Public Health England

Protecting and improving the nation's health

Understanding and changing behaviours related to preventing catheter associated urinary tract infections

A strategic behavioural analysis

Full technical report

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Contents

Glossary of terms relating to the behaviour science tools

Behaviour Change Technique (BCT)	The active ingredient in an intervention designed to bring about change. The defining characteristics of BCTs are that they are observable, replicable, and irreducible.
Behaviour Change Taxonomy (v1); (BCTTv1)	Version 1 classification of 93 behaviour change techniques.
Behaviour Change Wheel (BCW)	A comprehensive framework that includes a series of tools used to systematically develop and characterise behaviour change interventions.
COM-B model	'Capability', 'Opportunity', 'Motivation'–'Behaviour' is a model of behaviour change that helps to understand and potentially change behaviour.
Intervention functions	Purposes an intervention serves. These are: education, training, persuasion, enablement, incentivisation, coercion, modelling, environmental restructuring and restriction.
Policy categories	Channels through which interventions are implemented. These are: guidelines, service provision, legislation, regulation, fiscal measures, communication and marketing, environmental and social planning.
Strategic behavioural analysis	The process of investigating the theoretical congruence between the factors influencing the target behaviour (i.e, barriers and facilitators) and the content of interventions with the aim to identify the opportunities for intervention refinement.
Theoretical Domains Framework	A framework consisting of influences on behaviour. It includes 14 domains and it can be mapped on to the COM-B model. It is used to help categorise the facilitators that increase, and barriers that hinder the behaviour.
Theoretical congruence	Establishing theoretical congruence involves identifying the match between intervention components and theoretical influences (barriers and facilitators) these intervention components are targeting.

Executive summary

Catheter-associated urinary tract infection (CAUTI) is one of the most frequently acquired urinary tract infections occurring in a healthcare setting and a product of a complex set of interrelated behaviours performed by multiple individuals. This report focuses on the behaviour of Healthcare Professionals (HCP) in primary, secondary, community care and nursing homes.

Behavioural theory and evidence-based tools were used to:

- systematically classify the barriers and facilitators of HCP behaviours that lead to CAUTI (CAUTI-related behaviours) found in the literature,
- characterise the content of national or widely implemented local interventions to reduce CAUTI
- investigate the theoretical congruence (extent to which the theoretical domains representing the most important barriers and facilitators have been addressed by those interventions)

Studies typically focussed on barriers and facilitators to the implementation of bundles of behaviours, set out in stages, as part of interventions rather than individual behaviours. Stages were pre-insertion, maintenance and removal (for example deciding to insert a catheter, catheter insertion, removal, antibiotic prescribing).

The top 6 domains identified as influencing HCPs CAUTI-related behaviour, suggested to be prioritised for change are:

- environmental context and resources
- knowledge
- beliefs about consequences
- social influences
- memory, attention and decision-making
- social professional role and identity

Eleven nationally adopted interventions were identified targeting 4 CAUTI-related behavioural phases: pre-insertion, insertion, post-insertion maintenance, removal.

All identified interventions served the function of Education. Seven interventions served the function of Enablement and 4 served the function of Training. None of the interventions served the functions Persuasion, Restructuring the environment, Restriction or Coercion. Yet, some of the common barriers and facilitators could be targeted using these functions according to the behavioural matricies. For example, ‘Environmental context and resources’ (the most frequent barriers/facilitators domain)

as well as ‘Social influences’, could be tackled by restriction and environmental restructuring but none of the nationally adopted interventions employed these functions. This represents a missed opportunity to target these barriers and facilitators.

A very narrow range of policy strategies were used to deliver nationally adopted interventions. Most were delivered through ‘guidelines’. There were missed opportunities to deliver all functions identified in interventions through the policy category of regulation. Three other policy categories – communication/marketing, fiscal measures and environmental and social planning – were not used in any of the interventions.

The interventions typically included a narrow range of behaviour change techniques (BCTs). The most common BCTs were ‘Instruction on how to perform the behaviour’, ‘Information about health consequences’, ‘goal setting’ and ‘monitoring and feedback’.

Out of 25 BCTs identified in the interventions, 9 had high theoretical congruence, 6 medium, and 10 had low congruence (including the most frequently identified BCT, ‘Instruction on how to perform the behaviour’). Low theoretical congruence suggests that these BCTs were less likely to address the barriers or enable the facilitators to target the CAUTI related behaviours.

Based on the investigation of the fit between identified barriers and facilitators and BCTs identified in exsiting nationally adopted interventions there are numerous opportunities for further intervention design and refinement of existing interventions.

This report includes examples of different ways of potentially delivering BCTs that are already included in existing interventions, or additional, new BCTs that have not been identified in current interventions but are relevant to the key determinants of CAUTI-related behaviour.

Summary diagram of the key results for each study aim

CAUTI related-behaviours (Aim 1)

25 studies reporting on barriers and facilitators of CAUTI-related behaviours were identified:

- 23 studies conducted in secondary care (including three in tertiary care),
- 1 in nursing home
- 1 in community care

Studies typically focussed on barriers and facilitators to implementing bundles of behaviours across four stages:

- pre-insertion
- insertion
- maintenance and
- removal

Conceptual map of the behaviours and the actors involved: Figure 5

Influences on CAUTI-related behaviours (Aim 2)

Top 6 TDF domains representing key barriers, facilitators or both:

1. **Environmental Context and Resources** (e.g. limited and inconsistent documentation and records; transitions of care, e.g. between wards)
2. **Knowledge** (e.g. lack of knowledge of: clinical guidelines; duration of catheter insertion)
3. **Beliefs about consequences** (e.g. convenience and ease of monitoring, 'perceived severity of CAUTI')
4. **Social Influences** (e.g. requests from patients and their carers to have a catheter inserted; lack of peer support and buy-in)
5. **Memory, Attention, and Decision Making** (e.g. pre-empting subsequent urinary catheterisation; catheterisation decisions based on non-medical criteria)
6. **Social Professional Role and Identity** (e.g. having a hospital epidemiologist in post and nurses leading change in urinary catheterisation practice)

CAUTI intervention content (Aim 3)

11 nationally implemented interventions aiming to reduce CAUTI were identified
Table 2

Intervention functions they served (5 of 9 possible)

- Education (all)
- Enablement (7)
- Training (4)
- Modelling (2)
- Incentivisation (1)

Figure 6

Narrow range of **policy categories** were used (3 of 7 possible):

- Guidelines (9)
- Legislation (1)
- Service provision (1)

24 of 93 possible BCTs were used across the 11 national interventions. The average number of **BCTs** per intervention was 6 (range 2-11)

The most common **BCT**:

- Instruction on how to perform the behaviour (10 interventions)
- Information about health consequences (9 interventions)

Figure 7

Theoretical congruence (Aim 4)

Theoretical congruence (i.e. the extent to which BCTs linked to the most important domains representing the barriers and facilitators were identified in interventions) showed:

Of the 24 BCTs identified in interventions:

- 10 had **low** theoretical congruence
- 6 had **medium** congruence
- 9 had **high** theoretical congruence

- BCTs paired with 5 of the 6 important domains were not used frequently (i.e. less than 60%) in existing interventions.

- Opportunity seized was highest for the domains 'Memory, attention and decision processes' (100% of theoretically coherent BCTs were used at least once in interventions) and 'Knowledge' (57% of the theoretically coherent BCTs were used at least once in interventions).

Table 3

Missed opportunities for intervention design (Aim 5)

- The most missed opportunities were for the domains social professional role and identity and environmental context and resources.

- A narrow range of intervention functions were used: primarily education, delivered in the form of guidelines.

- There were missed opportunities to use intervention functions coercion, environmental restructuring and restriction.

- And missed opportunities for the policy categories regulation, communication/ marketing, fiscal measures and environmental and social planning.

Tables 4, 5 & 6.

- There are numerous opportunities for further intervention design and refinement of existing interventions.

Table 6

Introduction

Improving infection prevention and control (IPC) is a crucial step in addressing the global health threat of antimicrobial resistance [1, 2]. Reducing the need for antibiotic treatment for infections requires behaviours to change in health care professionals (HCPs), patients and general population across healthcare settings, for example primary, secondary, community care and nursing homes, as infection spread can occur as patients move between settings. Relevant HCP behaviours include keeping hands, equipment and environments clean, and protecting patients during invasive medical procedures (for example surgery, inserting catheters and other devices), continence care, and avoiding breach in skin or mucous membranes.

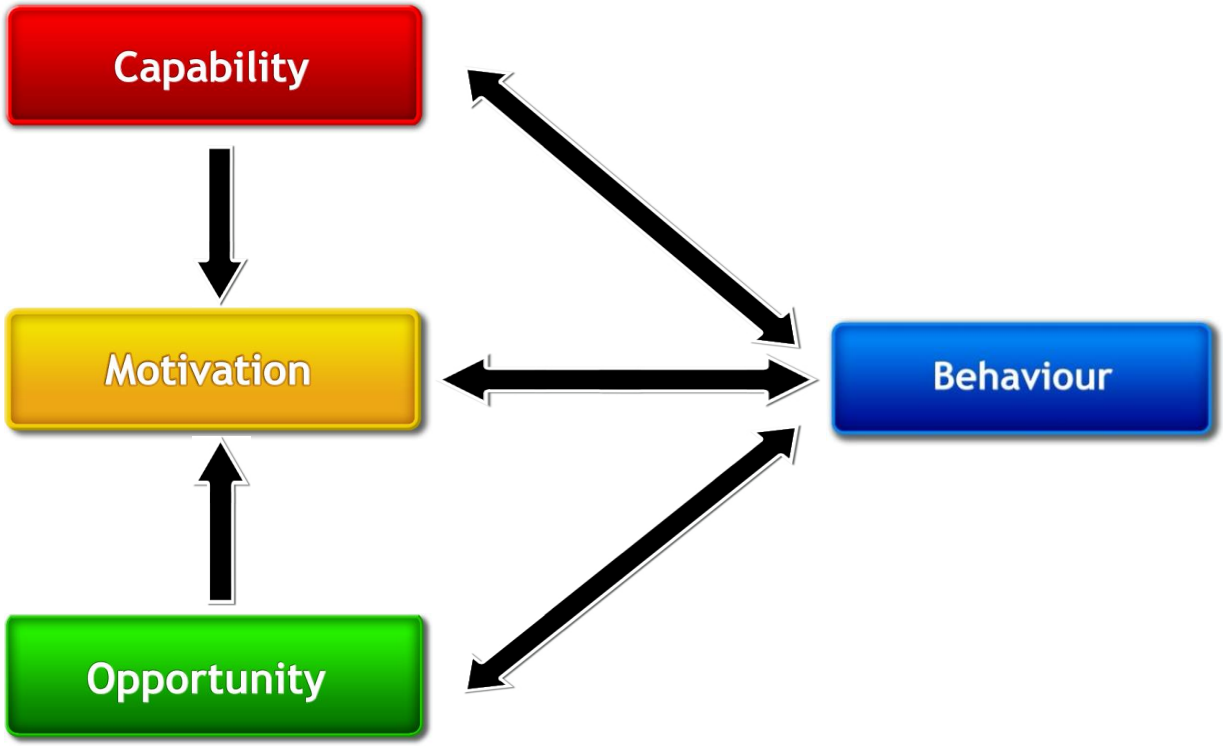
The University College London Centre for Behaviour Change (CBC) was commissioned by Public Health England Behavioural Insights Team (PHE BIT) to conduct a literature review and behavioural analysis of infection prevention control (IPC) in health and social care settings. Given the complexity and number of behaviours related to IPC, as a first step, to identify a specific area on which to focus the review CBC together with PHE conducted a prioritisation exercise based on behaviours identified in the Health and Social Care Act 2008 Code of Practice on the prevention and control of infections and a systematic review of health-care-associated infection prevention[3]: Experts rated each behaviour on: i) impact on reducing or controlling infections if the behaviour was changed and ii) the likelihood a behaviour could be changed. This resulted in a short list of behaviours related to infection prevention and control (IPC). From this list, PHE identified the following area as a priority: Behaviours related to preventing catheter-associated urinary tract infections (CAUTI) in primary, secondary and community care and nursing homes.

In the English National Health Service (NHSE), interventions to promote these behaviours have been implemented at different levels, such as the production of evidence-based guidelines by the National Institute of Health and Care Excellence (NICE) and local interventions to implement these guidelines that are nationally available. Interventions that include components to target factors influencing behaviour (that is barriers/enablers) are more likely to be effective in achieving behaviour change [4]. It is unclear the extent to which influences on CAUTI-related behaviours are targeted in current interventions.

Addressing such questions can be facilitated through the application of behavioural theory and evidence-based tools that have been developed to understand and classify influences on behaviour and intervention content. The COM-B model is a simple model to understand behaviour in terms of the Capability, Opportunity and Motivation needed to perform a Behaviour (Figure 1). Capability, opportunity and motivation interact as part of a system and all need to be present for behaviour to occur. Capability and

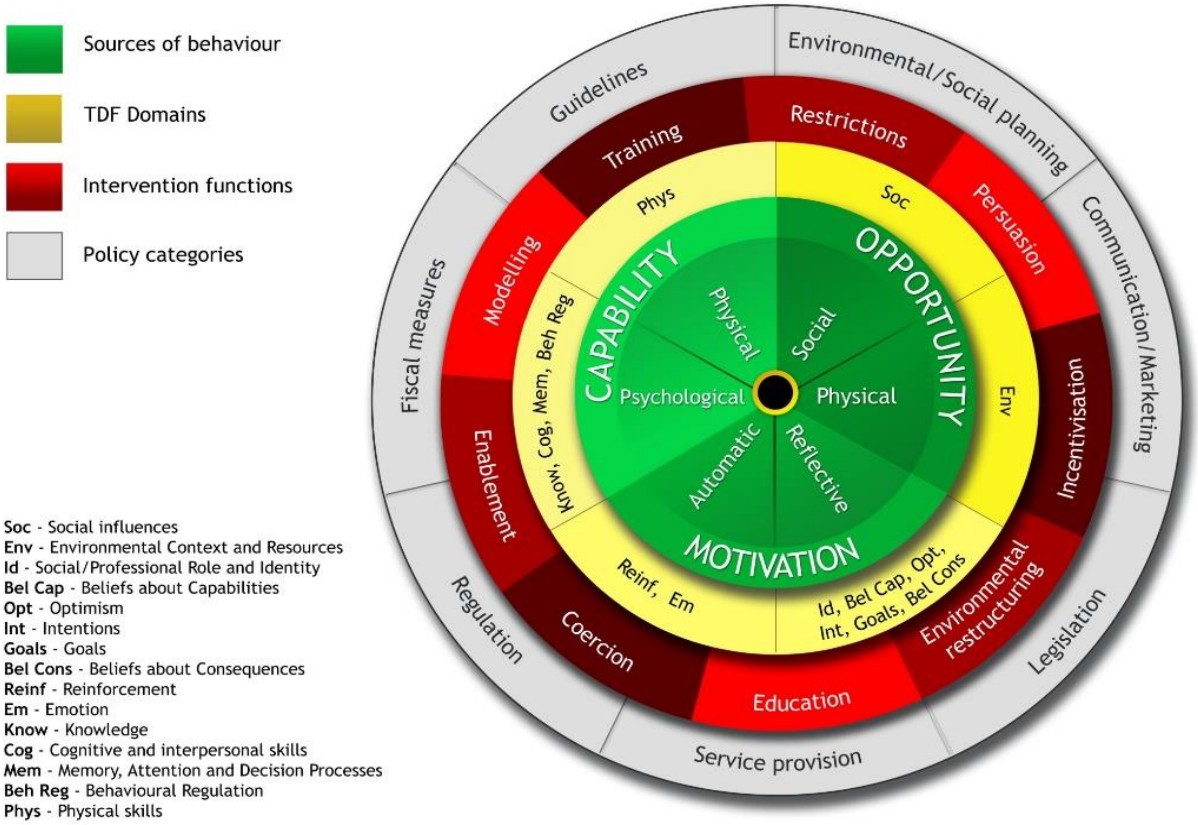
opportunity can influence motivation and behaviour directly, for example motivation to ride a bike might be increased by the ability to ride a bike (capability) or having access to a bike (opportunity); whereas motivation can only influence capability and opportunity through behaviour. For behaviour to be enacted, motivation must be stronger to perform the desired behaviour than any other competing behaviours.

Figure 1. COM-B model



A second model aimed at understanding influences on behaviour is the Theoretical Domains Framework (TDF). The TDF was developed in a collaboration between psychologists and implementation researchers.[5] It is an integrative framework synthesising 33 psychological theories and 84 psychological constructs into 14 theoretical domains influencing behaviour: knowledge; skills; memory, attention and decision processes; behavioural regulation; social/professional role and identity; beliefs about capabilities; optimism; beliefs about consequences; intentions; goals; reinforcement; emotion; environmental context and resources; and social influences. Figure 2 shows how the TDF domains are linked to each COM-B component with the 14 more detailed domains and their associated constructs sitting within the broader COM-B components. The TDF has been applied in an increasing number of systematic reviews as a framework for synthesising behavioural determinants across qualitative and quantitative studies reporting perceived barriers and facilitators to a range of behaviours, including increasing attendance to diabetic retinopathy screening [6] and triage, treatment and transfer of acute stroke patients in emergency care settings [7].

Figure 2. TDF domains linked to COM-B within the Behaviour Change Wheel



In order to identify the type of intervention that is likely to be effective, it is important to consider the full range of options available and use a rational system for selecting from among them. This requires an appropriate method for characterising or describing interventions and linking them to an analysis of the targeted behaviour. This should be underpinned by a model of behaviour and the factors that influence it. The Behaviour Change Wheel (BCW), a synthesis of 19 frameworks of behaviour change, supports such a method. COM-B sits at the 'hub' of the Wheel and is surrounded by 9 intervention functions, that is purposes an intervention serves such as to educate, persuade etc. The 9 functions are: education, training, enablement, incentivisation, coercion, modelling, environmental restructuring and restriction) and 7 policy categories, that is channels through which interventions are implemented (guidelines, service provision, legislation, regulation, fiscal measures, communication and marketing, environmental and social planning) (Figure 2) [8]. Matrices signpost to relevant intervention functions and policy categories (Appendix A). The BCW has been used previously to describe the content of national health policy [9].

How intervention functions are delivered can be described using a 93-item taxonomy of behaviour change techniques (Behaviour Change Techniques Taxonomy)[10]. Behaviour change techniques are defined as the active ingredients in interventions designed to bring about change. Their defining characteristics are that they are an observable, replicable, irreducible components of an intervention designed to change behaviour.

There is a wide range of potential behaviour change techniques (BCTs) which can be applied to try and change the various theoretical influences on different behaviours.[4] However, different BCTs are likely to be of greater or less relevance to addressing different types of theoretical influence. For example, the BCT 'behavioural rehearsal/ practice' is likely to be relevant and applicable where the key theoretical determinant is a lack of skill to perform the behaviour, but not where there is a lack of motivation to perform the behaviour.[4] In this example, the former scenario represents high theoretical congruence (that is match) between the intervention component and the theoretical influence it is targeting, whereas the latter illustrates low theoretical congruence (that is mismatch) between the intervention component and the theoretical influence at which it is directed. It has been argued that interventions are more likely to be effective if they include components that specifically target the important theoretical influences of behaviour and behaviour change.[4, 11]

Systematic exploration of the congruence between intervention components and theoretical influences of behaviour is facilitated through the availability of matrices that integrated the aforementioned behavioural science frameworks by mapping BCTs from taxonomy v1 and BCW intervention functions against construct domains from the TDF and COM-B. These matrices present numerous BCT x domain pairings, which achieved expert agreement that the BCT is likely to be effective in addressing a given construct domain (for example agreement that the BCT 'providing social support' is theoretically coherent with addressing the domain 'social influences').

Research questions

The overarching aim of this work is to investigate whether the national interventions address the theoretical and empirical influences on behaviours that influence CAUTI. We used a range of research methods and behavioural science tools, selected to correspond to each research question (Table 1):

Table 1. Overview of research questions, tasks and behavioural science tools

Research questions	Research methods & tasks	Behavioural science tools used
RQ1. What are the behaviours associated with CAUTI?	• Systematic review • Mapping the actors and behaviours relevant to CAUTI using a conceptual map	
RQ2. What are the influences (barriers and facilitators) on CAUTI-related behaviours?	• Systematic review of barriers and facilitators of CAUTI-related behaviours in primary, secondary, and community care and nursing homes	COM-B, TDF

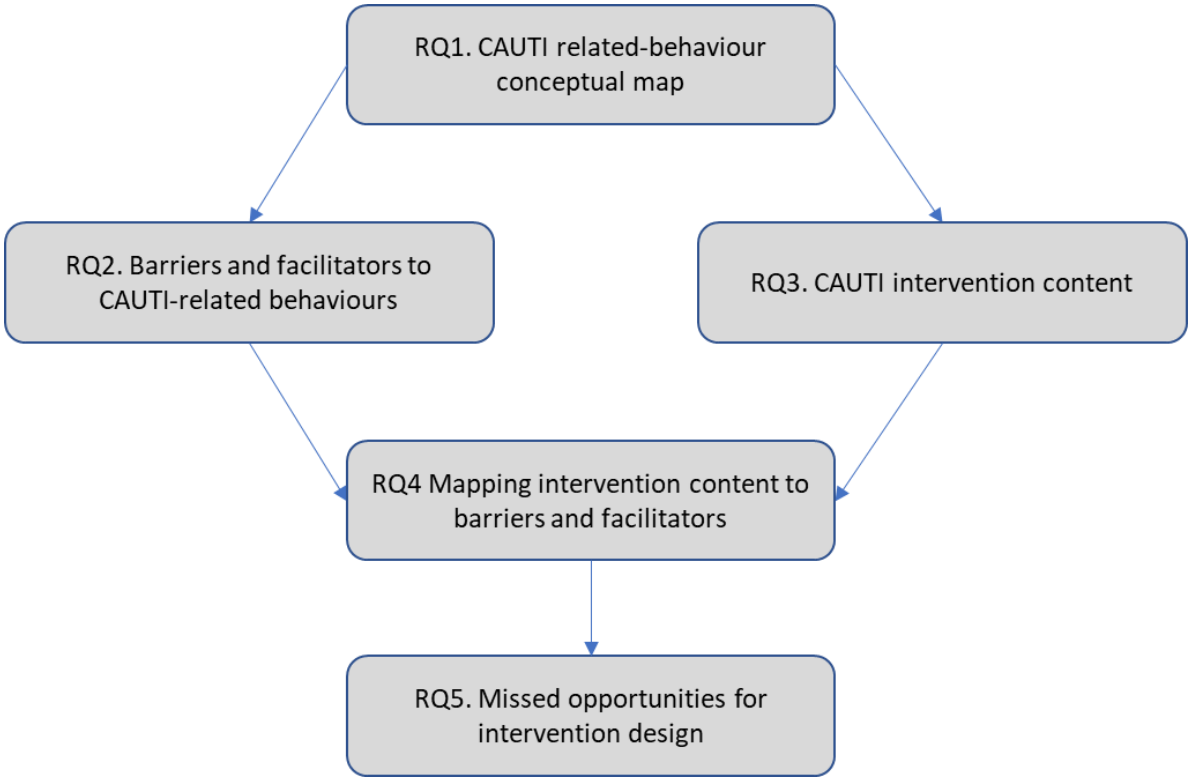
	• Synthesis of barriers and facilitators and coding into TDF and COM-B domains. • Ranking importance of TDF domains	
RQ3. What is the content of nationally available interventions in England to reduce CAUTI?	• Identify nationally available interventions targeting healthcare professionals CAUTI related behaviours in primary, secondary, and community care and nursing homes through stakeholder consultation and desk research • Content analysis of nationally available interventions	BCTTv1, BCW
RQ4. To what extent are barriers and facilitators to CAUTI-related behaviours (identified in RQs1&2) targeted by nationally available interventions (identified and described in RQ3)?	• Compare the most important TDF domains, representing the barriers and facilitators to CAUTI-related behaviours, with the behavioural content of nationally-implemented interventions targeting CAUTI	Matrix for mapping BCTs to TDF domains (Appendix A)
RQ5. What are the missed opportunities for intervention design and refinement?	• Recommendations for new intervention design and how existing interventions might be refined to target relevant barriers and facilitators	BCTTv1, TDF, BCW.

Methods

Summary

A mixed methods approach with 5 different sets of analyses, each corresponding to the research questions. (Figure 3) was used. RQ1 and RQ2 involved evidence synthesis of published literature on barriers and facilitators to CAUTI-related behaviours. RQ3 involved consultation with stakeholders to identify nationally available CAUTI interventions and content analysis of these interventions; RQ4 and RQ5 involved mapping findings from the evidence synthesis and content analysis (RQ2, RQ3) using published mapping matrices.

Figure 3. Structure and flow of the research questions



A project steering group from members of PHE and CBC was assembled including:

- from PHE, Dr Tim Chadborn, Dr Amanda Bunton, Anna Sallis, Dr Susan Hopkins, Karen Shaw, and Susie Singleton
- from CBC, Professor Susan Michie, Dr Fabi Lorencatto, Dr Annegret Schneider, Dr Lou Atkins

The search strategy for peer-review publications was shared with the group to confirm or amend the search strategy. The lists of identified papers and the list of nationally available interventions (described in sections 2.2 and 2.3 below) were shared with the steering group to confirm the lists were comprehensive and reflected the state of the science. When these were not comprehensive, the steering group members were aksed to signpost to relevant evidence. Methods addressing each research question are presented separately.

Methods for RQ1 (What are the behaviours associated with CAUTI?) and RQ2 (What are the influences (barriers and facilitators) on CAUTI-related behaviours)

Study design

Systematic review.

Data collection

Using OVID SP, Medline EMBASE and PsycINFO electronic databases were searched.

Types of studies
Any empirical qualitative and/or quantitative research or systematic review articles reporting barriers and facilitators to CAUTI-related behaviours performed by healthcare professionals, for example interviews or questionnaire studies investigating healthcare professionals' perceptions of factors influencing CAUTI-related behaviours in their setting were included. Where relevant conference abstracts were identified, a forward reference search was conducted to identify subsequent related peer-review publications.

Language
All papers with title and abstract written in English were included.

Time frame
The searches were limited to 1995 onwards to optimise generalisability to present day National Health Service England (NHSE) setting and acknowledge the improvement in the quality of reporting in peer-review literature since 1995.

Search strategy

A search for relevant papers reporting barriers and facilitators to IPC behaviours relevant to CAUTI in secondary care and nursing homes was conducted in November 2017. A second search of primary and community care settings (following expansion of the project scope) was conducted in February 2018. Terms were gathered from relevant systematic reviews and refined by the project steering group. A summary of terms used in both search strategies is provided below. The full search strategies are provided in Appendix B.

Secondary care and nursing home settings
The search strategy included the following terms:

Urinary tract infection* OR UTI OR CAUTI OR acute kidney injury OR health* associated infection
AND
Catheter*
AND
Secondary care OR hospi* OR nursing home OR care home OR residential care
AND
Barrier* OR facilitate* OR enable* OR lever* OR obstacle* OR influen* OR drive* OR determine* Or influence* or factor*

Primary and community care settings
The search strategy included the following terms:

Urinary tract infection* OR UTI OR CAUTI OR acute kidney injury OR health* associated infection
AND
Catheter*
AND
Primary care OR general practi* OR primary health care OR primary healthcare OR GP OR family physician* OR communit* OR continence nurses OR home care OR home nurs*
AND
Barrier* OR facilitate* OR enable* OR lever* OR obstacle* OR influen* OR drive* OR determine* Or influence* or factor*

Screening documents

First screening for eligibility
Titles and abstracts for each question were screened against the inclusion/exclusion criteria by LA and 10% doubled-rated by AS. Where there was insufficient information for assessment, the full article was scrutinised. Disagreements were resolved by consensus with another member of the review group (FL).

Second screening for eligibility
For abstracts meeting the inclusion/exclusion criteria at first screening and those where there was uncertainty at first screening, full papers were screened against the same inclusion/exclusion criteria. Any papers for which the decision is not clear were discussed with other members of the review group (FL and SM). Papers identified in secondary care and nursing home settings were screened by LA and double rated 10% by AS. Papers identified in primary and community care were screened by LA and

double rated 100% by FL (due to the small number of papers identified in the latter search).

Quality assessment

Mixed Methods Appraisal Tool (MMAT)[12] was used to assess quality of qualitative, quantitative and mixed methods studies.

Data extraction

Data extraction templates for quantitative and qualitative studies provided in the 'Methods for the development of NICE public health guidance'[13] to record methodological (publication, design etc.) and substantive characteristics (participant, setting etc.) of included studies were used.
Key information for collection included the population under study, study design, target behaviour, study setting, main outcomes, and study limitations. Data extracted regarding reported barriers/enablers included primary qualitative data, for example quotes from interviews and quantitative data, for example responses to questionnaires, as well as author interpretations of data. All data were extracted by LA and checked by FL. PHE Interns, Paulina Bondaronek and Marta GonzalezIraizoz extracted data on study characteristics.

Data management

Retrieved references were managed using Endnote and key details entered in customised Excel spreadsheets.

Data synthesis

Framework[14] and thematic[15] analysis were conducted to synthesise and explain influences on CAUTI-related behaviours identified in the systematic review.

RQ1 - Conceptual map of CAUTI-related behaviours
Based on a review of the peer-review literature we produced a conceptual map describing IPC behaviours related to CAUTIs in nursing homes and primary, secondary and community care settings. This map describes who performs which behaviours, how these behaviours interrelate (including which behaviours are contingent on other behaviours in the system) and when they are performed.

RQ2 - Barriers and facilitators to CAUTI-related behaviours

COM-B and TDF were used as frameworks through which to synthesise, categorise and describe in theoretical terms the influences, that is barriers and facilitators, to behaviours identified in the conceptual map, taking the following steps[6]:

1. A framework analysis was conducted by deductively coding extracted data into the COM-B and TDF domain they were judged to best represent. It was possible for a data point to be allocated to more than one domain where appropriate.
2. A thematic analysis was then conducted within each domain, by grouping similar data points and inductively generating theme labels. Theme labels aimed to summarise the role each domain plays in facilitating or hindering CAUTI-related behaviours.
3. The frequency of each theme was recorded, that is how many studies each theme was identified in.
4. Each theme was classified as either barrier, facilitator, or both.
5. Then each domain was classified as either barrier (a domain was classified as a barrier for a setting if 100% of identified themes within that setting were barriers), facilitator (a domain was classified as a facilitator for a setting if 100% of identified themes within that setting were facilitators) or both (if themes within the domain were a combination of barriers and facilitators).
6. To identify the key domains, each domain was ranked in terms of importance using established criteria: frequency, elaboration (number of themes) and evidence of conflicting beliefs within domains (for example if some participants report lack of knowledge of guidelines whereas others report familiarity with guidelines)[16].

This data is described using both COM-B and TDF, with COM-B offering a higher level summary and TDF offering a more granular level of analysis (see Appendix C for labels, definitions and examples for COM-B and TDF).

Methods for RQ3. What is the content of nationally available interventions in England to reduce CAUTI?

Study design

Content analysis of existing interventions.

Data collection

Stakeholders from 5 sources were asked to identify nationally available interventions to reduce CAUTI in secondary care and nursing homes which were:

- participants at
  - Patient First Conference[1], London on 21-22 November 2017
  - Knowlex IPC conference, 21 February 2018 (participants were also asked for nationally implemented interventions in primary and community care)
- members of clinical commissioning groups identified through PHE
- project steering group
- topic experts from relevant evidence-based guideline development groups identified by searching relevant guidelines.
- PHE AMR Programme Board

For the purposes of this work, interventions were defined as any programme, improvement strategy or policy currently nationally available in England where the primary aim is to reduce CAUTI. Locally implemented interventions and interventions described in peer-review literature but not available nationally in England were not included. Examples of interventions include, but are not limited to, evidence-based guidelines and policy papers, for example National Institute for Health and Care Excellence Quality Standard[17]. As much documentary evidence as possible was obtained on these existing interventions from intervention designers and relevant websites.
For comparison, information from devolved nations on nationally available interventions to reduce CAUTI in Wales, Scotland and Northern Ireland were sought. However, it was beyond the scope of the current project to analyse these in sufficient detail to draw robust conclusions about refinements to nationally available interventions in England.

Data extraction

The Behaviour Change Wheel (BCW) and the Behaviour Change Techniques Taxonomy (v1) (BCCTv1) were used as frameworks to identify and describe the content of existing interventions to reduce CAUTI in terms of their functions, the techniques used to serve these functions and the policy categories through which interventions are delivered (see Appendix D for BCW labels, definitions and examples). Data extraction templates were developed to code interventions according to: setting; intervention functions; policy categories and; behaviour change techniques. LA conducted data extraction, 10% were checked by FL.

Data analysis

The number of BCTs, intervention functions and policy categories were recorded for each intervention and calculated the mean and range.

[1] www.patientfirstuk.com/welcome-ipc

Next, the number of interventions each BCT and intervention function was present in (mean and range) was recorded; most frequent and least frequent BCTs were identified and; representative examples for each BCT across interventions were extracted.

Data management

Key details were entered in customised Excel spreadsheets.

Methods for RQ4 (To what extent are barriers and facilitators to CAUTI-related behaviours targeted by nationally available interventions?) and RQ5 (What are the missed opportunities for intervention design and refinement?)

Study design

Mapping theoretically coded barriers and facilitators to intervention content.

Data analysis

This analysis applied a merged matrix, integrating the 2 available matrices mapping the TDF to the BCTTv1 (Cane et al. 2015; Michie et al. 2008), to investigate the level of theoretical congruence between existing intervention strategies targeting CAUTI and the published literature on factors influencing behaviours related to CAUTI (see Appendix E for merged matrix). To achieve this, a two-way mapping exercise was performed:

1. The extent to which BCTs identified in existing interventions (RQ3) targeted the top 6 domains identified in RQ2, that is targeted the domains in which the key barriers and facilitators were identified. This enabled to classify BCTs as having:

    - low congruence – did not target any domains classified as important in RQ2
    - medium congruence – targeted at least one domain classified as important
    - high congruence – targeted 2+ important domains

2. TDF domains to BCTs were mapped. For the 6 most important domains according to the ranking exercise in RQ2, the mapping matrices were consulted to identify which BCTs are theoretically congruent with that domain. Then, the frequency with which that BCT was identified in existing interventions were investigated. The definitions applied were:

    - opportunity seized – instances where a theoretically congruent BCT (according to the matrix) was identified in an existing intervention at least once

- missed opportunity – instances where the theoretically congruent BCT was never identified once in existing interventions

3. Next, whether the congruent BCTs were actually delivered in a way that meaningfully addressed the barriers and facilitators identified within the domain was examined. For example, where the BCT Information about health consequences (defined as 'provide information, for example written, verbal, visual, about health consequences of performing the behaviour) was to target a congruent barrier or facilitator.
4. This mapping exercise was repeated at the level of BCW intervention functions and policy categories, by consulting the matrices mapping BCW against COM-B/TDF[18] to identify the extent to which functions and policy categories in existing interventions target key factors influencing behaviour, and what additional intervention functions and policies may be of relevance to addressing barriers/enablers within the most important domains.

Recommendations for intervention design

Recommendations for intervention design methods, intervention content and, where appropriate, further research based on findings from the literature search were produced.

Results

RQ1: conceptual map of CAUTI-related behaviours

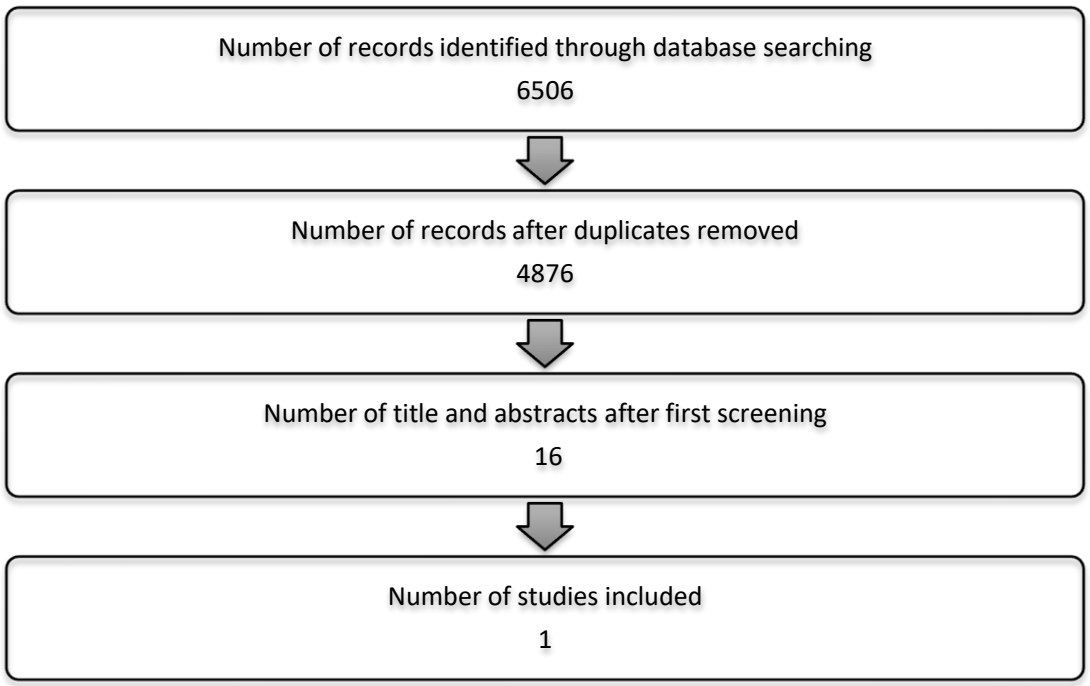
Identified peer review publications

We identified 25 studies which met the inclusion criteria. Appendix F provides a summary of these studies. Twenty-three studies were conducted in secondary care (including 3 in tertiary care), one in nursing home and one in community care. Of these, seventeen were conducted in the US with the remainder being conducted in France, Canada, UK, Australia, Taiwan and Thailand. One study was conducted in US nursing homes and one in the UK community care setting. See Figure 4 for a flow of information through the review.

Figure 4: Flow of information through the systematic review

Secondary care and nursing homes

Primary and community care

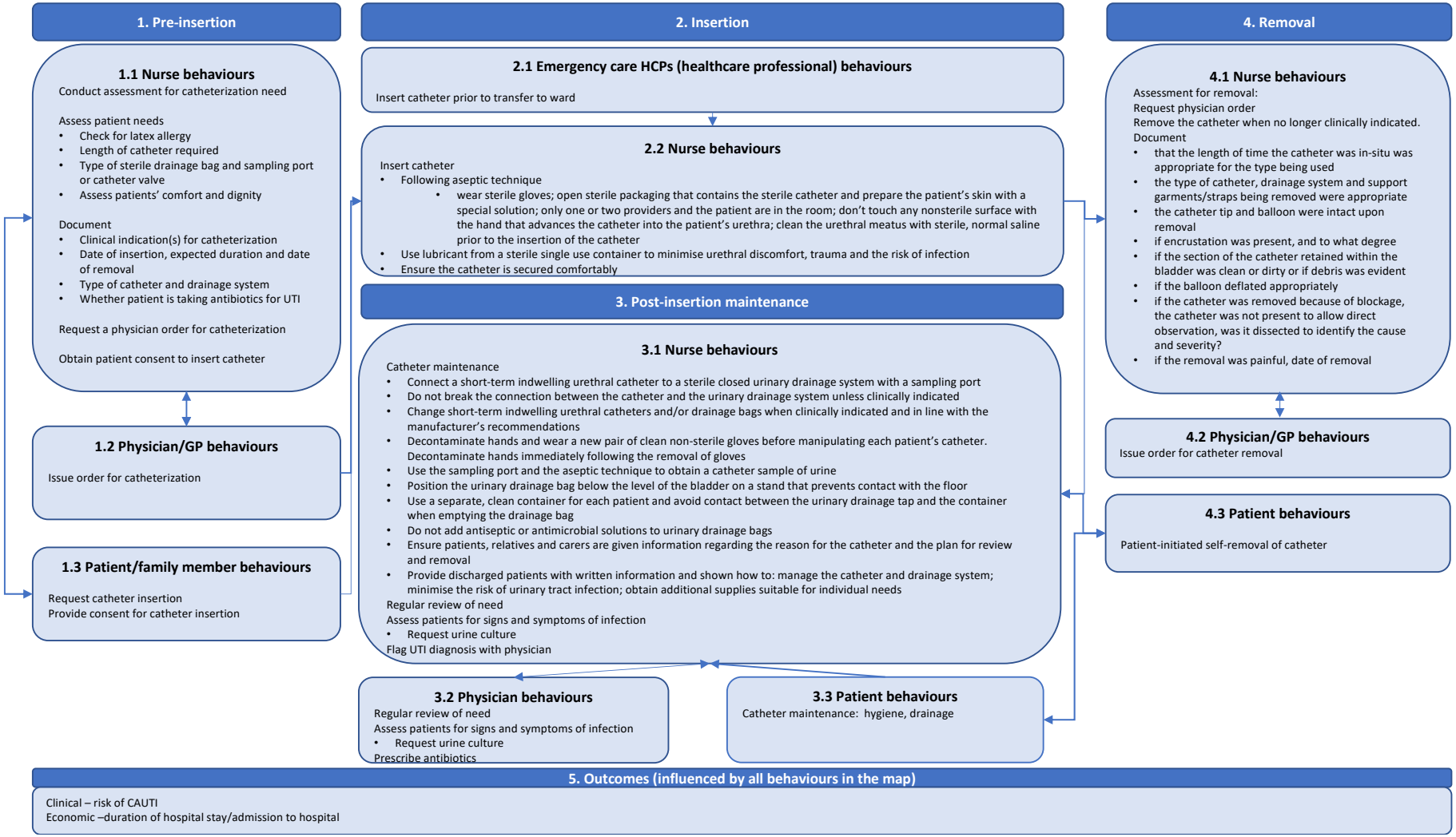


Conceptual map of behaviours

Behaviours reported in the systematic review of barriers and facilitators of CAUTI related behaviours and CAUTI interventions identified as part of RQ3 are provided in the conceptual map in Figure 5. As shown th Appendix F, studies identified in the systematic review of peer-review publications typically focussed on barriers and facilitators to the implementation of bundles of behaviours as part of interventions rather than individual behaviours (for example deciding to insert a catheter, catheter insertion, removal, antibiotic prescribing); this was the nature of the studies identified for inclusion as we searched for studies reporting any number of behaviours related to CAUTI. To complete the conceptual map, these bundles, along with those identified in the review of UK nationally available interventions were broken down into individual behaviours.

Whilst the target group is health professionals, for completeness, patient behaviours related to CAUTI have also been documented in the conceptual map. The map is divided into behaviours occurring at 4 sequential time periods: pre-insertion of the catheter; insertion; post-insertion maintenance; removal. Outcomes of these behaviours are also described.

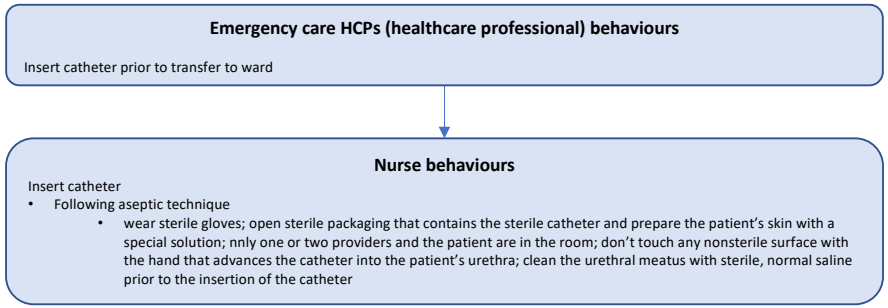
Figure 5. Conceptual map of CAUTI-related behaviours



Explanation of arrows in the conceptual map

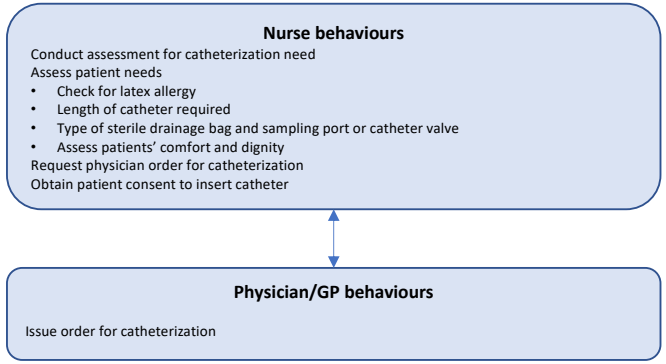
Single-headed arrow

Influences behaviours listed in the box, e.g. emergency HCP behaviours influence nurse behaviours.



Double-headed arrow

Influences and is influenced by behaviours listed in the boxes, e.g. nurses and physicans are influenced by each others behaviour.



RQ2: barriers and facilitators to CAUTI-related behaviours

We have presented integrated results across all care settings because we identified only one study conducted in community care and one in nursing homes. Table 2 provides a ranking of the importance of COM-B/TDF domains identified in the 25 peer-review publications included in the systematic review. Table 3 presents the 5 most frequently identified themes within each COM-B/TDF domain. Table 4 indicates in which settings TDF domains were identified as barriers, facilitators or both. Beliefs about capabilities, was identified as a facilitator in secondary and tertiary care.

Behavioural regulation was identified as both barrier and facilitator in secondary care. All other identified domains were classified as a mixture of either barrier or both barrier and facilitator across care settings. Appendix H is a full list of all themes per domain, according to each care setting and corresponding CAUTI-related behaviour phase from the conceptual map (that is pre-insertion, insertion, post-insertion). The 6 most frequently identified domains are summarised below.

1. Environmental context and resources

Themes related to this domain were identified in 13 studies. Themes in this domain included: limited and inconsistent documentation and records relating to urinary catheter use; transitions of care, for example between wards; lack of time to perform alternatives to urinary catheterisation such as taking patients to the bathroom; lack of available medical alternatives to urinary catheterisation (all of which were barriers to appropriate catheter usage) and choice and availability of urinary catheters which was a both a barrier and facilitator.

2. Knowledge

Knowledge-related themes were identified in 11 studies. Themes within this domain classified as barriers to appropriate catheter usage included lack of knowledge of: clinical guidelines; duration of catheter insertion; risks associated with catheter use and how to manage patients without catheterisation. The theme ‘knowledge of how to manage bacterial infections resulting from urinary catheterisation’ was classified as a facilitator of appropriate catheter usage.

3. Beliefs about consequences

Themes related to this domain were identified in 11 studies. Eight separate themes were identified. The most frequently identified theme was convenience and ease of monitoring, for example inserting catheters for convenience purposes such as for measuring patients’ urine output or avoiding transfers to a bedpan or commode, which

was identified in 5 studies. The theme ‘perceived severity of CAUTI’ was identified in 2 studies and classified as both a barrier and facilitator as some perceived CAUTI to be common and benign whilst others perceived it to be a potential source of risk for patients. Lack of perceived benefits to interventions targeting CAUTI was identified as a barrier to appropriate catheter usage in 2 studies.

4. Social influences

Six themes related to this domain were identified in 9 studies. Most frequently identified themes in this domain included requests from patients and their carers to have a catheter inserted (identified as a barrier in 5 studies); lack of peer support and buy-in, physicians dictating nurses’ practice and cultural norms regarding standard catheterisation practice for specific patient groups – these 3 themes were identified as barriers.

5. Memory, attention and decision-making

Themes related to this domain were identified in 8 studies. Eight themes were identified in this domain including pre-empting subsequent urinary catheterisation (identified as a barrier in 3 studies); catheterisation decisions based on non-medical criteria (identified as a barrier in one study) and patient symptoms prompting investigation and treatment of possible CAUTI (identified as a facilitator in one study).

6. Social professional role and identity

Four themes related to this domain were identified in 6 studies. These themes included facilitators such as having a hospital epidemiologist in post and nurses leading change in urinary catheterisation practice; and barriers such as lack of acceptance of responsibility for urinary catheterisation decision making or not perceiving CAUTI guidelines as relevant across hospital departments.

Based on the distribution of the data, we suggest these top 6 domains are prioritised for change.

Table 1. Ranking of TDF domain importance according to frequency of identification, thematic elaboration, and evidence of conflicting beliefs

Ranking	TDF Domain (COM-B)	Frequency (No. of studies identified in; max n=25)	Elaboration (Number of themes)	Evidence of barriers and/or facilitators within domains (Yes/No)
1	Environmental Context and Resources (physical opportunity)	13	8	Yes
2	Knowledge (psychological capability)	12	9	Yes
3	Beliefs about consequences (reflective motivation)	12	8	Yes
4	Social Influences (social opportunity)	9	6	Yes
5	Memory, Attention, and Decision Processes (psychological capability)	8	8	Yes
6	Social Professional Role and Identity (reflective motivation)	6	4	Yes
7	Behavioural Regulation	3	2	Yes
8	Beliefs about capabilities	2	2	No
Joint 9th And 10th	Skills	2	1	No
	Goals	2	1	No
Joint 11th – 14th	Reinforcement	0	0	-
	Intentions	0	0	-
	Optimism	0	0	-
	Emotions	0	0	-

Table 2. Summary of barriers and facilitators to CAUTI-related behaviours

COM-B	Theme	Frequency (n= 25 studies max)	Barrier/ facilitator/ Mixed	Behavioural phase	Example quote(s) [Setting; Study ID]
CAPABILITY (PSYCHOLOGICAL)	TDF Domain: Knowledge				
	Lack of knowledge of clinical guidelines and local procedural documents	3	Barrier	All	'Nurses lack of knowledge of evidence-based guidelines for: routine catheter maintenance; urinary catheter indications; bladder scanning; and intermittent catheterization.' [Secondary Care; S2] '40% of the Burn ICU nursing staff was not aware of the nurse driven catheter removal protocol that exists within our hospital.' [Secondary Care; S19]
	Lack of information regarding placement and duration of catheter insertion	2	Barrier	Insertion, post-insertion maintenance	'Physicians are often unaware that urinary catheterization has been excessively prolonged in their patients' [Secondary Care; S11] 'physicians were often not aware that patients had an indwelling catheter' [Tertiary Care; T1]
	Lack of awareness of the risks associated with use of urinary catheters	2	Barrier	All	"… so it's just making them [nurses] understand that there is a relationship between bladder infections and urinary tract infections and [urinary] catheter days…" [Secondary Care; S1]
	Lack of knowledge of how to manage patients without catheterisation	1	Barrier	Pre-insertion	'Not knowing how to manage critically ill patients in ICU without using indwelling urinary catheter.' [Secondary Care; S15]
	Knowledge of how to manage bacterial infections resulting from urinary catheterisation	1	Facilitator	Post-insertion maintenance	'Knowledge of how to manage catheter-associated bacteriuria: "The mean knowledge score was 57.5%, or slightly more than one-half of the questions answered correctly. The mean knowledge score was 57.5%, or slightly more than one-half of the questions answered correctly."' [Tertiary Care; T3]
	TDF Domain: Memory, attention, decision processes				
	Pre-emptively deciding to insert a catheter due to likely subsequent catheterisation	3	Barrier	Insertion	'Also, I think at the back of my mind is the likelihood is that they're going to get catheterised in the near future any way when they hit the wards for a management reason' [Secondary Care; S17]
	Catheterisation decisions based on non-medical criteria	1	Barrier	Pre-insertion	'Nonmedical criteria often determined urinary catheter placement decisions, with catheters being used to manage patients with incontinence' [Secondary Care; S6]

COM-B	Theme	Frequency (n= 25 studies max)	Barrier/ facilitator/ Mixed	Behavioural phase	Example quote(s) [Setting; Study ID]
	Patient symptoms prompt investigation and treatment of possible CAUTI	1	Facilitator	Post-insertion maintenance	'I usually order a urine culture on catheterized patients when there is a change in urine colour, cloudiness, or odour.' [Tertiary care; T3]
	Absence of standardised CAUTI diagnostic criteria to help decision-making	1	Barrier	Post-insertion maintenance	lack of clear, standardised criteria used to define CAUTI, to distinguish between symptomatic and asymptomatic CAUTI and to report outcomes' [Primary Care; p1]
	Reminders and prompts	1	Facilitator	Removal	'Hospital epidemiologist in post was significantly and positively associated with: i) Urinary catheter reminder or stop-order/nurse- initiated catheter discontinuation' [Secondary Care; S4]
CAPABILITY (PSYCHOLOGICAL)	TDF Domain: Behavioural regulation				
	Audit and feedback on CAUTI metrics	2	Facilitator	All	'One hospital even made it a point to collect urinary tract infection (UTI) data on patients 7 days post discharge to use as evidence for their staff that urinary catheters (and hence their actions related to the use of urinary catheters) do cause infections' [Secondary Care; S1]
	Inconsistent monitoring of compliance with guidelines	1	Barrier	All	'Inconsistent monitoring of compliance with evidence-based guidelines.' [Secondary Care; S2]
CAPABILITY (PHYSICAL)	TDF Domain: Skills				
	Poor urinary catheter insertion technique	2	Barrier	Insertion	'Urinary catheters were being inserted by nursing staff that did not demonstrate proper insertion technique and by medical students and residents who were untrained in catheter placement' [Secondary Care; S6]
OPPORTUNITY (PHYSICAL)	TDF Domain: Environmental context and resources				
	Limited and inconsistent documentation and records	6	Barrier	All	'Lack of medical documentation for use of urinary catheters was significantly associated with inappropriate catheter use' [Secondary Care; S8] The level of detail recorded was variable both within and between service groups. Of the patients with a CAUTI, the date diagnosed, method of diagnosis (for example urine culture) and antibiotic treatment given were recorded in over 85% of cases, although the causative organism was reported in <40%. However, it was rarely possible to confirm whether the CAUTI was symptomatic or asymptomatic. [Primary Care; P1]

COM-B	Theme	Frequency (n= 25 studies max)	Barrier/ facilitator/ Mixed	Behavioural phase	Example quote(s) [Setting; Study ID]
	Transitions of care	5	Barrier	All	'Transferences to ward from intensive care unit accounted for 6% of inappropriate catheterisations' [Secondary Care; S13] 'Staff turnover barrier to implementation of CAUTI reduction program' [Care homes; C1]
	Lack of time to perform alternatives to urinary catheterisation	3	Barrier	Pre-insertion	'Being too busy to be able to assist a patient to the bathroom' [Secondary Care; S1]
	Unavailability of medical alternatives to urinary catheterisation	2	Barrier	Pre-insertion	'Lack of medical alternatives, (for example, a bladder scanner that could help determine the need for a catheter) that may be contributing to these decisions' [Secondary Care; S1]
	Choice and availability of urinary catheters	2	Mixed	Pre-insertion	'Supply of urinary catheters being available in bedside supply carts added convenience and may have influenced their decision to insert one' [Secondary Care; S18] 'In acute care catheter availability was often limited to samples supplied by company representatives or the limited supply held in hospital pharmacies. In the community availability could be limited by a formulary. Of the prescribing nurses, 54% had unlimited choice of catheters, while 43% were restricted in their choice.' [Secondary care; Community Care; SC20]
OPPORTUNITY (SOCIAL)	TDF Domain: Social influences				
	Requests from patients and their carers	5	Barrier	Pre-insertion	'Pressure of requests by the patient or the family for catheters: "The family says, 'Well my mom really needs it in. . . . Mom can't get up, mom can't walk, she's incontinent [of urine]' [Secondary Care; S1]
	Lack of peer support and buy-in	4	Barrier	All	'Facility leads new to their positions often found it hard to gain buy-in, mainly due to a lack of relationship with the staff' [Care Homes; C1] 'As a charge nurse explained: "If you don't have the doctors on board, you're just going to be beating your head against the wall.' [Secondary Care; S1]
	Physicians dictate nurses' practice	3	Barrier	All	'My supervising physician generally prefers to treat positive urine cultures in catheterized patients.' [Tertiary Care; T3]

COM-B	Theme	Frequency (n= 25 studies max)	Barrier/ facilitator/ Mixed	Behavioural phase	Example quote(s) [Setting; Study ID]
					[Nurse:]'…You can keep asking, 'Can I pull the Foley?' and they'll [physicians] just say, 'leave it in.' [Secondary Care; S1]
	Cultural norms regarding standard catheterisation practice for specific patient groups	3	Barrier	Pre-insertion, Insertion	'The biggest challenge was changing the culture of practice of inserting indwelling urinary catheter in all ICU patients' [Secondary Care; S15]
	Local champions	2	Facilitator	All	'Presence of an emergency physician champion to establish indications for urinary catheter placement resulted in fewer orders for catheters' [Tertiary Care; T1]
	TDF Domain: Social professional role and identity				
	Having a Hospital Epidemiologist in post	2	Facilitator	Removal	'Hospital epidemiologist in post was significantly and positively associated with: i) Urinary catheter reminder or stop-order/nurse-initiated catheter discontinuation' [Secondary Care; S4]
	Acceptance of responsibility for urinary catheterisation decision making	2	Barrier	Pre-insertion	'Nurses felt that the decision to maintain an indwelling catheter was up to the physician and did not consider it within their scope of practice.' [Tertiary Care; T2]
	CAUTI guidelines not perceived as relevant across Hospital departments	1	Barrier	All	'I looked at the criteria set forward indications for [urinary] catheter use. I think my gut reaction was that perhaps some of those were not as applicable in the Emergency Department setting… that maybe they were more devised for the inpatient setting.' [Secondary Care; S1]
	Nurses leading change in urinary catheterisation practice	1	Facilitator	All	'We're really changing it [practice] from the bottom up, which I think is a great idea. We're the ones doing the work so we're the ones that make that change' [Secondary Care; S7]
MOTIVATION (REFLECTIVE)	TDF Domain: Beliefs about consequences				
	Convenience and ease of monitoring	5	Mixed	All	'Catheters inserted for convenience purposes, for example, to accurately measure a patient's urine output or to avoid frequent transfers to a bedpan or a bedside commode' [Secondary Care; S18] 'Perception that urinary catheters are a potential source of harm not convenient and benign' [Secondary Care; S7]
MOTIVATION (REFLECTIVE)	Perceived severity of CAUTI	2	Mixed	All	'Perception by nursing staff of urinary catheters and urinary tract infections as benign was quite common' [Secondary care; S1]

COM-B	Theme	Frequency (n= 25 studies max)	Barrier/ facilitator/ Mixed	Behavioural phase	Example quote(s) [Setting; Study ID]
					'Perception that urinary catheters are a potential source of harm not convenient and benign' [Secondary care' S7]
	Lack of perceived benefits to interventions targeting CAUTI	2	Barrier	All	'physicians did not realize the value or benefits of supporting program implementation' [Care Homes; C1]
	Improved patient hygiene	1	Facilitator	Pre-insertion	'you don't want them lying in their own urine…It's not a great for someone who's wet with potential pressure areas and lying in their own wee (ED consultant physician).' [Secondary Care; S17]
	Pros and cons of reusable catheters	1	Mixed	Pre-insertion, Insertion	'Major concerns included the perceived increased risk of urinary tract infection and increased patient burden. Potential advantages included increased patient choice, cost savings and reducing the fear/likelihood of running out of catheters' [Secondary Care; Community care; SC20]
	TDF Domain: Beliefs about capabilities				
	Nurse empowerment	1	Facilitator	All	'Empowering nurses to identify and address CAUTI improvement opportunities: [We're] really changing it [practice] from the bottom up, which I think is a great idea. We're the ones doing the work so we're the ones that make that change.' [Secondary Care; S7]
	Confidence in investigating and managing CAUTI	1	Facilitator	Post-insertion maintenance	'I feel confident in knowing when to order a urine culture on catheterised patients, …how to manage bacteriuria in catheterised patients…and that I can apply asymptomatic bacteriuria guidelines to my patients.' [Tertiary Care; T3]
	TDF domains: Goals				
	CAUTI is not a priority	2	Barrier	All	'… it's difficult to find people that are excited about getting Foleys out of patients; other things take higher priority like central lines and VAP' [Secondary Care; S1]

Table 3. Classification* of TDF domains as Barriers, Facilitators or Both across care settings

TDF DOMAIN	INPATIENT			OUTPATIENT
	Secondary Care	Tertiary Care	Care Homes	Primary Care/ Community
Knowledge				
Skills				
Beliefs about capabilities				
Beliefs about consequences				
Reinforcement				
Intentions				
Goals				
Social Professional Role and Identity				
Social Influences				
Optimism				
Emotions				
Environmental Context and Resources				
Memory, Attention, and Decision Making				
Behavioural Regulation				

Green = Facilitator
Red = Barrier
Yellow = Both barrier and facilitator
White= Indicates none of the extracted data for this setting were coded to this domain.

RQ3: interventions to reduce CAUTI

We identified 11 interventions implemented at a national level or local interventions that were consistently highlighted as having been widely adopted to reduce CAUTI: 6 were relevant to primary care, 7 relevant to secondary care; 8 relevant to community care and 5 relevant to nursing homes. Table 5 describes the intervention functions, policy categories and BCTS identified in each intervention. Only 2 intervention targeted all behavioural phases: i) The Health and Social Care Act 2008 Code of Practice on the prevention and control of infections and related guidance; ii) Catheter Care: Royal College of Nursing Guidance for nurses. The majority focused on behaviours related to pre-insertion, insertion and post-insertion maintenance rather than removal. The

evidence for these coding decisions gleaned from printed materials for these interventions is provided in Appendix I.

Table 5. BCTs, intervention functions and policy categories identified in each intervention

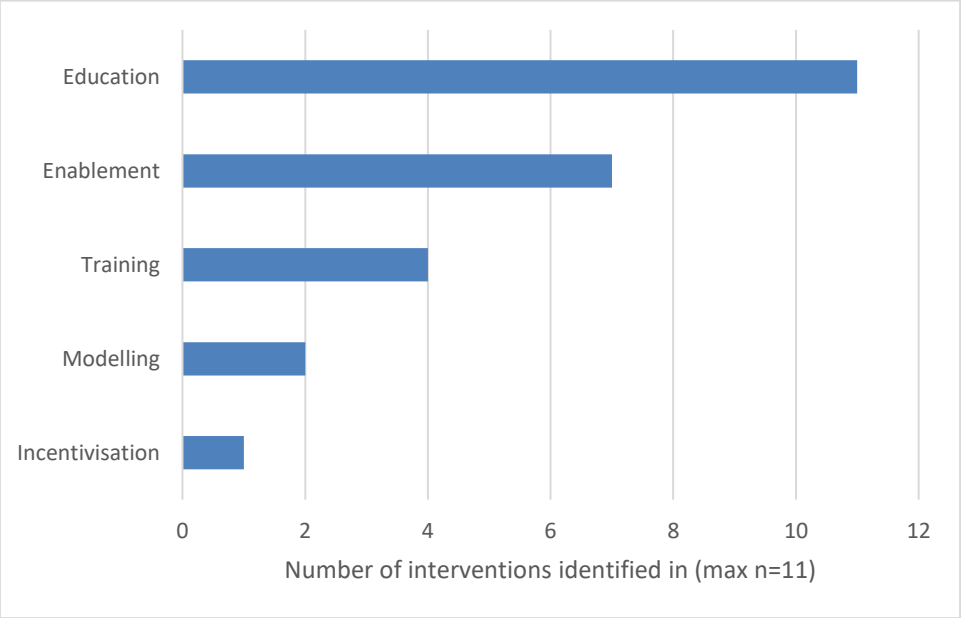
Intervention Name	Settings	Intervention functions	Policy Categories	Behaviour Change Techniques	Behavioural phase	Target group
The Health and Social Care Act 2008 Code of Practice on the prevention and control of infections and related guidance	Primary, Community, Secondary	Education, Training	Legislation	• Instruction on how to perform the behaviour • Monitoring of behaviours by others without feedback • Behavioural practice/ rehearsal	All	Nurse, secondary care physician, GP
NICE QS90: Urinary Tract Infections in Adults	Community	Education	Guidelines	• Instruction on how to perform the behaviour • Information about health consequences • Goal setting (behaviour)	Pre-insertion, post-insertion maintenance	Nurse, GP
NICE QSG1: Infection prevention and control	Primary, Community, Secondary	Education	Guidelines	• Instruction on how to perform the behaviour • Information about health consequences • Goal setting (behaviour)	Insertion, post-insertion maintenance	Nurse, secondary care physician, GP
NICE catheter audit tools	Primary, Community	Education, Enablement	Guidelines	• Goal setting (behaviour) • Self-monitoring (behaviour) • Self-monitoring (outcomes) • Action planning • Instruction on how to perform the behaviour • Credible source • Review behavioural goals • Social support (practical) • Discrepancy between behaviour and goal • Information about health consequences • Information about social environmental consequences	Insertion, post-insertion maintenance	Nurse, secondary care physician, GP
Department of Health and Public Health England (2013) Prevention and control of infections in care homes: an informative resource	Nursing Homes	Education, Training	Guidelines	• Instruction on how to perform the behaviour • Information about health consequences • Monitoring of outcome of behaviour without feedback • Monitoring of behaviours by others without feedback	Insertion, post-insertion maintenance	Care home staff
Safety thermometer	Primary, Community, Secondary, Nursing homes	Education, Enablement, Incentivisation	Service provision	• Goal-setting (outcome) • Self-monitoring (behaviour) • Self-monitoring (outcome) • Feedback on behaviour • Feedback on outcome • Reward (outcome) • Information Social environmental consequences • Credible Source • Social comparison	Post-insertion maintenance	All

Intervention Name	Settings	Intervention functions	Policy Categories	Behaviour Change Techniques	Behavioural phase	Target group
				•		
Epic 3	Secondary	Education, Enablement	Guidelines	• Self-monitoring (behaviour) • Information about health consequences • Instruction on how to perform the behaviour • Social support (practical) • Prompts/cues • Feedback (behaviour) • Feedback (outcomes)	Insertion, post-insertion maintenance, removal	Secondary care nurses and physicians
High Impact Intervention for best practice insertion and care	Secondary, Community	Education, Training, Enablement	Guidelines	• Self-monitoring (behaviour) • Credible source • Information social environmental consequences • Goal-setting (behaviour) • Discrepancy between behaviour and goal • Feedback (behaviour) • Feedback (outcome) • Information about health consequences	Insertion, post-insertion maintenance	Nurse, secondary care physician, GP
Catheter Care: Royal College of Nursing Guidance for nurses	Primary, Community, Secondary, Nursing homes	Education, training, modelling, enablement	Guidelines	• Credible source • Social support (practical) • Self-monitoring (behaviour) • Self-monitoring (outcome) • Instruction on how to perform the behaviour • Demonstration of the behaviour • Behavioural practice/ rehearsal • Identification of self as a role model • Information on health consequences • Information on emotional consequences • Information on social/ environmental consequences • Monitoring of behaviour by others without feedback	All	Nurse
Locally initiated widely adopted interventions						
HOUDINI Protocol	Secondary Care	Education, Enablement	Guidelines	• Instruction on how to perform the behaviour • Restructuring the social environment	Removal	Secondary care nurses and physicians
Catheter Passport	Primary, Community, Nursing homes	Education, Enablement, Modelling	Guidelines	• Information about health consequences • Social support (practical) • Instruction on how to perform the behaviour • Demonstration of the behaviour	Post-insertion maintenance	All

Intervention functions and policy categories identified in interventions

The mean number of intervention functions per intervention was 2.3 (range: 1 to 5). All identified interventions served the function of Education. Seven interventions served the function of Enablement and 4 served the function of Training (Figure 6). None of the interventions served the functions of persusion, restructuring the environment, restriction or coercion.

Figure 6. Frequency of identification of intervention functions



There was a very narrow range of policy strategies represented in the existing interventions analysed. The modal number of policy categories per intervention was 1 (range: 0 to 1) (Table 5). The most frequently identified policy category was ‘guidelines’ (n= 9). One intervention, the ‘Health and Social Care Act 2008 Code of Practice on the prevention and control of infections and related guidance’ served the policy category ‘legislation.’ One intervention, the ‘Patient Safety Thermometer’ served the policy category ‘service provision.’

BCTs identified in interventions

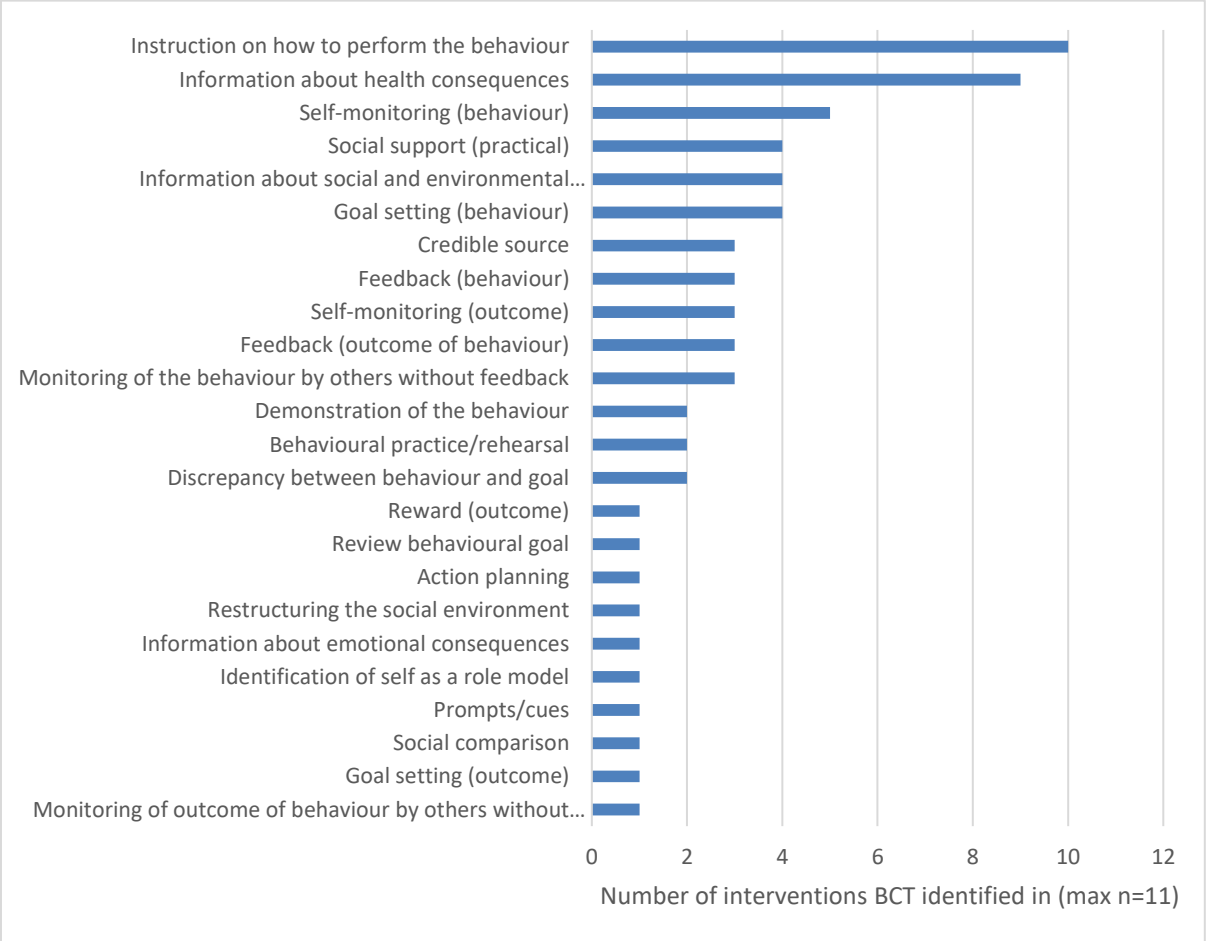
The interventions typically included a narrow range of BCTs. The mean number of BCTs per intervention was 6; range 2 - 11 (see Figure 7). Many interventions also included enablement functions, through goal setting, monitoring and feedback BCTs.

The BCT ‘Instruction on how to perform the behaviour’ was identified in 10/11 interventions. Instruction was typically identified in guidelines, in the form recommendations to perform the behaviour and how to do so, for a range of behaviours including those related to obtaining patient consent, catheter insertion, maintenance,

removal and provision of patient information. The BCT Information about health consequences was identified in 9 interventions. Examples of how this BCT was delivered included, explaining that unnecessary treatment with antibiotics can increase the resistance of bacteria that cause urinary tract infections, making antibiotics less effective for future use.

We took a generous and inclusive approach to our coding; in that many interventions were prompting techniques such as monitoring, feedback and planning, rather than providing these techniques directly (for example guidelines including recommendations to monitor and feedback on CAUTI related practice). We still coded for the presence of the techniques in such instances.

Figure 7. Frequency of identification of BCTs across interventions



Appendix J provides examples of how BCTs were operationalised in interventions.

RQ4: mapping barriers and facilitators (TDF domains) to CAUTI intervention content (BCTs)

The most frequently identified BCT, Instruction on how to perform the behaviour, was observed to have low theoretical congruence as the mapping matrix suggests it is congruent with the domain 'Skills,' which was ranked a joint ninth out of 14 in terms of importance (Table 2). The second most frequent BCT, Information about health consequences, was observed to have high theoretical congruence as it was paired with 2 domains rated as important – Knowledge and Beliefs about consequences.

Of the 24 BCTs identified in interventions, 10 BCTs had low theoretical congruence, 6 had medium congruence and 9 had high theoretical congruence. BCTs with low congruence included those relating to 'goal setting' and 'review'; 'monitoring by others of behaviours or outcomes'; 'instruction on how to perform the behaviour'; 'behavioural practice/rehearsal'; 'reward/outcome' and 'reframing' meaning that the BCTs selected to deliver the intervention were not related to any of the TDF domains identified as important in systematic review data linked to barriers and facilitators. BCTs with high congruence related to 'self-monitoring' and 'feedback'; 'information about health and social and environmental consequences' and 'restructuring the social environment' meaning that these BCTs would likely address the barriers or enable the facilitators to address the behaviours (see Table 7).

Table 4. Theoretical congruence between BCTs and TDF domains

BCT	Frequency (N Interventions, Max 11)	Linked TDF domains according to integrated linking matrix*	TDF Domain Importance Ranking**	Theoretical Congruence between BCT and Domain***
Feedback (on outcome of behaviour)	3	Knowledge Beliefs about consequences Beliefs about capabilities Goals	2 3 8 9-10	HIGH
Feedback (on behaviour)	3	Knowledge Beliefs about consequences Beliefs about capabilities Goals	2 3 8 9-10	HIGH
Self-monitoring (behaviour)	5	Memory, Attention, Decision Processes Behavioural regulation Skills Beliefs about consequences Beliefs about capabilities	5 7 9 3 8	HIGH
Self-monitoring (outcomes behaviour)	3	Memory, Attention, Decision Processes Behavioural regulation Skills Beliefs about consequences Beliefs about capabilities	5 7 9 3 8	HIGH
Social support (practical)	4	Social Influences Beliefs about capabilities Social professional role and identity Intentions Goals	4 8 6 11-14 9-10	HIGH
Information about health consequences	9	Knowledge Beliefs about consequences	2 3	HIGH
Information about social environmental consequences	4	Knowledge Beliefs about consequences	2 3	HIGH

BCT	Frequency (N Interventions, Max 11)	Linked TDF domains according to integrated linking matrix*	TDF Domain Importance Ranking**	Theoretical Congruence between BCT and Domain***
Prompts/cues	1	Memory, attention, decision processes Environmental context and resources Behavioural regulation	5 1 7	HIGH
Restructuring the social environment	1	Social Influences Environmental Context and Resources	6 1	HIGH
Action planning	1	Goals Intentions Memory, Attention, Decision Processes Behavioural regulation	9-10 11-14 5 7	MED
Information about emotional consequences	1	Knowledge Emotions	2 11-14	MED
Social comparison	1	Social influences	4	MED
Demonstration of behaviour	2	Social influences Skills	4 9	MED
Credible source	3	Beliefs about consequences Goals Intentions	3 9-10 11-14	MED
Identification of self as a role model	1	Social influences	4	MED
Goal-setting (behaviour)	4	Behavioural regulation Skills Beliefs about capabilities Goals Intentions	7 9 8 9-10 11-14	LOW
Goal-setting (outcome)	1	Behavioural regulation Skills Beliefs about capabilities Goals Intentions	7 8 9-10 11-14	LOW
Review behaviour goal(s)	1	Goals Intentions	9-10 11-14	LOW
Discrepancy between current behaviour and goal(s)	2	None	n/a	LOW
Monitoring of outcome of behaviour by others without feedback	1	Skills	9	LOW
Monitoring of the behaviour by others without feedback	3	Skills	9	LOW
Instruction on how to perform the behaviour	10	None	N/A	LOW
Reward (outcome)	1	Skills Reinforcement Goals Intentions	9 11-14 9-10 11-14	LOW
Behavioural practice/ rehearsal	2	Skills Beliefs about capabilities	9 8	LOW

*Merged matrix combing Cane et al 2015 and Michie et al 2008 TDF x BCT linking matrices.
**Domain ranking based on thematic analysis of barrier/facilitators literature (see Table 2).
***Classification of theoretical congruence: **Low**: BCT is not paired with any of the 6 key domains identified as important in the thematic analysis; **Medium**: BCT is paired with at least one domain identified as important; **High:** BCT is paired with 2 or more domains identified as important.

RQ5: missed opportunities for intervention design and refinement

Table 8 shows whether intervention functions identified in the 11 interventions appropriately targeted the 6 most important TDF/COM-B components. According the matrix TDF domains ‘Knowledge’ and ‘Memory, attention, decision-making’ could potentially be targeted by the functions education, training and enablement. These functions were identified in 12, 4 and 7 interventions respectively.

Barriers and facilitators related to the TDF domain ‘environmental context and resources’ could potentially be targeted by the following intervention functions: ‘training’, identified in 4 interventions; ‘enablement’, identified in 7 interventions and; ‘restriction’ and ‘environmental restructuring’ which were not identified in any interventions representing missed opportunities to target these barriers and facilitators.

Barriers and facilitators related to the TDF domain ‘social influences’ could potentially be targeted through the intervention functions ‘modelling’ and ‘enablement’ (identified in 2 and 7 interventions respectively). They could also be targeted through the intervention functions ‘restriction’ and ‘environmental restructuring’ which were not identified in any interventions again representing missed opportunities to target these barriers and facilitators.

The TDF domains ‘beliefs about consequences’ and ‘social professional role and identity’, could potentially be targeted through the intervention functions ‘education’, ‘persuasion’, ‘incentivisation’, ‘coercion’ and ‘modelling.’ ‘Education’ was identified in all interventions. ‘Coercion’ and ‘persuasion’ were not identified in any interventions representing a missed opportunity in all interventions. ‘Incentivisation’ was identified in one intervention and ‘modelling’ in 2 interventions. Whilst these are theoretically appropriate, they were identified in only a few interventions indicating that the majority of interventions missed opportunities to target barriers and facilitators related to ‘beliefs about consequences’ and ‘social professional role and identity’ using these domains.

Table 5. Seized and missed opportunities: intervention functions

	Intervention functions (number of interventions serving each function)								
	Education (n=11)	**Persuasion** (n=0)	**Incentivisation** (n=1) Safety Therm	**Coercion** (n=0)	**Training** (n=4)	**Restriction** (n=0)	**Environmental restructuring** (n=0)	**Modelling** (n=2)	**Enablement** (n=7)
COM-B: Physical capability*									
COM-B: Psychological capability **TDF:** Knowledge; Memory attention, decision making									
COM-B: Physical opportunity **TDF:** Environmental context and resources									
COM-B: Social opportunity **TDF:** Social influences									
COM-B: Automatic motivation*									
COM-B: Reflective motivation **TDF:** Beliefs about consequences; Social professional role and identity									

*None of the 6 most important TDF domains were linked to physical capability or automatic motivation

Green = Opportunity seized, that is a domain which is theoretically linked with an intervention function was identified. For example, the matrix indicates that to target social influences, interventions which serve the intervention functions either of restriction, environmental restructuring, modelling or enablement are likely to be more effective than other intervention functions. In this study, social influences was identified in the systematic review as a key influence on CAUTI-related behaviours. In our analysis of intervention content, we identified 2 interventions which served the function of modelling and 7 which served the function of enablement indicating the opportunity to design interventions with these relevant intervention functions was seized.

Red = Opportunity missed, that is an intervention function could potentially target a TDF domain but was not identified in this study. As described above, using either restriction or environmental restructuring could potentially target social influences; however, we identified no interventions which served these intervention functions indicating potential missed opportunities for intervention design.

Grey = Theoretical link between COM-B/TDF domain to intervention function but not relevant (that is no important barriers or facilitators representing them in this review)
White = Not linked in matrices.

Table 9 shows whether intervention functions identified in the 11 interventions were delivered through policy categories suggested by the BCW intervention function * policy category matrix. All intervention functions were delivered through at least one policy category suggested by the matrix. There was one instance in Catheter Care: Royal College of Nursing Guidance for nurses where the intervention function 'modelling' was delivered through 'guidelines' (observe catheterisation performed by others on actual patients) which is not suggested by the matrix. This function was also delivered through the appropriate policy category of 'service provision' and there was a missed opportunity for it to be delivered through 'communication and marketing.'

There were missed opportunities to deliver all functions identified in interventions through the policy category of regulation. Three other policy categories - communication/marketing, fiscal measures and environmental and social planning were not used to deliver identified functions suggested by the matrix.

Table 6. Seized and missed opportunities: Policy categories

	Policy categories (number of interventions delivered through policy category)						
	Communication/ marketing (n=0)	Guidelines (n=9)	Fiscal measures (n=0)	Regulation (n=0)	Legislation (n=1)	Environmental/ Social planning (n=0)	Service provision (n=2)
Education							
Persuasion							
Incentivisation							
Coercion							
Training							
Restriction							
Environmental restructuring							
Modelling							
Enablement							

Green = Opportunity seized
Red = Opportunity missed
Grey = Not relevant
Blue = Intervention function delivered through a policy category not suggested by the matrix

Table 10 presents the frequency with which BCTs paired with important TDF domains were identified in existing interventions. BCTs paired with 5 ('Knowledge', 'Beliefs about consequences,' 'Social influences,' 'Social professional role and identity' and

‘Environmental context and resources) of the 6 most important domains were not used frequently (that is less than 60%) in existing interventions. This finding indicates numerous missed opportunities for intervention design. Opportunity seized was highest for the domains ‘Memory, attention and decision processes’ (100% of the theoretically coherent BCTs were used at least once in interventions) and ‘Knowledge’ (57% of the theoretically coherent BCTs were used at least once in interventions). The most missed opportunities were for the domains social professional role and identity and environmental context and resources.

Table 7. Opportunities for intervention design: the frequency with which theoretically congruent BCTs with important theoretical domains were used in existing interventions

BCTs paired with domain as per predefined matrix (Appendix J)	BCT Frequency, *n* interventions	% Potential relevant BCTs used at least once
Memory, Attention, Decision Making		
Self-monitoring of behaviour	6	100%
Self-monitoring of outcome of behaviour	4	
Action planning	1	
Prompts and cues	1	
Knowledge		
Information on health consequences	10	57%
Biofeedback	0	
Antecedents	0	
Feedback on behaviour	4	
Information on social/ environmental consequences	4	
Information emotional consequences	1	
Salience of consequences	0	
Beliefs about consequences		
Information about emotional consequences	1	50%
Salience of consequences	0	
Covert Sensitization	0	
Anticipated regret	0	
Information about social/ environmental consequences	4	
Pros and Cons	0	
Vicarious reinforcement	0	
Threat	0	
Comparative imagining of future outcomes	0	
Self-monitoring of behaviour	6	
Self-monitoring of outcome of behaviour	4	
Information on health consequences	10	
Feedback on behaviour	4	
Biofeedback	0	
Feedback on outcome(s) of behaviour	3	
Persuasive communication (Credible source)	4	
Social Influences		
Social comparison	1	50%
Social support (unspecified)	0	
Social support (emotional)	0	

BCTs paired with domain as per predefined matrix (Appendix J)	BCT Frequency, *n* interventions	% Potential relevant BCTs used at least once
Social support (practical)	4	
Information about others' approval	0	
Vicarious consequences/ reinforcement	0	
Restructuring the social environment	1	
Identification of self as a role model	1	
Social Reward	0	
Demonstration of the behaviour	3	
Social Professional Role and Identity		
Social support (unspecified)	0	33%
Social support (emotional)	0	
Social support (practical)	4	
Environmental Context and Resources		
Restructuring the physical environment	0	33%
Discriminative (learned) cue	0	
Prompts/ Cues	1	
Avoidance/ changing exposure to cues for the behaviour	0	
Adding objects to the environment	0	
Restructuring the social environment	1	

Discussion

Summary of findings

This strategic behavioural analysis aimed to: i) identify the behaviours related to CAUTI; ii) the factors influencing these behaviours; iii) the content of interventions targeting CAUTI, which are currently nationally available in England; and iv) the extent to which existing interventions target the key influences on CAUTI-related behaviours.

The majority of studies included in the systematic review of barriers and facilitators of CAUTI-related behaviours focussed on bundles of behaviours, such as the implementation of an intervention or adherence to clinical guidelines, both of which involve several behaviours rather than specific, discrete behaviours. These bundles of behaviours tended to relate to reducing duration of catheter use (that is timely removal of catheters and reducing inappropriate catheter use) rather than behaviours related to hygiene practices during catheter insertion and maintenance.

We identified a total of 25 papers reporting barriers and facilitators to CAUTI-related behaviours across secondary care (n=23) nursing homes (n=1) and community care (n=1). The most frequently identified barriers and facilitators of CAUTI-related behaviours related to the following 6 TDF domains: 1) Environmental Context and

Resources, for example having the time and equipment to perform alternatives to catheterisation; 2) Knowledge, for example lack of knowledge of relevant clinical guidelines; 3) Beliefs about consequences, for example healthcare professionals' perceptions of severity of CAUTI, and of the ease and convenience associated with catheterisation; 4) Social Influences, for example family requests to catheterise the patient; 5) Memory, Attention, and Decision Making, for example making catheter-related decisions based on non-medical criteria and; 6) Social Professional Role and Identity, for example accepting responsibility for making catheter-related decisions.

We identified 11 interventions to reduce CAUTI that are implemented currently in England. These were typically in the form of clinical guidelines. All 11 interventions served the function 'education', 7 served an 'enabling' function and 4 served a 'training' function. We identified 24 behaviour change techniques (BCTs) across the interventions. The most frequently identified BCTs were: 'instruction on how to perform a behaviour' (identified in 10 interventions) with low theoretical congruence and 'information about health consequences (identified in 9 interventions) which had high theoretical congruence.' The BCT prompt 'self-monitoring of behaviour' was identified in 5 interventions.

In terms of the extent to which these BCTs targeted the TDF domains in which the majority of barriers/facilitators to CAUTI-related behaviours were identified: 9 BCTs targeted 2 or more of the 6 most important TDF domains (see Table 2) and were thus classified as having high theoretical congruence (that is a 'match' between the intervention content and the important influence on CAUTI-related behaviours. These high congruence BCTs were: 'Feedback (on outcome of behaviour);' 'Feedback (on behaviour);' 'Self-monitoring (behaviour);' 'Self-monitoring (outcomes behaviour);' 'Social support (practical);' 'Information about health consequences;' 'Information about social environmental consequences;' 'Prompts/cues;' and 'Restructuring the social environment.' Six further BCTs were classified as having medium theoretical congruence, in that they targeted only one of the 6 most important TDF domains: 'Action planning;' 'Information about emotional consequences;' 'Social comparison;' 'Demonstration of behaviour;' 'Credible source;' and 'Identification of self as a role model.' However, 10 BCTs in currently implemented interventions were classified as having low theoretical congruence, in that they do not target any of the 6 most important TDF domains influencing CAUTI-related behaviours: 'Goal-setting (behaviour);' 'Goal-setting (outcome);' 'Review behaviour goal(s);' 'Discrepancy between current behaviour and goal(s);' 'Monitoring of outcome of behaviour by others without feedback;' 'Monitoring of the behaviour by others without feedback;' 'Instruction on how to perform the behaviour;' 'Reward (outcome);' and 'Framing/re-framing.'

An important factor to consider in interpreting these data is the frequency with which BCTs were identified. For example, whilst BCTs 'Feedback on the outcome of behaviour' and 'Information about health consequences' were both classified as having

high theoretical congruence, ‘Feedback on the outcome of behaviour’ was identified in only 3 interventions, whereas ‘Instruction on how to perform the behaviour’ which had low theoretical congruence was identified in 10 interventions.

In addition, we consulted mapping matrices that pair TDF domains with BCTs that are likely to be effective in addressing barriers/enablers within that domain. We examined the extent to which the BCTs paired with the 6 most important domains influencing CAUTI-related behaviours were included in existing interventions. A number of ‘missed opportunities,’ for intervention design were identified in the form of theoretically congruent BCTs that are not currently included in interventions. This was particularly apparent for the domains Environmental Context and Resources, and Social Professional Role and Identity, for which only about a third of theoretically congruent BCTs were included (at least once) in existing interventions. Of note, although for some domains, such as Memory Attention Decision Making, a large proportion of congruent BCTs featured in existing BCTs, these were delivered at a very low frequency (that is n= 1 intervention); and arguably thus still represent a missed opportunity for intervention design and refinement.

Extent to which identified barriers and facilitators are targeted in current interventions

Below we further discuss the extent to which BCTs in existing interventions target the specific barriers/enablers themes identified within the 6 most important TDF domains.

Environmental context and resources

The most frequently identified TDF domain influencing CAUTI-related behaviours was Environmental Context and Resources, which included themes related to availability of resources, time to perform behaviours and required staff in post. Despite 8 themes relating to this domain being identified in 13/25 papers included in the systematic review, we identified only 2 BCTs in 2 interventions targeting this domain. In the EPIC 3 intervention, the BCT ‘Prompts and Cues’ was delivered as ‘reminders to review the continuing use or prompt the removal of catheters’ and in the HOUDINI intervention the BCT ‘Restructuring the social environment’ was delivered in the form of the intervention allowing nurses to remove catheters without asking for a physician written order.

Whilst the BCT ‘prompts and cues’ in the form of reminders may go some way to addressing the barrier theme within this domain of limited and inconsistent documentation and records, other key themes within this domain, such as inappropriate catheter use due to transitions of care (for example staff turnover or patient transfer between wards), lack of time to perform alternatives to urinary catheterisation, unavailability of medical alternatives to urinary catheterisation and availability of urinary catheters were not addressed by BCTs in nationally implemented interventions.

Recommendations for intervention development (that is BCT delivery) to address these themes are provided in Table 9 and discussed in section 4.3.

Knowledge

Nine themes relating to the TDF domain Knowledge were identified across 11 studies. Themes included lack of knowledge about: clinical guidelines, risks of infection associated with urinary catheters, how to manage patients without catheterisation, and infection management. Four BCTs targeting Knowledge were identified: 'Information about health consequences' (identified in 10/11 interventions); 'feedback on behaviour (identified in 3/11)' 'information on social/environmental consequences' (identified in 4/11 interventions) and; 'information on emotional consequences' (identified in 1/11 interventions).

The BCT Information about health consequences appears to have been delivered appropriately in interventions to address lack of knowledge about specific procedures, for example in NICE QS90 on Urinary Tract Infections in Adults, conveying that dipstick testing is not an effective method for detecting urinary tract infections in catheterised adults "because there is no relationship between the level of pyuria and infection in people with indwelling catheters." This BCT has also been used to address awareness of the risks associated with use of urinary catheters, for example in Department of Health & Public Health England (2013) Prevention and control of infections in care homes: an informative resource, conveying that "invasive devices such as a urinary catheter or intravenous line will increase a resident's risk of acquiring an infection."

However, we did not identify any examples of BCTs targeting lack of knowledge of how to manage patients without catheterisation. Furthermore, many of the interventions were in themselves guidelines; and there is thus a need for additional implementation intervention strategies and BCTs to address the knowledge gap around the awareness of guidelines (Table 11).

Beliefs about consequences

The 3 most commonly identified themes within this domain related to: perceptions of how easy, convenient and benign catheters are in being used to avoid taking patients to the bathroom or monitor urine output; different perceptions of how severe CAUTI is and; lack of perceived benefits to interventions targeting CAUTI.

Eight BCTs targeting themes related to beliefs about consequences were identified: 'Information on health consequences' (identified in 10/11 interventions); 'Self-monitoring of behaviour' (identified in 5/11 interventions); 'Self-monitoring of outcome of behaviour (identified in 3/11 interventions),' 'Information about social/ environmental consequences (identified in 4/11 interventions),' 'Feedback on behaviour (identified in

3/11 interventions),' 'Credible source' (all identified in 3/11 interventions); 'Feedback on outcome(s) of behaviour' (identified in 3/11 interventions) and 'Information about emotional consequences' (identified in one intervention).

The issue of catheterising for convenience is addressed with direct instructions in the RCN guidance for nurses on catheter care to "never catheterise or continue catheter usage for nursing convenience. Nurses must ensure that catheterisation is based on a balanced decision with more benefits than disadvantages, in consultation with the patient, where possible" and also in Epic 3 with the instruction to "remove the catheter when no longer clinically indicated." However, the TDF domain Beliefs about consequences is linked to the COM-B component reflective motivation. So, themes in this domain are likely better targeted by BCTs aiming to strengthen how much healthcare professionals value why it is important not to catheterise for convenience or to perceive CAUTI as severe rather than, for example, issuing direct instruction not to catheterise for convenience.

Social influences

Six themes relating to the domain Social influences were identified in 9 studies. The 4 most frequently identified themes were: requests from patients and their carers to catheterise (identified in 5 studies); lack of peer support and buy-in to adhere to practices promoting appropriate catheter use (identified in 4 studies); physicians dictating nurses' practice and cultural norms regarding standard catheterisation practice for specific patient groups (for example intensive care) (both identified in 3 studies).

We identified 5 BCTs relevant to this domain: 'Social support (practical),' for example, 'Organisations may like to make use of the tools developed by NICE to help implementation of the clinical guideline on Infection Control (Update). All the implementation tools can be found on the NICE website.' [NICE Catheter audit Tool] (identified in 4/11 interventions); 'Demonstration of the behaviour' (identified in 3/11 interventions), for example 'observe model/manikin being catheterised … observe catheterisation performed by others on actual patients' [Catheter Care: RCN guidance for nurses]. Whilst these BCTs are relevant to this domain out of context; in this context, the way they have been delivered in the interventions we identified is unlikely to effectively address the main themes related to this domain of managing patient and family requests, achieving staff buy in, or challenging the cultural norms to catheterise certain patient groups.

A further 3 BCTs were each identified in one intervention: 'Restructuring the social environment,' 'Identification of self as a role model' and 'Social comparison.' Two of which could address themes relevant to this domain: 'Restructuring the social environment,' for example the HOUDINI protocol that allows nurses to remove

catheters without asking for a physician written order. This could address the barrier of physicians dictating nurse practice. Identification of self as a role model was delivered in the RCN guidance for nurses on catheter care as the practice recommendation to "become a competent mentor for others" which could provide peer-support and promote staff-buy in.
However, no BCTs targeted at patients and their relatives to change their behaviour regarding requests for catheterisation were identified, nor were any BCTs to enable healthcare professionals to effectively challenge such requests. Furthermore, there were no BCTs to specifically challenge practice norms for catheterisation in specific patient groups, for example ICU patients.

Memory, attention, decision-making

Eight themes relating to Memory, Attention, Decision Making were identified in 8 papers. The most frequently identified theme (identified in 3 studies) was catheterising based on a perceived pre-emptive need, for example catheterising patients before they underwent a CT scan in case they lost continence during the procedure or before transfer to another ward because staff perceived healthcare professionals receiving the patient would want them to be catheterised.

All BCTs linked to this domain were identified in one or more interventions: 'Self-monitoring of behaviour' (identified in 5/11 interventions); 'Self-monitoring of outcome of behaviour' (identified in 3/11 interventions); 'Action planning;' and 'Prompts and cues,' (both identified in 1/11 interventions).
Examples of how 'self-monitoring of behaviour' were delivered included documenting: whether aseptic technique had been followed; daily assessment of the need of the short-term urinary catheter (identified in High Impact Intervention for best practice insertion and care). An example of how 'self-monitoring of outcome of behaviour' was delivered was identified in Department of Health & Public Health England (2013) Prevention and control of infections in care homes: an informative resource "where residents have an invasive device in place, this should be fully documented in the care plan and the resident should be monitored for signs of infection."

Whilst the self-monitoring BCTs are relevant to the domain 'Memory, attention, decision making,' the way in which they have been delivered in the interventions we identified is unlikely to effectively address the main theme related to this domain, catheterising based on a perceived pre-emptive need.

Social professional role and identity

Four themes identified in 6 papers were related to the domain Social Professional Role and Identity: Having a hospital epidemiologist in post (n=2 studies); acceptance of responsibility for urinary catheterisation decision making (n=2); CAUTI guidelines not

being perceived as relevant across hospital departments (n=1); and nurses leading change in urinary catheterisation practice (n=1).

Of the 3 BCTs that could potentially be used to address these themes, only one, social support (practical), was identified in 4/12 interventions. Whilst this was delivered as signposting to NICE online resources (see Table 6), it is unlikely effectively address the themes of epidemiologist being in post; accepting responsibility for decision making, recognising the relevance of CAUTI guidelines to a particular hospital department, or empowering nurses to champion change in CAUTI practice.

Recommendations for practice: intervention design and refinement

Based on the investigation of the fit between identified barriers and facilitators and BCTs identified in interventions in section 4.2, there are numerous opportunities for further intervention design and refinement of existing interventions. Table 11 provides initial recommendations of potential strategies to address the more frequently identified (n > 3 studies) barriers and facilitators within the 6 most important TDF domains. These recommendations include examples of different ways of potentially delivering BCTs that are already included in existing interventions, or additional, new BCTs that have not been identified in current interventions but are relevant to the key TDF domains (see Appendix J). The hypothetical example deliveries of these BCTs are intended as illustrations for how they might be operationalised; however, in moving forward with this work, the delivery of these BCTs would be co-designed with experts in the subject area using explicit criteria (see section 4.6).

Table 8. Recommendations for intervention design and refinement

Theme	Proposed new BCT	Example delivery to address theme
Environmental context and resources		
Limited and inconsistent documentation and records	Restructuring the physical environment; prompts/cues	Creating standardised computer-based documentation requiring staff to enter reason for catheterisation, date of insertion etc (that is not circumvent system by leaving fields blank).
Transitions of care	Restructuring the social environment	Creating the rule that ward staff transferring patients to another ward check with the staff receiving the patient whether catheterisation is necessary (this rule could be prompted by a checklist for transfer of patients to another ward/hospital or home where staff check if the catheter is needed).
Lack of time to perform alternatives to urinary catheterisation	Restructuring the social environment	Recognition of the need for additional support staffing to take patients to the bathroom

Theme	Proposed new BCT	Example delivery to address theme
Knowledge		
Lack of knowledge of clinical guidelines and local procedural documents	Information to consider including in guidelines/local procedural documents: • Alternatives to catheterisation • How to safely manage infections arising from catheterisation? Whilst the information contained in the guidelines appears to address lack of knowledge in, for example link between catheter duration and CAUTI, the issue may be more to do with dissemination. Guideline implementation strategies to accompany recommendations may promote this.	
Beliefs about consequences		
Convenience and ease of monitoring	Anticipated regret	Asking staff how they would feel if a patient was diagnosed with CAUTI after they had catheterised them for non-medical reasons
	Pros and Cons	Asking staff to list the benefits and disadvantages of catheterising for convenience compared with catheterising for medical reasons
	Salience of consequences	[There may be images which could emphasise the severity of CAUTI]
	Persuasive communication (Credible source)	Senior members of staff endorsing not catheterising for convenience
Social influences		
Requests from patients and their carers	Social comparison	Staff convey to patients/carers that most patients/carers don't request catheters and explain the reason why this is
	Demonstration of the behaviour	Staff role modelling challenging patient/carer requests
Lack of peer support and buy-in	Information about others' approval	Informing staff engagement with CAUTI-reducing practices is encouraged by peers/senior staff.
Physicians dictate nurses' practice	Restructuring the social environment	Strategies to empower nurses to lead on catheter decision-making (delivered through peers/senior team members)
	Social comparison	Provide examples of where the HOUDINI protocol has been effectively implemented

Theme	Proposed new BCT	Example delivery to address theme
Cultural norms regarding standard catheterisation practice for specific patient groups	Social comparison	Compare rates of catheterisation across wards/hospitals and corresponding rates of infection
Memory attention and decision processes		
Pre-empting subsequent urinary catheterisation	Action planning	Plan who will assess the patient for catheterisation and where this will happen
	Self-monitoring of behaviour	Document the action plan (see above) so there is agreement between staff on different wards whether the patient being transferred requires a catheter and if so, who will insert the catheter

Social professional role and identity is not included as no theme was identified in 3 or more studies

Whilst the BCTs suggested here are linked to multiple intervention functions – the most relevant functions interventions need to serve are: restructuring the social and physical environment (none of the identified interventions serve this function); persuasion and enablement.

The interventions identified in this work used a narrow range of strategies - primarily educational in nature, delivered in the form of guidelines. To better address barriers and facilitators identified in the systematic review, more proactive strategies are needed to increase implementation of these guidelines as passive guideline dissemination will only go so far.[19] Strategies could include auditing hospitals, GP practices and care homes against recommendations in guidelines and providing feedback on performance against these recommendations, highlighting any discrepancy between observed and desired behaviour and setting goals and action plans to reduce any observed discrepancy. Strategies such as this could also incorporate elements of social comparison such as comparing performance against other wards, teams or hospitals.

Limitations

There are 4 main limitations to this study. Firstly, bundles rather than specific behaviours tended to be the focus of studies included in the systematic review. Therefore, it was not possible to differentiate between which barriers/enablers related to specific behaviours, and in turn, to provide more specific recommendations for intervention development.

Secondly, as this is a secondary analysis of published literature, intervention descriptions are often poorly and vaguely specified and offer limited detail for coding. In addition, we were only able to synthesise barriers/enablers that were reported by the

authors of the included studies. This may have thus been prone to a reporting/ interpretation bias. Third, as none of the included studies investigated barriers/enablers using the TDF, it is possible that some of the TDF domains were not frequently identified because questions were not asked to assess the role that domain plays in influencing CAUTI-related behaviours for example we might hypothesise that reinforcement and emotion are likely to be important. Last, a separate analysis considering the healthcare setting would be optimal, it was not possible due to the limited number of studies in some settings.

Finally, the TDF x BCT domain pairings upon which the assessments of congruence are discussed are based on expert consensus, are not empirically validated, and do not differentiate between theoretically congruent pairings according to different types of behaviours. Therefore, some of the proposed theoretically congruent BCTs may not be as relevant or appropriate in the context of CAUTI. Ultimately we need to consider the present findings in the context of the behaviour of interest and use the APEASE criteria (Table 10) to consider which missed opportunities are appropriate to carry forward for intervention development.

Recommendations for future research

Identifying the factors influencing CAUTI-related behaviours

There were 2 main limitations to the existing literature on factors influencing CAUTI-related behaviours. First, they investigated factors influencing bundles of behaviours rather than individual CAUTI-related behaviours. CAUTI is a product of a complex set of interrelated behaviours performed by multiple individuals, for example nurses inserting a catheter; physicians ordering a catheter; microbiologists prompting removal/review, patients/family members requesting catheters. The factors driving these different behaviours and individuals are likely to vary and differ. The first step in the Behaviour Change Wheel approach to designing behaviour change interventions is to identify and map out the system of behaviours, then narrow down on the key behaviour(s) to target, by considering: i) the likely impact on outcome if the behaviour were to be changed; ii) how easy it is likely to be to change the behaviour; iii) the centrality of the behaviour in the system of behaviours: thus, the positive or negative ‘spillover’ effect to other behaviours and outcomes in the system if that behaviour were to be changed; iv) how easy it is to measure the behaviour in order to detect change.[18] Although the conceptual map of behaviours resulting from this analysis (Figure 5) provides a description of the behavioural system, further research is needed to prioritise ‘what are the key behaviours influencing CAUTI?’

Upon identification of the key behaviours, a more focused behavioural analysis can be conducted to identify ‘What are the behavioural determinants of key behaviours influencing CAUTI?’ Ideally, this investigation should be based on a relevant and

comprehensive behavioural theory or framework, such as the TDF or COM-B. This will ensure that the wide range of potential influences on behaviour are considered - from individual factors, to broader social and physical environmental factors. This will build on the findings here as to whether domains not identified in this systematic literature are relevant to CAUTI-related behaviours.

Importantly, there is a need for research that aims to identify ‘What are the factors influencing CAUTI-related behaviours primary care, community, and/or nursing homes?’ The vast majority of studies included in our analysis investigated the barriers/enablers to CAUTI-related behaviours in secondary care. However, the majority of the existing interventions analysed target primary care, community and nursing homes. This is an important discrepancy and limitation to the mapping exercise we conducted to establish whether existing interventions target the key factors influencing CAUTI-related behaviours. The factors influencing CAUTI-related behaviour are likely to be context specific and thus differ across care settings. Therefore, it is vital that further behavioural analysis research is done in under-investigated care settings so that a more accurate mapping of existing interventions may be conducted, and more targeted recommendations for intervention development identified.

Identifying which interventions are effective in targeting CAUTI-related behaviours

This work was a descriptive review and so we did not investigate which BCTs were associated with improved outcomes in existing interventions. This is because we looked at implemented interventions rather than peer-reviewed evaluations of interventions. Subsequent work could include reviews of the published, peer-reviewed evaluations of interventions targeting CAUTI, coupled with BCT coding of these interventions and meta-regression, to identify which BCTs, functions and policy categories are linked to effective interventions. Such an analysis could identify: i) the ‘active ingredients’ of effective interventions and in turn signpost to intervention development and also disinvestment; ii) the extent to which theoretical congruence is associated with outcomes.

Guideline implementation

Given a key finding in this work was lack of awareness of guidelines, more process evaluation research is recommended to identify why guidelines are not being implemented. Current strategies are mostly passive and our analysis of barriers and facilitators suggest they are not being successful; so investment in the development of new intervention strategies and their evaluation to is needed to reduce the evidence-implementation gap.

Next steps

Having identified potentially relevant BCTs in section 4.3, further exploration of how these BCTs could be delivered is needed. The following steps are suggested. Firstly, assemble a stakeholder group who relevant perspectives on the delivery of these BCTs. These include, IPC subject area experts, service users, behavioural scientists, policy makers and service managers.

Secondly, use the APEASE criteria (Appendix K) to permit a systematic approach to selecting which BCTs are appropriate to each context. The APEASE criteria is a checklist of list of considerations when selecting intervention content and mode of delivery, that is is it **A**ffordable (can it be delivered to budget?), **P**racticable (can it be delivered to scale?), **E**ffective (cost-effective (is there evidence it is likely to be (cost)effective?), **A**cceptable (is it acceptable to those delivering, receiving and commissioning it?), are there any **S**ide-effects/Safety issues?, is their **E**quity (that is does it disadvantage any groups?).

Using the APEASE criteria to guide stakeholder discussions, a priority list of BCTs can be generated.

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Appendices

Appendix A: BCW matrices

Links between COM-B and intervention functions

	Intervention functions								
	Education	Persuasion	Incentivisation	Coercion	Training	Restriction	Environmental restructuring	Modelling	Enablement
Physical capability					■				■
Psychological capability	■				■				■
Physical opportunity					■	■	■		■
Social opportunity						■	■	■	■
Automatic motivation		■	■	■	■		■	■	■
Reflective motivation	■	■	■	■				■	

Links between intervention functions and policy categories

	Policy categories						
	Communication /marketing	Guidelines	Fiscal measures	Regulation	Legislation	Environmental/ Social planning	Service provision
Education	■	■		■	■		■
Persuasion	■	■		■	■		■
Incentivisation	■	■	■	■	■		■
Coercion	■	■	■	■	■		■
Training		■	■	■	■		■
Restriction		■		■	■		
Environmental restructuring		■	■	■	■	■	
Modelling	■						■
Enablement		■	■	■	■	■	■

Appendix B: Electronic search strategies

Systematic review of barriers and facilitators to catheter associated urinary tract infections (CAUTI) behaviours in secondary care and nursing homes

1. (urinary adj1 tract adj1 infection*).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
2. UTI.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
3. CAUTI.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
4. (acute adj1 kidney adj1 injury).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
5. (health$ adj1 associated adj1 infection).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, an, ui, sy, tc, id, tm]
6. (secondary adj1 care).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
7. hospi$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
8. (nursing adj1 home).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
9. (residential adj1 care).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
10. catheter*.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
11. 1 or 2 or 3 or 4 or 5
12. 6 or 7 or 8 or 9
13. 10 and 11 and 12
14. barrier$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
15. facilitat$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
16. enable$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
17. lever$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
18. obstacle$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
19. influen$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
20. drive*.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
21. determin$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
22. factor$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
23. 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22
24. 13 and 23
25. limit 24 to english language
26. limit 25 to human
27. limit 26 to yr="1995 -Current"
28. limit 27 to humans

Systematic review of barriers and facilitators to catheter associated urinary tract infections (CAUTI) behaviours in primary and community care

1. (urinary adj1 tract adj1 infection*).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
2. UTI.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
3. CAUTI.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
4. (acute adj1 kidney adj1 injury).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
5. (health$ adj1 associated adj1 infection).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
6. (primary adj1 care).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
7. (general adj1 practi$).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
8. (primary adj1 health adj1 care).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
9. (primary adj1 healthcare).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
10. GP.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
11. (family adj1 physician$).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
12. (primary adj1 care adj1 physician$).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
13. communit$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
14. continence nurse$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
15. (home adj1 care).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, an, ui, sy, tc, id, tm]
16. (home adj1 nurs$).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, an, ui, sy, tc, id, tm]
17. catheter*.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
18. 1 or 2 or 3 or 4 or 5
19. 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17
20. 17 and 18 and 19
21. barrier$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
22. facilitat$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
23. enable$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
24. lever$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
25. obstacle$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
26. influen$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
27. drive*.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
28. determin$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
29. factor$.mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, nm, kf, px, rx, ui, sy, tc, id, tm]
30. 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29
31. 20 and 30

32. limit 31 to english language
33. limit 32 to human
34. limit 33 to yr="1995 -Current"
35. limit 34 to humans

Appendix C: Labels, definitions and examples of COM-B and Theoretical Domains Framework

COM-B model

COM-B model component Definition	***Example***
Physical capability Physical skill, strength or stamina	*Having the skill to take a blood sample*
Psychological capability Knowledge or psychological skills, strength or stamina to engage in the necessary mental processes	*Understanding the impact of CO^2 on the environment*
Physical opportunity Opportunity afforded by the environment involving time, resources, locations, cues, physical 'affordance'	*Being able to go running because one owns appropriate shoes*
Social opportunity Opportunity afforded by interpersonal influences, social cues and cultural norms that influence the way that we think about things, for example the words and concepts that make up our language	*Being able to smoke in the house of someone who smokes but not in the middle of a boardroom meeting*
Reflective motivation Reflective processes involving plans (self-conscious intentions) and evaluations (beliefs about what is good and bad)	*Intending to stop smoking*
Automatic motivation Automatic processes involving emotional reactions, desires (wants and needs), impulses, inhibitions, drive states and reflex responses	*Feeling anticipated pleasure at the prospect of eating a piece of chocolate cake*

Theoretical domains framework

Domain Definition	**Theoretical constructs represented within each domain**	***Interview questions****
Knowledge An awareness of the existence of something	Knowledge (including knowledge of condition /scientific rationale); procedural knowledge; knowledge of task environment	*Do you know about x?*
Skills An ability or proficiency acquired through practice	Skills; skills development; competence; ability; interpersonal skills; practice; skill assessment	*Do you know how to do x?*
Memory, attention and decision Processes The ability to retain information, focus selectively on aspects of the environment and choose between 2 or more alternatives	Memory; attention; attention control; decision making; cognitive overload / tiredness	*Is x something you usually do?*

Behavioural regulation Anything aimed at managing or changing objectively observed or measured actions	Self-monitoring; breaking habit; action planning	*Do you have systems that you could use for monitoring whether or not you have carried x?*
Social/professional role and identity A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting	Professional identity; professional role; social identity; identity; professional boundaries; professional confidence; group identity; leadership; organisational commitment	*Is doing x compatible or in conflict with professional standards/identity?*
Beliefs about capabilities Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use	Self-confidence; perceived competence; self-efficacy; perceived behavioural control; beliefs; self-esteem; empowerment; professional confidence	*How difficult or easy is it for you to do x?*
Optimism The confidence that things will happen for the best or that desired goals will be attained	Optimism; pessimism; unrealistic optimism; identity	*How confident are you that the problem of implementing x will be solved?*
Beliefs about consequences Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation)	Beliefs; outcome expectancies; characteristics of outcome expectancies; anticipated regret; consequents	*What do you think will happen if you do x?*
Intentions A conscious decision to perform a behaviour or a resolve to act in a certain way	Stability of intentions; stages of change model; transtheoretical model and stages of change	*Have they made a decision to do x?*
Goals Mental representations of outcomes or end states that an individual wants to achieve	Goals (distal / proximal) ; goal priority; goal / target setting; goals (autonomous / controlled); action planning; implementation intention	*How much do they want to do x?*
Reinforcement Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus	Rewards (proximal / distal, valued / not valued, probable / improbable); incentives; punishment; consequents; reinforcement; contingencies; sanctions	*Are there incentives to do x?*
Emotion A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event	Fear; anxiety; affect; stress; depression; positive / negative affect; burn-out	*Does doing x evoke an emotional response?*
Environmental context and resources Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities,	Environmental stressors ; resources / material resources ; organisational culture /climate ; salient events / critical incidents; person x environment interaction; barriers and facilitators	*To what extent do physical or resource factors facilitate or hinder x?*

independence, social competence, and adaptive behaviour		
Social influences Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours	Social pressure; social norms; group conformity; social comparisons; group norms; social support; power; intergroup conflict; alienation; group identity; modelling	*To what extent do social influences facilitate or hinder x?*

* Summarised from Michie et al. (2005)

Appendix D: Behaviour Change Wheel labels, defintions and examples

Intervention functions

Intervention function	Definition	*Example of intervention function*
Education	Increasing knowledge or understanding	*Providing information to promote healthy eating*
Persuasion	Using communication to induce positive or negative feelings or stimulate action	*Using imagery to motivate increases in physical activity*
Incentivisation	Creating an expectation of reward	*Using prize draws to induce attempts to stop smoking*
Coercion	Creating an expectation of punishment or cost	*Raising the financial cost to reduce excessive alcohol consumption*
Training	Imparting skills	*Advanced driver training to increase safe driving*
Restriction	Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviours)	*Prohibiting sales of solvents to people under 18 to reduce use for intoxication*
Environmental restructuring	Changing the physical or social context	*Providing on-screen prompts for GPs to ask about smoking behaviour*
Modelling	Providing an example for people to aspire to or imitate	*Using TV drama scenes involving safe-sex practices to increase condom use*
Enablement	Increasing means/reducing barriers to increase capability (beyond education and training) or opportunity (beyond environmental restructuring)	*Behavioural support for smoking cessation, medication for cognitive deficits, surgery to reduce obesity, prostheses to promote physical activity*

Policy category definitions

Policy Category	Definition	Example
Communication/ marketing	Using print, electronic, telephonic or broadcast media	*Conducting mass media campaigns*
Guidelines	Creating documents that recommend or mandate practice. This includes all changes to service provision	*Producing and disseminating treatment protocols*
Fiscal measures	Using the tax system to reduce or increase the financial cost	*Increasing duty or increasing anti-smuggling activities*
Regulation	Establishing rules or principles of behaviour or practice	*Establishing voluntary agreements on advertising*
Legislation	Making or changing laws	*Prohibiting sale or use*
Environmental/social planning	Designing and/or controlling the physical or social environment	*Using town planning*
Service provision	Delivering a service	*Establishing support services in workplaces, communities etc.*

Appendix E: Merged Theoretical Domain Framework x Behaviour Change Techniques matrices

COM-B component	TDF Domain	BCTs- CANE et al 2015	BCTs- MICHIE et al 2008	BCTs- MERGED
CAPABILITY (Psychological)	**Knowledge**	Information on health consequences Biofeedback Antecedents Feedback on behaviour	Information on health consequences + Information on social/ environmental consequences + Information emotional consequences + Salience of consequences	Information on health consequences Biofeedback Antecedents Feedback on behaviour Information on social/ environmental consequences Information emotional consequences Salience of consequences
	Memory, Attention, Decision Making	NONE	+ Self-monitoring of behaviour + Self-monitoring of outcome of behaviour + Action planning + Prompts and cues	Self-monitoring of behaviour Self-monitoring of outcome of behaviour Action planning Prompts and cues
	Behavioural Regulation	Self-monitoring of behaviour	+Goal setting (behaviour) + Goal setting (outcome)	Self-monitoring of behaviour Goal setting (outcome) Goal setting behaviour

			+ Behavioural contract + Action planning (including implementation intentions) + prompts/cues	Behavioural contract Action planning (including implementation intentions) Prompts/cues
CAPABILITY (Physical/ Psychological)	**Skills**	Graded tasks Behavioural rehearsal/practice Habit reversal Body changes Habit formation	Graded tasks Behavioural rehearsal/practice +goal setting (outcome) + goal setting (behaviour) +monitoring by others without feedback +self-monitoring +reward (outcome) + self-reward +Incentive +Material reward +Non-specific reward +demonstration of the behaviour (modelling) +generalisation of target behaviour	Graded tasks Behavioural rehearsal/practice Habit reversal Body changes Habit formation goal setting (outcome) goal setting (behaviour) monitoring by others without feedback self-monitoring reward (outcome) self-reward Incentive Material reward Non-specific reward demonstration of the behaviour (modelling) generalisation of target behaviour
OPPORTUNITY (social)	**Social Influences**	Social comparison Social support (unspecified) Social support (emotional) Social support (practical)	Social processes of encouragement, pressure or support +demonstration of the behaviour (modelling)	Social comparison Social support (unspecified) Social support (emotional) Social support (practical)

		Information about others' approval Vicarious consequences/ reinforcement Restructuring the social environment Identification of self as a role model Social Reward		Information about others' approval Vicarious consequences/ reinforcement Restructuring the social environment Identification of self as a role model Social Reward Demonstration of the behaviour
OPPORTUNITY (physical)	**Environmental Context and Resources**	Restructuring the physical environment Discriminative (learned) cue Prompts/ Cues Avoidance/ changing exposure to cues for the behaviour Restructuring the social environment	+Environmental changes (for example objects to facilitate behaviour) that is adding objects to the environment	Restructuring the physical environment Discriminative (learned) cue Prompts/ Cues Avoidance/ changing exposure to cues for the behaviour Restructuring the social environment Adding objects to the environment
MOTIVATION (Reflective)	**Beliefs about consequences**	Information about emotional consequences Salience of consequences Covert Sensitization Anticipated regret Information about social/ environmental consequences Pros and Cons	+Self-monitoring of behaviour +Self-monitoring of outcome of behaviour +Information on health consequences +Feedback on behaviour +Biofeedback +Feedback on outcome(s) of behaviour	Information about emotional consequences Salience of consequences Covert Sensitization Anticipated regret Information about social/ environmental consequences Pros and Cons

		Vicarious reinforcement Threat Comparative imagining of future outcomes	+Persuasive communication (Credible source) Information on social/ environmental consequences Salience of consequences Information emotional consequences	Vicarious reinforcement Threat Comparative imagining of future outcomes Self-monitoring of behaviour Self-monitoring of outcome of behaviour Information on health consequences Feedback on behaviour Biofeedback Feedback on outcome(s) of behaviour Persuasive communication (Credible source)
	Beliefs about capabilities	Verbal persuasion to boost self-efficacy Focus on past success	Motivational interviewing (that is verbal persuasion to boost self-efficacy) +Self-monitoring of behaviour +Self-monitoring of outcome of behaviour + Graded tasks + Problem solving + Goal setting (Behaviour) + Goal setting (outcome) +coping skills + behavioural practice/rehearsal +Social support (unspecified) +Social support (emotional) +Social support (practical) + feedback (behaviour)	Verbal persuasion to boost self-efficacy Focus on past success Self-monitoring of behaviour Self-monitoring of outcome of behaviour Graded tasks Problem solving Goal setting (Behaviour) Goal setting (outcome) Coping skills Behavioural practice/rehearsal Social support (unspecified) Social support (emotional) Social support (practical)

			+ feedback (outcome) +Self-talk	Feedback (behaviour) feedback (outcome) Self-talk
	Optimism	Verbal persuasion to boost self-efficacy	NONE	Verbal persuasion to boost self-efficacy
	Social professional role/ identity	NONE	+Social support (unspecified) +Social support (emotional) +Social support (practical)	Social support (unspecified) Social support (emotional) Social support (practical)
	Intentions	Commitment Behavioural contract	Commitment Behavioural contract	Commitment Behavioural contract
	Goals	Goal setting (outcome) Goal setting (behaviour) Review of outcome goal(s) Review behaviour goals Action planning (Implementation Intentions)	Goal setting (outcome) Goal setting (behaviour) + Problem solving +Social support (unspecified) +Social support (emotional) +Social support (practical) + feedback (behaviour) + feedback (outcome) +Motivational interviewing (that is verbal persuasion to boost self-efficacy) +Stress management (that is reduce negative emotions; conserving mental resources) + persuasive communication (that is verbal persuasion to boost self-efficacy) +reward (outcome) + self-reward +Incentive +Material reward +Non-specific reward	Goal setting (outcome) Goal setting (behaviour) Review of outcome goal(s) Review behaviour goals Action planning (Implementation Intentions) Problem solving Social support (unspecified) Social support (emotional) Social support (practical) Feedback (behaviour) feedback (outcome) Verbal persuasion to boost self-efficacy Reduce negative emotions Conserving mental resources Reward (outcome) Self-reward Non-specific reward
MOTIVATION	**Reinforcement**	Threat	NONE	Threat

(Automatic)		Self-reward Differential reinforcement Incentive Thinning Negative reinforcement Shaping Counter conditioning Discrimination training Material reward Non-specific reward Response cost Anticipation of future rewards or removal of punishment Punishment Extinction Classical Conditioning		Self-reward Differential reinforcement Incentive Thinning Negative reinforcement Shaping Counter conditioning Discrimination training Material reward Non-specific reward Response cost Anticipation of future rewards or removal of punishment Punishment Extinction Classical Conditioning
	Emotions	Reduce negative emotions Information about emotional consequences Self-assessment of affective consequences Social support (emotional)	Reduce negative emotions +Conserving mental resources	Reduce negative emotions Information about emotional consequences Self-assessment of affective consequences Social support (emotional) Conserving mental resources

Appendix F: Summary of included studies

Community care					
Getliffe & Newton T 2006. Catheter-associated urinary tract infection in primary and community health care. Age and Ageing, 35: 477–481 doi:10.1093/ageing/afl052doi:10.1093/ageing/afl052[20]	UK	Not specified	District nurses (101/129 total sample; 18 community hospital and 10 nursing home care staff)	Record keeping relating to catheter care and CAUTI	Self-report questionnaire
Nursing home					
Krein et al. 2017. A national collaborative approach to reduce catheter-associated urinary tract infections in nursing homes: A qualitative assessment. American Journal of Infection Control, 45: 1342-1348[21].	US	Not specified	Organizational and facility leaders	Implementing 'The Agency for Healthcare Research and Quality (AHRQ) Safety Program for Long-term Care: Health Care-Associated Infections/ Catheter-Associated Urinary Tract Infection'	Semi-structured telephone interviews
Secondary care					
Krein et al 2013. Barriers to Reducing Urinary Catheter Use A Qualitative Assessment of a Statewide Initiative. JAMA Intern Med, 173(10): 881-886. doi:10.1001/jamainternmed.2013.105 [22] **Harrod et al. 2013. Variations in risk perceptions: A qualitative study of why unnecessary urinary catheter use continues to be problematic. BMC Health Services Research, 13, 151. http://www.biomedcentral.com/1472-6963/13/151[23]**	US	Not specified	Infection control nurse (42), nurse/nurse manager (25), other, for example quality manager (2), Hospital epidemiologist or infectious diseases physician (1); prevention specialists	Implementing the 'Bladder Bundle' care package	Semi-structured interview
Alexaitis & Broome, 2014. Implementation of a nurse-driven protocol to prevent catheter-associated urinary tract infections. Journal of Nursing Care Quality, 29(3): 245-252[24]	US	Neuroscience Intensive Care Unit: Common diagnoses include aneurysms, arteriovenous malformations, central nervous system neoplasms, traumatic brain injuries, spinal cord injuries,	Patients (183), nurses (107)	Discontinuation of indwelling catheters and use of bladder ultrasonography in conjunction with intermittent catheterizations	Pre-post study: Catheter utilization, CAUTI rates, number of CAUTIs per month, LOS (length of stay, and cost associated with treating CAUTIs

		hemorrhagic and ischemic strokes, and status epilepticus.			
Andreessen et al. 2012. Preventing catheter-associated urinary tract infections in acute care: the bundle approach. Journal of Nursing Care Quality, 27(3): 209-217[25]	US	Not specified	Male in-patients with acute indwelling urinary catheters; staff of the medical centre	Implementing evidence-based guidelines and a urinary catheter bundle (Adult Catheter Bundle) focusing on optimizing the use of urinary catheters through continual assessment and prompt catheter removal.	Pre-post study: catheter device days, compliance with urinary catheter orders, and computer documentation of continued catheter indications.
Apisarnthanarak et al, 2017. National survey of practices to prevent health care-associated infections in Thailand: the role of prevention bundles. American Journal of Infection Control, 45(7): 805-810[26]	Thailand	Not specified	Survey: general personnel; interview: lead infection preventionist	Prevention practices for CAUTI, CLABSI, and VAP	Survey; interview assessing prevention practices
Bursle et al. 2015. Risk factors for urinary catheter associated bloodstream infection. Journal of Infection, 70(6): 585-591[27]	Australia	Not specified	Patients with urinary source bloodstream infection associated with an indwelling urinary catheter	Insertion of urinary catheter.	Case-control study: assessing risk factors for urinary catheter associated bloodstream infection
Carter et al. 2016. Emergency department catheter-associated urinary tract infection prevention: multisite qualitative study of perceived risks and implemented strategies. Infection Control & Hospital Epidemiology, 37(2): 156-162[28] **Carter et al. 2016. A Qualitative Study of Factors Facilitating Clinical Nurse Engagement in Emergency Department Catheter-Associated Urinary Tract Infection Prevention. The Journal of Nursing Administration, 46(10): 495-500[29]**	US	Not specified	Staff at emergency department	Implementing a CAUTI prevention program among Emergency Departments	Qualitative comparative case study
Hu et al. 2015. Inappropriate use of urinary catheters among hospitalized elderly patients: clinician awareness is key. Geriatrics & Gerontology International, 15(12): 1235-1241[30]	Taiwan	Not specified	65 years or older	Insertion of urinary catheter	Prospective study: risk factors and outcomes for inappropriate use of urinary catheters

Conner et al. 2013. Exploring factors associated with nurses' adoption of an evidence-based practice to reduce duration of catheterization. Journal of Nursing Care Quality, 28(4): 319-326[31]	US	Not specified	Nurses	Nurse driven early catheter discontinuation; assessing a patient's need for indwelling urinary catheterization beyond 48 hours	Pre-post study: factors associated with nurses' adoption of an evidence-based practice to reduce the duration of catheterization
Conway et al. 2012. Adoption of policies to prevent catheter-associated urinary tract infections in United States intensive care units. American Journal of Infection Control, 40(8): 705-710[32]	US	Not specified	IPC (infection prevention control) department managers or directors	Adherence to CAUTI prevention policies	Cross-sectional survey on presence of CAUTI prevention policies, adherence to policies, CAUTI incidence rates
Crouzet et al. 2007. Control of the duration of urinary catheterization: impact on catheter-associated urinary tract infection. Journal of Hospital Infection, 67(3): 253-257[33]	France	Not specified	Five hospital departments (not specified further)	Reducing the duration of the catheterisation	Non-random intervention study: duration of catheterisation, late CAUTI frequency
Dugyon-Escalante et al. 2015. The Impact of Multidisciplinary Team Approach to Combat Catheter Associated Urinary Tract Infection in a Large Government Hospital. American Journal of Infection Control, 43(6): S45-S46[34]	US	Not specified	Patients in intensive care units	Managing catheter use by multidisciplinary teams	Number of CAUTI cases and infection rates: pre-post
Fakih et al. 2008. Effect of nurse-led multidisciplinary rounds on reducing the unnecessary use of urinary catheterization in hospitalized patients. Infection Control & Hospital Epidemiology, 29(9): 815-819[35]	US	Not specified	Patients in medical-surgical units	Unnecessary use of urinary catheters	Quasi-experimental study with a control group: reduction in the rate of UC utilization

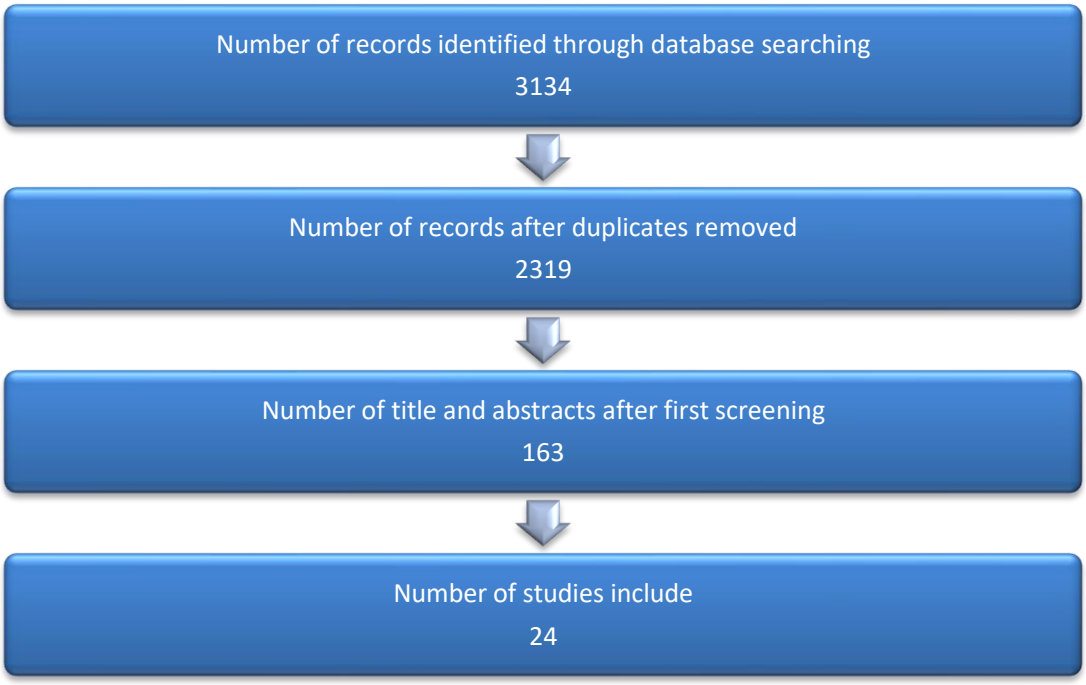
Fakih M et al. Implementing a national program to reduce catheter-associated urinary tract infection: A quality improvement collaboration of state hospital associations, academic medical centers, professional societies, and governmental agencies. Infection Control & Hospital Epidemiology, 2013, 34: 1048-1054[36]	US	Not specified	Nurse and physician champions. Nurses caring for the patients. Other healthcare workers (for example, infection preventionist, quality manager, safety officer, utilization manager)	Urinary catheter use and appropriateness of the indication for use (accountability at the unit level).	Symptomatic National Healthcare Safety Network (NHSN) CAUTI rate and population-based CAUTI rate. AHRQ's Hospital Survey on Patient Safety Culture administered both at baseline and 15 months later to evaluate changes in patient safety culture over time. Readiness assessment per unit at the beginning of the project and team check-up tool quarterly to report on progress with the implementation of CUSP principles and barriers
Gupta et al. 2017. Successful strategy to decrease indwelling catheter utilization rates in an academic medical intensive care unit. American Journal of Infection Control, 45: 1349-1355[37]	US	Not specified (ICU patients)	MICU medical director, MICU fellows, nurse managers, and an infection control nurse	1. Restricting IUC use to a limited list of predetermined indications. 2. Physicians and nurses were required to discontinue urinary catheters in all patients on admission unless warranted. 3. Narrowing down the criteria for urinary catheter utilization to urinary retention and genitourinary procedures only. 4. Use of sonographic bladder scanning to identify high-risk patients who may need indwelling catheters in the near future	IUC utilization ratio (number of urinary catheter days/patient days) and catheter-associated urinary tract infection (CAUTI) rates (number of CAUTI infections in a particular location or number of urinary catheter days in a particular location x 1,000)
Mann et al. 2013. Catheter-associated urinary tract infection (CAUTI): A significant case for concern. American Journal of Infection Control, 41: S124[38]	Canada	Not specified (intensive care units and rehabilitation unit)	Intensive care and rehabilitation unit nurses	Compliance with CAUTI prevention measures (Foley maintenance)	Compliance with the following evidence-based practices: catheter securement, tamper evident seal (TES) intact, absence of dependent loop, catheter below bladder level, drainage bag not touching floor, and drainage bag not overfilled

Murphy et al. 2015. "It's easier to stick a tube in": A qualitative study to understand clinicians' individual decisions to place urinary catheters in acute medical care. BMJ Quality & Safety Online First, doi:10.1136/bmjqs-2015-004114[39]	UK	Not specified (ED, medical assessment unit, cardiology wards, and older people's acute medicine wards)	8 nurses and 22 physicians in retrospective think aloud - RTA interviews. 20 of these (not specified how many nurses/physicians) also took part in a semi-structured interview	Decision making regarding IUC placement	30 RTA interviews and 20 semi-structured interviews
Patrizzi et al. 2009. A collaborative, nurse-driven initiative to reduce hospital-acquired urinary tract infections. Journal of Emergency Nursing, 2009, 35: 536-539[40]	US	Not specified (ED and inpatient units)	ED nurses	Implementing a nurse-driven protocol to reduce CAUTI: Emergency department behaviours: 1. Removing direct access to catheters by placing them centrally in a supply closet instead of in each bedside supply cart. 2. Only storing 14F catheters (and no larger ones) in the supply closet as risk of infection increases with size. 3. Adding intermittent urinary catheterization kits to the supply closet as an alternative. 4. Education (for example, The PPMC 'UTI Bundle' mandatory education day). 5. Availability of a bladder scanner. 6. New order set for indwelling urinary catheterization that lists 5 different indications to justify catheter placement (following hospital policy) instead of the previous 'Foley catheter insertion' order. 7. Collaboratively discussion between physician and nurse if the latter feels the insertion does not meet the established criteria. Inpatient unit behaviours: 1. Monitoring sheet placed on each patient's medical record. 2. Daily assessment of a. necessity and b. standards for managing the catheter are being kept (for example, bag below level of bladder)	Percentage of patients admitted from ER with indwelling urinary catheters
Smith L et al. 2015. Decreasing the rate of catheter-associated urinary tract infections through a nurse-driven intervention. Proceedings of the American Burn Association 47th Annual Meeting, https://academic.oup.com/jbcr/article-abstract/36/suppl_1/S66/4569202[41]	US	Not specified	Burn ICU nurses	Insertion, maintenance, and removal of urinary catheters.	CAUTI rates and catheter utilization rates

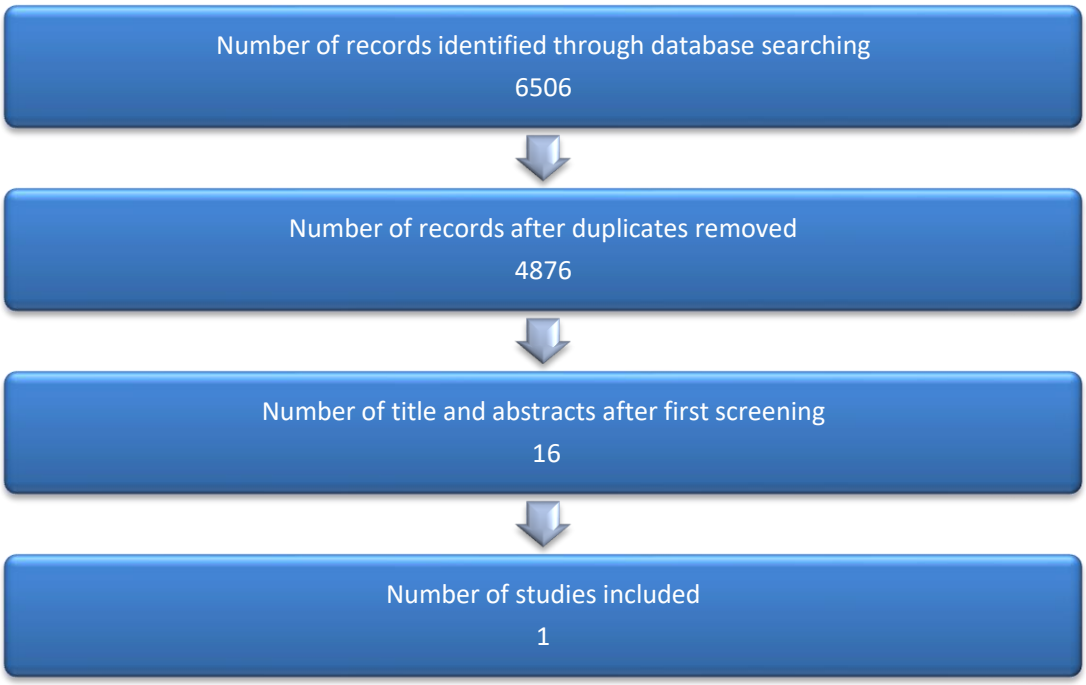
Tertiary care					
Fakih M et al. 2010. Effect of establishing guidelines on appropriate urinary catheter placement. Academic Emergency Medicine, 17: 337-340[42]	US	Not specified	EPs and resident staff in ED	Adherence to guidelines for urinary catheter placement	Data on urinary catheter presence on emergency department arrival, placement of a urinary catheter in the emergency department, documentation of a physician order for urinary catheter placement, reasons for placement, and compliance with the indications were collected retrospectively reviewing the emergency department records
Trautner et al. 2014. Overtreatment of asymptomatic bacteriuria: Identifying provider barriers to evidence-based care. American Journal of Infection Control, 42: 653-8. http://dx.doi.org/10.1016/j.ajic.2014.02.003[43]	US	Not specified	169 physicians	Management of catheter-associated urine cultures	Self-report questionnaire
Kolonoski et al. 2012. An interdisciplinary approach toward reducing the incidence of catheter-associated urinary tract infections in a post-acute facility. American Journal of Infection Control, 40: e54-e55[44]	US	Not specified (post-acute units patients)	Physicians and nurses	Implementation of quality improvement programme to reduce CAUTI	Interview and point prevalence survey of Foley catheter use

Appendix G: Flow of information through the systematic review

Secondary care and nursing homes



Primary and community care



Number of additional records identified through Steering Group to be added.

Appendix H: All reported barriers and facilitators within each domain** of the Theoretical Domains Framework identified across all care settings (primary/community care, secondary care, tertiary care, care homes), nested according to COM-B components

COM-B component	Theme	Behavioural phase*	Care settings	Frequency (n= 24 studies max)	Barrier/ Facilitator/ Mixed	Example quote(s) [Setting; Study ID]
CAPABILITY (Psychological)	**TDF Domain: KNOWLEDGE**					
	Lack of knowledge of clinical guidelines and local procedural documents	All	Secondary, Tertiary	3	Barrier	'Nurses lack of knowledge of evidence based guidelines for: routine catheter maintenance; urinary catheter indications; bladder scanning; and intermittent catheterization.' [Secondary Care; S2] '40% of the Burn ICU nursing staff was not aware of the nurse driven catheter removal protocol that exists within our hospital.' [Secondary Care; S19]
	Lack of information regarding placement and duration of catheter insertion	Insertion, Post-insertion maintenance	Secondary, Tertiary	2	Barrier	'Physicians are often unaware that urinary catheterization has been excessively prolonged in their patients' [Secondary Care; S11] 'physicians were often not aware that patients had an indwelling catheter' [Tertiary Care; T1]
	Lack of awareness of the risks associated with use of urinary catheters	All	Secondary	2	Barrier	'Several participants stated that they were unaware of the risks associated with catheter duration [Secondary care; S9]
	Lack of awareness of the link between UTIs and the use of urinary catheters	All	Secondary	1	Barrier	"… so it's just making them [nurses] understand that there is a relationship between bladder infections and urinary tract infections and [urinary] catheter days…" [Secondary Care; S1]

CAPABILITY (Psychological)	Lack of standardised CAUTI education	All	Secondary	1	Barrier	'Lack of standardized CAUTI education' [Secondary Care; S12]
	Lack of knowledge of how to manage patients without catheterisation	Pre-insertion	Secondary	1	Barrier	'Not knowing how to manage critically ill patients in ICU without using indwelling urinary catheter.' [Secondary Care; S15]
	Knowledge of how to manage bacterial infections resulting from urinary catheterisation	Post-insertion maintenance	Tertiary	1	Facilitator	'Knowledge of how to manage catheter-associated bacteriuria: "The mean knowledge score was 57.5%, or slightly more than one-half of the questions answered correctly. The mean knowledge score was 57.5%, or slightly more than one-half of the questions answered correctly."' [Tertiary Care; T3]
	Awareness of different types of urinary catheters available	Pre-insertion	Secondary, Primary/ Community	1	Barrier	'20% of respondents did not realise re-usable catheters were used at all in the UK, or that re0use was more common in some countries.' [Secondary Care; Community Care; SC20]
	Not attributing urinary infections to catheterisation due to the delay between infection onset and catheterisation	Post-insertion	Secondary	1	Barrier	'We even track UTI associated with a [urinary] catheter post hospital… We're trying to get some [infections] to show people, "See? There it is, a UTI occurring. It just didn't happen quick enough for you to see it in the hospital.' [Secondary Care; SC1]
	TDF Domain: MEMORY, ATTENTION, DECISION MAKING					
	Pre-empting subsequent urinary catheterisation	Insertion	Secondary	3	Barrier	'Also I think at the back of my mind is the likelihood is that they're going to get catheterised in the near future any way when they hit the wards for a management reason' [Secondary Care; S17]
	Providing metrics increases day-to-day awareness of CAUTI	All	Secondary	1	Facilitator	'Nurse leaders made it a priority to actively share ED CAUTI metrics with clinical nurses, with 1 nurse manager reasoning, " If it's not brought to the forefront, people tend to forget about it" "Shift huddles every day they [staff] were hearing the information we did dashboards and graphs and things like that keep it in front of them and let them see the target going down that worked really well' [Secondary Care; S7]

	Catheterisation decisions based on non-medical criteria	Pre-insertion	Secondary	1	Barrier	'Nonmedical criteria often determined urinary catheter placement decisions, with catheters being used to manage patients with incontinence' [Secondary Care; S6]
	Reminders and prompts	Removal	Secondary	1	Facilitator	'Hospital epidemiologist in post was significantly and positively associated with: i) Urinary catheter reminder or stop-order/nurse initiated catheter discontinuation' [Secondary Care; S4]
	Patient symptoms prompt investigation and treatment of possible CAUTI	Post-insertion maintenance	Tertiary	1	Facilitator	'I usually order a urine culture on catheterized patients when there is a change in urine colour, cloudiness, or odour.' [Tertiary care; T3]
	Cognitive biases: Patient age	Pre-insertion	Tertiary	1	Barrier	'I am more likely to treat catheter-associated asymptomatic bacteriuria in older patients than in younger patients' [Tertiary Care; T3]
	Variation in urinary catheterisation decision making across wards	Pre-insertion	Secondary	1	Barrier	'Compared with the wards, clinicians in the ED (and to a lesser extent, the medical assessment unit) were more likely to make the decision to place an IUC at a lower threshold' (S17)
	Absence of standardised CAUTI diagnostic criteria to help decision-making	Post-insertion maintenance	Primary/ Community	1	Barrier	lack of clear, standardised criteria used to define CAUTI, to distinguish between symptomatic and asymptomatic CAUTI and to report outcomes' [Primary Care; p1]
	TDF Domain: BEHAVIOURAL REGULATION					
	Audit and feedback on CAUTI metrics	All	Secondary	2	Facilitator	'One hospital even made it a point to collect urinary tract infection (UTI) data on patients 7 days post discharge to use as evidence for their staff that urinary catheters (and hence their actions related to the use of urinary catheters) do cause infections' [Secondary Care; S1]
	Inconsistent monitoring of compliance with guidelines	All	Secondary	1	Barrier	'Inconsistent monitoring of compliance with evidence based guidelines.' [Secondary Care; S2]
CAPABILITY (PHYSICAL)	**TDF Domain: SKILLS**					
	Poor urinary catheter insertion technique	Insertion	Secondary	2	Barrier	'Urinary catheters were being inserted by nursing staff that did not demonstrate proper insertion technique

						and by medical students and residents who were untrained in catheter placement' [Secondary Care; S6]
OPPORTUNITY (PHYSICAL)	**TDF Domain: ENVIRONMENTAL CONTEXT AND RESOURCES**					
	Limited and inconsistent documentation and records	All	Secondary, Primary/ Community,	6	Barrier	'Lack of medical documentation for use of urinary catheters was significantly associated with inappropriate catheter use' [Secondary Care; S8] The level of detail recorded was variable both within and between service groups. Of the patients with a CAUTI, the date diagnosed, method of diagnosis (for example urine culture) and antibiotic treatment given were recorded in over 85% of cases, although the causative organism was reported in <40%. However, it was rarely possible to confirm whether the CAUTI was symptomatic or asymptomatic. [Primary Care; P1]
	Transitions of care	All	Secondary, Tertiary, Care homes	5	Barrier	'Transferences to ward from intensive care unit accounted for 6% of inappropriate catheterisations' [Secondary Care; S13] 'Staff turnover barrier to implementation of CAUTI reduction program' [Care homes; C1]
OPPORTUNITY (PHYSICAL)	Lack of time to perform alternatives to urinary catheterisation	Pre-insertion	Secondary, Care homes	3	Barrier	'Being too busy to be able to assist a patient to the bathroom' [Secondary Care; S1]
	Lack of staff	All	Secondary, Care homes	2	Barrier	'Facilities insufficiently staffed to implement the program' [Care Homes, C1]
	Unavailability of medical alternatives to urinary catheterisation	Pre-insertion	Secondary	2	Barrier	'Lack of medical alternatives, (for example, a bladder scanner that could help determine the need for a catheter) that may be contributing to these decisions' [Secondary Care; S1]
	Cost of alternatives to urinary catheterisation	Pre-insertion	Secondary	2	Barrier	'Expense incurred by use of diapers' [Secondary Care; S15]
	Choice and availability of urinary catheters	Pre-insertion	Secondary, Primary/ community	2	Mixed	'Supply of urinary catheters being available in bedside supply carts added convenience and may have

						influenced their decision to insert one' [Secondary Care; S18] 'In acute care catheter availability was often limited to samples supplied by company representatives or the limited supply held in hospital pharmacies. In the community availability could be limited by a formulary. Of the prescribing nurses, 54% had unlimited choice of catheters, while 43% were restricted in their choice.' [Secondary care; Community Care; SC20]
	Lack of resources (general)	All	Secondary	1	Barrier	'Healthcare workers complain of limited resources to help them "do the right thing' [Secondary Care; S14]
OPPORTUNITY (SOCIAL)	**TDF Domain: SOCIAL INFLUENCES**					
	Requests from patients and their carers	Pre-insertion	Secondary, Tertiary	5	Barrier	'Pressure of requests by the patient or the family for catheters: "The family says, 'Well my mom really needs it in. . . . Mom can't get up, mom can't walk, she's incontinent [of urine]' [Secondary Care; S1]
	Lack of peer support and buy-in	All	Secondary, Care homes	4	Barrier	'Facility leads new to their positions often found it hard to gain buy-in, mainly due to a lack of relationship with the staff' [Care Homes; C1] 'As a charge nurse explained: "If you don't have the doctors on board you're just going to be beating your head against the wall. ' [Secondary Care; S1]
	Physicians dictate nurses' practice	All	Secondary, Tertiary	3	Barrier	'My supervising physician generally prefers to treat positive urine cultures in catheterized patients.' [Tertiary Care; T3] [Nurse:]'…You can keep asking, 'Can I pull theFoley?' and they'll [physicians] just say, 'leave it in.' [Secondary Care; S1]
	Cultural norms regarding standard catheterisation practice	Pre-insertion, Insertion	Secondary, Tertiary	3	Barrier	'The biggest challenge was changing the culture of practice of inserting indwelling urinary catheter in all ICU patients' [Secondary Care; S15]

OPPORTUNITY (SOCIAL)	for specific patient groups					
	Local champions	All	Secondary, Tertiary	2	Facilitator	'Presence of an emergency physician champion to establish indications for urinary catheter placement resulted in fewer orders for catheters' [Tertiary Care; T1]
	Challenging unnecessary urinary catheterisation requests	Pre-insertion	Secondary	1	Facilitator	'Empowering clinical nurses to speak up to physicians if they believed a patient was unnecessarily ordered for a urinary catheter.'[Secondary Care; S7]
	TDF Domain: SOCIAL PROFESSIONAL ROLE AND IDENTITY					
	Having a Hospital Epidemiologist in post	Removal	Secondary	2	Facilitator	'Hospital epidemiologist in post was significantly and positively associated with: i) Urinary catheter reminder or stop-order/nurse initiated catheter discontinuation' [Secondary Care; S4]
	Acceptance of responsibility for urinary catheterisation decision making	Pre-insertion	Secondary, Tertiary	2	Barrier	'Nurses felt that the decision to maintain an indwelling catheter was up to the physician, and did not consider it within their scope of practice.' [Tertiary Care; T2]
	CAUTI guidelines not perceived as relevant across Hospital departments	All	Secondary	1	Barrier	'I looked at the criteria set forward indications for [urinary] catheter use. I think my gut reaction was that perhaps some of those were not as applicable in the Emergeny Department setting… that maybe they were more devised for the inpatient setting.' [Secondary Care; S1]
	Nurses leading change in urinary catheterisation practice	All	Secondary	1	Facilitator	'We're] really changing it [practice] from the bottom up, which I think is a great idea. We're the ones doing the work so we're the ones that make that change' [Secondary Care; S7]
MOTIVATION (REFLECTIVE)	**TDF Domain: BELIEFS ABOUT CONSEQUENCES**					
	Convenience and ease of monitoring	All	Secondary	5	Mixed	'Catheters inserted for convenience purposes, for example, to accurately measure a patient's urine output or to avoid frequent transfers to a bedpan or a bedside commode' [Secondary Care; S18]

MOTIVATION (REFLECTIVE)						'Perception that urinary catheters are a potential source of harm not convenient and benign' [Secondary Care; S7]
	Perceived severity of CAUTI	All	Secondary	2	Mixed	'Perception by nursing staff of urinary catheters and urinary tract infections as benign was quite common' [Secondary care; S1] 'Perception that urinary catheters are a potential source of harm not convenient and benign' [Secondary care' S7]
	Lack of perceived benefits to interventions targeting CAUTI	All	Tertiary, Care homes	2	Barrier	'physicians did not realize the value or benefits of supporting program implementation' [Care Homes; C1]
	Patient safety and injury	All	Secondary	1	Mixed	'Patients keep forgetting that the Foley is there and they keep feeling like they have to urinate. The catheter will get pulled out by the patient or they are going to try and get out of bed and injure themselves…We have taken them [Foleys] out for patient safety.' [Secondary Care; S1] 'Well, do I really want this person hopping out of bed [to go to the bathroom] and can I really be sure that they're going to call me to help them? We don't want there to be any falls.' [Secondary Care; S1]
	Improved patient hygiene	Pre-insertion	Secondary	1	Facilitator	'you don't want them lying in their own urine…It's not a great for someone who's wet with potential pressure areas and lying in their own wee (ED consultant physician).' [Secondary Care; S17]
	Avoiding damage to medical equipment	Pre-insertion	Secondary	1	Facilitator	'If you're transferring someone that's critically ill to CT, I would be more likely to catheterise someone than not simply because you've got a patient who is potentially going to wet themselves in the CT scanner and that's going to cause problems for the CT scanners' [Secondary Care; S17]

	Adhering to guidelines improve patient care	All	Tertiary	1	Facilitator	'My clinical colleagues believe that following clinical practice guidelines improves patient care' [Tertiary Care; T3]
	Certain types of infections are more harmful than others in catheterised patients	Post-insertion maintenance	Tertiary	1	Facilitator	'Gram-negative organisms in the urine of a catheterized patient are more harmful than gram-positive organisms.' [Tertiary Care; T3]
	Pros and cons of reusable catheters	Pre-insertion, Insertion	Secondary, Primary/ Community	1	Mixed	'Major concerns included the perceived increased risk of urinary tract infection and increased patient burden. Potential advantages included increased patient choice, cost savings and reducing the fear/likelihood of running out of catheters' [Secondary Care; Community care; SC20]
	TDF Domains: BELIEFS ABOUT CAPABILITIES					
	Nurse empowerment	All	Secondary	1	Facilitator	'Empowering nurses to identify and address CAUTI improvement opportunities: [We"re] really changing it [practice] from the bottom up, which I think is a great idea. We"re the ones doing the work so we"re the ones that make that change.' [Secondary Care; S7]
MOTIVATION (REFLECTIVE)	Confidence in investigating and managing CAUTI	Post-insertion maintenance	Tertiary	1	Facilitator	'I feel confident in knowing when to order a urine culture on catheterised patients, …how to manage bacteriuria in catheterised patients…and that I can apply asymptomatic bacteriuria guidelines to my patients.' [Tertiary Care; T3]
	TDF Domain: GOALS					
	CAUTI is not a priority	All	Secondary	2	Barrier	'… it's difficult to find people that are excited about getting Foleys out of patients; other things take higher priority like central lines and VAP' [Secondary Care; S1]

*Behavioural phases from Conceptual Map: pre-insertion, insertion, post-insertion maintenance, removal

** Note: No barrier/facilitator themes were identified within the TDF domains: Reinforcement, Intentions, Optimism, Emotions

Appendix I: Nationally implemented interventions to reduce CAUTI in the UK

Intervention Name	Intervention content*	Setting
NICE QS90: Urinary Tract Infections in Adults	Quality statement 2: Diagnosing urinary tract infections in adults with catheters Quality statement: Healthcare professionals do not use dipstick testing to diagnose urinary tract infections in adults with urinary catheters. Rationale: Dipstick testing is not an effective method for detecting urinary tract infections in catheterised adults. This is because there is no relationship between the level of pyuria and infection in people with indwelling catheters (the presence of the catheter invariably induces pyuria without the presence of infection). To ensure that urinary tract infections are diagnosed accurately and to avoid false positive results, dipstick testing should not be used. Quality statement 5: Antibiotic treatment for asymptomatic adults with catheters and non-pregnant women Quality statement: Healthcare professionals do not prescribe antibiotics to treat asymptomatic bacteriuria in adults with catheters and non-pregnant women. Rationale: Antibiotics are not effective for treating asymptomatic bacteriuria in adults with catheters or non-pregnant women. Unnecessary treatment with antibiotics can also increase the resistance of bacteria that cause urinary tract infections, making antibiotics less effective for future use. Quality statement 6: Antibiotic prophylaxis to prevent catheter-related urinary tract infection Quality statement: Healthcare professionals do not prescribe antibiotic prophylaxis to adults with long-term indwelling catheters to prevent urinary tract infection unless there is a history of recurrent or severe urinary tract infection. Rationale: Evidence shows that antibiotic prophylaxis is not effective in preventing symptomatic urinary tract infection in adults with long-term indwelling catheters unless there is a history of recurrent or severe urinary tract infection.	Community
NICE QS61: Infection prevention and control	Quality statement 4: Urinary catheters Quality statement: People who need a urinary catheter have their risk of infection minimised by the completion of specified procedures necessary for the safe insertion and maintenance of the catheter and its removal as soon as it is no longer needed. Rationale: Catheter-associated urinary tract infections comprise a large proportion of healthcare-associated infections, and can occur whether a person has either a short-term or a long-term catheter. There is a strong association between duration of urinary catheterisation and risk of infection, and catheters are sometimes inserted inappropriately or there is a delay in removing them. This risk is greatly reduced by complying with all parts of the process for safe catheter insertion, maintenance and removal as soon as it is no longer needed. This is important in terms of both infection prevention and patient comfort and experience.	Primary, Community, Secondary
The Health and Social Care Act 2008 Code of Practice on the prevention and control of infections	Criterion 9: Have and adhere to policies, designed for the individual's care and provider organisations that will help to prevent and control infections. a. Standard infection prevention and control precautions All staff should have training on hand hygiene and when and how personal protective equipment should be used. Policies should also be in place for the safe handling and disposal of sharps and the safe disposal of waste. 6.3 Where staff undertake procedures, which require skills such as aseptic technique, staff must be trained and demonstrate proficiency before being allowed to undertake these procedures independently	Primary, Community, Secondary

Intervention Name	Intervention content*	Setting
and related guidance	s. Use and care of invasive devices Policy should be based on evidence-based guidelines and should be easily accessible by all relevant care workers. Compliance with policy should be audited. Information on policy should be included in infection prevention and control training programmes for all relevant staff groups.	
Department of Health and Public Health England (2013) Prevention and control of infections in care homes: an informative resource	Use and care of invasive devices Invasive devices such as a urinary catheter or intravenous line will increase a resident's risk of acquiring an infection and the care home should have a policy in place for the care of invasive devices, the policy should be audited on a planned basis. Where residents have an invasive device in place, this should be fully documented in the care plan and the resident should be monitored for signs of infection. Staff should be trained in the care of residents with invasive devices and in how to recognise signs and symptoms of infection. Urinary catheter care: Residents with a urinary catheter in place are at an increased risk of acquiring an infection. Bacteria can enter the urethra at the point where the catheter enters the body. The date of catheter insertion and the indication for catheterisation should be recorded in the resident's notes. The resident's clinical need for catheterisation should be reviewed regularly by the GP or district nurse and the urinary catheter removed as soon as possible. The following advice will minimise the risk of the resident acquiring an infection. Handling the catheter • Hands should be washed and a clean pair of non-sterile gloves should be put on before handling the catheter or drainage bag. Hands should be cleaned again after removing gloves. • The point at which the catheter enters the body should be cleaned daily with soap and water. Managing the drainage system • The drainage bag or catheter valve should be connected to the catheter at all times, except when changing the bag. This 'closed system' reduces the risk of infection. • At night, the special night drainage bag should be added without breaking the closed system. • The drainage bag should be kept lower than the bladder to allow urine to drain. • The bag should not be allowed to touch the floor because this can increase the infection risk. Catheter bag stands should be used. • The drainage bag should be emptied regularly to maintain the flow of urine.	Nursing Homes
Safety thermometer	The tool is built around 4 steps: Step 1: Setting an improvement goal Step 2: Ongoing monitoring Step 3: Identifying and reviewing special cause Step 4: Working out the CQUIN payment	Primary, Community, Secondary, Nursing homes
Epic 3	Assessing the need for catheterisation UC1 Only use a short-term indwelling urethral catheter in patients for whom it is clinically indicated, following assessment of alternative methods and discussion with the patient. UC2 Document the clinical indication(s) for catheterisation, date of insertion, expected duration, type of catheter and drainage system, and planned date of removal.	Secondary

Intervention Name	Intervention content*	Setting
	UC3 Assess and record the reasons for catheterisation every day. Remove the catheter when no longer clinically indicated. Selection of catheter type UC4 Assess patient's needs prior to catheterisation in terms of: • latex allergy • length of catheter (standard, female, paediatric) • type of sterile drainage bag and sampling port (urometer, 2-L bag, leg bag) or catheter valve • comfort and dignity. UC5 Select a catheter that minimises urethral trauma, irritation and patient discomfort, and is appropriate for the anticipated duration of catheterisation. UC6 Select the smallest gauge catheter that will allow urinary outflow and use a 10-mL retention balloon in adults (follow manufacturer's instructions for paediatric catheters). Urological patients may require larger gauge sizes and balloons. Catheter insertion UC7 Catheterisation is an aseptic procedure and should only be undertaken by healthcare workers trained and competent in this procedure. UC8 Clean the urethral meatus with sterile, normal saline prior to the insertion of the catheter. UC9 Use lubricant from a sterile single use container to minimise urethral discomfort, trauma and the risk of infection. Ensure the catheter is secured comfortably. Catheter maintenance UC10 Connect a short-term indwelling urethral catheter to a sterile closed urinary drainage system with a sampling port. UC11 Do not break the connection between the catheter and the urinary drainage system unless clinically indicated. UC12 Change short-term indwelling urethral catheters and/or drainage bags when clinically indicated and in line with the manufacturer's recommendations. UC13 Decontaminate hands and wear a new pair of clean non-sterile gloves before manipulating each patient's catheter. Decontaminate hands immediately following the removal of gloves. UC14 Use the sampling port and the aseptic technique to obtain a catheter sample of urine. UC15 Position the urinary drainage bag below the level of the bladder on a stand that prevents contact with the floor. UC16 Do not allow the urinary drainage bag to fill beyond three-quarters full. UC17 Use a separate, clean container for each patient and avoid contact between the urinary drainage tap and the container when emptying the drainage bag. UC18 Do not add antiseptic or antimicrobial solutions to urinary drainage bags. UC19 Routine daily personal hygiene is all that is required for meatal cleansing. Education of patients, relatives and healthcare workers	

Intervention Name	Intervention content*	Setting
	UC20 Do not use bladder maintenance solutions to prevent catheter-associated urinary tract infection. UC21 Healthcare workers should be trained and competent in the appropriate use, selection, insertion, maintenance and removal of short-term indwelling urethral catheters. UC22 Ensure patients, relatives and carers are given information regarding the reason for the catheter and the plan for review and removal. If discharged with a catheter, the patient should be given written information and shown how to: • manage the catheter and drainage system • minimise the risk of urinary tract infection • obtain additional supplies suitable for individual needs. System interventions for reducing the risk of infection UC23 Use quality improvement systems to support the appropriate use and management of short-term urethral catheters and ensure their timely removal. These may include: • protocols for catheter insertion • use of bladder ultrasound scanners to assess and manage urinary retention • reminders to review the continuing use or prompt the removal of catheters • audit and feedback of compliance with practice guidelines • continuing professional education. UC24 No patient should be discharged or transferred with a short-term indwelling urethral catheter without a plan documenting the: • reason for the catheter • clinical indications for continuing catheterisation • date for removal or review by an appropriate clinician overseeing their care.	
High Impact Intervention for best practice insertion and care	Using the high impact interventions tool 1. Each time a care element is performed, insert a [tick] in the relevant column. If the action is not performed leave it blank. 2. Ensure you only [tick] it when an element of care is performed correctly or if the element is not applicable. 3. Calculate the totals and compliance levels by totalling the columns and using the tools provided. 4. Your goal is to perform every element of care every time it is needed. The ""All elements performed"" column should be ü when every care element is given correctly. This should total to 100% compliance when all care elements have been given correctly on every occasion. 5. Where elements have not been performed overall compliance will be less than 100%. This provides immediate feedback for users of the tool on those elements missed, and actions can then be taken to improve on compliance levels. 6. The percentage compliance figures for individual care elements show you where you need to focus effort to improve overall compliance. 7. The number of times when all elements are performed should be the same as the number of observations you perform. For example if you monitor the care process 10 times, then there should be 10 occasions when all elements were performed.	Secondary, Community

Intervention Name	Intervention content*	Setting
	High Impact Interventions to prevent catheter associated urinary tract infection Aim To reduce the incidence and consequences of urinary tract infection associated with both short and long term urethral catheters. Why use the high impact intervention? Catheter associated urinary tract infections comprise a large proportion of healthcare associated infections and occur whether a person has either a short term catheter or long term catheter. There is a strong association between duration of urinary catheterisation and risk of infection and these are becoming more serious with the continued development of a wide range of multi-resistant bacteria which can cause catheter associated urinary tract infections and associated life threatening complications (RCN 2012). Risks are greatly reduced complying with all parts of the process for safe catheterisation, maintenance, and removal as soon as no longer needed. This is important in both terms of promoting comfort, safety and infection prevention control measures. (NICE guidelines 2014). Elements of the care process There are 2 sets of actions outlined below as good practice. a. Insertion phase b. Routine maintenance and assessment for continuing indication phase Insertion phase 1. Assessment for catheter indication Assessment of the need of the catheter is to be documented ensuring a clear clinical indication which includes exploring alternative options. 2. Aseptic procedure Catheterisation should follow an aseptic procedure including hand hygiene and is documented. 3. Urethral meatus The meatus should be cleaned with normal saline prior to insertion. Use a lubricant gel from a sterile single use sachet/syringe to minimise urethral trauma. 4. Catheter insertion documentation Document as a minimum the following: • date of insertion, • indication for catheterisation • catheter size • type of catheter and planned date for removal. Routine maintenance and assessment for continuing indication phase 1. Hand hygiene Hands are decontaminated immediately before and after each episode of patient contact using the correct hand hygiene technique.	

Intervention Name	Intervention content*	Setting
	2. Personal protective equipment Wear personal protective equipment only when indicated and in accordance with local policy. 3. Assessment Daily assessment of the need of the short term urinary catheter needs to be clearly documented. Long term catheters should be reviewed regularly, at least every catheter change and documented. 4. Catheter hygiene Routine daily personal hygiene is required for meatal cleaning. 5. Routine maintenance • Do not break the connection between the catheter and the urinary drainage system unless clinically indicated. Use a separate clean/disposable container when emptying the drainage bag. • Document on the drainage bag when last changed and should be changed in line with the manufacturer's recommendation. The urinary catheter tubing and leg bag should be fixed to the patient's leg using a leg strap. 6. Patient information Ensure patients and carers are given information regarding the reason for the catheter and the plan for review and removal for example indwelling urinary catheter passport.	
Catheter Care: Royal College of Nursing Guidance for nurses	You need to apply: • legislation, policy and good practice, the current international, European, UK and national legislation, guidelines and local policies, protocols and procedures which affect your work practice in relation to the care of individuals using urinary catheters • a factual knowledge of the current European and national legislation, national guidelines, organisational policies and protocols in accordance with clinical/corporate governance which affect your work practice in relation to the care of individuals using urinary catheters (not sure if this is sufficient to code as education). Practice recommendations The suggested structure for gaining competence in catheterisation is as follows: • gain a theoretical knowledge and understanding in aspects of catheterisation • observe model/manikin being catheterised • practise catheterisation on a model/manikin under supervision until confident • observe catheterisation performed by others on actual patients • undertake supervised catheterisation on actual patients [does not meet definition of behavioural practice/rehearsal] • be able to catheterise without direct supervision	Primary, Community, Secondary, Nursing homes

Intervention Name	Intervention content*	Setting
	• gain experience and become confident • become a competent mentor for others • have catheterisation technique observed as part of clinical audit (Saving lives). In all care settings nurses should have observed clinical practice for the following procedures: assessing individual patients to ensure catheterisation is still required • obtaining a CSU • changing urinary drainage systems • emptying a urine bag or catheter valve • catheter insertion • catheter removal • meatal cleansing • bag position and support. • In relation to all aspects of catheter care it is recommended that nurses have a formal update at least every 5 years, and more often if appropriate or required. Documentation What you need to do: • you need to record clearly, accurately, and correctly any relevant information in the ongoing catheter care records. You also need to be aware of the importance of documentation, the data protection act, care of patient records and disclosure of information with consent from the patient and your employer and the legal and professional consequences of poor practice. Some general principles relating to documentation apply. These include confidentiality, legibility and that documents can be photocopied. Documentation has a number of purposes, and these include: • contributing to and establishing a diagnosis • influencing a care bundle and pathway of catheter care for an individual patient • a legal record of care bundle provision and what actually happened	

Intervention Name	Intervention content*	Setting
	• effective communication for other health care professionals involved in a patient's care • a point of reference used to influence decisions for further interventions • facilitating product tracing, if for any reason an individual patient experiences product failure • a record for the investigation of complaints and/or litigation • facilitating critical reflective thinking • focus for clinical professional supervision and identification of learning needs • completing an episode of care, end of a procedure or care bundle (group of procedures, tasks or activities forming a bundle of care). In the development of documentation related to catheter care, ensure the documentation is designed to be audit friendly and understood by the patient. Regard must be given to the documentation of consent, whether this is written or verbally given. Catheter insertion documentation should include: • the reason for the catheterisation, catheter change or ongoing need for a catheter with all its risks • well/unwell/serious health status of the patient prior to catheterisation • is the patient febrile, temperature (over 39°C, are blood cultures needed)? • if taking antibiotics for a urinary tract infection, are they effective? • is the individual patient in any form of localised discomfort or pain? • initially it may be necessary to record fluid intake balanced against urinary output and in some cases this may be ongoing (for example renal function and or failure) • the results of a risk assessment prior to catheterisation • allergy status (for example latex, gels and medication) • consent obtained for the procedure; some organisations now require this to be in written form • if antibiotic cover was used, state drug and dosage (see infection control and catheter care section on page 43) • meatal or genital abnormalities observed, including discharge	

Intervention Name	Intervention content*	Setting
	• if the insertion was easy or difficult • indications used to ensure catheter was inserted correctly (in men – amount of catheter inserted, obstruction felt at prostatic area, patient reaction to passing the prostatic area, urine drained, no resistance to balloon inflation, no patient reaction or pain related to balloon inflation, free movement of the catheter once balloon inflated) • if urine is drained, the amount, colour, smell and, if necessary, dipstick and record the result (blood, protein, pH, glucose, nitrite, leucocytes) • if no urine drains, document what actions you took • brand, catheter name, material, tip type, catheter length, charriére size, balloon size, batch number, expiry date • cleaning fluid used • lubricant/anaesthetic gel used • if specimens were sent, and why. Drainage equipment documentation should include: • is this type of urinary drainage system appropriate for this particular patient? • appropriateness of brand, capacity, tube length • support system being used and if it was appropriate • if a link system is being used and the type of night bag (single use or drainable) • check when the drainage system was previously changed and if this was appropriate. Note date of change of bag or valve • urinary drainage bags are dated whenever they are changed within health and social care settings • batch number of equipment and sterility expiry date • any problems with product function • any problems with the supply of equipment • any problems with comfort • any associated skin or allergy problems	

Intervention Name	Intervention content*	Setting
	• any problems related to lifestyle or daily activities • is the system being used cost effective? Catheter removal documentation should include: • that the length of time the catheter was in-situ was appropriate for the type being used • the type of catheter, drainage system and support garments/straps being removed were appropriate • the catheter tip and balloon were intact upon removal • if encrustation was present, and to what degree • if the section of the catheter retained within the bladder was clean or dirty or if debris was evident • if the balloon deflated appropriately • if the catheter was removed because of blockage, the catheter was not present to allow direct observation, was it dissected to identify the cause and severity? • if the removal was painful • if blood was present, and if so, where (catheter tip, in the bag, around the meatus, clots in drainage bag tube) and to what degree (clot, red coloured urine, • meatal bleeding, frank haematuria)? • observation around the meatus for any abnormalities (inflammation, swelling, meatal erosion, discharge/amount/colour) • observations of urine for signs of infection (cloudy, debris, amount, colour and smell) • patient tolerance of the catheter. Ongoing observations documentation should include, if a problem occurs: • the health status of the patient (well/unwell/seriously ill) • is the patient febrile, temperature (over 39°C, are blood cultures needed)? • if taking antibiotics for a urinary tract infection, type, duration of course and are they effective?	

Intervention Name	Intervention content*	Setting
	• patient tolerance of the catheter and associated drainage system • is the individual patient in any form of discomfort or pain? • the fluid intake balanced against urinary output • if first-time catheterisation takes place in primary care, it is safe practice to monitor urine output for 4 hours after catheterisation. If the patient passes more than 200mls per hour after initial drainage, they need to be referred to the accident and emergency unit for fluid replacement as they are in risk of hypovolaemic shock • hourly urine output in critically ill patients • bowel activity • renal status • blood results (prostatic specific antigen PSA, urea, creatinine), the results, diagnosis and further interventions • glycosuria, in a known diabetic is indicative of poor control and infection risk, if diagnosis is unknown then further investigations are needed to establish a diagnosis • blood pressure status, in relation to proteinuria and nocturnal polyuria (increased night time urinary output) to help establish a diagnosis • immune status influencing interventions and associated risks • communication with other members of the multidisciplinary team regarding this individual patient's observations. Anatomy and physiology What you need to know: You need to apply: • an indepth understanding of the anatomy and physiology of the male and female lower urinary tract in relation to lower urinary tract function and continence status including: a) urine production and what influences this b) normal micturition c) the nervous system including autonomic dyssreflexia d) the bowel and its links to voiding problems	

Intervention Name	Intervention content*	Setting
	e) endocrine system f) sexual function and links to catheter usage g) the prostate gland, urethral sphincters and the urethra h) anatomy and physiology applied to voiding dysfunction and how a urethral urinary catheter could be used to relieve this (BCT 5.1) i) anatomy and physiology links of how common catheter related complications occur. • an indepth understanding of how to educate and advise individuals in the use of catheters in relation to their anatomy, its function and sensation. Consent What you need to do: • you need to obtain the individual's valid consent for the procedure (catheterisation), and, in terms of the care and support of the individual, know how to obtain valid consent and how to confirm that sufficient information has been provided on which to base this judgement (catheterisation). • avoid coercing or restraining patients for catheterisation, including aspects of ongoing catheter care, as this is assault in law and demonstrates a lack of consent. Reasons for, and decisions influencing, catheterisation What you need to do • During individual assessment when instrumental bladder drainage is deemed necessary, consideration needs to be given to the patient's suitability for intermittent, suprapubic or urethral catheterisation. • You need to understand the reasons for catheterisation and constantly review the need for continued catheter usage. • Where it is viewed as appropriate for the patient to use a catheter, such as end-of-life care, disability, unfit for surgery, nurses must remember that the risks associated with catheter usage are of a serious nature that increasingly may become more difficult to justify. • Never catheterise or continue catheter usage for nursing convenience. • Nurses must ensure that catheterisation is based on a balanced decision with more benefits than disadvantages, in consultation with the patient, where possible.	

Intervention Name	Intervention content*	Setting
	• Routine catheterisation must not be routinely supported by nurses, particularly in specific patient groups such as fractured neck or femur. • Incontinence is rated as a major factor in the development of pressure ulcers. Inserting an indwelling catheter could be assessed as reducing this risk, however with a catheter in-situ, there is less need for the patient to mobilise as they would with toileting or pad changes, so the risk can be higher (BCT 5.1). • Catheterisation of patients who are agitated and/or cognitively impaired is best avoided where possible. • Where a residual volume of urine is identified, the patient's symptom and severity profile along with their renal function and cognitive status must be considered prior to considering catheterisation. • Where a residual volume of urine is identified and a decision to catheterise is made, it is imperative that the nurse ensures that the route of catheterisation is made within a multi-disciplinary team (MDT) framework. • Nurses must always assess clinical need for catheter usage as part of their professional role, even if medical directives state 'to catheterise'. • When an indwelling catheter is inserted the nurse should consider and plan for early removal as the infection risk increases on a daily basis. • Nurses should not, under any circumstance, present or promote catheterisation to patients as an easy, best option to regain continence. • With the continued development of multi-resistant bacteria and lack of effective antibiotics, nurses must be mindful of the serious implications when making the decision to catheterise. Suprapubic catheterisation Positive aspects of suprapubic catheterisation: • there is no risk of urethral trauma, necrosis or catheter induced urethritis • there is greater comfort, particularly for patients who are wheelchair users (these are 2 of 6 pros of suprapubic catheterisation) Negative aspects of suprapubic catheterisation:	

Intervention Name	Intervention content*	Setting
	• altered body image (Addison and Mould, 2000) • cystostomy complications (Ichsan and Hunt, 1987), including swelling, infection, cellulitis, encrustation and granulation may be encountered (Addison, 1999c) *(these are 2 of 11 cons of suprapubic catheterisation)* Trial without catheter How to minimise discomfort during a TWOC: • in removing a catheter at the start of a TWOC, check water volume in balloon. Avoid pulling on the syringe as this may create a vacuum and cause the balloon to cuff making removal difficult. Instead allow water to drain out of the balloon under its own pressure. Where to perform a TWOC and why: • at home, if possible, as it is more relaxed for the patient and reduces the risk of cross infection by not bringing them back into a hospital ward environment Intermittent self-catheterisation • before commencing a patient on intermittent catheterisation, their symptom severity profile, renal function, risk assessment, psychological and physical ability to perform intermittent catheterisation and residual urine status must be considered. It is not best practice to initiate intermittent catheterisation based solely on the residual urine status	
HOUDINI Protocol	HOUDINI is an acronym used to list the indications for continued use of a UC: • Haematuria • Obstruction • Urology surgery • Decubitus ulcer • Input and output measurement • Nursing end of life care • Immobility	Secondary Care

Intervention Name	Intervention content*	Setting
	If none of the above criteria are met, the registered nurse is to discontinue urinary catheter per nursing protocol and document in CERNER. After urinary catheter removal • assess for voiding within six (6) hours of removal • if patient spontaneously voids within six (6) hours but it's <200ml, perform bladder scan initiate straight catheterisation if PVR is >200ml. • if patient spontaneously voids within six (6) hours, but is incontinent, perform bladder scan, straight catheterisation if PVR is >200ml. • If patient has not voided within six (6) hours after straight catheterisation, notify physician.	
Catheter Passport	All service users with a urinary catheter are at increased risk of acquiring a UTI and the longer a catheter is in place the greater the risk. Catheter hygiene Routine personal hygiene, such as a daily bath or shower, is important to maintain catheter hygiene. For those who are unable to bathe or shower, staff should wash the genital area including around the catheter at least daily with soap and water. For women, it is important to wash the genital area from front to back to prevent contamination from the anal area. Always remember that catheter straps should be used to secure the catheter tube to the leg to prevent trauma Emptying a catheter bag A catheter drainage bag should not be emptied more often than necessary as this increases the risk of infection. However, the bag must be emptied when it is no more than two thirds full to avoid back flow of urine into the bladder. There is an increased risk of acquiring an infection when the catheter bag is emptied. Therefore, it is essential to follow good practice. • Before emptying the bag, always wash hands and wear a disposable apron and gloves. • In a healthcare setting, the tap on the drainage bag should be wiped with an alcohol wipe before opening the tap and after closure, to reduce the risk of transmission of infection. In a person's own home, use a clean tissue to wipe the tap after closure to prevent drips. • Empty the urine into a container by opening the drainage tap.	Primary, Community, Nursing homes

Intervention Name	Intervention content*	Setting
	• In a healthcare setting, the container should be single use and disposable or if reusable, washed in an automated bed pan washer after each use. In a person's own home, the container can be used again after washing with detergent and warm water and dried with a disposable paper towel, such as kitchen roll. Avoid contact between the tap on the drainage bag and the container to prevent contamination and infection. • Urine should be disposed of into a sluice or toilet. • Remove gloves and disposable apron and wash hands with warm water and liquid soap. Changing a catheter bag Catheter bags, including leg bags, should be sterile and changed according to the manufacturer's instructions, usually weekly. There is an increased risk of acquiring an infection when the catheter bag is changed. Therefore, it is essential to follow good practice. • Before changing the bag, always wash hands and wear a disposable apron and gloves. • When detaching the used bag from the catheter, to prevent contamination and infection, do not touch the end of the catheter. • When removing the cap from the new catheter bag tube, to prevent contamination and infection, do not touch the end of the tube. • Empty the urine from the bag into a sluice or toilet and dispose of the bag as non-infectious/offensive waste. In a person's own home, double wrap the bag and dispose of as household waste. • Remove gloves and disposable apron and wash hands with liquid soap and warm water. • Always record when the catheter bag is changed. Overnight drainage bags If a leg bag is used during the day, an additional larger linked drainage bag (night bag) should be used for overnight use. The night bag should be attached to the leg bag to keep the original system intact. • Always wash hands and wear a disposable apron and gloves when attaching a night bag. • Attach the night bag to a stand to prevent the tap from touching the floor.	

Intervention Name	Intervention content*	Setting
	• In a healthcare setting, wipe the leg bag drainage tap with an alcohol wipe to reduce the risk of transmission of infection. In a person's own home, it is not necessary to wipe the tap. • When removing the cap from the new night bag tube, to prevent contamination, do not touch the end before attaching it to the drainage tap on the leg bag. • Remove gloves and disposable apron and wash hands. • Night bags are single use only and should be disposed of on removal and should not be used again.	
NICE catheter audit tools	All catheterisations carried out by healthcare workers should be aseptic procedures. After training, healthcare workers should be assessed for their competence to carry out these types of procedures. When changing catheters in patients with a long-term indwelling urinary catheter: • do not offer antibiotic prophylaxis routinely • consider antibiotic prophylaxis for patients who have a history of symptomatic urinary tract infection after catheter change or experience trauma] during catheterisation Long-term urinary catheters Education of patients, their carers and healthcare workers • Patients and carers should be educated about and trained in techniques of hand decontamination, insertion of intermittent catheters where applicable, and catheter management before discharge from hospital. • Community and primary healthcare workers must be trained in catheter insertion, including suprapubic catheter replacement and catheter maintenance. [2003] • Follow-up training and ongoing support of patients and carers should be available for the duration of long-term catheterisation. Assessing the need for catheterisation • Indwelling urinary catheters should be used only after alternative methods of management have been considered. • The patient's clinical need for catheterisation should be reviewed regularly and the urinary catheter removed as soon as possible.	Primary, Community

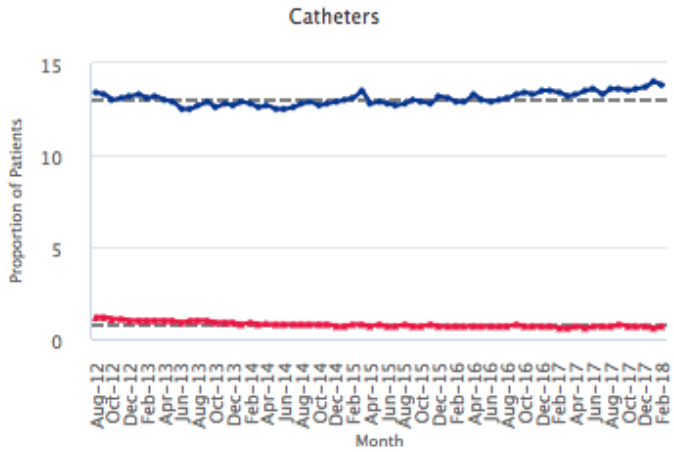
Intervention Name	Intervention content*	Setting
	• Catheter insertion, changes and care should be documented. Catheter drainage options • Following assessment, the best approach to catheterisation that takes account of clinical need, anticipated duration of catheterisation, patient preference and risk of infection should be selected. • Intermittent catheterisation should be used in preference to an indwelling catheter if it is clinically appropriate and a practical option for the patient. • Offer a choice of either single-use hydrophilic or gel reservoir catheters for intermittent self-catheterisation. • Select the type and gauge of an indwelling urinary catheter based on an assessment of the patient's individual characteristics, including: age any allergy or sensitivity to catheter materials gender history of symptomatic urinary tract infection patient preference and comfort previous catheter history reason for catheterisation. • In general, the catheter balloon should be inflated with 10 ml of sterile water in adults and 3–5ml in children. • In patients for whom it is appropriate, a catheter valve may be used as an alternative to a drainage bag (BCT 4.1). Catheter insertion • All catheterisations carried out by healthcare workers should be aseptic procedures. After training, healthcare workers should be assessed for their competence to carry out these types of procedures. • Intermittent self-catheterisation is a clean procedure. A lubricant for single patient use is required for non-lubricated catheters. • For urethral catheterisation, the meatus should be cleaned before insertion of the catheter, in accordance with local guidelines/policy. • An appropriate lubricant from a single-use container should be used during catheter insertion to minimise urethral trauma and infection.	

Intervention Name	Intervention content*	Setting
	Catheter maintenance • Indwelling catheters should be connected to a sterile closed urinary drainage system or catheter valve. • Healthcare workers should ensure that the connection between the catheter and the urinary drainage system is not broken except for good clinical reasons (for example changing the bag in line with the manufacturer's recommendations). • Healthcare workers must decontaminate their hands and wear a new pair of clean, non-sterile gloves before manipulating a patient's catheter, and must decontaminate their hands after removing gloves. • Patients managing their own catheters, and their carers, must be educated about the need for hand decontamination before and after manipulation of the catheter, in accordance with the recommendations in the standard principles section. • Urine samples must be obtained from a sampling port using an aseptic technique. • Urinary drainage bags should be positioned below the level of the bladder, and should not be in contact with the floor. • A link system should be used to facilitate overnight drainage, to keep the original system intact. • The urinary drainage bag should be emptied frequently enough to maintain urine flow and prevent reflux, and should be changed when clinically indicated. • The meatus should be washed daily with soap and water. • To minimise the risk of blockages, encrustations and catheter-associated infections for patients with a long-term indwelling urinary catheter: • develop a patient-specific care regimen consider approaches such as reviewing the frequency of planned catheter changes and increasing fluid intake document catheter blockages. • Bladder instillations or washouts must not be used to prevent catheter associated infections. • Catheters should be changed only when clinically necessary or according to the manufacturer's current recommendations. • When changing catheters in patients with a long-term indwelling urinary catheter: do not offer antibiotic prophylaxis routinely consider antibiotic prophylaxis for patients who: have a history of symptomatic urinary tract infection after catheter change or experience trauma during catheterisation.	

Only text relevant to health professional behaviour change for CAUTI-related behaviours is included here

Appendix J: Examples of BCT identification

<table>
<tr><th>Behaviour Change Technique label</th><th>Definition from Taxonomy v1*</th><th>Example from analysed interventions [Intervention label]</th></tr>
<tr><td>Goal-setting (behaviour)</td><td>Set or agree on a goal defined in terms of the behaviour to be achieved</td><td>The audit standards in this document include a reference to the guideline recommendation numbers, and any associated NICE quality standard statements and exceptions. NICE recommends compliance of 100%. for example ‘Healthcare workers must decontaminate their hands and wear a new pair of clean, non-sterile gloves before manipulating a patient’s catheter, and must decontaminate their hands after removing gloves. [NICE Catheter Audit Tool]</td></tr>
<tr><td>Goal-setting (outcome)</td><td>Set or agree on a goal defined in terms of a positive outcome of wanted behaviour. Note code as outcome if goal unspecified or if a behavioural outcome.</td><td>Step 1: Setting an improvement goal’ [Safety Thermometer]</td></tr>
<tr><td>Review behaviour goal(s)</td><td>Review behaviour goal(s) jointly with the person and consider modifying goal(s) or behaviour change strategy in light of achievement. This may lead to re-setting the same goal, a small change in that goal or setting a new goal instead of (or in addition to) the first, or no change</td><td>‘NICE recommends compliance of 100%. If this is not achievable an interim local target could be set, although 100% should remain the ultimate aim’ [NICE Catheter Audit Tool]</td></tr>
<tr><td>Discrepancy between current behaviour and goal(s)</td><td>Draw attention to discrepancies between a person’s current behaviour (in terms of the form, frequency, duration, or intensity of that behaviour) and the person’s previously set outcome goals, behavioural goals or action plans (goes beyond self-monitoring of behaviour)</td><td>Your goal is to perform every element of care every time it is needed (. The "All elements performed" should total to 100% compliance when all care elements have been given correctly on every occasion. Where elements have not been performed overall compliance will be less than 100%. [High Impact Intervention for best practice insertion and care]</td></tr>
<tr><td>Action planning</td><td>Prompt detailed planning of performance of the behaviour (must include at least one of context, frequency, duration and intensity). Context may be environmental (physical or social) or internal (physical, emotional or cognitive) (includes ‘Implementation Intentions’)</td><td>Action planning template:
<table><tr><th>Recommendation</th><th>Actions required (specify ‘None’, if none required)</th><th>Action by date</th><th>Person responsible</th><th>Comments/action status (Provide examples of action in progress, changes in practices, problems encountered in facilitating change, reasons why recommendation has not been actioned etc)</th><th>Change stage (see Key)</th></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>[NICE Catheter Audit Tool]</td></tr>
<tr><td>Monitoring of outcome of behaviour by others without feedback</td><td>Observe or record behaviour with the person’s knowledge as part of a behaviour change strategy</td><td>‘Where residents have an invasive device in place, this should be fully documented in the care plan and the resident should be monitored for signs of infection’ [Department of Health & Public Health England (2013) Prevention and control of infections in care homes: an informative resource]</td></tr>
<tr><td>Monitoring of the behaviour by others without feedback</td><td>Observe or record outcomes of behaviour with the person’s knowledge as part of a behaviour change strategy</td><td>‘Compliance with policy should be audited’ [The Health and Social Care Act 2008 Code of Practice on the prevention and control of infections and related guidance]</td></tr>
</table>

Behaviour Change Technique label	Definition from Taxonomy v1*	Example from analysed interventions [Intervention label]
Feedback (on outcome of behaviour) (on outcome of behaviour)	Monitor and provide feedback on the outcome of performance of the behaviour	Dashboard reporting rates of catheterisation (behaviour) and UTI (outcome of behaviour)overtime:  [Safety Thermometer]
Self-monitoring (behaviour)	Establish a method for the person to monitor and record their behaviour(s) as part of a behaviour change strategy	'Each time a care element is performed, insert a [tick] in the relevant column. If the action is not performed leave it blank. Ensure you only [tick] it when an element of care is performed correctly or if the element is not applicable.' [High Impact Intervention for best practice insertion and care]
Self-monitoring (outcomes behaviour)	Establish a method for the person to monitor and record the outcome(s) of their behaviour as part of a behaviour change strategy	'Ongoing observations documentation should include, if a problem occurs: the health status of the patient (well/unwell/seriously ill), if the patient febrile, temperature (over 39°C, are blood cultures needed), if taking antibiotics for a urinary tract infection, type, duration of course and are they effective, if patient tolerance of the catheter and associated drainage system, if the individual patient in any form of discomfort or pain…' [Catheter Care: RCN guidance for nurses]
Social support (practical)	Advise on, arrange, or provide practical help (for example from friends, relatives, colleagues, 'buddies' or staff) for performance of the behaviour	'Organisations may like to make use of the tools developed by NICE to help implementation of the clinical guideline on Infection Control (Update). All the implementation tools can be found on the NICE website.' [NICE Catheter audit Tool]
Information about health consequences	Provide information (for example written, verbal, visual) about health consequences of performing the behaviour. Note: consequences can be for any target, not just the recipient(s) of the intervention;	'Antibiotics are not effective for treating asymptomatic bacteriuria in adults with catheters or non-pregnant women. Unnecessary treatment with antibiotics can also increase the resistance of bacteria that cause urinary tract infections, making antibiotics less effective for future use.' [NICE QS90: Urinary Tract Infections in Adults]
Information about emotional consequences	Provide information (for example written, verbal, visual) about emotional consequences of performing the behaviour. Note: consequences can be related to emotional health disorders (for example depression, anxiety) and/or states of mind (for example low mood, stress); consequences can be for any target, not just the recipient(s) of the intervention	'Where to perform a TWOC and why: at home, if possible, as it is more relaxed for the patient' [Catheter Care: RCN guidance for nurses]

Behaviour Change Technique label	Definition from Taxonomy v1*	Example from analysed interventions [Intervention label]
Information about social environmental consequences	Provide information (for example written, verbal, visual) about social and environmental consequences of performing the behaviour. Note: consequences can be for any target, not just the recipient(s) of the intervention;	**'**The cost-effectiveness model developed for this guideline combined evidence of clinical effectiveness, costs and quality of life with respect to symptomatic urinary tract infection and associated complications. The results of the analysis showed that reusable non-coated catheters were the most cost-effective option for intermittent self-catheterisation.' [NICE Catheter audit tool]
Instruction on how to perform the behaviour	Advise or agree on how to perform the behaviour (includes 'Skills training')	'Always remember that catheter straps should be used to secure the catheter tube to the leg to prevent trauma' [Catheter Passport]
Social comparison	Draw attention to others' performance to allow comparison with the person's own performance	Harm report dashboard that compares the performance of different healthcare organisations on a number of metrics, including urinary tract infections rates. [Safety Thermometer]
Demonstration of behaviour	Provide an observable sample of the performance of the behaviour, directly in person or indirectly for example via film, pictures, for the person to aspire to or imitate (includes 'Modelling').	'observe model/manikin being catheterised…observe catheterisation performed by others on actual patients' [Catheter Care: RCN guidance for nurses]
Prompts/cues	Introduce or define environmental or social stimulus with the purpose of prompting or cueing the behaviour. The prompt or cue would normally occur at the time or place of performance.	'reminders to review the continuing use or prompt the removal of catheters' [EPIC 3]
Behavioural practice/ rehearsal	Prompt practice or rehearsal of the performance of the behaviour one or more times in a context or at a time when the performance may not be necessary, in order to increase habit and skill.	'practise catheterisation on a model/manikin under supervision until confident' [Catheter Care: RCN guidance for nurses]
Credible source	Present verbal or visual communication from a credible source in favour of or against the behaviour. Note: code this BCT if source generally agreed on as credible for example, health professionals, celebrities or words used to indicate expertise or leader in field and if the communication has the aim of persuading.	'The tool was developed by a community of users who iteratively tested the tool to ensure it is quick and easy to use and gives useful information which can be used for local improvement' [Safety Thermometer]
Identification of self as a role model	Inform that one's own behaviour may be an example to others.	'become a competent mentor for others' [Catheter Care: RCN guidance for nurses]
Reward (outcome)	Arrange for the delivery of a reward if and only if there has been effort and/or progress in achieving the behavioural outcome (includes 'Positive reinforcement') Note: this includes social, material, self and non-specific rewards for outcome.	'Step 4: Working out the CQUIN payment' [Safety Thermometer]
Restructuring the social environment	Change, or advise to change the social environment in order to facilitate performance of the wanted behaviour or create barriers to the unwanted behaviour (other than prompts/cues, rewards and punishments).	'This intervention allows nurses to remove catheters without asking for a physician written order' [HOUDINI protocol]

Appendix K: APEASE criteria for designing and evaluating interventions

Criterion	Description
Affordability	Interventions often have an implicit or explicit budget. It does not matter how effective, or even cost-effective it may be if it cannot be afforded. An intervention is affordable if within an acceptable budget it can be delivered to, or accessed by, all those for whom it would be relevant or of benefit.
Practicability	An intervention is practicable to the extent that it can be delivered as designed through the means intended to the target population. For example, an intervention may be effective when delivered by highly selected and trained staff and extensive resources but in routine clinical practice this may not be achievable.
Effectiveness and cost-effectiveness	Effectiveness refers to the effect size of the intervention in relation to the desired objectives in a real world context. It is distinct from efficacy which refers to the effect size of the intervention when delivered under optimal conditions in comparative evaluations. Cost-effectiveness refers to the ratio of effect (in a way that has to be defined, and taking account of differences in timescale between intervention delivery and intervention effect) to cost. If 2 interventions are equally effective then clearly the most cost-effective should be chosen. If one is more effective but less cost-effective than another, other issues such as affordability, come to the forefront of the decision making process.
Acceptability	Acceptability refers to the extent to which an intervention is judged to be appropriate by relevant stakeholders (public, professional and political). Acceptability may differ for different stakeholders. For example, the general public may favour an intervention that restricts marketing of alcohol or tobacco but politicians considering legislation on this may take a different view. Interventions that appear to limit agency on the part of the target group are often only considered acceptable for more serious problems [45].
Side-effects/safety	An intervention may be effective and practicable, but have unwanted side-effects or unintended consequences. These need to be considered when deciding whether or not to proceed.
Equity	An important consideration is the extent to which an intervention may reduce or increase the disparities in standard of living, wellbeing or health between different sectors of society.