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Antimicrobial Stewardship in Care Homes: Outcomes of Importance to Stakeholders

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Antimicrobial Stewardship in Care Homes: Outcomes of Importance to Stakeholders

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SUMMARY

Background: Heterogeneity of outcomes measured in trials to improve antimicrobial stewardship (AMS) in care homes has compromised quality of evidence. A core outcome set (COS) is needed to facilitate interpretation and synthesis of evidence in this area.

Aim: To determine outcomes deemed important by relevant stakeholders for interventions aimed at improving AMS in care homes, and to produce a refined list of outcomes that could be considered for use in future research.

Methods: Semi-structured face-to-face or telephone interviews were conducted with key stakeholders. Outcomes reported in previous randomised controlled trials (RCTs) of AMS in care homes were included in a topic guide for interviews. Content analysis was undertaken to identify potential outcomes suggested by participants, followed by further review.

Findings: Twenty-seven outcomes reported in RCTs were refined into a list of 12 overarching outcomes. Interviews with participants (six researchers, 31 healthcare professionals, and four family members of care home residents) identified 40 additional outcomes that were important to them. From these 52 outcomes, the total number of antimicrobials, the appropriateness of antimicrobial prescribing and adherence to guidelines were highlighted by most participants. After reviewing all 52 outcomes, a refined list of 14 outcomes potentially feasible for use in AMS trials in care homes was generated.

Conclusion: A number of potential outcomes for AMS in care homes, some of which had not been reported in previous studies, were identified. The refined list of 14 outcomes will be used in a future study to agree a COS for care home AMS trials.

INTRODUCTION

High rates of antimicrobial prescribing and inappropriate antimicrobial treatment in terms of dosage, regimens, and treatment duration in long-term nursing care facilities or residential care homes have been reported in a number of studies [1–5]. This may lead to unnecessary complications and increase the likelihood of antimicrobial resistance (AMR) [4,6,7]. Therefore, antimicrobial stewardship (AMS), defined as interventions designed to enhance the appropriateness of antimicrobial prescribing [8], should be practiced in care homes.

In our systematic review of randomised controlled trials (RCTs) to improve AMS in care homes, we reported that heterogeneity of outcomes measured impeded synthesis of evidence and production of definitive conclusions [9]. There has also been a call for selection of meaningful outcomes for AMS interventions in both hospital and community settings [10].

The Core Outcome Measures in Effectiveness Trials (COMET) initiative has encouraged development and application of core outcome sets for clinical trials to facilitate evidence interpretation by reducing outcome reporting bias and divergent outcomes across studies [11].

A core outcome set (COS) is defined as a standardised list of outcomes achieved by consensus that represents the minimum to be reported in trials of a specific health area [12].

During the development of a COS, a number of approaches are recommended to identify important outcomes that are meaningful, not only to researchers, but also patients and carers.

While systematic reviews aggregate reported outcomes deemed to be of interest to researchers and perhaps policy makers, qualitative approaches facilitate the exploration of views of other key stakeholders such as healthcare professionals and patients regarding outcomes that are important to them [11]. This study aimed to identify and understand outcomes that relevant stakeholders deemed to be important in evaluating the effectiveness of interventions aimed at improving AMS in care homes, and to produce a refined set of outcomes that could be considered in a future consensus study.

METHODS

Inclusion criteria and participants

The context for this study, which took place in Northern Ireland, was care homes for older people. Ethical approval was granted by the HSC Research Ethics Committee in Northern Ireland (REC Approval Number: 18/NI/0154). The study focused on stakeholders including:

- Researchers who had experience of conducting research on infections, AMR or AMS.
- Healthcare professionals who were associated with care homes or were responsible for AMS, including general practitioners (GPs).
- Family members of care home residents aged 65 years or over. We did not recruit care home residents because of concerns regarding capacity, and the ability to participate in data collection exercises.

We undertook semi-structured interviews with key stakeholders, which is an approach that has been used in other studies as part of COS development [11,13].

Compilation of a list of overarching outcomes from a systematic review

Twenty-seven outcomes reported in RCTs in our previous systematic review [9] were reviewed and refined by two researchers (HN and CH) to compile a list of overarching outcomes. Outcomes measuring a similar feature were merged into one overarching outcome. For instance, outcomes measuring the prescribing of quinolones, nitrofurantoin and other specific antibiotics were merged into an outcome measuring antimicrobials prescribed in general.

Sampling and recruitment

Purposive and snowball sampling were used to gain a wide range of perspectives from stakeholders and enhance recruitment. We first approached researchers who were known to the research team. Healthcare-related organisations in Northern Ireland, including five Health & Social Care (HSC) Trusts (provider organisations), were also approached to assist with

recruitment of healthcare professionals. Independent Health & Care Providers, a representative member body for organisations which provide care to older and vulnerable people, was contacted to recruit care home staff and family members of care home residents. Recruitment was guided by data saturation [13]. In order to identify the point of data saturation, data analysis and data collection were conducted simultaneously.

Data collection and management

Two topic guides, piloted with other researchers, with open-ended questions were used for interviews with researchers and healthcare professionals, and care home residents' family members, respectively (Appendix A). These guides had been developed by reference to the literature [9,14,15] and the list of overarching outcomes compiled previously.

Interviews were carried out face-to-face or over the telephone by the researcher (HN), depending upon participant preference, from October 2018 to June 2019. Prior to the start of each interview, written informed consent was obtained. The main issues that were discussed included participants' concerns about AMR in care homes, solutions for AMR in care homes, and important outcomes for AMS interventions in care homes. Prompts were given, when required, to facilitate discussion.

Each participant was allocated a unique identification number to ensure anonymity. All interviews were audio-recorded using a digital recorder and transcribed verbatim. All transcripts were managed in a software package (NVivo Pro[®] software, version 11, QSR International Pty Ltd, Victoria, Australia).

Data analysis

Data analysis was undertaken concurrently with data collection by two independent researchers (HN, and either CH or MT). Transcripts and recordings from the interviews were read and listened to iteratively to help familiarise contexts. Following familiarisation, content analysis was performed to identify themes that represented outcomes which were important

to participants. Potential outcomes suggested by participants, along with their definitions, were identified from the themes to produce a list of outcomes deemed important by stakeholders. Outcomes focusing on a similar topic were grouped into a key domain (category).

This study was reported according to the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist (Appendix B) [16].

Compilation of a refined list of outcomes

The list of overarching outcomes from the systematic review, along with outcomes suggested by stakeholders were collated in an Excel[®] spreadsheet, along with definitions and summaries of opinions from the stakeholders outlining why the outcomes were considered important. These data were screened by the research team (HN, DB, MT, and CH) to produce a refined set of outcomes for AMS in care homes.

The refinement process included three rounds of review, with responses from the former round fed back at the beginning of the next round. Within each round, each member of the team reviewed each of the outcomes independently and decided whether it was 'included', 'excluded' or 'unsure'. An outcome was retained in the refined list if it was 'included' by all members, or 'unsure' by one member and 'included' by the others. Conversely, an outcome was not retained if it was 'excluded' by all members, or 'unsure' by one member and 'excluded' by the others.

RESULTS

Compilation of a list of overarching outcomes from a systematic review

Twenty-seven outcomes reported in previous RCTs [9] were refined to produce a list of twelve overarching outcomes (Appendix C). While compiling a list of outcomes to facilitate interviews with researchers and healthcare professionals, further refinement took place. The two outcomes, 'all-cause hospitalisation' and 'hospitalisation due to infection', were merged into a single outcome 'hospitalisation', and the two outcomes, 'all-cause mortality' and 'mortality due to infection' were merged into a single outcome 'mortality'. This resulted in a list of ten outcomes, along with definitions, which were then included in the topic guide for interviews with researchers and healthcare professionals (Appendix A).

Study population

We approached seven administrative organisations/ academic institutions, five HSC Trusts and two nursing homes to recruit participants. Forty people in Northern Ireland and one in Scotland participated in this study, with 17 face-to-face and 24 telephone interviews carried out. Interviews lasted from 11 to 49 minutes. Key demographic information about the sample is shown in Table I. Fifteen healthcare professionals working in five HSC Trusts were recruited including five physicians who were consultant clinical microbiologists, one nurse, and nine pharmacists.

Outcomes important to participants

A total of 49 outcomes, comprising nine outcomes from the list of ten outcomes used in the topic guide and 40 additional outcomes suggested by participants, were deemed important to be measured in studies aimed at improving AMS in care homes. These outcomes were classified into five categories: antimicrobial use, adherence and appropriateness, safety and patient-related outcomes, infection and resistance, and other outcomes. The list of 49 outcomes is presented in Table II.

Antimicrobial use

The total number of antimicrobials prescribed was deemed to be important by most participants. It was considered to be a common, straightforward and measurable outcome in relation to antimicrobial prescribing which may indicate whether or not an AMS programme was working.

“...having a look to see if there’s improvement of antimicrobial stewardship by looking at if there is a reduction in the number of antimicrobials being prescribed.” (Trust pharmacist 4)

Types of antimicrobials were often believed to be an important outcome, especially broad-spectrum antimicrobials. Using broad-spectrum antimicrobials was thought to trigger adverse events such as *Clostridioides difficile* infection, and contribute to antimicrobial resistance.

“Broad-spectrum antimicrobials being used more liberally will drive the antimicrobial resistance.” (Administrative pharmacist 1)

Antimicrobial consumption based on defined daily doses (DDD) was deemed important by some participants as it was comparable across different geographic regions. However, one person thought this outcome might not reflect the most appropriate prescribing practice.

“...And you could increase the DDD by actual practicing good stewardship and following guidelines and more appropriate prescribing.” (Researcher 2)

Several participants focused on antimicrobial use in prophylaxis, especially urinary tract infections (UTIs), as it largely contributed to high rates of antimicrobial prescribing which may have been inappropriate. ‘Days of therapy’ was also of interest as this outcome could reflect adherence to practice guidelines and appropriateness of antimicrobial prescribing.

A few participants thought that the incidence of antimicrobial prescribing may peak in time periods after usual working hours; therefore, antimicrobials prescribed out-of-hours were suggested. Participants also proposed antimicrobial use at an individual level and the number of important World Health Organisation antimicrobials prescribed (e.g. quinolones).

189 *Adherence and appropriateness*

190 Many participants considered that prescribing of antimicrobial courses adherent to guidelines
191 and appropriateness of antimicrobial prescribing were important as these could be fed back to
192 prescribers, which may then improve prescribing practice. It was suggested that these two
193 outcomes should be used together as the guidelines were not always suitable for every case,
194 especially with older people.

195 *“...adherence to guidelines as well because occasionally antibiotics may be prescribed which are*
196 *stronger than needed or more broad-spectrum than needed and in that instance potentially*
197 *increase the risk of resistance to very important drugs.” (GP2)*

198 *“...it [prescribing antimicrobials] wasn’t in line with the guidance but it was appropriate for*
199 *the patient.” (Trust pharmacist 5)*

200 Cases showing healthcare staff’s adherence to guidelines were important to several
201 participants. Nevertheless, adherence was thought to be difficult to measure by others.
202 Another outcome that was deemed important was antimicrobials prescribed via a telephone
203 call without the prescriber seeing the patient. This method of prescribing was recognised as
204 possibly contributing to high rates of antimicrobial use and inappropriateness of prescribing.
205 All family member participants reported that GPs should have visited their relatives more
206 often.

207 *“So I think a doctor really does need to look at the patient to make sure, and examine them,*
208 *and don’t just give them out for no reason you know, like over the phone or anything they*
209 *really just need to be seen by a doctor.” (Family member 3)*

210 From their own experience, participants also suggested other outcomes related to
211 appropriateness of prescribing such as antimicrobials prescribed following medication
212 review, antimicrobials prescribed using evidence, and antimicrobials prescribed before taking
213 samples.

Safety and patient-related outcomes

Hospitalisation due to infection was thought to be an important outcome by a number of participants, especially care home managers/staff and family members. They considered hospital admissions as a negative outcome for care home residents.

“And perhaps looking at instances of hospital admissions as well, looking at how many people were hospitalised due to infections, and how has the intervention prevented that.”

(Care home manager/staff 4)

Mortality, especially due to infections, was also deemed to be important. Participants thought that a reduction in mortality may indicate a successful intervention with appropriate prescribing.

Adverse drug events were another outcome suggested to be measured as it was deemed associated with antimicrobial use. Clinical microbiologist participants preferred rates of *C. difficile* infection to be measured separately as it could reflect the consequences of antimicrobial use. Other suggested outcomes related to safety included emergency department admissions, healthcare-associated infections, and rates of infection complication.

With regards to patient-related outcomes, infection and antimicrobial treatment were thought to impact on physical and mental health of residents in care homes, which may not be sufficiently reported in trials; therefore, it was suggested that quality of life should be measured. Medication adherence by care home residents was also mentioned because participants suspected that patients did not actually take medicines that had been prescribed which may bias the results of interventions.

Infections and resistance

Rate of resistance was important to a number of participants, especially researchers and clinical microbiologists. This outcome was agreed to reflect the success of an AMS programme and could also be used to inform prescribing practice.

“... you look at the resistance rate like what percentage of *E[scherichia] coli*’s are resistant to co-amoxiclav for example. Use it as a measure so if you see growing year on year then you realise that something needs to be done...” (Clinical microbiologist 2)

The number of laboratory test samples was also deemed important as participants suggested that laboratory test results could help prescribers decide appropriate treatment for their patients. A few participants were interested in ‘infections per resident’ since they thought it could suggest issues within the care home environment. As dipstick tests were often used inappropriately to prompt antimicrobial prescribing, their use was also suggested to be measured. Other proposed outcomes related to infection are presented in Table II.

Other outcomes

Participants suggested studies should measure the level of patient care for prevention and treatment of infection within care homes such as hydration to prevent UTIs, mouth care and encouraging mobility to avoid respiratory tract infections. They believed these practices could support infection treatment or prevent infection from happening.

“And that is about mobility to prevent respiratory tract infection, that’s about hydration to prevent urinary tract infection...” (Hospital nurse 1)

Uptake of intervention was also deemed essential because participants were concerned about whether an intervention was acceptable to healthcare staff. In addition, participants suggested outcomes related to infection control including vaccination, uptake of infection prevention, disinfectant use, as it was recognised that a decrease in infection incidence may reduce antimicrobial prescribing. The other outcomes proposed are presented in Table II.

Refinement of outcomes

The 40 additional outcomes suggested by the participants, along with the 12 overarching outcomes derived from the systematic review [9], were reviewed by the research team to produce a final refined list.

After three rounds of review, 14 outcomes were included in the final refined list and 38 outcomes were excluded. Reasons for exclusion comprised 'duplicate' (4 outcomes), 'irrelevant to AMS in care homes' (27 outcomes), 'process measure' (4 outcomes) and 'infeasible to measure' (3 outcomes). The refined list of 14 outcomes is presented in Table III.

DISCUSSION

Interviews with researchers, healthcare professionals, and family members of care home residents) identified a total of 49 outcomes deemed to be important for studies aimed at improving AMS in care homes. The total number of antimicrobials prescribed and the appropriateness of antimicrobial prescribing were the two most common outcomes. Other important outcomes suggested by participants included antimicrobials prescribed via a telephone call, types of antimicrobials, and hospitalisation. We produced a refined list of 14 outcomes after reviewing outcomes derived from previous RCTs and those identified by the participants.

Nine outcomes reported in previous RCTs were of interest (Table II). Other outcomes deemed important that had been measured in previous non-RCTs were identified, including days of therapy, rate of resistance, and *C. difficile* rate [17]. It is unsurprising that the total number of antimicrobials prescribed, the appropriateness of antimicrobial prescribing, and antimicrobial courses adherent to guidelines were the three outcomes most frequently suggested as the main aim of AMS is to facilitate appropriate prescribing of antimicrobials to reduce AMR [8]. In addition, outcomes related to antimicrobial use, such as the total number of antimicrobials prescribed, could be good surrogates for AMR, which is difficult to measure in trials, due to the strong relationship between antimicrobial consumption and AMR [18–20].

Interestingly, participants in the study suggested a number of outcomes that could be useful to measure but have seldom been used in previous AMS studies in care homes. It has been suggested that types of antimicrobials, especially broad-spectrum antimicrobials, should be measured [9,20]. Although such antimicrobials are effective in treating a wide range of infection, they are recommended to be prescribed prudently due to the possibility of *C. difficile* infection and promotion of resistance [20,21]. Antimicrobials prescribed via a

telephone call was another suggested outcome as such antimicrobials are frequently prescribed, with no examination of the resident [5,22]. Furthermore, high rates of antimicrobials for prophylaxis associated with inappropriate prescribing, especially in UTIs recorded in the literature [23,24], may have prompted participants to suggest focusing on prophylaxis. Although infection control and prevention is beyond the scope of AMS [8], outcomes related to this area were also of concern to some participants due to the association between a reduction in incidence of infection and a reduction in antimicrobial use. This fact supports the recommendation to implement good practices in both AMS and infection control and prevention to improve healthcare for older people in care homes [25].

Additionally, several suggested outcomes were important to specific groups. All care home participants (i.e. care home managers/staff and family members of care home residents) reported hospitalisation as being important since they considered being transferred to hospital as a negative consequence of infection. However, this outcome has been reported in only four out of 18 trials of AMS in care homes [17]. In contrast, no family members were interested in antimicrobial use which has been commonly measured in AMS research; in fact, they were likely to support antimicrobial use to prevent hospital admissions. The belief that early administration of antimicrobials could prevent hospitalisation has also been supported by research involving GPs in the United Kingdom [26]. Support for antimicrobial use from family members could potentially prompt prescribers to opt for antimicrobial treatment [26,27]. Furthermore, antimicrobials prescribed via a telephone call was of concern to care home participants since GP home visits were believed to result in more appropriate treatment for care home residents thereby preventing hospitalisation. Inappropriate medication prescribing due to lack of regular physician visits to care homes [28,29] may warrant further research.

To the best of our knowledge, this is the first qualitative study exploring what should be measured in trials aimed at improving AMS in care homes. Diverse information was collected from 41 participants with heterogeneous demographics and a variety of backgrounds. However, several limitations to our study should be recognised. We used our previous systematic review, which excluded non-RCTs, to screen for potential outcomes for AMS in care homes. Despite this fact, outcomes from non-RCTs reported in a previous systematic review were also identified by study participants [17]. Almost all participants were from Northern Ireland, so views may not be generalizable beyond this region. We were also only able to recruit two care homes to the study, and interviews were not conducted with residents due to the need to assess capacity to consent to participate in the study. However, we endeavoured to explore opinions from family members and care home staff who provided direct care to residents.

In summary, this qualitative study identified a number of AMS outcomes of relevance to stakeholders who were involved in healthcare for care home residents, and reasons for their importance. By exploring distinctive perspectives of different stakeholders, we identified many outcomes which had not been considered in previous studies. This highlights a potential gap in existing knowledge which may be resolved by developing a COS [11]. Metrics to assess the impact of AMS have been developed for hospital settings hitherto [30,31], but not for care home settings. Following recommendations from the COMET Initiative [11], the refined list of outcomes will be used in a future consensus study to identify a COS for trials to improve AMS in care homes.

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Conflict of interest statement

None declared

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1 **Table I** Participant demographics

	Age (range)	Female	Years of professional experience (range)	Interview duration (range, minutes)
Researchers (n=6)	38–63	2	6–25	16–49
General practitioners (n=6)	30–58	3	3.5–16	17–35
Administrative pharmacists (n=6)	33–52	3	7–27	15–26
Hospital healthcare staff (n=15)	30–63	10	1.3–31	11–48
Care home managers/staff (n=4)	40–56	4	21–38	16–21
Family members of care home residents (n=4)	48–56	4	NA	11–31

2 NA, not applicable

3 **Table II** Outcomes deemed important by participants with illustrative quotes

Outcome deemed important	Number of participants	Illustrative quote
Antimicrobial use		
The total number of antimicrobial courses prescribed*	18	<i>“First of all it’s the volume of antibiotic use...we can see a reduction in a total of number of antibiotic use in care homes, that’s an indication that antibiotic stewardship is working.” (Clinical microbiologist 2)</i>
Types of antimicrobials	15	<i>“You can look and see that there was less broad spectrum antibiotics prescribed that could be audited early in the GP practices” (GP3)</i>
Antimicrobial consumption based on defined daily doses*	5	<i>“...and presumably you want to go down the defined daily doses, you know, defining that sort of measures, sort of comparability between across regions, and so certainly be used as well.” (GP4)</i>
Days of therapy	5	<i>“Guidance says giving three days, but [they’re] giving a week or more. But I can think 10 to 20 percent were for five days. So people were not giving the recommended dose in that” (GP1)</i>
Antimicrobial use in prophylaxis	5	<i>“Because the prophylaxis is building up the resistance...so maybe you would need to delve further back to see it’s a prophylactic [for] known infection or is it no diagnosis of infection on an antibiotic.” (Administrative pharmacist 6)</i>
Antimicrobial use at individual level	3	<i>“You might want to look at individual patients and see...you know some patients will have been prescribed twelve courses of antibiotics in the last year...” (Administrative pharmacist 3)</i>
Antimicrobials prescribed out-of-hours	2	<i>“Antibiotics...quite often can be prescribed out-of-hours, evenings or the weekends. And I think it would be useful to see whether prescribing rates to care homes are higher out-of-hours than in-hours.” (GP4)</i>

Outcome deemed important	Number of participants	Illustrative quote
World Health Organisation important antimicrobials prescribed	1	<i>"I think maybe another quest would be auditing the antimicrobial prescribing against the WHO critically important list of antibiotic, antimicrobials." (Researcher 6)</i>
Adherence and appropriateness		
Appropriateness of antimicrobial prescribing [*]	18	<i>"Appropriateness of prescribing is somehow you need to measure... It's alright to leave the guideline, and sometimes important to leave the guideline because it may not suit your needs" (Clinical microbiologist 5)</i>
Antimicrobial courses adherent to guidelines [*]	16	<i>"The two things are really important is the antimicrobial consumption and the guidelines. These I think that you can easily measure, from the outset, and you can feed back to a GP." (Clinical microbiologist 2)</i>
Cases showing healthcare staff's adherence to guidelines [*]	9	<i>"...the prescribers, the health care prescribers...they should be following the standard protocol, making sure that they all adhere to that one" (Care home manager/staff 3)</i>
Antimicrobials prescribed through a telephone call	10	<i>"But then if you're speaking to somebody over the phone, how do you know that they've got a throat infection? How do you know if a urine infection?" (Family member 1)</i>
Antimicrobials prescribed following medication review	6	<i>"In the hospital at the moment we've changed our design of our prescriptions, so that we are forcing doctors to review antimicrobials. So maybe there's something about the frequency of antimicrobial review." (Trust pharmacist 7)</i>
Antimicrobials prescribed using evidence	4	<i>"...how many prescriptions are supported by a supporting test or a clinical decision support tool?" (GP4)</i>
Antimicrobials prescribed before taking samples	2	<i>"I appreciate that it's difficult for some of these patients that are incontinent but I mean...are they on their third or fourth antibiotic for UTI before anybody manages</i>

Outcome deemed important	Number of participants	Illustrative quote
<i>to get a urine sample sent off?” (GP5)</i>		
Safety and patient-related outcomes		
Hospitalisation (including all-cause hospitalisation and hospitalisation due to infection)*	13	<i>“I definitely don’t want older people to be admitted to hospital. Definitely not, because like once they go out of here, out of their surroundings like, it’s not good for them right at all.” (Family member 2)</i>
Adverse drug events	6	<i>“...and ideally I suppose what you want to show is that not giving antibiotics, that we actually [had] an improvement in outcomes because patients didn’t have the side effects associated with antibiotics” (GP3)</i>
Mortality (including all-cause mortality and mortality due to infection)*	5	<i>“...ideally if you’re prescribing antibiotics that is much more appropriate, you should see the thing mortality either stays the same or goes down.” (Clinical microbiologist 3)</i>
Quality of life	6	<i>“...there are many pure outcomes that occur when the patient is still a resident in their nursing home. Like the number of times that the patient is unable to make it downstairs to a common area to socialize with other residents...” (Trust pharmacist 8)</i>
Rate of <i>Clostridioides difficile</i> infection	3	<i>“C diff infection is very important. I see as a side effect because it tights into safety, because it contributes to hospitalisation and mortality.” (Clinical microbiologist 2)</i>
Patient medication adherence	3	<i>“Now if the holder is empty, the patient’s taken it, or the patient’s hidden it, or the patient has thrown it down the toilet...” (Researcher 6)</i>
Rate of infection complication	1	<i>“...they could get complications which would result in...maybe having to see the GP, but maybe not admitted to hospital.” (GP2)</i>
Healthcare-associated infections	1	<i>“...the impact of healthcare associated infections on nursing home residents, it’s a truly horrible, actual tragic disease. For the rate of healthcare associated infection</i>

Outcome deemed important	Number of participants	Illustrative quote
Emergency department admission	1	<i>diminishing is only a positive thing.” (Trust pharmacist 8)</i> <i>“...the number of residents which are sent up to casualty [emergency department] and may be sent home... They will aggressively manage patients in the medical assessment unit for maybe 48 hours and then discharge back into the community.” (GP1)</i>
Infections and resistance		
Rate of antimicrobial resistance	10	<i>“In terms of the infections that you're seeing, if you had excellent antimicrobial stewardship and you saw a fall in resistant bacteria that would be reflected in your surveillance data, that would be very useful.” (Researcher 3)</i>
Number of laboratory test samples*	6	<i>“I would say [that] the number of test increases will be good measure...because, you know to see if they're not going to prescribe antibiotics that they're justifying their decision, you know, they consider another course.” (GP2)</i>
Infections per care home resident*	4	<i>“...infections per resident as well...because from the measurement tool if somebody is having reoccurring infections on a continuous basis, then you need to look at what might be causing that.” (Care home manager/staff 2)</i>
Time to resolution of infection	3	<i>“It's a better measure of whether the antibiotic was effective and whether not the patient died or ended up in hospital. I guess those are too pretty stark, you know, time to resolution of infection, something like that.” (Researcher 1)</i>
Inappropriate dipstick use	3	<i>“..within the care home setting that preponderant to dipsticks on lots of individuals who complain of non-descript kinds of symptoms, I think that leads antimicrobial use much more quickly than just all watch and wait for particularly UTIs.” (Administrative pharmacist 1)</i>
Infection outbreak	1	<i>“...if you've got an outbreak in a home how many patients are affected and how</i>

Outcome deemed important	Number of participants	Illustrative quote
Infections per home	1	<i>long does it take to get that infection under control. So I suppose that would be an outcome as well.” (Administrative pharmacist 5)</i>
Type of infection	1	<i>“You probably want also infections per home, so stratify that by different types of home whether looking at residential, nursing, dementia care units.” (Researcher 3)</i>
Relapse of infection	1	<i>“I guess another outcome is to be the measure what the infections are, because I suspect majority of infections in care homes are probably restricted to two or three, urinary tract, respiratory tract, and that kind of thing.” (Researcher 1)</i>
Inappropriate laboratory tests done	1	<i>“...if they’re [care home residents] getting one infection after another after another, they’re frail and they’re elderly and in between times they may not recover the fluid capacity that they had before the infection.” (Administrative pharmacist 5)</i>
Other outcomes		
Patient care for infection treatment and prevention	8	<i>“The number of inappropriate lab tests done would be important... it’s [to have a lab test done] not necessarily indicative of having an infection.” (Trust pharmacist 8)</i>
Uptake of education/ intervention	6	<i>“Let’s see urine infections maybe if they get more water, have to drink more fluids, that might be alleviated. Just infection control may be looked at more, you know.” (Family member 3)</i>
Vaccination	3	<i>“It might be worth sort of monitoring uptake of that, you know, how many healthcare professionals or patients and relatives sort of participated in education.” (Trust pharmacist 3)</i>
		<i>“Doctors seem misdiagnose flu as a chest infection and someone can get antibiotics so can lead them more prescribing so I think uptake of a pneumococcal would be interesting.” (GP4)</i>

Outcome deemed important	Number of participants	Illustrative quote
Timely assessment and treatment	3	<i>"It's definitely [that] catching infection in time before it has had a chance to really affect the dementia condition is so important." (Care home manager/staff 4)</i>
Documentation of care by care home staff	3	<i>"If I give an antibiotic prescription over the phone, I will at least expect I have a full set of observations from the nursing home... Some sort of clinical background that is not always the case." (GP1)</i>
Antimicrobial request from care home staff	2	<i>"The one that I was thinking of was possibly if we could monitor request for antibiotics...there's a lot of request, nurses staff a kind of prone to phoning up and looking" (Trust pharmacist 2)</i>
Financial impact of an intervention	2	<i>"...if you reduce the number of prescribing you should save money because you're using less antibiotics." (Clinical microbiologist 5)</i>
Number of general practitioners per home	1	<i>"...say a practice had ten GPs looking after residents had much worse prescribing than a home that had two GPs looking after." (GP4)</i>
Staff awareness of current guidelines	1	<i>"...you look at how many people were aware of the guidelines or read the guidelines, or recent guidelines were updated..." (Clinical microbiologist 5)</i>
Uptake of infection prevention	1	<i>"...looking at training uptake of infection prevention and control training within care homes...because a resistant infection starts in one individual but with good infection prevention control hopefully it would stay within that one individual" (GP4)</i>
Disinfectant use	1	<i>"What disinfectants do they use to keep place clean? Because some of them do not use the proper agents...the person got the infection due to transmission from the patient in the next pair and the next area..." (Trust pharmacist 5)</i>
Mechanism of resistance	1	<i>"...the patterns of resistance and the mechanisms of resistance that are being seen, but</i>

Outcome deemed important	Number of participants	Illustrative quote
		<i>that's what my laboratory hat on and an interest in those areas as well." (Researcher 5)</i>
Time period that residents stay healthy	1	<i>"Whether a person has returned to baseline would be a measure of whether an antimicrobial treatment was successful or not..." (Trust pharmacist 8)</i>
Falls and delusion	1	<i>"When I think of infections within a dementia environment I think of the disorientation delusion, hallucination and fall rate." (Care home manager/staff 2)</i>
Aggression or agitation	1	<i>"...when we're looking at dementia conditions, how the preference of an infection can really exasperate the condition. And maybe I had spoken about how that can lead to increased agitation and perhaps aggression." (Care home manager/staff 1)</i>
4 [*] <i>Outcomes reported in previous randomised controlled trials; GP, general practitioner; UTIs, urinary tract infections</i>		

5 **Table III** The refined list of outcomes related to AMS in care homes

Outcome	Original source	Definition
The total number of antimicrobial courses prescribed	Systematic review	The total number of antimicrobial courses that are prescribed for care home residents over a period of time
Antimicrobial courses adherent to guidelines	Systematic review	Antimicrobial courses that are prescribed in accordance with recommended guidelines
Appropriateness of antimicrobial prescribing	Systematic review	Antimicrobial courses that are prescribed in accordance with the best available evidence and are suitable for a patient, taking their medical history and medical conditions into consideration.
Antimicrobial consumption based on defined daily doses	Systematic review	The level of antimicrobial use that is described by defined daily doses which are published by the World Health Organisation. The defined daily dose of an antimicrobial is the assumed average maintenance dose per day for a particular antimicrobial used for its main indication in adults
Hospitalisation due to infection	Systematic review	Care home residents' admission to hospital for treatment or monitoring due to infection
All-cause mortality	Systematic review	The number of deaths of care home residents for any reason
Mortality due to infection	Systematic review	The number of deaths of care home residents due to infection
Antimicrobials prescribed through a telephone call	Stakeholders	Antimicrobial courses prescribed during a telephone call with care home staff by prescribers without seeing patients
Antimicrobial use in prophylaxis	Stakeholders	Antimicrobial courses that are prescribed for preventing infection (e.g. UTI)
Types of antimicrobials	Stakeholders	The different types of antimicrobials that are prescribed for care home residents (e.g. broad spectrum, first-line, or intravenous administration)
Days of therapy	Stakeholders	The duration (in days) of antimicrobial courses that are prescribed for care home residents
Rate of antimicrobial resistance	Stakeholders	The number of cases in which antimicrobial-resistant bacteria are identified
Rate of <i>Clostridioides difficile</i> infection	Stakeholders	The number of cases of <i>Clostridioides difficile</i> infection among care home residents
Rate of infection complication	Stakeholders	The number of care home residents who develop infectious complications

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