Project title

'StOP UTI' - Strategies for Older People living in care homes to prevent Urinary Tract Infection: a realist synthesis of the evidence

HRA protocol compliance declaration

This protocol has regard for the HRA guidance and order of content and the RAMESES publication standards for realist syntheses [1].

Research type

Evidence synthesis

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STUDY SUMMARY

Research question: Preventing urinary tract infection (UTI) among older people with or without urinary catheters living in care homes: what works, for whom, why and in what circumstances?

Background: The incidence of urinary tract infection (UTI) increases with age and is highest among those living in care homes. Several factors predispose older people to UTI e.g. genitourinary tract disorders, asymptomatic bacteriuria, cognitive impairment, urinary catheters. Resistance to antibiotics commonly used to treat UTI is now common and infections caused by resistant bacteria more likely to spread to the bloodstream. One third of admissions to hospital from care homes are due to UTI and rates of emergency admissions to hospitals have increased markedly since 2001. However, guidance about strategies for preventing UTI in care homes is limited and does not account for the varying contexts in which care is delivered, challenges presented by residents with complex health needs, or demands of care delivery by unqualified staff with limited supervision. Systems that support early recognition of UTI by care home staff are critical to driving improvements in UTI prevention to monitor the effectiveness of prevention strategies. Over-diagnosis of UTI is recognised as a problem in this setting and it is not clear how complex diagnostic algorithms are understood and applied.

Aims & objectives: This research proposes a realist synthesis (RS) of existing evidence to produce evidence-informed programme theories identifying which strategies are effective (or not) in preventing older people in care homes from acquiring UTI. Potential theories will be developed by searching different bodies of evidence/sources and consultation with stakeholders.

Method and timeline for delivery: The RS will draw on evidence from health and social care, including primary research relating to UTI prevention in older people in care homes and improvement project reports in grey literature. Purposive searching will also include wider literature that provides opportunities for transferable learning, such as evidence on how patterns of care, organisation culture and leadership in care homes support outcomes of implementation. The synthesis will examine the relationship between interventions /phenomena of interest and the context in which they are applied, thereby providing explanations about the causal mechanisms and what outcomes they produce. The review will be conducted in 4 iterative stages over 18 months to (1) construct a theoretical framework and initial programme theories; (2) retrieve, review and synthesise evidence relating to interventions designed to prevent UTI, guided by the programme theory; (3) test and refine the programme theories in consultation with stakeholders to establish practical relevance and potential for implementation and (4) formulate recommendations for preventing and recognising UTI in a care home setting.

Anticipated impact and dissemination: Our findings will address an important gap in evidence by providing evidence-informed programme theories identifying which strategies are effective in preventing and recognising UTI in older people in care homes. It will provide unique recommendations that are relevant for care home settings, which can be incorporated into policy, guidance and educational programmes to help guide successful delivery of future improvement programmes and research. The incidence of UTI, recurrent UTI and CAUTI will be reduced.

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STUDY FLOWCHART

1. BACKGROUND

Epidemiology

Urinary tract infection (UTI) is the most commonly diagnosed infection in older people. It is caused by the multiplication of microorganisms within the urinary tract and can result in a number of clinical syndromes including pyelonephritis, cystitis and urethritis. Infection can also spread to the bloodstream. Sequalae can range from a mild self-limiting illness to severe sepsis with a mortality rate of 20-40% [2,3]. Inadequate antimicrobial therapy significantly increases the risk of infection spreading to the bloodstream. Resistance to antibiotics normally used to treat UTI is now common in the UK, with 40% of uropathogens now resistant to trimethoprim [4]. Older people who experience repeated episodes of UTI, and therefore frequent exposure to antibiotics, are at greater risk of acquiring resistant pathogens associated bloodstream infections [5,6]. UTI accounts for more than 50% of antibiotic prescriptions in long-term care settings [7].

The incidence of UTI increases with age in both men and women and is highest among those living in long-term care facilities at 44 to 58 infections per 100 residents per year [3]. Several factors predispose older people to UTI including genitourinary tract disorders, increased susceptibility to asymptomatic bacteriuria (bacteria in the urine), cognitive impairment and incontinence [7,8]. Older people living in care homes are more likely to have these comorbidities and are therefore at particular risk of acquiring UTI. In a cohort and nested case-control study undertaken in 6 long term care facilities in Norway, the incidence of UTI was 2 per 1000 resident days (95%CI 1.8-2.2) and they accounted for 40% of infections acquired by residents [9]. Risk factors for UTI included being confined to bed (OR 2.7), an indwelling urinary catheter (OR 2.0), skin ulcers (OR 1.8) and urinary incontinence (OR 1.5) [9].

Although most UTIs in this setting are not associated with an invasive device, the presence of a urinary catheter (UC) provides a route for bacteria colonising the perineum to gain access to the bladder and increases the risk of UTI by 3 - 8% per day [10,11]. A prevalence survey of 425 care homes in the UK found 6.9% of the 12,827 resident population had a urinary catheter [12]. This study also provided evidence of variation in practice both in relation to discharge from hospital with a UC in situ and its removal once in the care home, suggesting there is room for a more pro-active approach to reducing UC use.

UTI is one of the most common reasons for hospitalisation accounting for one-third of the admissions from care homes. In those admitted with bloodstream infections, half occur as a result of a urinary source [10]. In a study of community-acquired infections in older people admitted to hospital residents in care home were found to have more co-morbidities (p = 0.048) and higher rates of resistant bacteria (70% versus 36%, p = 0.026) compared to people resident in their own homes [13]. Improving understanding of the strategies that could be effective in preventing UTI in in long-term care settings is a priority given the increased susceptibility of this population, the frequency with which UTI occur and the impact on the wider population in terms of acute care resources and increasing antimicrobial resistance.

Prevention strategies

Although the predominant cause of infection among older people is UTI, guidance about strategies for prevention in care homes is limited and mainly focused on urinary catheters [14,15]. Guidance does not account for the varying contexts in which care is delivered [16], the challenges presented by residents with complex health needs, or the demands of care delivery by unqualified staff with limited supervision [17,18]. A systematic review by Lee *et al* [19] explored evidence for the impact of different components of infection prevention programmes on practice and infection outcomes. Education, monitoring, and feedback were identified as essential components in strategies for affecting behavioural changes in healthcare workers at long-term care facilities. However, little is known about the practicality of implementing these approaches in UK care homes.

A recent systematic review of interventions to reduce UTI in nursing home residents identified 19 studies, most of which were small scale, non-randomised before and after studies [20]. The majority of were focused on prevention of infection related to urinary catheters, for example by replacing indwelling catheters with intermittent or condom catheterisation, ensuring appropriate indication for the catheter and improving management to reduce the risk of UTI. Six studies were focused on improving continence care and bladder training [20].

Optimising the care of urinary catheters and the use of alternatives to a catheter are key strategies for preventing UTI. Duration of catheterisation is the most important modifiable risk factor for catheter-associated UTI [11] and so timely review and removal of catheters is imperative. Urinary catheters are commonly inserted in older people while they are in hospital, but can remain in place following discharge from hospital when there no clear plan for review and removal. A recent prevalence survey of patients with an indwelling urinary catheters (those placed within 4 weeks in patients without a catheter previously) originated in hospital, with only half having an active management plan likely to result in early removal of the catheter [21]. Most patients with a newly-placed catheter were men aged 70 years or older, of whom 11% were in residential care or on an assisted living unit.

In residents without a catheter, studies have focused on strategies to reduce the risk of recurrent UTI (at least 2 UTI in 6 months or 3 in 12 months) using a range of non-antibiotic agents that prevent uropathogens adhering to epithelial tissue in the urinary tract (D-Mannose), create an antiseptic environment in the bladder (methenamine hippurate, cranberry) and support natural defences against UTI (probiotics and oestrogen). There is a body of evidence from small scale trials and systematic reviews, although the efficacy and feasibility of using such approaches in a care home setting are important considerations [22].

The difficulty of conducting randomised controlled trials in long-term care settings means that most evidence is drawn from more pragmatic designs such as quasi experimental, qualitative or improvement methodology [23]. These provide critical evidence about the contextual factors that mediate knowledge translation and implementation of best practice [24]. However, the evidence from these types of study are more difficult to either publish in

standard peer review publications or include in conventional systematic reviews of effectiveness [25].

In the UK there have been a number of quality improvement initiatives published mainly in grey literature, which have focused on preventing UTI by improving hydration of elderly care home residents. Wilson et al [23] used improvement methods in two residential care homes to develop and test practical care interventions aimed at extending drinking opportunities and choice. The long-term impact of the interventions was assessed by measuring daily laxative and antibiotic consumption, weekly incidence of adverse health events including UTI, and average fluid intake of residents. Although the number of events was too small to detect a change in incidence of UTI, they were associated with an increase in the amount and range of fluids consumed and a significant decrease in laxative use. This study highlighted some of the important practical and organisational barriers in this care setting that affected the environment of care and the sustainability of interventions. These included the approach to communication between care staff, the organisation of care, the priority given to various care activities and monitoring and responding to indicators of resident safety [23,26]. The study also explored the impact of focused training on hydration in this care setting and identified supporting the development of skills in reflective practice as being critical to translating improvement in knowledge into change in practice [27].

In another study aimed at improving hydration of care home residents in 4 care homes in the UK, a daily programme of seven structured drink rounds were introduced accompanied by staff training and raising awareness. This initiative was reported to reduce UTIs requiring antibiotics by 58% and UTIs requiring hospital admissions by 36%. The intervention was supported by other strategies such as staff training and raising awareness [28]. Other initiatives to improve hydration in elderly care residents have been associated with reductions in UTI and published online [29].

A common theme in these studies is the role of leadership in determining successful outcomes in a setting where residents are highly dependent and care is delivered by unqualified staff with limited supervision [17]. Leadership is critical in structuring and monitoring care delivery, defining staff responsibilities, fostering teamwork and championing, modelling and driving change [23,26,28].

Transferable learning from other studies about the organisation of care delivery, including the influence of approach, culture and routines on implementation outcomes, will enhance understanding of how to support effective implementation of strategies in these settings [30,31]. Other evidence of relevance might include evaluations of interventions relating to hydration or continence in older people with cognitive impairment or dementia, pressure ulcer prevention in care homes and evidence on leadership and implementation in care homes [30-36].

Recognising UTI and residents at increased risk in care homes

Mechanisms that support early recognition of UTI by care home staff, nurse practitioners and GPs are critical to driving improvements in UTI prevention as they enable informed assessment of individual residents and monitoring of the effectiveness of prevention strategies (see Figure 1). Over-diagnosis of UTI is a known problem in care homes [37-39] and without accurately distinguishing infection from asymptomatic bacteriuria it is not possible to measure the impact of prevention strategies.



Figure 1 How recognition of UTI is integral to its prevention

Early recognition of UTI in long term care is problematic. In younger adults, a combination of clinical features and the presence of bacteria in the urine has high positive predictive value for UTI [40]. However, in adults over 65 asymptomatic bacteriuria is more common and less discriminatory for UTI and they can present with more generalised symptoms such as abdominal or back pain [41]. In addition, a high proportion of care home residents are living with cognitive impairment or dementia and may not be able to communicate symptoms. Reagent strip tests (dipsticks) are commonly used by care home staff and clinicians as a UTI diagnostic tool despite their unreliability in older people and recommendations in national guidelines to cease using in this group [42-44]. Use of urine dipsticks may drive unnecessary antibiotic prescribing [8], placing individuals at risk of future UTI, leading to increased rates of adverse drug effects and more recurrent infections with antibiotic-resistant bacteria [41].

Significant resources within primary care would be required to provide full clinical assessments for all suspected UTI cases in care homes and therefore GPs rely on care staff to make clinically accurate observations. Staff working in care homes for older people may have limited capacity or clinical expertise to recognise relevant signs and symptoms and limited access to specialist advice. GPs often provide prescriptions over the phone in response to reports from non-medically trained care staff.

One study evaluated UTIs diagnosed in care homes against standardised criteria and found that only 6% of reported UTIs met these criteria, with 40% meeting neither clinical or microbiological criteria [45]. Phillips [38] found that antibiotics were frequently used to treat asymptomatic bacteriuria in patients with urinary catheters and half of prescriptions in residents without a catheter were given in the absence of any symptoms of UTI. O'Kelly [37] found a number of complex psychological and behavioural factors influenced the misdiagnosis of UTI in older people attending an emergency department. These included

prejudiced judgments and assumptions, responding to peer pressure and fear of legal consequences.

Public Health England [43] have recently recommended specific criteria to support more accurate diagnosis of UTI in older adults. However, these are complex and it is not clear how they are understood and applied by staff working in care homes, particularly in relation to residents with dementia [46]. Using patient information to support early recognition of UTI is one approach that has been recently evaluated and has highlighted the importance of linking simple information on recognising UTI with prevention strategies such as hydration and continence management [46].

Evidence for why research is needed now

Rates of emergency hospital admissions due to UTI are reported to have increased markedly in England since 2001 [47] and one third of admissions to hospital from care homes are due to UTI [10]. UTI prevention is therefore an important driver for reducing admission rates. Older people, particularly those in care homes, are the most vulnerable to UTI, yet guidance on effective prevention strategies is limited and mostly not directed at this setting. Consequently, there is an urgent need for coherent, evidenced based programmes to support the prevention of UTI that are both relevant and practical to implement in care homes in the UK.

High rates of resistance to antibiotics used to treat UTI have emerged as a major public health problem, with a high proportion of urinary *E. coli* isolates now resistant to trimethoprim [4]. Up to 50% of antibiotics administered in care homes for older people are prescribed for UTI [10,48]. However, because UTI is difficult to diagnose accurately in this population a high proportion of antimicrobial prescriptions are unnecessary [8,49], whilst if UTI is present, inadequate antimicrobial therapy significantly increases the risk of bloodstream infection [2]. In the last decade there has been a rapid, year-on-year, increase in incidence of invasive infections caused by the most common uropathogen, *Escherichia coli* (*E. coli*), with more than 43,000 cases reported in England in 2019 [50]. The majority of these infections occur as a result of UTI, 68% originate outside acute healthcare settings, 70% occur in adults over 65.5 [23], and cases associated with substantial antimicrobial resistance and increases in ambient temperatures [5].

In recognition of the important threat to public health presented by these trends in *E. coli* infections and resistance in uropathogens, national targets have been set to reduce the number of Gram-negative bloodstream infections by 50% by 2021 [51]. Since the majority of these infections occur as a result of UTIs in elderly people, identifying strategies that prevent UTI and understanding how to implement them effectively are essential to address this target. This research will therefore provide evidence-informed theories for preventing UTI that can be used to improve outcomes, such as decreased hospital admissions and use of antimicrobial agents, and drive practice and NHS policy change for residents of care homes.

2. RESEARCH QUESTIONS, OBJECTIVES AND FOCUS

The purpose of the Strategies for Older People living in care homes to prevent UTI ('StOP UTI') realist synthesis of evidence is to explain the effectiveness of programmes that aim to reduce UTI in care homes for older people. More specifically, the review will produce evidence-informed programme theories identifying which strategies are effective (or not) and explain the mechanisms by which they work (or why they fail). It will also assess the approach to recognising UTIs as this is essential to driving and evaluating prevention initiatives (see Figure 1, pg. 9). Targeting prevention strategies at those residents at greatest risk of UTI may be a useful approach but this also requires reliable mechanisms to identify residents who experience recurrent infections.

This theory-driven understanding of what needs to be in place for the successful implementation of UTI prevention programmes will identify the active components of complex interventions, thus helping to guide the development and successful delivery of future programmes to prevent older people in care homes in the UK from acquiring UTI. The focus will be to develop explanatory models of how and why UTI prevention programmes are believed to work.

The primary research question is underpinned by a secondary (applied) research question, from which the research aim and objectives are derived (see Figure 2). The outcomes of interest are a reduction in number of UTIs (including recurrent UTI), reduction in UTI- associated bloodstream infections, reduction in antimicrobial use and reduction in hospital admissions.



Figure 2 Research questions, aim and objectives

3. RATIONALE FOR USING REALIST SYNTHESIS

A systematic synthesis of evidence using a realist approach [52] will be undertaken based on principles of best practice. This approach offers the most appropriate way of reviewing the literature for this project as it will reveal how best to deliver interventions to recognise and prevent UTI in care home settings. The review will examine the relationship between interventions and the context in which they are applied, thereby providing explanations about their mechanisms of action and what outcomes they produce [53].

As an approach to research, realist review and synthesis provides a means to understand what triggers particular behaviours, the consequences of such behaviours and what contextual factors affect them [54]. This approach provides the opportunity to take a holistic approach to the synthesis of bodies of evidence that will inform the translation and evaluation of evidence-informed interventions in the care home setting. In realist terms a programme theory represents the underpinning mechanism of action, rather than the intervention [52] and realist synthesis results in context, mechanism, outcome configurations (CMOc) that explain how a theory might or might not work. These configurations ensure external validity as they enable theory building to a level of abstraction that means the theories are useful in other contexts [54].

The CMOc are often referred to as mid-range theories and provide the appropriate level of closeness to practice to enable the testing of initial programme theory propositions [1]. They are essential to understanding how interventions to prevent UTI can and should be delivered in the residential/long-term care context, providing a clear account of the mechanisms of action. Mechanisms of action provide an explanation of the way in which the resource element of an intervention might work. In scientific realism, mechanisms are a combination of the resources offered by an intervention e.g., a risk assessment tool, and the reasoning or behaviour that is required to implement them; e.g., how this changes the reasoning of stakeholders to bring about the desired outcome [55]. CMOc therefore provide explanations of what works, for whom and in which contexts and circumstances (Figure 3).



Figure 3 A CMOc Framework (adapted from Dalkin et al 2015) [56]

The analytical task will be to construct causal explanations of interventions/phenomena of interest to prevent UTI and how they operate to impact on delivering effective care for older people living in care homes. These causal explanations are expressed as relationships between CMO. This will provide a theory-driven understanding of what needs to be in place for the implementation of programmes to support the recognition and prevention of UTI and its recurrence in older people with and without a urinary catheter living in care homes in the UK, addressing an important gap in evidence.

4. STUDY DESIGN

This realist synthesis will draw on evidence from health and social care, including primary research relating to UTI prevention in older people in care homes and improvement project reports in grey literature. Purposive searching will also include wider literature that provides opportunities for transferable learning, such as evidence on how patterns of care, organisation culture and leadership in care homes support outcomes of implementation. The synthesis will examine the relationship between interventions/phenomena of interest and the context in which they are applied, thereby providing explanations about the causal mechanisms and what outcomes they produce. It will be conducted in four stages over 18 months to (1) formulate the review's initial programme theories; (2) retrieve and review the evidence relating to interventions designed to prevent UTI in older people living in care homes, guided by the programme theories; (3) synthesise the evidence and refine the programme theories in consultation with stakeholders to establish their practical relevance and potential for implementation and (4) formulate recommendations for preventing and recognising UTI in care home settings (see Figure 4). Whilst these stages are described sequentially, in practice there is considerable iteration between them with stakeholder engagement, including involvement of PPI representatives, embedded throughout.

Stakeholders will be involved throughout the process to inform the development of initial and refined programme theories (CMOc) and establish their practical relevance and potential in the real-world. A stakeholder analysis exercise will be undertaken at the start of the review to identify a range of people who need to be involved in the various aspects of the review process. Lists of potential stakeholders will be drawn up to consider their potential input for the review, and at what stage. Stakeholder group membership is likely to include users of care home services, their care partners and families; providers of services, service commissioners and other relevant organisations (e.g. inspectorate bodies). We will use a purposive approach to identifying stakeholders based on the stakeholder analysis. Using our extensive networks and guided by our PPI co-applicant and wider research team we will build a broad membership representative of the diversity seen in care homes, taking account of geography, age, ethnicity, disability and public/private ownership.

This level of stakeholder engagement aims to promote joint decision-making at key stages of the review and will ensure that the synthesis is underpinned by multiple perspectives and focuses upon what is important to care home residents and those who provide care. The narrative we develop around each programme theory will describe the relationships between mechanisms and the contexts in which they occur. In Stage 1 our stakeholder workshops will guide initial theory development. In Stage 3 the teacher-learner interviews will inform theory refinement. Our stakeholder conference in Stage 4 will enable us to work co-creatively to tailor our outputs towards care home residents, managers and staff, clinicians, educators and researchers and support dissemination of findings that can be used to improve existing practices and inform development of future interventions.

Figure 4 Study protocol



Outputs:

- 1. Programme theory that describes how UTI prevention and recognition strategies work to reduce the occurrence of UTI in care home settings.
- 2. Recommendations for practitioners and other stakeholders.
- 3. Resources to support implementation of recommendations to prevent and recognise UTI in care homes.

5. DATA COLLECTION AND ANALYSIS

Stage 1: Programme theory development

In realist reviews theories are ideas about how particular interventions may or may not work in practice. Stage 1 will formulate initial programme theories, driven by consultation with stakeholders, that will be refined and tested throughout the review. A process of concept mining [30,56,57] will be used to map evidence about approaches to recognising and preventing UTI in older people living in care homes, how they might work and any reported enablers or barriers to their successful implementation. This will involve searching different bodies of evidence and consulting with stakeholders to develop the scope of the study and identify information, key terms and concepts that could help with theory building.

Scoping of the literature

The scoping or "background" search [58] will extend a preliminary search carried out in December 2019 during development of the research proposal, for which Medline, CINAHL and grey literature searches were undertaken. This preliminary search focused on evidence that directly addressed the recognition and prevention of UTI in older people in long-term care facilities. It identified key empirical studies, reviews and guidelines, together with newer evidence emerging on this topic. The scoping search will update and expand this to include additional bibliographic databases (including Embase, Cochrane Library, Web of Science Core Collection, Sociological Abstracts, Bibliomap and NIHR Journals Library). As with the preliminary search it will focus on literature relating to recognition and prevention of UTI in older people in long-term care facilities.

Supplementary searches, for example, using key index studies (highly cited) to find 'sibling' studies/papers (contemporaneous papers/studies that share a context), will also be undertaken at this stage, using Google Scholar and 'Publish or Perish' software. English language and ten-year date limits will be used since there is no obvious policy change or reason to suggest a particular date limit and ten years reflects the large volume of literature identified. This generic topic-based multipurpose search will be followed by more targeted searches in Stage 2 exclusively to inform the realist synthesis [58].

Stakeholder involvement

A theory-building workshop will be used to explore what is necessary for UTI to be effectively recognised and prevented and identify the common approaches used and how they are understood to work in care home settings. Stakeholders will be invited to contribute on why they think certain approaches work, in what circumstances and why. Three key groups have been identified, although other expert groups may be co-opted as part of the scoping process:

- Providers of care: Care home managers and support workers
- Recipients of care: Care home residents and their representatives
- Professional practitioners: Clinicians and specialists with a role in care homes

Using the evidence from the concept mining process and the output from the workshops a set of preliminary hypotheses in the form of 'if-then' statements [59] will be developed as tentative programme theories. This will provide an initial explanation of how different types

of interventions for recognising and preventing UTI in care home settings might work given the impact of ageing on its prevention and recognition [10] and the complexities inherent in how care is organised and knowledge mobilised in long-term care settings [24,30].

The output from Stage 1 will be formulation of initial programme theories.

Stage 2: Evidence retrieval

The purpose of this stage is to determine whether the initial programme theories are supported by evidence within the literature and to ensure that all the relevant literature has been identified. Guided by the initial programme theories we will search purposively for sources of programme theory and for empirical studies to test and refine theory [53,58]. Unlike undertaking a systematic review where the search strategy is exhaustive, the search strategy in a realist synthesis is both iterative and purposive and may require multiple search strategies throughout the review process (see Fig 4)[60]. The searching evolves to uncover theories which were not apparent at the beginning of the concept mining process but that emerge as new lines of inquiry are studied [61].

In realist methodology the unit of analysis is the programme theory, or underpinning mechanism of action, rather than the intervention [52]. This means we will be able to draw on a wider literature that provides opportunities for transferable learning. We will search for literature specific to the care of older people in care homes in areas such as interventions for people with dementia in care homes, and evidence on how patterns of care, culture, organisation management and leadership in care homes support outcomes of implementation [30,31]. This will also include interventions that focus on the reliable recognition of UTI [8], minimising UTI risk and recurrence in older people with and without a urinary catheter [7,16,62,63] managing incontinence and incomplete bladder emptying [7], general hygiene to reduce infection [7], improving hydration [23] and UTI prophylaxis [22,64].

Search strategy

We will build on the scoping search to include all care settings, published and grey literature using the following databases:

- Peer reviewed literature: Cochrane, MEDLINE, CINAHL, EMBASE, ASSIA, Scopus, Sociological Abstracts, Bibliomap, NIHR Journals Library;
- Grey literature: Google Scholar, OpenGrey, NHS Evidence, and Social Care Online
- Policy and narrative literature: websites of relevant organisations.

In order to aim to identify "conceptually rich" or "contextually thick" evidence, we will use citation searching and author searching to identify clusters of related papers [54]. It is likely that some relevant evidence may exist in unpublished form and therefore we will seek to maximise opportunities for identification of this literature through consultation with our Project Advisory Group (PAG), stakeholders and communication with relevant policy, professional and third sector organisations.

Search topics/terms

Search terms will be developed to capture literature that relates to the mechanisms that trigger the prevention and recognition of UTI in older people in care homes including:

- non-antimicrobial prophylaxis e.g. oestrogen, methenamine hippurate, dietary supplementation
- optimum hydration to prevent UTI
- indications for alternative bladder management strategies and use of urinary catheters
- urinary incontinence and UTI, advanced dementia and UTI, recurrent UTI
- organisational culture and quality of care in care homes

Limits

We consider it important to include evidence from health systems in other countries, including similarly resourced systems where there are services for long-term care, to identify potential strategies that may be realistic in the UK context. We will limit our search to English language papers published within the last 10 years, taking account of both the relevance and volume of literature retrieved in order to achieve a manageable approach without excluding important key studies.

Review inclusion criteria

The test of inclusion for a realist review is based on relevance and rigour [52]. Members of this team have developed an approach for the test of relevance and rigour, which will be used in this review [57]. Relevance is defined as the extent to which evidence can contribute to theory building and/or testing, and rigour is defined as the extent to which the methods used to generate that particular piece of data are credible and trustworthy.

Selection and assessment of data

The titles and abstracts of identified studies/documents will be sifted and cross-checked across at least two members of the team, including input from our senior team members. This level of checking will also be applied to the assessment of relevance and rigour. Discrepancies in opinions about the relevance of articles will be resolved through discussion amongst the project team and decisions documented.

Data extraction

The data extraction process will be undertaken by one reviewer, with at least a 30% proportion (aiming for 50% depending on volume) of those identified for inclusion being peer reviewed and checked by a second reviewer (distributed across 5 team members, 4 of whom are senior academics (see Flowchart – page 6). Evidence will be extracted to record two aspects of the review process. A conventional summary table will include the study characteristics, including methods, setting and outcomes. This will be adapted for nonresearch-based literature. A bespoke data extraction form based on the initial programme theories will be used to structure the extraction of relevant information, insights and the charting of data so that the theory areas are populated with evidence on what appears to work, for whom, how and in what contexts (see Figure 5)[53]. It will be used in conjunction with a conventional data extraction form, used for systematic reviews, to record information about study characteristics and findings of relevance to the review questions and provide consistency. The evidence tables will then be reviewed by the project team, with input from all 6 senior academics, to check against propositions developed in the initial programme theories and note any new evidence to support or refute them. This combined approach will provide evidence of relevance and rigour.





The output from Stage 2 will be a comprehensive evidence base representing the different bodies of literature linked to initial theories. Each theory area will have a single evidence table including all relevant articles.

Stage 3: Testing and refining programme theories

Stage 3 will involve the theming of the evidence within and across the evidence tables and the formulation of chains of inference from the identified themes to develop Context-Mechanism-Outcome configurations (CMOc - see example in Figure 6) [52,53]. CMOc are essential to understanding how interventions to prevent UTI can and should be delivered in the care home context, providing a clear account of the mechanisms of action. They will provide explanations of what works, for whom and in which contexts and circumstances.

Figure 6: Example of a CMOc on hydration



From these CMOc, the 'if – then' statements will be refined, framed and linked to the source(s) of evidence. Findings from different studies will be compared and contrasted, seeking both confirmatory and contradictory findings as part of the synthesis and theory refinement process. For each hypothesis a record of this process (see Table 1) will be systematically documented to capture data across studies that contributes to the context, impact/effectiveness and interpretation of the evidence [57].

Table 1: Example of data	analysis record for	orm (based on William	s et al, 2016)[57]
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Hypothesis 1: "If…, then…"				
Sources: x, y, z				
Study no.	Supporting evidence	Context/ impact/ effectiveness	Interpretation	
x				
y, z				

As realist synthesis is theory-driven we will use abductive reasoning, that is, seeing something new in evidence or observation and making inference to the plausible explanations for the hypotheses, and retroduction to understand the cause of an event beyond what can be seen, checking and prioritising across the evidence tables to look for emerging patterns [52]. This aspect of the review process is resource-intensive and reliant on discussion and deliberation, including consultation with key stakeholders and involvement of our PPI participants.

Theory testing and refining

We will conduct up to 10 'teacher-learner' interviews to elicit stakeholder (teacher) views on the plausibility of the programme theories and establish the credibility and transferability of the underpinning CMOc [52]. A purposive sample of key stakeholders, such as managers, clinicians, support workers, lay representatives of older people and service commissioners or funders will be identified to participate in semi-structured audiorecorded telephone interviews. The interviews will be transcribed verbatim and stored and organised using NVivo[™] software. A framework approach using the CMOc as a heuristic will be used to analyse the interviews and confirmatory or refutational data mapped directly on to the CMOc.

The output of Stage 3 will be a refined and tested programme theory consisting of CMOc, which are supported by relevant evidence.

Stage 4: Actionable recommendations

In Stage 4 we will develop a narrative around the final programme theory, summarising the nature of CMOc links and the characteristics of the underpinning evidence [53]. In consultation with the Project Advisory Group (PAG) we will produce a theory driven account of what needs to be in place for implementation of programmes to support the prevention and recognition of UTI in care homes. This will describe the relationships between interventions and the contexts in which they occurred and will be used to underpin recommendations for preventing and recognising UTI in a care home setting.

Stakeholder conference

We will hold a stakeholder conference involving care home managers and staff (in the NHS, local authorities and the independent sector), clinicians, residents and their representatives, healthcare commissioners and policy makers, care home provider organisations, charities and educators.

The aim of this conference will be to engage stakeholders in:

- discussion of the findings of the review
- advising on resources that would support the use of the findings
- advising on dissemination strategies

Resources to support dissemination and implementation

We will develop material that describes the CMOc in a way that is relevant to the care home setting, together with a range of implementation support tools, such as care planning and decision support tools, systems to support improvement (e.g. process mapping, stakeholder analysis, PDSA and measurement templates); promotional material (e.g. infographics, posters, educational material including training/information videos and case studies). We will draw on views captured in the stakeholder conference and our previous experience to develop material that is relevant and practical for care home staff and other stakeholders to use. We anticipate that in addition to developing new material, we will draw on existing resources [4,34] and all material will be made available online.

The resources will be relevant to key stakeholders who are involved in the organisation and delivery of care such as care home staff, residents and their families, GPs, commissioners, care home provider organisations, charities and educators. The material developed will be informed by our PPI representatives, PAG members and the other stakeholders we involve in the realist synthesis.

The output from Stage 4 will be programme theories and a report of the review including relevant and actionable recommendations together with accessible resources to support their implementation.

6. ETHICAL AND REGULATORY COMPLIANCE

The 'StOP UTI' study was identified as a service evaluation/service development following submission to the UK Health Research Authority and subsequent review by the University of Southampton Faculty Ethics Committee.

7. DISSEMINATION STRATEGY

We aim to publish this realist synthesis in a peer-reviewed journal with international readership. The outputs from this research will be (i) programme theory that describes how UTI prevention and recognition strategies work to reduce the occurrence of UTI in care home settings, (ii) recommendations for practitioners and other stakeholders and (iii) resources to support implementation of recommendations to prevent and recognise UTI in care homes. Our dissemination strategy will focus on the distribution of targeted material for a wide range of stakeholders from long-term care settings. Patient and public involvement will be crucial to ensuring that our findings reach carers and the public. We will

engage with national organisations able to drive policy (e.g. NHS England, Social Care Institute of Excellence), third sector organisations (e.g. Age UK, Care UK) and our networks including Academic Health Science Networks, National Institute for Health Research (NIHR) Applied Research Collaborations (ARCs) and professional groups (e.g. Infection Prevention Society, National Hydration Network) to support the communication and dissemination of the research findings and recommendations.

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