlier NI Strategy for Tackling Antimicrobial Resistance 2012-17 (Department of Health, Social Services and Public Safety, 2012). These reports emphasised the importance of better stewardship of antimicrobials which encompasses **optimising therapy for individual patients, prevention of overuse, misuse and abuse, and the subsequent minimisation of resistance at both patient and community levels**. Education of the healthcare workforce was seen as an essential element to highlight AMR and appropriate antimicrobial stewardship (Davies, 2013; Department of Health, 2013; Department of Health, Social Services and Public Safety, 2012. This project will combine the priorities outlined in the CMO Report to develop and feasibility test a cohesive intervention which will seek to address antimicrobial prescribing for highly prevalent infections in a vulnerable population.

This research is timely and relevant, particularly in light of the CMO's Report and the UK AMR Strategy (Davies, 2013; Department of Health, 2013). Prescribing in care homes has been a perennial issue of concern. Several relevant systematic reviews have been published, addressing infection control, medication use in older people and those resident in care homes, and one review has focused on antibiotic prescribing in long-term care. Hughes and Tunney have produced a Cochrane review on infection-control strategies for preventing meticillin-resistant *Staphylococcus aureus* (MRSA) transmission in nursing homes for older people (Hughes *et al.,* 2013). Only one study met the inclusion criteria, which failed to show that an education-based intervention affected the prevalence of MRSA in residents and staff in nursing homes randomised to receive this intervention; however, fidelity to the intervention was problematic. The review emphasised the importance of considering context in intervention development and implementation. An intervention that may work in one context is not necessarily transferable to another; for example, care homes are very different to an acute hospital setting. Other relevant systematic reviews e.g. polypharmacy in older people, (Patterson *et al.* 2014), interventions to improve prescribing (including antimicrobials) in care homes (Arnold and Straus 2005; Alldred *et al.,* 2013; Fleming *et al.,* 2013), have indicated that multifaceted interventions involving education to improve prescribing skills and multidisciplinary working, were generally acceptable and had some effect on outcomes; however, the quality of evidence was low. A search of trial registries has revealed no on-going studies on this or related topics and further searches for systematic reviews have not identified any further publications.

There are promising data from Canada suggesting that a multi-faceted intervention on antimicrobial prescribing for urinary tract infections (UTIs), may be effective in reducing antibiotic use (Loeb *et al.,* 2005). We have evaluated this approach in a feasibility study in two nursing homes in NI, using some of the same intervention components (McClean, 2012), such as interactive sessions, written material, out-reach visits to homes and educational sessions with GPs, along with the use of algorithms. The intervention was well-received by staff and GPs and provides confidence that we can extend this approach on a greater scale.

In this study we will take the Canadian intervention and our feasibility findings, both of which focused solely on UTIs, and adapt for use in two UK geographic regions in a non-randomised feasibility study, extending the focus to other infections common in care homes, specifically respiratory and skin. **Our over-arching research question for this feasibility study is: 'Can a multifaceted intervention focussing on appropriate antimicrobial prescribing involving care home staff and associated GP practices be successfully implemented?'**

2. OVERALL AIM

Our aim is to evaluate the feasibility and acceptability of a multifaceted intervention on rational prescribing for infections in a non-randomised feasibility study in care homes. The intervention will consist of an educational and management approach, supported by discussion on resident cases.

This study is being funded through the Health Services and Delivery Research (HS&DR) stream of the National Institute for Health Research, and specifically the Antimicrobial Resistance themed call.

3. STUDY DEVELOPMENT AND DESIGN

The Reducing Antimicrobials in Care Homes (REACH) study is a non-randomised feasibility study that employs a mixed methods design. The study will be carried out in Northern Ireland (NI) and in England (i.e. Coventry and Warwickshire). Two research fellows (to be appointed) will be responsible for the day-to-day management of the study [one based at Queen's University Belfast (QUB) and one based at Warwick University]; another research fellow (intervention developed; to be appointed at QUB) will be responsible for the development of the intervention material used during the study.

The study will consist of three workstreams and an over-arching process evaluation which will run throughout the study (see Figure 1). The workstreams are:

1. Recruitment of care homes and adaptation of the intervention
2. Training
3. Implementation

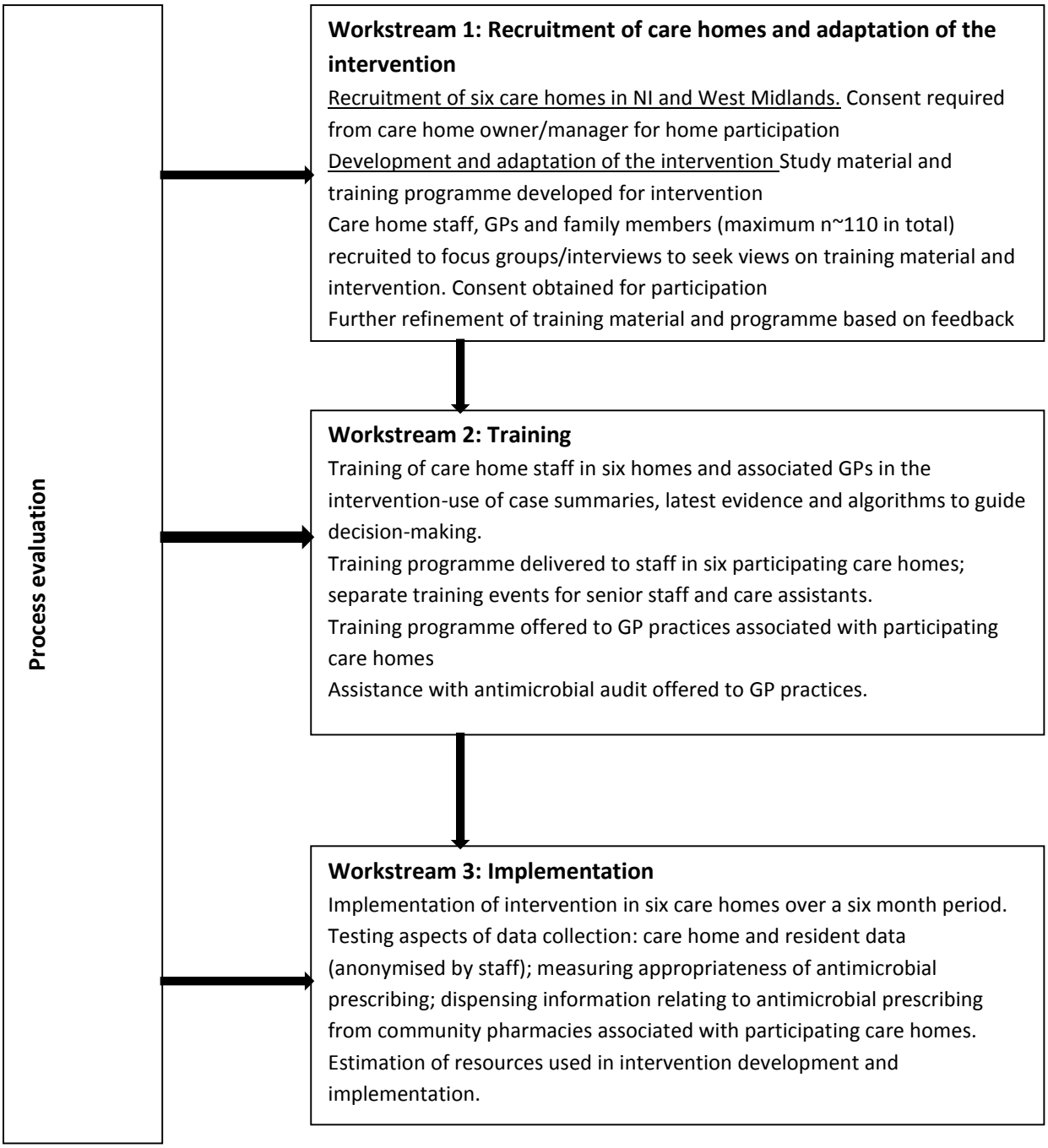

Figure 1. Overview of workstreams within REACH.

3.1 Workstream 1: Recruitment of care homes and adaptation of the intervention

The objectives of this workstream are as follows:

1. To recruit six care homes; three in NI and three in Coventry and Warwickshire;
2. To develop and adapt an intervention originally developed and implemented in Canadian care homes.

Recruitment

We have given careful consideration to the number of homes required for this feasibility study. The sample size has been informed by the research team's previous experience in care home studies, in terms of what is considered acceptable for a feasibility study, what will provide the type and quality of data required, and allow us to understand the process and implementation challenges (Schweizer *et al.,* 2005; Underwood *et al.,* 2013; Ellard *et al.,* 2014).

Therefore, we will recruit a purposive, sample, (informed by size, ownership, presence of nursing care, urban/rural), of **six care homes**, three in NI and three in Coventry/Warwickshire. The inclusion criteria are:

- care homes (some with/without nursing care), principally providing 24 hour care for older residents,
    - a minimum of 20 (permanent) residents,
    - associated with a small number of general practices (up to four per home providing care for a minimum of 80% of residents within a home)
    - an exclusive arrangement with one pharmacy for dispensing medications.

A list of homes with more than 20 beds within a reasonable distance of each research centre (Queen's University and University of Warwick; available from public data) will be compiled by the research fellow in the two areas. We will contact selected homes. We will provide an outline of the study and follow-up the letter with a telephone call to gauge interest, and if appropriate, confirm eligibility.

If a home meets the criteria, and the manager (or appropriate contact person who can make decisions on participation) expresses interest, the research fellow will visit the home and provide more detail about the study (verbal and written; Diazordaz *et al.,* 2013). Consent can be taken at this visit if the manager is willing to participate; otherwise, the manager will be given three days to come to a decision (follow-up telephone call to confirm). If the manager (or appropriate contact person)

agrees, the home will, following written, informed consent from the manager or appropriate person in authority, be formally recruited to the study. This approach will continue until we have recruited a purposive sample of six homes, three in each region (with a range of characteristics as dictated by the sampling approach). Individual residents will not be recruited to the study as the intervention will be delivered at the level of the home and staff (Diazordaz *et al.,* 2013).

The research team in each area (NI & Coventry/Warwickshire) will collect data pertaining to the characteristics of each of the homes and their location. Data gathered will include:

- Setting (rural, urban);
- Ownership (private, statutory), part of a chain or single ownership;
- Capacity (number of beds);
- Number of staff (categorised according to roles)

The research team will be in regular contact with the homes throughout the duration of the study. Visits to homes will be recorded and field notes relating to each visit will be recorded and retained. These will document interactions and conversations related to the study and its processes. These field notes will form part of the data synthesis in the process evaluation.

Development and adaptation of the intervention

Broadly, the intervention will consist of the application of diagnostic (signs and symptoms) and treatment algorithms for the most prevalent infections in care homes at nursing home level, supported by small group educational interactive sessions for staff and a DVD, written material, outreach visits and face-to-face sessions with GPs. The previous Canadian study (Loeb *et al.,* 2005) has provided 'proof of concept' that antimicrobial prescribing can be influenced by this type of educational intervention. However, as a previous systematic review has shown (Hughes *et al.,* 2013) context is important, in this case, the difference between the Canadian care home context and that of the UK. Transposing the intervention from Canada to the UK without any modification is unlikely to be successful. Furthermore, the evidence on management of infections in older people will have developed since the Canadian study was undertaken (last follow-up was in 2003; paper published in 2005). Therefore, the intervention developed for the Canadian study will be updated and adapted for UK use through:

(i) production of rapid reviews and updating of minimum criteria for initiating antimicrobials

(ii) development of intervention material and a training programme

(iii) **adaptation of the intervention** via focus groups with care home staff, resident family members and semi-structured interviews with GPs.

(i) Production of rapid reviews and updating of minimum criteria for initiating antimicrobials: the research team will undertake a series of rapid reviews (Khangura *et al.,* 2012), with respect to antimicrobial prescribing for the most prevalent infections in care homes: urinary, skin and respiratory. The rapid reviews will examine systematic reviews, recent trials, guidelines and other sources of high quality evidence. Sources for evidence will be informed by members of the research team, consultation with clinical colleagues and subject librarians.

(ii) Development of intervention material and training programme: Intervention material will be prepared at QUB by the intervention developer, with input from co-applicants from Warwick and McMaster universities. This will consist of the following: **case scenarios (**cases illustrating the most common infections encountered in care homes residents), **summarised evidence on the management of infections** (including leaflets and educational material on best prescribing practice), and copies of the **signs/symptoms (classification) and treatment algorithms** (which will assist in decision-making on antimicrobial prescribing). The algorithms will be based on the most recent evidence on the standard of care. We will also focus on **communication** between care home staff and GPs [employing the use of a communication tool called SBAR-Situation-Background-Assessment-Recommendation (NHS Institute for Improvement and Innovation, 2008)].

The intervention developer, with input from all other members of the team, will produce a training programme, based on the various components outlined above. A blended learning approach will be taken, including conventional presentation material which will provide background to the study, problem-based learning using the case scenarios to demonstrate the use of evidence and algorithms, and role play to demonstrate the use of the SBAR tool (NHS Institute for Improvement and Innovation, 2008). This programme will be implemented in the six participating homes (see section 3.3).

iii) Adaptation of intervention: We will convene six care home staff focus groups (~6-8 per group; one group per home), three in NI and three in Coventry/Warwickshire respectively, recruiting care staff participants, with different experiences and qualifications, from each of the participating homes. We will also conduct semi-structured interviews with up to 10 GPs in NI and Coventry and Warwickshire (five in each area); our experience is that arranging focus groups for GPs is impractical. All participants will receive an honorarium for their time as noted in the relevant information sheet.

To recruit care home staff, the research teams will approach the manager in each of the participating homes to assist in this process. Written information about the focus group phase will be provided to the managers who will be asked to distribute it to all members of staff. If required, the research fellows will also make a brief presentation during staff meetings, outlining the nature of the study. Follow-up by telephone call will be made to the manager 10 days after the initial distribution of the invitation letter and information sheet to staff. Written consent will be required for participation.

The teams will approach the practices (up to four) associated with the participating homes, and will seek to recruit up to five GPs in the two respective geographic areas (10 in total). Initial approach will be made via the practice manager in each practice who will be provided with a verbal overview of the study. An invitation letter with an information sheet will be sent to GPs in the practice. Follow-up by telephone will be made to the practice after 10 days from the initial mailing of the invitation letter and information sheet. Participation will be voluntary and written, informed consent will be obtained.

We will also ask the care home managers to assist in the recruitment of family members of residents to participate in focus groups. Previous research has shown that family members can be influential in decision-making in relation to prescribing of antimicrobials (Schweizer *et al.,* 2005); therefore, we feel that it would be important to explore their views on the intervention and their perceptions of facilitators and barriers to implementation. We will seek to convene one family member focus group per home, each with between six-eight participants. Managers will be provided with written information to pass on to family members, and the team will be available by telephone to provide further explanation. Follow-up by telephone call will be made to the manager 10 days after the initial distribution of the invitation letter and information sheet to family members. Again, participation will be voluntary and written, informed consent will be obtained. All participants will receive an honorarium (£50) for their time as noted in the relevant information sheet.

Focus groups and interviews will be held at a time and place suitable for the participants and will be facilitated by the research team. In the focus groups for staff and interviews for GPs, the background to the study will be presented by the research fellow, followed by an overview of the intervention, and the supporting materials which will be used. Each component of the intervention will be discussed and views sought. Particular attention will be paid to how the intervention can be

implemented, embedded and sustained in the UK context. For the family member focus groups, a brief background to the study will be provided, along with an outline of the intervention (the educational approach and the use of algorithms to guide management). The family member topic guide will explore family members' views on antimicrobial prescribing, if they consider the intervention to be acceptable, and any other aspects that may be raised by participants. All discussions will be recorded and transcribed verbatim.

Participating in focus group may cause family members to become upset or distressed by prompting thoughts related to experiences of care. Risk will be minimised through provision of the study information sheet. During the interview, the researcher will monitor participants for signs of distress. If the participant becomes upset or distressed, a distress protocol will be followed. This protocol has been established within the School of Pharmacy, Queen's University Belfast, and has been followed in previous studies. Researchers conducting one-to-one interviews will act in accordance with the University/departmental lone worker policy to ensure their safety.

Analysis will be undertaken using the 'Framework Method' (Pope *et al.,* 2000), which we have used in previous studies (Patterson *et al.,* 2007; Ellard *et al.,* 2014). The Framework Method is considered appropriate for this study as the objectives are set in advance i.e. adaptation of the intervention for use in the UK. All transcripts will be read and re-read to enhance familiarisation with the content. The main themes will be identified and coded according to the outline of the Canadian approach. Participant responses will be mapped on to the elements of the Canadian model, but with consideration given to the adaptations required for the UK setting as recognised and discussed by the participants. Findings will be presented to the research team for comment and feedback. We will consider views on the components of the intervention (what will be delivered and what is considered impractical) and the mode of delivery. We will pay close attention to how we can introduce best practice and evidence-based prescribing, while recognising the pressures of everyday practice in care homes and primary care. The intervention will then be refined by the research team, and focus group participants and interviewees will receive an overview of the refined intervention for final comment. The adapted intervention will then be tested in a non-randomised implementation phase (see section 3.3).

3.2 Workstream 2: Training

The objective of this workstream is as follows:

1. To deliver training in respect of the intervention in the care homes and associated general practices.

Care homes

Training will be provided in all six homes by the research team. Attendance will be maximised by careful liaison with the care home management; providing training at times that are least disruptive to the home and at times to suit the staff. The training will take place in the care home and each training session will be approximately two hours long. To ensure that all categories of staff are aware of the study, the training will be provided to as many staff as possible including care assistants. Two levels of training will be provided:

1. Intervention training for senior staff and home manager as they will be responsible for implementing the intervention
2. Information/training for care assistants to ensure that they have a working knowledge of the study

We recognise that it will not be possible for all staff to attend the training session, as care-related activities will need to continue in the home. Furthermore, night staff may also be unable to attend the designated session. Therefore, we will produce a DVD recording of a training session for viewing by staff unable to attend (consent taken from those present). We are also aware that turnover of staff can be substantial in care homes (figures range from 19-42% annually; Lievesley *et al.,* 2011; Thompson *et al.,* 2014). Thus we need to consider new staff who will require training at various times during the course of the implementation phase. Hence, the team will ask the manager to identify up to two members of staff (to account for different shifts within the homes) who can act as 'intervention leads' and who will be responsible for delivering training to staff who are unable to attend the original session. These leads will receive the requisite training by the research team. We recognise the importance of trying to embed this new approach to antimicrobial management in care homes, and the importance of engaging staff as fully as possible. Therefore, to further encourage attendance at the training sessions, we will offer a £10 voucher to each staff member, along with a certificate of attendance which will serve as evidence for continuing professional development (CPD) where required. Both the voucher and the certificate will only be provided on completion of the training.

The training sessions for senior staff and management will comprise:

- Introduction
- Current best evidence
- Signs and symptoms
- Treatment algorithms
- Conveying information to health professionals
- Training in using the SBAR tool (NHS Institute for Improvement and Innovation, 2008)
- Case studies

The sessions will be interactive with discussions around the key elements and some role-playing practice. The information/training sessions for care assistants will include similar content but will focus on more general aspects of the study rather than the implementation of the intervention.

GP training

We will offer training to up to four main general practices for each home. If the offer is accepted, this training will be delivered at a convenient time for staff, such as a lunchtime or staff meeting. We will fit into the usual routine of the practice as far as possible. All GPs and nurses within the practice will be invited to attend, and light refreshments will be provided.

The aim of this training is to encourage the GPs to use the algorithms when considering antimicrobial prescribing in the study care homes. The training will follow a similar format to that provided in the homes (see above). All those who attend the session will receive a certificate for CPD purposes (appropriately accredited). For practices which do not wish to avail of the training (and this will be noted), all material will be sent to them.

Data collected in this workstream will relate to the delivery of the training in care homes and practices including:

- Information about arranging training sessions e.g. difficulties getting appointments
- Training registers recording attendance
- Training feedback (proforma) assessing views of those who attended training

We will also facilitate an **audit** of antimicrobial prescribing within each practice visited. It is a usual requirement within general practice that audits are conducted on a range of activities in order

to promote reflection on practice (Evans, 2008), and institute change if required. The research fellow will liaise with the appropriate person within the practice, to enable an audit of antimicrobial prescribing for care home residents to take place. Standard methodology will be used whereby an assessment of prescribing will take place against agreed standards.

3.3 Workstream 3: Implementation

The objective of this workstream is as follows:

1. To implement the intervention in the six homes and test aspects of data collection.

Following the training programme, staff will apply the algorithms in all cases where residents present with signs and symptoms that may suggest an infection (see Appendix 4 as an example). They will use the SBAR tool (NHS Institute for Improvement and Innovation, 2008) when contacting a GP to help structure communication. This phase will last for six months. Posters will be displayed in the participating care homes, indicating that the study is taking place, its focus, and the main contact person for further information (Research fellows based at QUB and Warwick).

Data Collection

Here we outline the data that we plan to collect. This includes both quantitative and qualitative data. As this is a non-randomised feasibility study, there is no specific primary outcome as we are not powered to test effectiveness. Data will be collected from care homes and community pharmacies. In recognition of the contribution of care home staff to data collection, each care home will receive £500.

(i) Collection of data from care homes: The following outlines the data to be collected from each care home. Note we are not seeking individual resident consent so all data collected will be anonymised by care home staff before it is given to the team (Diazordaz *et al.,* 2013).

- Demographic data relating to residents (age, gender, length of time in home, recorded medical conditions, medications and any other indicators (e.g. a cognitive assessment);

In this feasibility study, we are also exploring the ability to monitor NHS events (e.g. hospitalisations and deaths) at a resident level from large centralised databases, in anticipation of a larger study. We will seek the relevant permissions to do this using residents' NHS numbers that can be provided in

an encrypted form by the community pharmacist (see later, section 3.3ii) and sent directly to the data curators without breaching confidentiality and a pooled anonymous dataset returned. This is a challenging area for data retrieval. In the event that permission is not forthcoming for our preferred approach, we will seek to obtain a pooled dataset on all hospital admissions and deaths based on the post codes of the homes.

An important output from workstream 1 will be the updating of the criteria for assessment of when it is appropriate to initiate an antimicrobial. The updated criteria will determine the data that will need to be collected. At a minimum, data (anonymised) will be recorded on:

- The number of times the algorithms are used including if they were used and no prescription was produced;
- If a GP is contacted in respect of a suspected infection
- If a GP visits the home
- Diagnosis made
- If prescribing of an antimicrobial takes place
- Hospitalisation
- Deaths

The research team will carry out monitoring visits to the homes and during these visits will, using the revised criteria, assess the appropriateness (using a standardised form) of antimicrobial prescribing and provide formal feedback to the manager.

(ii) Collection of antimicrobial prescribing data from community pharmacies

The research team will liaise closely with the community pharmacies which provide a service to the study care homes. Feasibility work undertaken during the development of the grant application for this study has demonstrated that these pharmacies maintain excellent computer records. The feasibility work revealed that these records can be interrogated and provide data on dispensing of antimicrobials in care homes. In the early stages of the implementation of the study, the pharmacies associated with the care homes will be asked to conduct a download of their dispensing records. This download will relate to all antimicrobials dispensed in each participating home. We will use dispensing data from the year prior to study entry as our baseline level of antimicrobial use. A second download will be carried out at the end of the study period. Historical data may be available for up to six years. Subject to there being adequate data of a suitable quality,

we will conduct an interrupted time series analysis which is a more robust approach than simply comparing one year before, and after joining the study.

Antimicrobials are defined as those medicines which are listed in Chapter 5 (Infections) of the British National Formulary (BNF; Joint Formulary Committee, 2014). The antimicrobials of interest are listed in numbered sections of Chapter 5 and are as follows: antibacterial drugs (section 5.1), antifungal drugs (section 5.2) and selected agents from antiviral drugs (section 5.3). The extracted data will include the name, strength, formulation and quantity of antimicrobial dispensed and cost. This will allow us to calculate a Defined Daily Dose (DDD) exposure which is a commonly used measure of drug usage. The data will be produced in a comma delimited file which can then be directly transferred into Excel in the first instance. **No individual resident will be identified in this download as all personal information will be removed by the pharmacist, but each will be assigned a unique identifier**. Collection of these data will allow us to conduct a sample size calculation that can inform a future definitive randomised study and should, depending on quality and quantity of the available data, allow us to produce some evidence for any effect our intervention has on prescribing. In recognition of the contribution made by community pharmacists in providing this data, a payment of £100 per pharmacy will be provided.

(v) Economic evaluation: The cost of the intervention will be measured in this feasibility study by recording the resource use associated with distinct costing stages:

Stage 0 - development of the intervention

Stage 1 - planning and preparation for delivery

Stage 2 – delivery stage

Costs will include those associated with labour, training, intervention materials, equipment and space and will be gathered prospectively where possible, by the research fellows. These resource use data will be combined with appropriate unit costs to estimate a mean cost per patient and per nursing home to deliver the intervention. We will also ask staff to maintain a running monthly log of GP contact (visit or telephone call), visits by community nurses, and other health care professionals over the course of the six-month implementation phase. Feedback from nursing home staff on the acceptability of maintaining these logs will be obtained during the qualitative interviews planned in the process evaluation. This will inform the design of a full cost-effectiveness analysis in a future trial.

3.4 Process Evaluation.

The process evaluation will run throughout the study and across the three workstreams. It will provide a rich and detailed account of all aspects of the study as outlined below.

The aims of the process evaluation are:

- To comprehensively describe the implementation of this intervention, including the facilitators and barriers to implementation;
- To develop a set of transferable principles regarding the intervention to inform its implementation on a wider scale.

The objectives are:

- To monitor implementation processes (e.g. recruitment, development of the intervention, delivery of the intervention and acceptability/use of the intervention in practice);
- to undertake an ethnographic type observational study in the homes to understand current practice and to explore possible changes due to the intervention;
- To carry out in-depth interviews with a sample of care home staff, care managers and other stake holders e.g. GPs. We will sample and recruit as described in the adaptation exercise as outlined in Section 3.

The process evaluation is based on the framework proposed by Stecklar and Linanne (2002). We plan to gather data relating to:

- Context (examining aspects of the larger social, political and economic environment that may influence implementation)
- Reach (the proportion of the intended target audience (homes) that participates in the feasibility study)
- Dose delivered (how much training is delivered)
- Dose received (was the training attended, were the materials used) and the overall implementation of the study

The outcomes that we are interested in for this feasibility study are predominantly process-related e.g. the acceptability of the intervention in terms of recruitment and delivery of training, feasibility of data collection from a variety of sources, the feasibility of measuring appropriateness of prescribing and collecting dispensing data from community pharmacies, and a comprehensive overview of the implementation of the intervention. The feasibility study will also produce data to inform the design of a future definitive study.

Figure 2 below outlines the various workstreams, associated data collection and related ethics documentation.

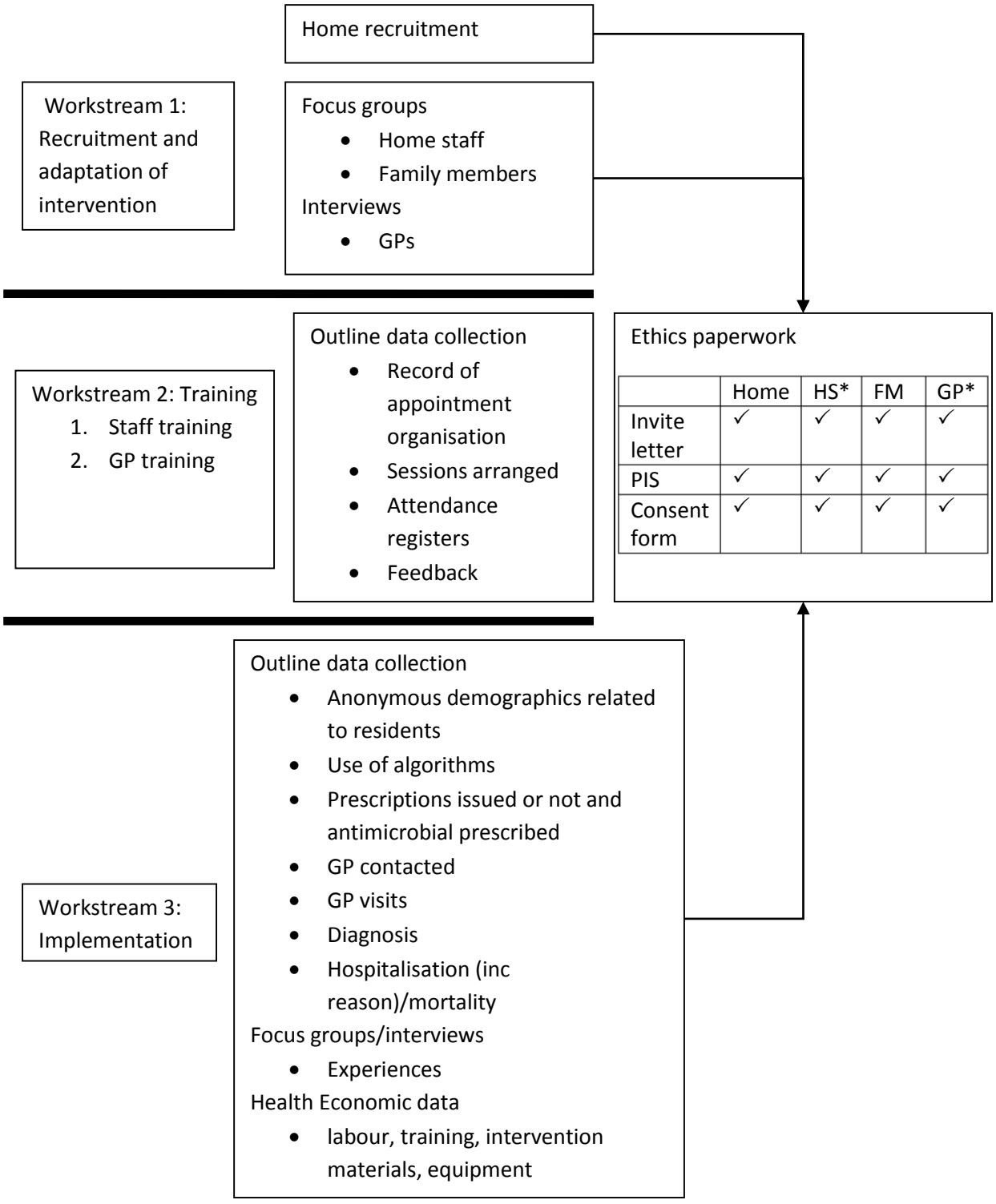

Figure 2. Outline of study flow, key data collected and ethics related paperwork.

3.5 Data analysis

Qualitative data

Interviews and focus groups will be transcribed verbatim; these and field note transcripts will be analysed using the Framework method (Pope *et al.,* 2000), through the use of NVivo®. All transcribed material will be anonymised and participants given a unique code number. Quotations will be used as exemplars of themes.

Quantitative data

Analysis will be primarily descriptive, providing an overview of the characteristics of participating homes and residents. We will have data on antimicrobial prescribing extracted from community pharmacy computerised records at baseline, and at the end of the implementation phase. These latter data will allow us to undertake a sample size calculation, estimate the effect size and intraclass correlation (ICC) from this non-randomised feasibility study, thus informing the parameters for a full study. As stated under 3.3ii, subject to the quality of data collected from community pharmacies, we will undertake an interrupted time series analysis to explore the trends in the prescription of antimicrobials before and after the intervention.

4. SAFETY AND ADVERSE EVENT MANAGEMENT

An adverse event (AE) is defined as any untoward medical occurrence in a participant and which does not necessarily have a causal relationship with this treatment/intervention.

We would not expect any adverse events from the work in this feasibility study. However, any such events will be dealt with in accordance with the Northern Ireland Clinical Trials Unit (NICTU) Standard Operating Procedures (SOPs) for Safety Reporting. We will be collecting data on hospitalisations and mortality (see section 3.3i) and will monitor these data very carefully. In the original Canadian trial on which this feasibility study is based, there were no differences found in admissions to hospitals or mortality between the intervention and control arms (Loeb *et al.,* 2005).

5. DATA MANAGEMENT

All data collected during the study will be handled and stored according to relevant legislation and SOPs utilised by Queen's University, Warwick University and NICTU. Data will be stored on secured servers and access to such data will be restricted to authorised personnel. Any data transfer would be in accordance with SOPs and require data sharing agreements to be in place.

Study related documents will be made available for internal monitoring and audit activities, and this has been highlighted in participant information sheets.

All data returned to NICTU will be dealt with in accordance with its SOPs and only accessed by authorised personnel. There may be the possibility that anonymous data will be shared with other researchers outside the research team. If this is the case, such data transfer will be subject to the appropriate agreements and safeguards. Anonymity will be assured.

Case report forms (CRFs) will be developed to collect all required study data. A member of the research team will check the data and input into a study-specific database designed by the NICTU. Due to the developmental nature of this study, it has not been possible to present the CRFs at this time. The various algorithms which will be used to assist care home staff in decision making will be developed as part of Workstream 1, and these algorithms will dictate the data elements that need to be collected. We are also testing feasibility of data collection as part of this study, and will monitor missing data closely and follow-up with care home staff and other relevant individuals as to why data may be missing.

After all data has been entered into the database, the original of the CRF will be securely stored in archiving facilities.

Qualitative data from interviews and focus groups will be transcribed verbatim and the data will be managed using NVivo software. If the interviews are transcribed by someone external to the University, they will be asked to sign a confidentiality agreement.

Study documentation and data will be archived for at least 5 years after completion of the study in accordance with QUB and NICTU SOPs.

6. STUDY ORGANISATION AND OVERSIGHT

Queen's University Belfast will act as Sponsor and a sub-contract has been drawn up with the University of Warwick and the NICTU. The study will be led by Hughes as Chief Investigator (CI) and a multidisciplinary team of investigators from Queen's University, Warwick University, McMaster University and the NICTU, all of whom have the necessary expertise and experience to undertake the work. The day-to-day running of the two-year study will be undertaken by researchers

based at QUB and Warwick and an intervention developer to oversee the production of all intervention material (QUB).

All listed members (Chief Investigator and all co-applicants) will constitute the **Feasibility Study Management Group (FSMG)** as core members. The FSMG will meet on a monthly basis, and all meetings will be chaired by the Chief Investigator (CH). There will be two face-to-face meetings held during the course of the study, one in Belfast and one in Warwick, involving all applicants, and research fellows. All other meetings will be conducted via teleconference. An agenda will be compiled in advance of each meeting, minutes will be taken and filed, and available for inspection by the funder. Close attention will be paid to progress as assessed against the study timetable (see above) and the achievement of key milestones and deliverables. As requested by the funding body, we will submit 6 monthly reports which will outline progress to date and provide other information/data as required. The key milestones for the project will be (following receipt of all necessary approvals): recruitment of homes; completion of the adaptation of the Canadian intervention model; training in homes and associated practices; completion of the implementation phase and process evaluation; analysis and write-up of study.

Although we are not running a trial per se, NIHR considers that it would be good practice to have an independent **Study Steering Committee (SSC)**. This will meet at the start and end of the feasibility study, via teleconference. Prof. Catherine Sackley (King's College London) has agreed to act as the independent Chair. Prof. Sackley has experience of care home research and cluster trials. Two members of the research team (CH and DE) will also sit on this committee to provide advice and context for the study. We also have the agreement of Prof. Stephanie Taylor (Queen Mary University of London), and Mr. Gordon Kennedy (Research Volunteer, Alzheimer's Society) to sit on the SCC. At the time of submission of this protocol we are seeking the agreement of another health care professional with an interest in infection, and another lay member. We have given careful consideration to the need for a Data Monitoring and Ethics Committee (DMEC). We view this feasibility study to be low-risk, and will ask the SSC to monitor safety aspects of this study.

Although the proposed research is a feasibility investigation, it will be registered with an International Standard Randomised Controlled Trial Number (ISRCTN) Register.

Indemnity cover is outlined in the letter from the Sponsor (QUB), which has been provided with the IRAS form.

7. ETHICAL CONSIDERATIONS

We have considered the potential ethical issues for this study very carefully and have taken advice from a number of organisations. We have been advised that the data required for the proposed primary outcome (drug dispensing data) can be obtained without requiring individual resident consent as the data will be available at home level from community pharmacies and we will not be able to link this back to individual residents. We will also need to collect data from care homes in respect of resident characteristics, limited clinical information, and hospitalisations and mortality. In this case, data will be extracted, anonymised and/or aggregated by the direct care team (care home staff). We have consulted with the Health Research Authority, the Office of Research Ethics Committees Northern Ireland (ORECNI) and the Privacy Advisory Committee (PAC) in NI who advised that our general approach is likely to be acceptable (see Appendix 17).

The research team have considerable experience of carrying out research within care homes. The team are very aware that a care home is the 'home' for each and every resident within it and they are also complex workplaces for the staff. The team will liaise closely with the homes managers to ensure the minimum of disruption to the day-to-day running of the home. Where possible, researcher visits to the homes will be pre-arranged and the visiting researchers will all have appropriate training and approvals. Researcher visits are an important part of this study and during these visits, the researcher will be an 'observer'. In a setting such as this, non-participant observation is almost impossible as residents and staff may want to interact. The researchers will be respectful of residents' wishes and space and will remain in public areas of the home.

Interviews undertaken with the various stakeholders will be at a time and a place to suit participants. To ensure researcher safety, standard lone worker policies will be in place (see Appendix 16).

8. PATIENT AND PUBLIC INVOLVEMENT

For this feasibility study, we will convene two Advisory Groups to provide Patient and Public Involvement (PPI) perspectives as well as contributing to the study design and development. One group will consist of residents (those with capacity) and/or next-of-kin of residents drawn from the homes. This first Advisory Group will provide advice on implementation of the intervention. The second Advisory Group will consist of care home staff and GPs associated with our homes. We will consult individually with members of the first group as residents in particular, may have difficulty in attending and contributing to meetings. The research fellows in each geographic region will visit

residents and/or next-of-kin at the home in question. For the second group, there will be two meetings (face-to-face or via teleconference) over the course of the study. Both groups will advise on development of participant information sheets and consent forms to ensure clarity and lack of ambiguity. They will also be asked to comment on draft reports, and other forms of communication about the study that will be specifically aimed at key stakeholders such as IHCP, and the public. As part of our research team, we have Mr. Robert (Bob) Stafford who is Head of Care and Compliance at Orchard Care Homes. Mr. Stafford has responsibility for care compliance across the organisation which consists of over 100 care homes across the UK. As someone who has direct experience of managing and overseeing care homes, his perspective will be invaluable. He will participate in all FSMG meetings and will advise on implementation and trouble-shooting as and when required. We have also secured the agreement of Dr. Hilary Buchanan (former GP and volunteer with the Alzheimer's Society) who has a family member in a care home, to sit on the FSMG.

9. DISSEMINATION AND PUBLICATION

A final report on the feasibility study will be delivered to the funder. As required by the HS&DR programme, we will publish our findings in the NIHR HS&DR Journal. We will also publish findings in mainstream journals (all open-access), particularly those within the Biomed Central group of publications which welcome feasibility studies. We anticipate that one major paper will be published on this project, incorporating the adaptation and implementation phase, along with the process evaluation. We will also consider a separate publication from the focus groups conducted with family members. We will produce an abridged lay summary of the main findings, written in an accessible way for all health care professionals, carers and resident participants as appropriate, with a link to the full report. The algorithms developed from this work will be made available on a University-hosted website. We will also present our work at relevant research conferences, through oral presentations and/or posters.

10. STUDY GANTT CHART

Activity\Month	-5	2	4	6	8	10	12	14	16	18	20	22	24
Set-up and ethics submission													
WS1-Recruitment of homes													
WS1-Development and Adaptation: (i) Production of rapid reviews and updating of minimum criteria for initiating antimicrobials													
WS1- Development and Adaptation: (ii) Development of intervention material and training programme													
WS1- Development and Adaptation: (iii) Adaptation of intervention including recruitment of staff, GPs and family members for focus groups and interviews													
WS2-Training:Homes and GP practices													
WS3-Implementation: Implementation of intervention, data collection and analysis													
Process evaluation													
Survey of care homes													
Analysis and write-up													

WS-Workstream

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