Public Health England

Protecting and improving the nation's health

Exploring the implementation of interventions to reduce catheter-associated urinary tract infections (ENACT)

Contents

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List of acronyms

Acronym	Meaning
APEASE	Criteria used to assess feasibility of interventions, including Affordability, Practicability, Effectiveness, Acceptability, Side effects and safety, and Equity
BCT	Behaviour Change Technique
BCTT	Behaviour Change Technique Taxonomy
BCW	Behaviour Change Wheel
CAUTI	Catheter-associated urinary tract infection
CBC	Centre for Behaviour Change
CCG	Clinical commissioning group
COM-B	Capability, opportunity, motivation and behaviour
HCP	Healthcare professional
HSC	Health and Social Care
NICE	National Institute of Clinical Excellence
PHEBI	Public Health England Behavioural Insights
RQ	Research question
TDF	Theoretical Domains Framework
TWOC	Trial without catheter
UTI	Urinary tract infection

Executive summary

This report builds on the previous work undertaken by Public Health England Behavioural Insights (PHEBI) and the University College London, Centre for Behaviour Change (CBC). The previous work identified barriers and facilitators to healthcare professional (HCP) CAUTI-related behaviours. Eleven nationally adopted interventions targeting incidence of CAUTI through HCP behaviour change were identified (see diagram). This report explores how national interventions could be improved across primary and community care, secondary care and care homes in England.

We sought to:

1. identify research interventions effective at reducing incidence of CAUTI
2. compare content of effective research and nationally implemented interventions
3. identify intervention components which may optimise national interventions to reduce CAUTI
4. evaluate individual national interventions on congruence between theoretical domains representing known barriers and facilitators and behaviour change techniques employed

Methods

We used a mixed methods approach which included:

- a rapid review of the literature to identify interventions shown to be effective in research studies at reducing CAUTI incidence or rate
- a behavioural analysis of the content of effective research interventions using the Theoretical Domains Framework (TDF), Behaviour Change Wheel (BCW) and the Behaviour Change Technique Taxonomy (BCTTv1)
- a stakeholder focus group and survey to develop new intervention components and to assess the relevance and feasibility of these in relevant settings
- a behavioural analysis of individual national interventions to identify areas for optimisation

The BCW is a useful tool to characterise interventions using 9 intervention functions, that is, purposes an intervention serves (for example, Education or Incentivisation) and 7 policy categories, that is, channels through which interventions are implemented (for example, Guidelines, Service provision or Legislation) (1). The TDF is an integrative framework of 14 theoretical domains which influence behaviour (for example, Skills, Social Influences, Knowledge) (2). The delivery of an intervention can be described through the use of a 93-item taxonomy of behaviour change techniques (3). Behaviour change techniques (BCTs) are defined as active ingredients of an intervention designed to bring about change.

Results

Effective research interventions

We identified 37 interventions which were effective at reducing CAUTI incidence or rate. All were multi-faceted and contained education for HCPs, either guidelines or training. Many interventions contained protocols or audits for hospital ward staff to follow (for example, nurse driven catheter removal protocol, daily ward rounds questioning need for continued catheter use). Some included specific training for staff, for example, on catheter insertion techniques and some provided new equipment including alternatives to catheters. Several interventions included amending the electronic medical record system to support decision making on, and recording of, catheter use. Some interventions introduced clinical champions to improve catheter use.

Each effective intervention used 7 BCTs (27 BCTs used across all 37 interventions) and targeted 4 TDF domains on average. As a group the interventions targeted 8 out of 14 TDF domains these included 6 key TDF domains identified as representing key influences on HCP behaviour in the previous work (Knowledge; Environmental Context and Resources; Memory, Attention and Decision Making; Social Influences; Social Professional Role and Identity; Beliefs about Consequences).

All effective interventions served the function of Education (for example, healthcare professionals being provided with information about new procedures in catheter care). Interventions also served the following functions: Enablement (for example, being provided with support from senior staff or peers in order to reduce number of catheters), Environmental restructuring (for example, provision of bladder scanners), Training (for example, provision of face-to-face or online workshops on appropriate catheter insertion technique), Persuasion (for example, senior staff approving changes to catheter management and endorsing consideration of catheter alternatives on a daily basis), Incentivisation (for example, HCPs rewarded for their efforts in reducing CAUTI with financial incentives) and Modelling (for example, nurses being employed as peer educators and mentors). None of the research interventions served the functions of Coercion or Restriction.

The most frequent policy category was Service provision (for example, implementing clinical champion programmes), followed by Guidelines (for example, provision of local protocols and guidelines to managing catheters) and Communication ormarketing (for example, delivering webinars about importance of prevention of CAUTI). None of the interventions served the policy category of Fiscal measures, Regulation, Legislation or Environmental and social planning.

Comparison to national interventions

The 6 key TDF domains were targeted to a greater extent in the 37 effective research interventions than in the 11 national interventions. Research interventions addressed 4 of the 6 key TDF domains well (Environmental Context and Resources; Social Influences; Memory,

Attention and Decision Making; and Social Professional Role and Identity) by using more than 60% of the relevant BCTs within each domain. National interventions only addressed one of the 6 key TDF domains well (Memory, Attention and Decision Making) using more than 60% of the relevant BCTs for this domain. For the remaining 5 key TDF domains few of the available BCTs were used (between 33% to 57% for each domain) indicating potential missed opportunities.

New intervention components

We developed a list of 39 potential intervention components addressing key influences on HCP behaviours across the 6 key TDF domains. This list was discussed by 14 stakeholders (clinicians and other health professionals, including CCG staff) in a focus group. Based on their feedback and input from the research team and project steering group the list was reduced to 20 components which were rated in a survey by 14 stakeholders.

Seven out of 20 intervention components met the prioritisation criteria for at least one setting:

- closer collaboration between HCPs working in different settings or wards at the point of patient transfer (all 3 settings: primary or community care, secondary care and care homes)
- promote working closely with patients and their families, by making sure that they are able to make an informed choice about catheter use (all 3 settings)
- promote a standardised approach by ensuring that HCPs in different settings adhere to the same guidelines when managing patients with catheters (primary or community and secondary care)
- ensuring that information about catheter use is recorded in a similar way across settings, thus allowing documentation to be shared between HCPs working in different settings (secondary care and care homes)
- addressing staff beliefs and knowledge about risks associated with use of catheters (care homes)
- introduction of CAUTI champions, including nurses and doctors who support their peers in managing patients' catheter requests (secondary care)
- provision of bladder scanners with staff training in use of scanners (secondary care)

Individual national interventions

For 7 interventions at least 50% of the BCTs used were theoretically congruent with the 6 key TDF domains representing key influences on behaviour (see diagram). EPIC 3 was the only intervention to use BCTs which targeted all 6 key domains (for example, 'Self-monitoring behaviour', 'Prompts and cues' and 'Feedback on behaviour'), 6 out of 7 of the BCTs used were theoretically congruent. The Catheter Care Guidance and NICE Catheter Audit Tools used the most BCTs (12 and 11 respectively) with 9 and 7 (respectively) of these being congruent with 5 key domains. The Safety Thermometer and Catheter Passport used 9 and 4 BCTs respectively, 7 and 3 of which were congruent with 4 key domains. High Impact Interventions used 8 BCTs, 6 of which were congruent with 3 key domains. The HOUDINI protocol used 2 BCTs, only one of

which (‘Restructuring the social enviornment’) was congruent with 2 key domains (Social influences and Social Professional Role and Identity).

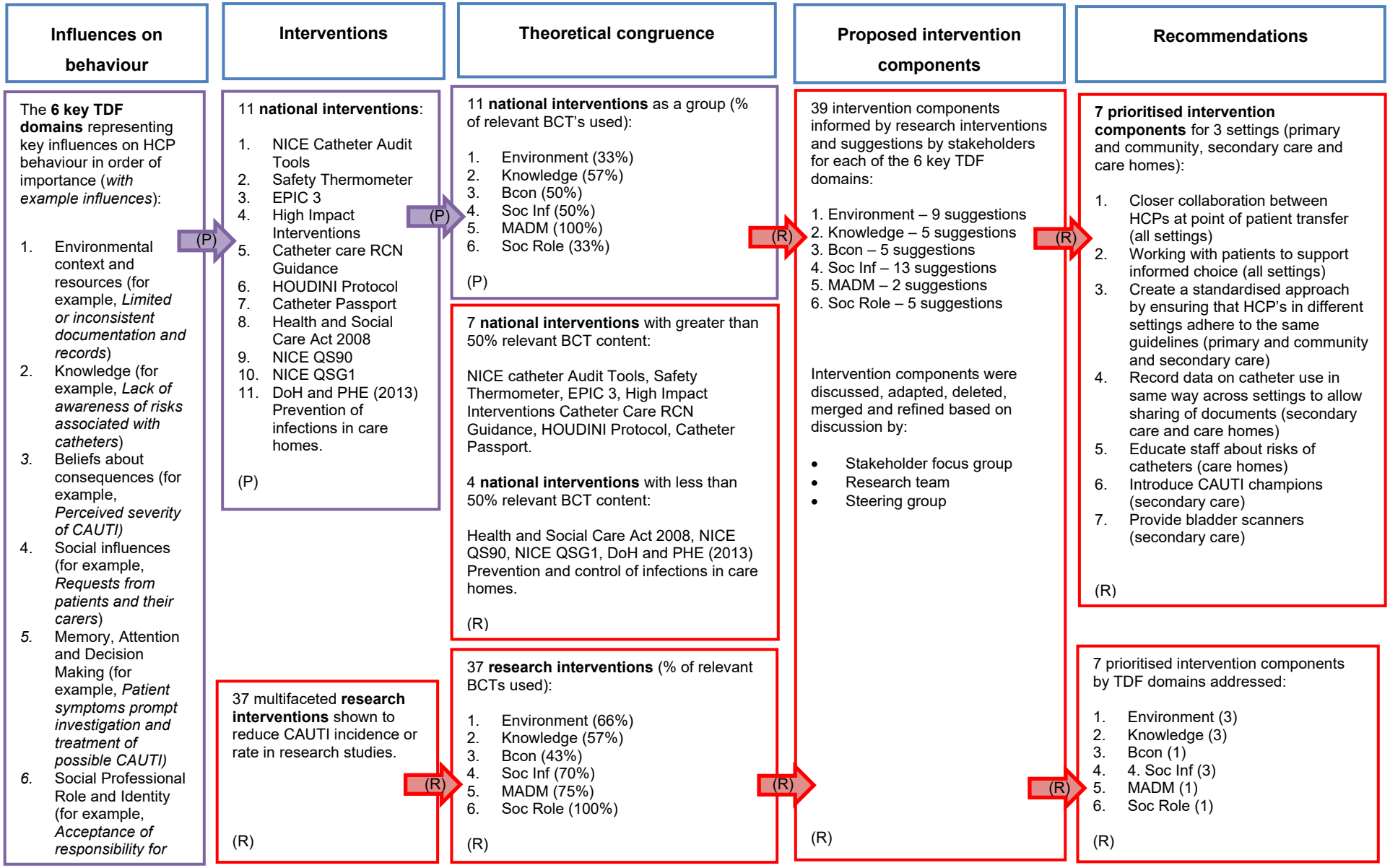
For 4 interventions less than 50% of BCTs used were theoretically congruent to the 6 key domains.The HSC Act 2008 used 3 BCTs none of which were theoretically congruent to any of the key domains. The Department of Health and PHE guidance (2013) ‘Prevention and control of infection in care homes’ used 4 BCTs with only one BCT (‘Information about health consequences’) congruent with 2 key domains (Knowledge and Beliefs about Consequences). NICE guidelines QS90 and QSG1 both used 3 BCTs (‘Instruction on how to perform the behaviour’, ‘Information about health consequences’, and ‘Goal setting behaviour’), only the first of which was congruent to 2 key domains for both (Knowledge and Beliefs about Consequences).

All interventions used intervention functions which targeted relevant influences on behaviour and therefore intervention functions do not need to change substantially. Nine out of 11 interventions were guidelines and therefore may be restricted in the type of BCT content that can be included. Policy makers may choose to optimise these different groups of interventions, or single interventions, based on whether they intend to continue using all strategies, for example considering whether there is duplication of intervention functions. Policy makers may also wish to consider new interventions which are delivered through alternative intervention functions and policy categories.

Conclusions

Effective interventions were seen to utilise different BCTs, intervention functions and policy categories than national interventions. Seven new intervention components were assessed as relevant and feasible for implementation. These intervention components could either be added to national interventions by working with intervention owners and designers or further developed as stand-alone interventions. Further work is needed to identify to what extent specific barriers (rather than just key TDF domains) were addressed by each of the national interventions. This would allow policy makers to identify whether all barriers to CAUTI-related behaviour are being targeted by national interventions.

Results identified in previous project (purple boxes and arrows (P)) and current report (red boxes and arrows (R))



Results identified in previous project and current report: accessible text alternative

This figure summarises the key results found within the previous project and current report and includeds findings on influences on behaviour (previous project), interventions (previous and current report), theoretical congruence (previous and current report), proposed intervention components (current report) and suggested recommendations (current report).

Influences on behaviour (previous project)

The 6 key TDF domains representing key influences on HCP behaviour in order of importance (with example influences):

- Environmental Context and Resources (for example, limited or inconsistent documentation and records)
- Knowledge (for example, lack of awareness of risks associated with catheters)
- Beliefs about Consequences (for example, perceived severity of CAUTI)
- Social Influences (for example, requests from patients and their carers)
- Memory, Attention and Decision Making (for example, patient symptoms prompt investigation and treatment of possible CAUTI)
- Social Professional Role and Identity (for example, acceptance of responsibility for catheterisation decision making)

Interventions (previous and current report)

Previous project

Eleven national interventions:

- NICE Catheter Audit Tools
- Safety Thermometer
- EPIC 3
- High Impact Interventions
- Catheter care RCN Guidance
- HOUDINI Protocol
- Catheter Passport
- Health and Social Care Act 2008
- NICE QS90
- NICE QSG1
- DoH and PHE (2013) Prevention of infections in care homes

Current report

Thirty seven multifaceted research interventions were shown to reduce CAUTI incidence or rate in research studies.

Theoretical congruence (previous and current report)

Previous project

Eleven national interventions as a group (percentage of relevant BCT's used):

- Environment (33%)
- Knowledge (57%)
- Beliefs about Consequences (50%)
- Social Influences (50%)
- Memory, Attention And Decision Making (100%)
- Social Professional Role and Identity (33%)

Current report

Seven national interventions with greater than 50% relevant BCT content:

- NICE catheter audit tools
- Safety Thermometer
- EPIC 3
- high impact interventions catheter care RCN guidance
- HOUDINI protocol
- Catheter Passport

Four national interventions with less than 50% relevant BCT content:

- Health and Social Care Act 2008
- NICE QS90
- NICE QSG1
- DoH and PHE (2013) Prevention and control of infections in care homes

Proposed intervention components (current report)

Thirty-nine intervention components informed by research interventions and suggestions by stakeholders for each of the 6 key TDF domains:

- Environment (9 suggestions)
- Knowledge (5 suggestions)
- Beliefs about Consequences (5 suggestions)
- Social Influences (13 suggestions)
- Memory, Attention and Decision Making (2 suggestions)
- Social Professional Role and Identity (5 suggestions)

Intervention components were discussed, adapted, deleted, merged and refined based on discussion by:

- stakeholder focus group

- research team
- steering group

Recommendations (current report)

Seven prioritised intervention components for 3 settings (primary, community, secondary care and care homes):

- closer collaboration between HCPs at point of patient transfer (all settings)
- working with patients to support informed choice (all settings)
- create a standardised approach by ensuring that HCP's in different settings adhere to the same guidelines (primary or community and secondary care)
- record data on catheter use in same way across settings to allow sharing of documents (secondary care and care homes)
- educate staff about risks of catheters (care homes)
- introduce CAUTI champions (secondary care)
- provide bladder scanners (secondary care)

Seven prioritised intervention components by TDF domains addressed:

- Environment (3)
- Knowledge (3)
- Beliefs about Consequences (1)
- Social Influences (3)
- Memory, Attention and Decision Making (1)
- Social Professional Role and Identity (1)

Introduction

Urinary tract infection (UTI) is the second most common healthcare associated infection in the UK, with up to 50% of infections occurring in patients with a catheter (4). The link between catheter use and UTI is well established with unnecessary catheter use, poor insertion technique and prolonged catheter use as the most common reasons for infection (5), often leading to negative patient outcomes and higher healthcare costs (6). Preventing catheter-associated urinary tract infection (CAUTI) is a complex task requiring change in a number of behaviours by both patients and healthcare professionals across different settings. Healthcare professionals play a key role in appropriate catheter care and are often the target of interventions. Interventions which target the influences on healthcare professionals' behaviours are crucial in making sure that healthcare professionals can be supported to deliver optimal patient care and subsequently help reduce the incidence of CAUTI (1).

In previous work, Public Health England Behavioural Insights (PHEBI) together with the University College London, Centre for Behaviour Change (CBC) used behavioural science tools to:

- identify from the literature barriers and facilitators (influences) to healthcare professionals' behaviours that lead to or prevent catheter associated urinary tract infections (from this point CAUTI-related behaviours) in primary or community care, secondary care and care homes in England
- identify 11 nationally adopted interventions to reduce CAUTI in these settings; and
- determine the theoretical congruence (that is, match) between influences on healthcare professional behaviour and the behavioural content of interventions aimed at changing this behaviour. The purpose was to identify gaps in our national response to CAUTI in these contexts and to identify opportunities for intervention refinement

This report builds on this work by looking at research evidence for interventions which have shown to be effective at changing health professional behaviour but have not been nationally adopted. The 11 national interventions previously identified were:

- the Health and Social Care Act 2008 code of practice on the prevention and control of infections and related guidance (HSC Act 2008)
- NICE QS90: urinary tract infections in adults (NICE QS90)
- NICE QSG1: infection prevention and control (NICE QSG1)
- NICE catheter audit tools
- Department of Health and Public Health England (2013) prevention and control of infections in care homes: an informative resource (DH PHE 2013)
- Safety Thermometer
- EPIC 3
- high impact intervention for best practice insertion and care (high impact)

- Catheter care: Royal College of Nursing guidance for nurses (catheter care)
- HOUDINI protocol (HOUDINI)
- Catheter Passport

This is important as nationally adopted interventions have not been formally evaluated and exploring effective research interventions can inform potential modifications to national interventions with the aim of optimising the effectiveness of their content. We further explore how the 11 nationally adopted interventions (see Appendix A) could be improved for implementation across primary or community care, secondary care and care home settings. For the purposes of brevity, this report will refer to effective research interventions as research interventions and to nationally adopted interventions, as national interventions.

The research questions (RQ) which this project aims to address are:

- RQ1: Which research interventions, targeting healthcare professional behaviours, have shown to be effective at reducing incidence of CAUTI?
- RQ2: What is the content of effective research interventions?
- RQ3: To what extent are key influences on healthcare professional behaviour identified in the previous report addressed by research interventions in comparison to national interventions?
- RQ4: How can we address key influences on health care professional behaviour?
- RQ5: How can national interventions be optimised to improve implementation in relevant settings?

Methods

Summary

We used a range of research methods and behavioural science tools, selected to correspond to each research question (Table 1). Behavioural science tools such as the Behaviour Change Wheel (BCW), the Theoretical Domains Framework (TDF) and the Behaviour Change Technique Taxonomy (BCTTv1) can be helpful when trying to examine to what extent the barriers and facilitators to a behaviour are addressed in interventions (7).

The Behaviour Change Wheel (BCW) is a useful tool to characterise interventions using 9 intervention functions, that is, purposes an intervention serves (Education, Training, 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, and Environmental and social planning) (1). The BCW was used to characterise 11 nationally adopted interventions in the previous report.

The Theoretical Domains Framework (TDF) is an integrative framework of 14 theoretical domains which influence behaviour (Environmental Context and Resources; Social Influences; Social Professional Role and Identity; Beliefs about Capabilities; Optimism; Intentions; Goals; Beliefs about Consequences; Reinforcement; Emotion; Knowledge; Memory, Attention and Decision Making; and Behavioural Regulation) (2). It has been previously used as a framework for classifying barriers and facilitators to a number of behaviours including HCP CAUTI related behaviours in the previous report (8, 9).

The delivery of an intervention can be described through the use of a 93-item taxonomy of behaviour change techniques known as the Behaviour Change Technique Taxonomy (BCTTv1) (3). Behaviour change techniques are defined as active ingredients designed to bring about change, when used in the interventions and can be used when designing interventions or, as in the case of the previous CAUTI report, it can be used to retrospectively code existing interventions and to then assess whether key barriers and facilitators are addressed appropriately in these interventions (7).

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

Research question	Research methods	Behavioural science tools used
RQ1: Which research interventions, targeting healthcare professional behaviours, have shown to be effective at reducing incidence of CAUTI? And RQ2: What is the content of research interventions?	• rapid review of the literature to identify relevant studies and effective research interventions. • describe the content of research interventions in terms of BCTs, intervention functions and policy categories.	BCTTv1,TDF, BCW
RQ3: To what extent are key influences on healthcare professional behaviour identified in the previous report addressed by research interventions in comparison to national interventions?	• assess behavioural content of research interventions against the key TDF domains representing influences on healthcare professional CAUTI-related behaviours and consider in relation to the previous report on national interventions.	Merged mapping matrix (Appendix E CAUTI report (7))
RQ4: How can we address key influences on health care professional behaviour?	• develop list of intervention components which address key influences on healthcare professional behaviour using corresponding BCTs and evidence from the research interventions. • stakeholder focus group and expert feedback to explore views on national interventions and proposed intervention components. • stakeholder survey to assess the relevance and feasibility of intervention components in each health setting. • identify the most promising intervention components for each healthcare setting using	BCTTv1, TDF, BCW, APEASE criteria

Research question	Research methods	Behavioural science tools used
	prioritisation criteria: a) at least 50% of stakeholders responding for a setting considering this intervention component to be relevant; b) the intervention component scoring at least 60% of the maximum APEASE score.	
RQ5: How can national interventions be optimised to improve implementation in relevant settings?	• establish the degree of theoretical congruence (that is, match) between influence on behaviour and intervention content of each national intervention individually. • identify intervention functions present in national interventions targeting key influences on behaviour (opportunity seized) • identify additional intervention functions not present in national interventions able to target key influences on behaviours (opportunity missed).	TDF, BCW, BCTTv1

Methods for RQ1 and RQ2

Study design

Rapid review of systematic reviews, to identify relevant studies and interventions shown to be effective, and content analysis of effective interventions.

Data collection

We conducted a literature search using Medline, EMBASE, PsycINFO, Cochrane Library, CINAHL, and Prospero.

Type of studies

We included any systematic review which reviewed studies assessing interventions aimed at changing healthcare professionals' behaviour to reduce incidence of CAUTI in primary care, secondary care or care home settings. The inclusion criteria were:

i) reviews published since 1 January 2014
ii) reviews including studies in high income countries
iii) reviews written in English

These criteria were applied to ensure that research most relevant to the UK setting was selected. The date cut off was to find a reasonable number of studies which could be analysed given limited resources. A second search was conducted to identify primary research studies covering the period since the most recent systematic review search (1 January 2016 to 23 October 2018). We searched for studies assessing the effect of interventions targeted at healthcare professionals aimed at reducing CAUTI, following the criteria above. Resources were not available to translate studies published in languages other than English.

Search strategy

Databases were searched from 1 January 2014 to 23 October 2018. Search terms were informed by the previous CAUTI report (7) and were reviewed by an information specialist. The full search strategy is provided in Appendix B.

Screening

Titles and abstracts of systematic reviews and primary research studies were screened against the inclusion and exclusion criteria by MW with 20% screened by AB. Disagreements were resolved by consensus with another author (STC). Full texts were obtained for abstracts meeting the inclusion criteria and all full texts were screened by MW. Where there was uncertainty about inclusion, texts were discussed with AB and STC.

Data extraction

For included studies MW extracted data on study design, setting, target behaviour, description of the intervention, outcome measures and effect on incidence of CAUTI.

We used the BCW, the BCTTv1 and TDF to identify and describe the content of effective research interventions. An intervention was deemed effective if it reduced CAUTI, measured by a statistically significant reduction in CAUTI incidence or CAUTI rate. For each intervention and each intervention component, we extracted data on BCTs, intervention functions, policy categories and TDF domains. We coded any information on the intervention provided in the published article. We first coded intervention content by BCT, identifying a component of the intervention which had been described and assessing how it best fitted against the BCTTv1. We then used a merged BCT by TDF pairings matrix (Appendix C) to determine which TDF domain best fitted with the BCT as described in the intervention. We also recorded which behavioural phase of catheter care the intervention targeted: pre-insertion, insertion, maintenance or removal (7). MW conducted data extraction and coding for all interventions, with queries checked by LA.

Data analysis

We recorded the number of BCTs, intervention functions and policy categories for each research intervention and calculated their mean and range. We also recorded the number of interventions each BCT, intervention function and policy category were present in; and the most frequently used BCTs. Data were managed in Excel.

Methods for RQ3

Study design

We used behavioural science tools to:

- map theoretically coded barriers and facilitators (from the previous report) to the content of research interventions
- compare mapping of research interventions with that for national interventions (work undertaken in previous CAUTI report (7))

Data analysis

The previous CAUTI report carried out a review to identify key barriers and facilitators influencing health care professionals' behaviour related to CAUTI prevention (7). When summarising the influences on behaviours the authors identified 35 barriers and facilitators which represented the influences which occurred most frequently within each of the 10 identified TDF domains (Appendix D). These were:

- Behavioural Regulation

- Environmental Context and Resources
- Knowledge
- Beliefs about Consequences
- Goals
- Skills
- Beliefs about Capabilities
- Social Influences
- Memory, Attention and Decision Making
- Social Professional Role and Identity

Once barriers and facilitators were mapped to the TDF, the team identified 6 key TDF domains. These were:

- Environmental Context and Resources
- Knowledge
- Beliefs about Consequences
- Social Influences
- Memory, Attention and Decision Making
- Social Professional Role and Identity

The key domains were chosen based on the number of studies reporting facilitators or barriers relevant to each domain, number of themes within each domain and evidence of conflicting beliefs within domains. There were 22 most frequently identified barriers (4 of which were both a barrier and a facilitator) related to these key TDF domains. For each domain they identified theoretically congruent BCTs through mapping matrices to enable assessment of how well the content of national interventions addressed the barriers and facilitators identified.

For the current report the same 6 key TDF domains and theoretically congruent BCTs were used to assess the content of the research interventions and how well they address the barriers and facilitators to CAUTI-related behaviours. This was done by looking at the frequency with which these theoretically congruent BCTs were present in research interventions.

We then compared research and national interventions in relation to the extent to which they targeted the 6 key TDF domains and used theoretically congruent BCTs. This was conducted using a matrix prepared as part of the previous CAUTI report (7) and was based on previous matrices published in Cane and others 2015 (10) and Michie et al., 2008 (11). We also compared whether intervention functions and policy categories identified in the research interventions targeted the key TDF domains using matrices mapping BCW to the TDF (12).

Methods for RQ4

Study design

The study design included:

- development of a list of intervention components which address key influences on healthcare professional behaviour.
- stakeholder focus group and expert feedback.
- stakeholder survey to assess the relevance and feasibility of intervention components.
- identification of the most promising intervention components for each healthcare setting.

Data collection

1. Developing a list of potential intervention components which address key influences on healthcare professional behaviour

We developed a list of potential intervention components targeting each of the 6 TDF domains and most frequently reported barriers within these. This was based on the previous CAUTI report (7) and the information gathered from the research interventions. The previous CAUTI report identified theoretically congruent BCTs relevant to each of the 6 key TDF domains and provided examples of intervention components delivered using theoretically congruent BCTs. This was complemented by information gathered from research evidence which suggested other ways in which barriers could be addressed. This included intervention components mostly using theoretically congruent BCTs and other BCTs used in research interventions relevant to the barrier. Non-theoretically congruent BCTs were also included on occasion where they addressed the relevant barriers. This is important to note as matrices comparing BCTs and TDF domains are still in development and examples of these pairings could be informative for this work. The list of intervention components comprised suggestions for both stand-alone interventions and intervention components which could be added within national interventions.

2. Stakeholder focus group and expert feedback

Key stakeholders were identified by members of the project steering group; these were health care professionals with an interest and expertise in managing CAUTI in primary or community care, secondary care and care home settings. Stakeholders were invited to attend a 3-hour focus group by email from a member of the research team and queries were answered by email and telephone. Stakeholders attended a face to face meeting in London.

The list of potential intervention components was presented to stakeholders as well as descriptions of the 11 national interventions. The list of intervention components comprised suggestions for both stand-alone interventions and intervention components which could be

added within existing interventions. Stakeholders discussed the interventions and suggested amendments and additions to the list of intervention components. Following the stakeholder focus group, the list of intervention components was further refined by the research team and project steering group. The project steering group included members who were experts in the subject area and individuals who had experience in influencing national policy.

3. Stakeholder survey

We designed a survey to get further feedback from stakeholders on the list of intervention components. The survey asked about 2 aspects: whether intervention components were a) relevant to a primary care, secondary care and care homes and b) suitable for implementation in these settings. We assessed whether an intervention component was suitable for implementation by asking participants to answer questions based on the APEASE criteria:

- affordability ('is it affordable?')
- practicability ('can it be delivered easily'?)
- effectiveness and cost effectiveness ('will it be effective in reducing cauti?')
- acceptability ('would it be acceptable to staff?')
- side effects and safety ('is it safe to implement?')
- equity ('will it avoid inequalities in patient care?').

The survey was designed and delivered using Survey Monkey software. Stakeholders previously identified by the project steering group were invited to respond to the survey. Three further stakeholders were invited based on additional suggestions from the steering group. Participants were invited via email providing them with brief information about the survey and a link to completing it online.

Data analysis

Survey responses were collected using Survey Monkey software. We identified how many participants answered any statement for each of the 3 settings (primary care, secondary care and care home settings) to work out the denominator response for each setting. For each of the intervention components, we recorded the proportion of stakeholders who deemed it relevant for each healthcare setting (based on the denominator for that setting). When an intervention component which was deemed relevant to a setting, we calculated the total APEASE score. We also calculated the percentage of the maximum possible APEASE score for each intervention component. Maximum score was calculated by taking the denominator for each setting and multiplying by 6 (number of APEASE criteria). This was based on the denominator for each setting to aid comparison between intervention components in each setting.

Prioritisation of intervention components

In order to prioritise the intervention components for each setting, intervention components had to meet 2 criteria:

1. At least 50% of stakeholders who responded for a setting deemed this intervention component to be relevant.
2. The intervention component scored at least 60% of the maximum APEASE score.

These thresholds were decided by the research team. This provided a final list of the most promising intervention components for each of the 3 healthcare settings.

Methods for RQ5

Study design

We used behavioural science tools to:

1. Identify theoretical congruence between influences on behaviour (TDF domains) and intervention content (BCTs) of each national intervention individually. The previous report did this for the interventions as a group only.
2. Identify intervention functions present in national interventions targeting key influences on behaviour (opportunity seized) and additional intervention functions not present in national interventions able to target key influences on behaviours (opportunity missed).

Data analysis

1. Theoretical congruence between influence on behaviour and intervention content

We applied a matrix prepared as part of the previous CAUTI report (7) that included the BCT by TDF pairings to investigate the level of theoretical congruence between the content of national interventions and the published literature on factors influencing behaviours related to CAUTI (Appendix C). To achieve this, for each BCT identified in a national intervention, we consulted the TDF by BCT matrix to see which domains it was paired with. We then looked at findings from the previous CAUTI report (7) to see whether the domain(s) the BCT was paired with was classified as a key domain (that is, a key influence on HCP CAUTI related behaviour). BCTs were then classified as having either:

- low congruence: BCT is not paired with any of the 6 key domains identified as key
- medium congruence: BCT is paired with at least one domain identified as key
- high congruence: BCT is paired with 2 or more domains identified as key

This method established the extent of redundancy in national interventions, that is, whether or not they contained BCTs which did not target key influences on CAUTI-related behaviours.

Identification of intervention functions and policy categories in national interventions
In addition to investigating the extent to which BCTs identified in interventions were linked to key domains (Step 1), we also sought to establish, of the key domains identified in the systematic review, which potentially relevant intervention content (functions) were suggested in

the matrix. If functions suggested by the matrix are not identified in national interventions, these represent missed opportunities for intervention design. We classified each potentially relevant function as:

- opportunity seized - instances where a theoretically congruent function (according to the COM-B and TDF by intervention function matrix (12)) was identified in a national intervention at least once
- missed opportunity – instances where the theoretically congruent intervention function was never identified in a national intervention

This method allowed us to determine the extent to which additional content could theoretically be added to existing content of national interventions to target key influences not currently targeted by intervention functions. After identifying intervention functions for each intervention we also used matrices to identify the policy categories served by each intervention.

Results

Results for RQ1 and RQ2

Summary of research studies

From our initial search, we identified 2 systematic reviews, containing 13 relevant studies; from our follow-up search we identified an additional 24 primary studies (13 to 49). In total, we identified 37 studies describing 37 interventions which met the inclusion criteria. Two studies were excluded as they did not measure CAUTI incidence or rate but only reported decrease in catheter use (50, 51). A flowchart showing the selection of included studies is in Appendix E. Thirty-five studies were conducted in secondary care. Of these, 32 were conducted in the US, 2 in the UK and 1 in Spain. Two studies were conducted in US nursing homes. No studies were conducted in primary or community care.

The 37 interventions were all multi-faceted interventions which contained a number of elements targeted at behaviours which could help reduce CAUTI. A detailed description of each intervention, including their components is presented in Appendix F. All interventions contained some sort of educational component for health professionals either in the form of evidence-based guidelines or training, occasionally including specific education days on CAUTI prevention. Many interventions contained protocols or audits for ward staff to follow, for example, nurse driven catheter removal protocol, daily ward rounds questioning need for continued catheter use). Some interventions included specific training for staff, for example, on catheter insertion techniques and some provided new equipment to staff including alternatives to catheters. Several interventions included amending the electronic medical record system, for example, a mandatory drop-down box listing appropriate indications for catheter, requiring the provider to select 1 before they could continue with the catheter order. Lastly some interventions included the appointment of a unit-based clinical nurse champion for appropriate catheter use.

Content of the research interventions

Research interventions used a wide range of BCTs and intervention functions and targeted all key TDF domains. Nine interventions targeted all behavioural phases in catheter care: pre-insertion (for example, nurse education about alternatives to catheters), insertion (for example, training on sterile insertion techniques), maintenance (for example, checklists for nurses about appropriate catheter care including positioning of catheter bag) and removal (for example, prompts for healthcare professionals to check catheter removal date). The majority focused on behaviours related to pre-insertion (30 interventions) and removal of catheters (28 interventions). Appendix G shows the BCTs, intervention functions, policy categories and TDF domains identified in each intervention.

Intervention functions and policy categories identified

The mean number of intervention functions per research intervention was 3.3 (an intervention could be coded as serving more than one function). All interventions served the function of Education (for example, healthcare professionals being provided with information about new procedures in catheter care). Interventions also served the following functions:

- Enablement (31 interventions; for example, being provided with support from senior staff or peers in order to reduce number of inserted catheters)
- Environmental restructuring (25 interventions; for example, provision of bladder scanners or standardised catheters across the hospital)
- Training (22 interventions; provision of face-to-face or online workshops on appropriate catheter insertion technique)
- Persuasion (6 interventions; for example, senior staff approving changes to catheter management and endorsing consideration of catheter alternatives on a daily basis)
- Incentivisation (5 interventions; for example, healthcare professionals rewarded for their efforts in reducing CAUTI with financial incentives)
- Modelling (3 interventions; for example, staff nurses being employed as peer educators and mentors)

None of the research interventions served the functions of Coercion or Restriction.

The mean number of policy categories per research intervention was 1.9. The most frequently identified policy category was Service provision (36 interventions; for example, implementing clinical champions programmes) followed by Guidelines (17 interventions; for example, provision of local protocols and guidelines to managing catheters) and Communication or marketing (17 interventions; for example, delivering webinars about importance of prevention of CAUTI). None of the interventions served the policy categories of Fiscal measures, Regulation, Legislation or Environmental or social planning.

BCTs identified

Twenty-seven BCTs were identified across 37 research interventions. The mean number of BCTs per intervention was 6.9. The most frequently identified BCTs were ‘Instruction on how to perform a behaviour’ (36 interventions; for example, instruction on cleaning patient prior to catheter insertion), followed by ‘Feedback on behaviour’ (27 interventions; for example, nurses being provided with feedback about their knowledge of clinical indications for catheters insertion), ‘Adding objects to the environment’ (22 interventions; for example, implementation of new catheter insertion kits) and ‘Demonstration of behaviour’ (17 interventions; nurses training on appropriate insertion technique including demonstration on mannequins). Appendix H shows the frequency of policy categories, intervention functions and BCTs in both research and national interventions.

TDF domains identified

Research interventions targeted 8 Theoretical Domains Framework (TDF) domains. These were:

- Knowledge
- Environmental Context and Resources
- Memory, Attention and Decision Making
- Social Influences
- Social Professional Role and Identity
- Beliefs about Consequences
- Skills
- Goals

The first 6 of these domains had been identified as key influences on healthcare professionals' behaviour. The mean number of targeted TDF domains per intervention was 4.2. The most frequently targeted TDF domains were Skills (37 interventions), Knowledge (31 interventions) and Environmental Context and Resources (30 interventions). Two of these (Knowledge and Environmental Context and Resources) were key TDF domains.

Results for RQ3

High congruence was defined as a BCT being paired with 2 or more of the 6 key TDF domains, medium congruence was defined as a BCT being paired with at least one key TDF domain, and low congruence was defined as a BCT not being paired with any of the key TDF domains. Of the 27 BCTs identified in the research interventions, 10 BCTs had high theoretical congruence, 8 had medium congruence and 9 had low congruence with the 6 key TDF domains representing the barriers and facilitators to behaviour (Appendix I).

Table 2 shows the frequency of all theoretically congruent BCTs paired with the 6 key TDF domains (according to the matrix in the previous CAUTI report, Appendix C) for both research and, as per the previous report, national interventions. The research interventions contained BCTs which were paired with 4 of the 6 key TDF domains: Environmental Context and Resources (66%), Social Influences (70%), Memory, Attention and Decision Making (75%) and Social Professional Role and Identity (100%). For the other 2 domains (Knowledge and Beliefs about Consequences) associated BCTs were used less frequently (less than 60%).

Table 2. Opportunities for intervention design: the frequency with which theoretically congruent BCTs were used in national and research interventions

TDF domain	All BCTs paired with key TDF domain as per predefined matrix (7)	BCTs included in national interventions, with frequency in brackets (maximum possible frequency is 11)	% Potential relevant BCTs used at least once	BCTs included in research interventions, with frequency in brackets (maximum possible frequency is 37)	% potential relevant bcts used at least once
Environmental Context and Resources	• Restructuring the physical environment • Discriminative (learned) cue • Prompts or cues • Avoidance or changing exposure to the cues for the behaviour • Adding objects to the environment • Restructuring the social environment	• Prompts or cues (1) • Restructuring the social environment (1)	33%	• Restructuring the physical environment (6) • Prompts or cues (15) • Adding objects to the environment (22) • Restructuring the social environment (8)	66%
Knowledge	• Information on health consequences • Biofeedback • Antecedents • Feedback on behaviour • Information on social and environmental consequences • Information about emotional consequences • Salience of consequences	• Information on health consequences (9) • Feedback on behaviour (3) • Information on social and environmental consequences (4) • Information about emotional consequences (1)	57%	• Information on health consequences (7) • Feedback on behaviour (27) • Information about emotional consequences (3) • Saleince of consequences (2)	57%
Beliefs about Consequences	• Information about emotional consequences • Salience of consequences • Covert sensitisation • Anticipated regret • Information about social and environmental consequences • Pros and cons • Vicarious reinforcement • Threat • Comparative imaging of future outcomes • Self-monitoring of behaviour • Self-monitoring of outcome of behaviour • Information on health consequences • Feedback on behaviour • Biofeedback • Feedback on outcome of behaviour	• Information about emotional consequences (1) • Information about social and environmental consequences (4) • Self-monitoring of behaviour (5) • Self monitoring of outcome of behaviour (3) • Information on health consequences (9) • Feedback on behaviour (3) • Feedback on outcome of behaviour (3) • Persuasive communication (credible source) (3)	50%	• Information about emotional consequences (3) • Salience of consequences (2) • Self-monitoring of behaviour (8) • Information on health consequences (7) • Feedback on behaviour (27) • Feedback on outcome of behaviour (13) • Persuasive communication (credible source) (7)	43%

TDF domain	All BCTs paired with key TDF domain as per predefined matrix (7)	BCTs included in national interventions, with frequency in brackets (maximum possible frequency is 11)	% Potential relevant BCTs used at least once	BCTs included in research interventions, with frequency in brackets (maximum possible frequency is 37)	% potential relevant bcts used at least once
	• Persuasive communication (credible source)				
Social Influences	• Social comparison • Social support unspecified • Social support emotional • Social support practical • Information about others approval • Vicarious consequences or reinforcement • Restructuring the social environment • Identification of self as a model • Social reward • Demonstration of behaviour	• Social comparison (1) • Social support practical (4) • Restructuring the social environment (1) • Identification of self as a model (1) • Demonstration of behaviour (3)	50%	• Social support unspecified (3) • Social support emotional (1) • Social support practical (13) • Information about others approval (5) • Restructuring the social environment (8) • Social reward (4) • Demonstration of the behaviour (17)	70%
Memory, Attention and Decision Making	• Self-monitoring of behaviour • Self-monitoring of outcome of behaviour • Action planning • Prompt and cues	• Self-monitoring of behaviour (5) • Self-monitoring of outcome of behaviour (3) • Action planning (1) • Prompt and cues (1)	100%	• Self-monitoring of behaviour (8) • Self-monitoring of outcome of behaviour (9) • Prompts and cues (15)	75%
Social Professional Role and Identity	• Social support unspecified • Social support emotional • Social support practical	• Social support practical (4)	33%	• Social support unspecified (3) • Social support emotional (1) • Social support practical (13)	100%

Appendix J shows whether the intervention functions identified in the research interventions appropriately targeted the 6 key TDF domains. According to the matrix mapping BCW against TDF (12), all 6 key TDF domains were targeted by at least one intervention function. The intervention function 'Restriction' was not used in any intervention and therefore did not target the associated key TDF domains 'Social Influences' and 'Environmental Context and Resources'.

Appendix K shows whether intervention functions identified in research interventions were delivered through policy categories suggested by the BCW intervention function or policy category matrix (12). All identified intervention functions were delivered through at least one policy category suggested by the matrix. Policy categories of Regulation, Fiscal measures, Legislation and Environmental or social planning were not used in any of the research interventions.

Comparison with national interventions

The 6 key TDF domains were targeted to a greater extent in the 37 research interventions than in the 11 national interventions although there were a greater number of research interventions reviewed. In research interventions, BCTs paired with 4 of the 6 key TDF domains: Environmental Context and Resources; Social Influences; Memory, Attention and Decision Making; and Social Professional Role and Identity were used frequently (more than 60%). In comparison with national interventions, BCTs paired with only one of the domains (Memory, Attention and Decision Making (100%) were used frequently (Table 2). All other BCTs were used less frequently meaning that national interventions did not target any of the key influences on behaviour with more than 60% of appropriate BCTs aside from the aforementioned Memory, Attention and Decision-Making domain.

Below, we present a narrative summary to what extent the key TDF domains were addressed by national and research interventions. The summarised list of most frequent barriers and facilitators previously identified (7) is presented in Appendix D. For the research interventions authors mostly had to infer which barriers and facilitators to CAUTI related behaviour were being addressed by interventions components as research publications did not often explicitly mention influences on behaviour. This was done when identifying BCTs within research interventions. This was not possible for national interventions as the authors did not have detailed information on the BCT content of each national intervention in order to match this with barriers and facilitators. In order to get this information researchers would need to look at the intervention content of each of the 11 national interventions and match each BCT identified with a barrier or facilitator. Examples are provided in RQ5.

Environmental Context and Resources

National interventions used only 2 theoretically congruent BCTs: 'Prompts and Cues' and 'Restructuring the social environment' to address key influences on healthcare professional behaviour in this TDF domain. Research interventions used 4 theoretically congruent BCTs

('Restructuring the physical environment', 'Prompts and cues', 'Adding objects to the environment' and 'Restructuring the social environment').

Research interventions addressed 4 out of 5 barriers related to this domain: inconsistent documentation; transitions of care; unavailability of medical alternatives; and choice and availability of catheters. The fifth barrier of lack of time to perform alternatives was not addressed by research interventions. Research interventions addressed the barrier of inconsistent documentation by using the BCT of 'Prompts and cues', which was delivered as various types of reminders (for example, electronic, paper-based, stickers on patient notes) for clinicians to review the catheter (usually on a daily basis). Research interventions also used BCT of 'Restructuring the social environment' delivered as creating a rule for staff transferring and receiving patients or ensuring that departments work together when transferring patients, in order to address the barrier of transitions of care. Research interventions also addressed the barriers of unavailability of medical alternatives to urinary catheterisation and choice and availability of catheters by using BCTs not used in national interventions such as 'Adding objects to the environment' and 'Restructuring the physical environment' which were delivered as introducing bladder scanners, creating bath kits, or providing a new type of catheters and alternatives to catheter products, often supplemented by staff education and training on using these alternatives.

Knowledge

National interventions used 4 theoretically congruent BCTs: 'Information on health consequences', 'Feedback on behaviour', 'Information on social or environmental consequences' and 'Information about emotional consequences' to address key influences in this TDF domain. Research interventions used 4 theoretically congruent BCTs ('Information on health consequences', 'Feedback on behaviour', Information about emotional consequences, and Salience of consequences).

Research interventions addressed all 4 barriers related to this domain: lack of knowledge about guidelines and specific procedures; lack of knowledge about risks of use of urinary catheters; lack of information regarding placement and duration of catheter insertion; and lack of knowledge of how to manage patients without catheters. Research interventions used the BCTs of 'Information about health consequences' and 'Instruction how to perform behaviour' to target the barrier of lack of knowledge about guidelines and specific procedures, which was mainly related to appropriate insertion technique and catheter maintenance, use of bladder scanners or measuring urine output of catheters. Research interventions also addressed the barrier of lack of knowledge about the risks of use of urinary catheters by using the following BCTs: 'Information about emotional consequences' and 'Salience of consequences' delivered, for example, by providing staff with reasons for a new approach in managing catheters, risks associated with catheters and patient benefits of not using catheters. Finally, research interventions also addressed the barrier of lack of knowledge of how to manage patients without catheters by using BCTs of 'Information about health consequences', complemented by 'Adding objects to the environment', often delivered by providing evidence-based protocols for bladder

scanners or educating staff about indications for catheter use and alternatives (these issues also overlap with the domain Environmental Context and Resources discussed above).

Beliefs about Consequences

National interventions used 8 theoretically congruent BCTs to address key influences in this TDF domain: 'Information about emotional consequences', 'Information about social or environmental consequences', 'Self-monitoring of behaviour', 'Self-monitoring of outcome of behaviour', 'Information on health consequences', 'Feedback on behaviour', 'Feedback on outcome of behaviour', and 'Persuasive communication (credible source)'. Research interventions used 7 theoretically congruent BCTs, 6 of which were the same as the ones used in national interventions (did not use 'Self-monitoring of outcome of behaviour'). They have used one additional BCT: 'Salience of consequences'.

Research interventions addressed 3 out of 4 barriers related to this domain: catheterising for convenience; perceived severity of CAUTI; and lack of perceived benefits to interventions targeting CAUTI'. They did not address the barrier of pros and cons of reusable catheters. Research interventions used the BCTs of 'Feedback on behaviour' and 'Feedback on outcome of behaviour' to address the barrier of catheterising for convenience and risks of using catheters. They also used the BCTs of 'Information about emotional consequences' and 'Salience of consequences' to highlight, for example, the importance of appropriate catheter care and delivering high quality care for patients. This was sometimes complemented by the use of the BCT 'Credible source', delivered by endorsement of these messages by senior members of staff (for example, Chief Medical Officer).

Social Influences

National interventions used 5 theoretically congruent BCTs: 'Social comparison', 'Social support practical', 'Restructuring the social environment', 'Identification of self as a model' and 'Demonstration of behaviour'. Research interventions used 7 theoretically congruent BCTs: 'Social support unspecified', 'Social support emotional', 'Social support practical', 'Information about others approval', 'Restructuring the social environment', 'Social reward' and 'Demonstration of behaviour'.

Research interventions addressed 2 out of 4 barriers related to this domain: lack of peer support and buy-in; and physicians dictating nurses' practice. They did not address 2 other barriers: requests from patients and their carers; and cultural norms regarding catheterisation. Research interventions often addressed the barrier of physicians dictating nurse practice by using the BCT of 'Restructuring the social environment' delivered as implementing protocols allowing nurses to remove catheter without clinician's order. They also addressed the barrier of achieving staff buy-in by using the BCT 'Social support practical' delivered as, for example, having quality champions among nurses or physicians responsible for creating and distributing education materials to healthcare professionals, or providing advice.

Memory, Attention and Decision Making

National interventions used all 4 theoretically congruent BCTs: ‘Self-monitoring of behaviour’, ‘Self-monitoring of outcome of behaviour’, ‘Action planning’ and ‘Prompt and cues’. Research interventions used 3 theoretically congruent BCTs: Self-monitoring of behaviour’, ‘Action planning’ and ‘Prompt and cues’.

Research interventions addressed 2 of the 3 barriers in this domain: pre-emptively catheterising patients; and catheterisation based on non-medical criteria. They did not address the barrier of absence of standardised CAUTI diagnostic criteria. Research interventions used the BCTs of ‘Action planning’ and ‘Prompts and cues’ frequently to address the barrier of catheterisation based on non-medical criteria and the barrier of pre-emptively catheterising patients. ‘Action planning’ was often delivered as a requirement for a specific activity to be performed by nurses or clinicians in a pre-specified time period, for example, conducting a nurse round every 4 hours to check on the need for a catheter. ‘Prompts and cues’ was delivered by asking or reminding staff about criteria for catheter use, by prompting use of a drop-down selection list, or by providing reminders from others.

Social Professional Role and Identity

National interventions used only one theoretically congruent BCT: ‘Social support practical’. Research interventions used all 3 theoretically congruent BCTs: ‘Social support unspecified’, ‘Social support emotional’ and ‘Social support practical’.

Research interventions addressed both of the barriers in this domain: staff accepting responsibility for decision making; and CAUTI guidelines not perceived as relevant. Research interventions addressed the barrier of staff accepting responsibility for decision making by using the BCT of ‘Social support’ delivered as implementation of quality champion programmes providing education to peers, addressing staff concerns and providing reassurance. The barrier of recognising the relevance of CAUTI guidelines to a particular environment was addressed by creating specific hospital guidelines and protocols, and active strategies for ensuring that staff were aware of them.

Results for RQ4

Development of a list of intervention components

The national interventions to some extent addressed all the 6 key TDF domains, which were (Table 2):

- Environmental Context and Resources
- Knowledge
- Beliefs about Consequences
- Social Influences

- Memory, Attention and Decision Making
- Social Professional Role and Identity

All the relevant BCTs were used within the domain Memory, Attention and Decision Making and 33% to 57% of relevant BCTs were used in the remaining 5 domains. As we did not have information on the specific barriers interventions were addressing we concentrated on all 6 key TDF domains to ensure that any relevant content from research interventions was considered.

We developed a list of 39 potential intervention components for the 6 TDF domains, representing key influences on healthcare professional behaviours. This list was based on the previous CAUTI report (5) and the information gathered from the research interventions. The list of intervention components comprised suggestions for both stand-alone interventions and intervention components which could be added within national interventions. The list of intervention components is presented in Appendix L.

Stakeholder focus group and expert feedback

Twenty stakeholders were invited to the workshop and 14 indicated willingness to participate (70% response rate). Twelve stakeholders attended a focus group to provide feedback on the suggested intervention components. Feedback was also gathered from 2 more stakeholders over the telephone. Stakeholders represented the 3 settings: secondary care (n=7); primary and community care (n=4); and care homes (n=3).

Stakeholders provided feedback on the list of intervention components by making suggestions about adding or removing components and also proposing new intervention components. Some of their suggestions for intervention component addressed barriers which were not in the 6 key TDF domains or did not use theoretically congruent BCTs. A summary of their feedback is presented in Appendix M and Appendix N. Based on their feedback, the list of intervention components was further refined by the immediate research team, and then by the project steering group. This resulted in a final list of 20 intervention components. The vast majority of the intervention components addressed the 6 key TDF domains, using theoretically congruent BCTs to address the missed opportunities within national CAUTI interventions. Other intervention components were included where stakeholders and the project team felt strongly that they would be beneficial to practice. Appendix O provides the final list of intervention components included in the survey which was the next step.

Results from stakeholder survey

Twenty-three stakeholders were invited to complete the survey and 14 completed it (60% response rate). Responses were anonymous. Five represented secondary care, 5 represented primary or community care and 6 represented care homes.

All intervention components were deemed relevant to all 3 settings by at least 4 participants. Appendices P, R and S provide scores for all intervention components for each of the 3 settings.

Eleven participants rated intervention components for their relevance to primary or community care. Between 6 (54%) and 11 (100%) participants deemed each intervention component relevant. The average APEASE score was 34 out of 66 (range 22 to 48), which represented 33% to 72% of the maximum possible score for 11 respondents.

Nine participants rated intervention components for their relevance to secondary care. Between 5 (55%) and 9 (100%) participants deemed each intervention component relevant. The average APEASE score was 30 out of 54 (range 19 to 37), which represented 35% to 68% of the maximum possible score for 9 respondents.

Ten participants rated intervention components for the relevance to care homes. Between 4 (40%) and 9 (90%) participants deemed each intervention component relevant. The average APEASE score was 30 out of 60 (range 15 to 47), which represented 25 to 78% of the maximum possible score for 10 respondents.

Identification of the most promising intervention components for each setting

Overall, 7 out of 20 intervention components met the prioritisation criteria ((a) at least 50% of stakeholders who responded deemed this intervention component to be relevant to the setting; b) the intervention component scored at least 60% of the maximum APEASE score). Three out of 16 intervention components met the prioritisation criteria for primary or community care; 6 out of 18 intervention components met the prioritisation criteria for secondary care, and 4 out of 14 intervention components met the prioritisation criteria for care homes (Table 3, below). Two of the intervention components met the prioritisation criteria across all 3 settings, 2 intervention components met the prioritisation criteria in 2 settings, and 3 interventions met the prioritisation criteria for a single setting. Appendix T provides a list of excluded intervention components.

Table 3. Overview of prioritised intervention components

Intervention component	Primary and community care	Secondary care	Care homes
Creating the rule that staff transferring catheterised patients to another setting, check or review the need for a catheter with the receiving team. This rule could be prompted by a checklist for discharge or admission of patients to another setting	✓	✓	✓
Before inserting catheters, staff are required to inform patients and relatives about pros and cons of catheters, risks associated with catheter use, including sepsis and antibiotic resistance as well as the importance of hydration (with or without written resources) and record that this has been explained to patients.	✓	✓	✓
Ensure availability of setting and profession specific guidelines which are in agreement and which include examples of how to adapt to local contexts where possible.	✓	✓	
Standardised nationwide computer-based documentation, accessible across healthcare sectors, requiring person initiating urinary catheterisation to insert details such as date of catheter insertion, reason for catheterisation, an action plan for review and removal and details of difficult catheterisation (if relevant). Provided when transferring patients across settings.		✓	✓
Intervention to persuade staff of benefits of not using catheters for both patients (for example, loss of mobility, bed sores, lower risk of infection) and staff (for example, fewer patients developing infection, improved patient outcomes, lower costs). Reassure staff that not using catheters does not lead to suboptimal care and reframing severity of CAUTI as patient safety issue with a story of a patient who contracted CAUTI.			✓
Introduction of ‘CAUTI Champions’ (nurses and doctors). Champions role model how to manage patient and carer requests for catheter, lead on staff education and provide practical support for colleagues wanting to support patients to TWOC (trial without catheter		✓	

Intervention component	Primary and community care	Secondary care	Care homes
Provision of bladder scanners, accompanied by staff training on how to use scanners, to aid decisions in relation to problems with urinary retention.		✓	

Prioritised intervention components and missed opportunities

We assessed how well the intervention components prioritised by stakeholders addressed previously identified barriers. Table 4 lists the 22 most frequent barriers identified in the previous CAUTI report and shows which were addressed by the prioritised intervention components. We did not consider facilitators to behaviour here but did count any influence which could be considered a barrier or a facilitator.

Table 4. Overview of most frequently reported barriers addressed and not addressed by prioritised intervention components

TDF domain	Barrier	Addressed by prioritised intervention components
Environmental Context and Resources	Limited and inconsistent documentation and records	Standardised nationwide computer-based documentation, accessible across healthcare sectors, requiring person initiating urinary catheterisation to insert details such as date of catheter insertion, reason for catheterisation, an action plan for review and removal and details of difficult catheterisation (if relevant). Provided when transferring patients across settings.
Environmental Context and Resources	Transitions of care	Standardised nationwide computer-based documentation, accessible across healthcare sectors, requiring person initiating urinary catheterisation to insert details such as date of catheter insertion, reason for catheterisation, an action plan for review and removal and details of difficult catheterisation (if relevant). Provided when transferring patients across settings.

TDF domain	Barrier	Addressed by prioritised intervention components
Environmental Context and Resources	Transitions of care	Creating the rule that staff transferring catheterised patients to another setting, check or review the need for a catheter with the receiving team. This rule could be prompted by a checklist for discharge or admission of patients to another setting.
Environmental Context and Resources	Lack of time to perform alternatives to urinary catheterisation	Not included in survey as perceived to be unfeasible by stakeholders and steering group.
Environmental Context and Resources	Unavailability of medical alternatives to urinary catheterisation	Provision of bladder scanners, accompanied by staff training on how to use scanners, to aid decisions in relation to problems with urinary retention.
Environmental Context and Resources	Choice and availability of urinary catheters	Not included in survey as perceived to be unfeasible by steering group.
Knowledge	Lack of knowledge of clinical guidelines and local procedures	Ensure availability of setting and profession specific guidelines which are in agreement and which include examples of how to adapt to local contexts where possible.
Knowledge	Lack of information regarding placement and duration of catheter insertion	Standardised nationwide computer-based documentation, accessible across healthcare sectors, requiring person initiating urinary catheterisation to insert details such as date of catheter insertion, reason for catheterisation, an action plan for review and removal and details of difficult catheterisation (if relevant). Provided when transferring patients across settings.
Knowledge	Lack of awareness of the risks associated with use of urinary catheters	Intervention to persuade staff of benefits of not using catheters for both patients (for example, loss of mobility, bed sores, lower risk of infection) and staff (for example, fewer patients developing infection, improved patient outcomes, lower costs). Reassure staff that not using catheters does not lead to suboptimal care and reframing severity of CAUTI as patient safety issue with a story of a patient who contracted CAUTI.

TDF domain	Barrier	Addressed by prioritised intervention components
Knowledge	Lack of knowledge of how to manage patients without catheters	Provision of bladder scanners, accompanied by staff training on how to use scanners, to aid decisions in relation to problems with urinary retention.
Beliefs about Consequences	Convenience and ease of monitoring	Intervention to persuade staff of benefits of not using catheters for both patients (for example, loss of mobility, bed sores, lower risk of infection) and staff (for example, fewer patients developing infection, improved patient outcomes, lower costs). Reassure staff that not using catheters does not lead to suboptimal care and reframing severity of CAUTI as patient safety issue with a story of a patient who contracted CAUTI.
Beliefs about Consequences	Perceived severity of CAUTI	Intervention to persuade staff of benefits of not using catheters for both patients (for example, loss of mobility, bed sores, lower risk of infection) and staff (for example, fewer patients developing infection, improved patient outcomes, lower costs). Reassure staff that not using catheters does not lead to suboptimal care and reframing severity of CAUTI as patient safety issue with a story of a patient who contracted CAUTI.
Beliefs about Consequences	Lack of perceived benefits to interventions targeting CAUTI	Intervention to persuade staff of benefits of not using catheters for both patients (for example, loss of mobility, bed sores, lower risk of infection) and staff (for example, fewer patients developing infection, improved patient outcomes, lower costs). Reassure staff that not using catheters does not lead to suboptimal care and reframing severity of CAUTI as patient safety issue with a story of a patient who contracted CAUTI.
Beliefs about Consequences	Pros and cons of reusable catheters	Not included in survey as perceived to be unfeasible by steering group.
Social Influences	Requests from patients and their carers	Before inserting catheters, staff are required to inform patients and relatives about pros and cons of catheters, risks associated with catheter use, including sepsis and antibiotic resistance as well as the importance of hydration (with or without written resources) and record that this has been explained to patients.

TDF domain	Barrier	Addressed by prioritised intervention components
Social Influences	Lack of peer support and buy-in	Introduction of 'CAUTI Champions' (nurses and doctors). Champions role model how to manage patient or carer requests for catheter, lead on staff education and provide practical support for colleagues wanting to support patients to TWOC (trial without catheter).
Social Influences	Physicians dictate nurses' practice	Introduction of 'CAUTI Champions' (nurses and doctors). Champions role model how to manage patient or carer requests for catheter, lead on staff education and provide practical support for colleagues wanting to support patients to TWOC (trial without catheter).
Social Influences	Cultural norms regarding standard catheterisation practice for specific patient groups	Creating the rule that staff transferring catheterised patients to another setting, check or review the need for a catheter with the receiving team. This rule could be prompted by a checklist for discharge or admission of patients to another setting.
Memory, Attention and Decision Making	Pre-emptively deciding to insert catheters due to likely subsequent catheterisation	Creating the rule that staff transferring catheterised patients to another setting, check or review the need for a catheter with the receiving team. This rule could be prompted by a checklist for discharge or admission of patients to another setting.
Memory, Attention and Decision Making	Catheterisation decisions based on non-medical criteria	Not prioritised in the survey.
Memory, Attention and Decision Making	Absence of standard CAUTI diagnostic criteria to help decision making	Not prioritised in the survey.
Social Professional	Acceptance of responsibility for urinary	Not prioritised in the survey (relevant only to secondary care).

TDF domain	Barrier	Addressed by prioritised intervention components
Role and Identity	catheterisation decision making	
Social Professional Role and Identity	CAUTI guidelines not perceived as relevant across hospital departments or settings	Ensure availability of setting and profession specific guidelines which are in agreement and which include examples of how to adapt to local contexts where possible.

The previous CAUTI report identified 22 most frequently reported barriers (4 of which were both a barrier and a facilitator) across 6 key TDF domains (7). Sixteen out of 22 barriers were addressed by the prioritised intervention components. Six barriers were not addressed by prioritised intervention components; 3 because intervention components addressing these barriers were not prioritised by the survey participants and 3 because intervention components addressing these barriers were viewed as unfeasible by stakeholders or the steering group.

Table 5 shows the prioritised intervention components alongside the barriers addressed, TDF domains, BCTs and intervention functions used. The majority of prioritised intervention components used theoretically congruent BCTs and relevant intervention functions and all of them targeted the key TDF domains according to the literature review in the previous CAUTI report.

Table 5. Overview of prioritised intervention components and their content

Intervention component	Setting	Barrier addressed	Behavioural phase addressed	TDF domain represented	BCTs	Intervention function
Ensure availability of setting and profession specific guidelines which are in agreement and which include examples of how to adapt to local contexts where possible.	Primary and community; secondary care	CAUTI guidelines not perceived as relevant across hospital departments or settings	All	Social Professional Role and Identity	Adding objects to the environment, Restructuring the physical environment, Social support practical	Environmental restructuring; Enablement; Education
Creating the rule that staff transferring catheterised patients to another setting, check or review the need for a catheter with the receiving team. This rule could be prompted by a checklist for discharge and admission of patients to another setting.	Primary and community; secondary care; care homes	Transitions of care; Pre-emptively deciding to insert catheters due to likely subsequent catheterisation; Cultural norms regarding standard catheterisation practice for specific patient groups	Removal	Environmental Context and Resources, Memory, Attention and Decision Making, Social Influences	Restructuring the social environment, Prompts and cues, Action planning	Environmental restructuring; Enablement
Standardised nationwide computer-based documentation, accessible across healthcare sectors, requiring person initiating urinary catheterisation to insert details such as date of catheter insertion, reason for catheterisation, an action plan for review and removal and details of difficult catheterisation (if relevant). Provided when transferring patients across settings.	Secondary care; care homes	Limited and inconsistent documentation and records'; Transitions of care; Lack of information regarding placement and duration of catheter insertion	Insertion, removal	Environmental Context and Resources, Knowledge	Restructuring the physical environment, Prompts and cues, Action planning, Restructuring the social environment	Environmental restructuring; Enablement
Before inserting catheters, staff are required to inform patients and relatives about pros and cons of catheters, risks associated with catheter use, including sepsis and antibiotic resistance as well as the importance of hydration (with or without written resources) and record that this has been explained to patients	Primary and community care; secondary care; care homes	Requests from patients and their carers	Pre-insertion	Social Influences	Information about health consequences, Salience of consequences, Pros and cons.	Enablement; Persuasion
Intervention to persuade staff of benefits of not using catheters for both patients (efor example, loss of mobility, bed sores, lower risk of infection) and staff (for example, fewer patients developing infection, improved patient outcomes, lower costs). Reassure staff that not using catheters does not lead to suboptimal care and reframing severity of CAUTI as patient safety issue with a story of a patient who contracted CAUTI.	Care homes	Convenience and ease of monitoring; Perceived severity of CAUTI; Lack of perceived benefits to interventions targeting CAUTI; Lack of awareness of the risks associated with use of urinary catheters	Pre-insertion	Beliefs about Consequences, Knowledge	Information about health consequences, Salience of consequences, Information about emotional consequences, Social support unspecified, Anticipated regret	Education; Persuasion

Intervention component	Setting	Barrier addressed	Behavioural phase addressed	TDF domain represented	BCTs	Intervention function
Introduction of 'CAUTI Champions' (nurses and doctors). Champions role model how to manage patient or carer requests for catheter, lead on staff education and provide practical support for colleagues wanting to support patients to TWOC (trial without catheter).	Secondary care	Physicians dictate nurses' practice; Lack of peer support and buy-in	Pre-insertion, removal	Social Influences	Restructuring the social environment, Social support practical,	Enablement
Provision of bladder scanners, accompanied by staff training on how to use scanners, to aid decisions in relation to problems with urinary retention.	Secondary care	Unavailability of medical alternatives to urinary catheterisation; Lack of knowledge of how to manage patients without catheters	Pre-insertion	Environmental Context and Resources, Knowledge	Adding objects to the environment, Behavioural substitution, Instruction on how to perform a behaviour, Behavioural practice or rehearsal	Enablement; Environmental restructuring

Results for RQ5

Identification of theoretical congruence between influences on behaviour and intervention content of each national intervention

We assessed to what extent individual national interventions targeted key influences on CAUTI related behaviour. Appendices U and V provide a summary of BCTs and all linked key TDF domains for each of the national interventions. Below, we present a short narrative summary for each intervention.

HSC Act 2008 used 3 BCTs:

- 'Instruction on how to perform the behaviour'
- 'Monitoring of behaviour by others without feedback'
- 'Behavioural practice or rehearsal'

None of the BCTs targeted key influences on CAUTI-related behaviours.

NICE QS90 used 3 BCTs:

- 'Instruction on how to perform the behaviour'
- 'Information about health consequences'
- 'Goal setting behaviour'

Only one BCT ('Information about health consequences') targeted 2 key TDF domains: Knowledge and Beliefs about Consequences.

NICE QSG1 used 3 BCTs:

- 'Instruction on how to perform the behaviour'
- 'Information about health consequences'
- 'Goal setting behaviour'

Only one BCT ('Information about health consequences') targeted 2 key TDF domains: Knowledge and Beliefs about Consequences.

NICE Catheter Audit Tools used 11 BCTs; 4 BCTs did not target any of the key TDF domains:

- 'Goal setting behaviour'
- 'Instruction on how to perform a behaviour'
- 'Review behavioural goals'
- 'Discrepancy between behaviour and goal'

Two medium congruence BCTs ('Credible source' and 'Action planning') targeted one of the key TDF domains each (Beliefs about Consequences; and Memory, Attention and Decision Making respectively). This intervention also used 5 high congruence BCTs:

- 'Self–monitoring (behaviour)'
- 'Self-monitoring (outcomes)'
- 'Social support (practical)'
- 'Information about health consequences'
- 'Information about social environmental consequences'

Which together targeted 5 key TDF domains:

- Memory, attention and decision making
- Beliefs about consequences
- Social influences
- Social professional role and identity
- Knowledge

DH PHE 2013 used 4 BCTs:

- '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'

Only one BCT ('Information about health consequences') targeted 2 key TDF domains: Knowledge and Beliefs about Consequences.

Safety Thermometer used 9 BCTs; 2 of the BCTs ('Goal setting (outcome) and 'Reward (outcome)' did not target any of the key TDF domains. Two of the medium congruence BCTs ('Credible source' and 'Social comparison') targeted one of the key TDF domains each (Beliefs about Consequences and Social Influences, respectively).

This intervention also used 5 high congruence BCTs which together targeted 3 key TDF domains:

- Beliefs about Consequences
- Memory, Attention and Decision Making
- Knowledge

This meant the BCTs targeted 4 key TDF domains in total.

Epic 3 used 7 BCTs. One of the BCTs ('Instruction on how to perform the behaviour') did not target any of the TDF domains.

Six highly theoretically congruent BCTs together targeted all 6 key TDF domains:

- 'Self-monitoring (behaviour)'
- 'Information about Health Consequences'
- 'Social support practical'
- 'Prompts and cues'
- 'Feedback (behaviour)'
- 'Feedback (outcomes)'

High Impact Interventions used 8 BCTs. Two of the BCTs ('Goal setting behaviour', 'Discrepancy between behaviour and goal') did not target any of the key TDF domains. One medium theoretically congruent BCT ('Credible source') targeted one of the key TDF domains (Beliefs about Consequences).

This intervention also used 5 highly theoretically congruent BCTs which together targeted 3 key TDF domains:

- Beliefs about Consequences
- Knowledge
- Memory, Attention and Decision Making

Catheter care used 12 BCTs. Three of the BCTs did not target any of the key TDF domains:

- 'Instruction on how to perform a behaviour'
- 'Behavioural practice or rehearsal'
- 'Monitoring of behaviour by others without feedback'

Three medium congruence BCTs ('Credible source', 'Demonstration of the behaviour' and 'Identification of self as a role model') targeted 2 of the key TDF domains (Social Influences and Beliefs about Consequences).

This intervention also used 6 highly theoretically congruent BCTs:

- 'Social support (practical)'
- 'Self-monitoring (behaviour)'
- 'Self-monitoring (outcome)'
- 'Information on health consequences'
- 'Information on emotional consequences'
- 'Information on social and environmental consequences'

Which together targeted 5 key TDF domains:

- Social Influences
- Social Professional Role and Identity
- Beliefs about Consequences
- Knowledge
- Memory, Attention and Decision Making

HOUDINI used 2 BCTs. One of the BCTs ('Instruction on how to perform the behaviour') did not target any of the key TDF domains and the other highly congruent BCT ('Restructuring the social environment') targeted 2 key TDF domains: Social Influences; and Social Professional Role and Identity.

Catheter Passport used 4 BCTs. One of the BCTs ('Instruction on how to perform the behaviour') did not target any of the key TDF domains. One medium congruence BCT ('Demonstration of the behaviour') targeted one key TDF domain, 'Social Influences'. This intervention also used 2 highly theoretically congruent BCTs: 'Information about health consequences' and 'Social support practical' which together targeted 4 key TDF domains:

- Knowledge
- Beliefs about Consequences
- Social Influences
- Social Professional Role and Identity

Overall, at least half the BCTs identified in 7 interventions targeted key influences on healthcare professionals CAUTI–related behaviours. These were:

- NICE catheter audit tools
- Safety Thermometer
- EPIC 3
- High impact interventions
- Catheter care
- HOUDINI
- Catheter Passport

The relevant BCT content of the other 4 interventions was less than half: HSC Act 2008, NICE QS90, NICE QSG1 and DH PHE 2013.

Identification of intervention functions in national interventions

We assessed to what extent national interventions used intervention functions which targeted key influences on CAUTI related behaviour according to mapping matrices (12). Below, we present a narrative summary on each of the national interventions. Appendix W provides a summary of intervention functions and linked key TDF domains for each national intervention.

HSC Act 2008 targeted 5 key TDF domains using:

- education and training to target Knowledge and Memory, Attention and Decision Making but could also have used intervention function Enablement
- education to target Beliefs about Consequences and Social Professional Role and Identity but could also have used Persuasion, Incentivisation, Coercion and Modelling
- training to target Environmental Context and Resources but could have also used Restriction, Environmental Restructuring or Enablement

The key TDF domain of Social Influences was not targeted using any of the appropriate intervention functions.

NICE QS90 targeted 4 key TDF domains using:

- education to target Knowledge and Memory, Attention and Decision Making but could also have used Enablement and Training
- education to target Beliefs about Consequences and Social Professional Role and Identity but could also have used Persuasion, Incentivisation, Coercion and Modelling

The key TDF domains of Environmental Context and Resources and Social Influences were not targeted using any of the appropriate intervention functions.

NICE QSG1 targeted 4 key TDF domains using:

- education to target Knowledge and Memory, Attention and Decision Making but could also have used Enablement and Training
- education to target Beliefs about Consequences and Social Professional Role and Identity but could also have used Persuasion, Incentivisation, Coercion and Modelling

The key TDF domains of Environmental Context and Resources and Social Influences were not targeted using any of the appropriate intervention functions.

NICE Catheter Audit Tools targeted all 6 key TDF domains using:

- education and Enablement to target Knowledge and Memory, Attention and Decision Making but could also have used the intervention function Training
- enablement to target Environmental Context and Resources but could also have used Training, Restriction or Environmental Restructuring
- enablement to target social influences, but could also have used Restriction, Environmental Restructuring or Modelling

- education to target Beliefs about Consequences and social or professional role and identity but could also have used Persuasion, Incentivisation, Coercion or Modelling

DH PHE 2013 targeted 5 key TDF domains using:

- education and Training to target Knowledge and Memory, Attention and Decision Making but could also have used intervention function Enablement
- education to target Beliefs about Consequences and Social Professional Role and Identity but could also have used Persuasion, Coercion and Modelling
- training to target environmental context and resources but could also have used Restriction, Environmental Restructuring and Enablement

The key TDF domain of Social Influences was not targeted using any of the appropriate intervention functions.

Safety Thermometer targeted all 6 key TDF domains using:

- education and Enablement to target Knowledge and Memory, Attention and Decision Making but could also have used the intervention function Training
- enablement to target environmental context and resources but could also have used training, restriction or Environmental Restructuring
- enablement to target social influences, but could also have used Restriction, Environmental Restructuring or Modelling
- education and Incentivisation to target Beliefs about Consequences and Social Professional Role and Identity but could also have used Persuasion, Coercion and Modelling

EPIC 3 targeted all 6 key TDF domains using:

- education and Enablement to target Knowledge and Memory, Attention and Decision Making but could also have used the intervention function Training
- education to target Beliefs about Consequences and Social Professional Role and Identity but could also have used Persuasion, Incentivisation, Coercion and Modelling
- enablement to target Environmental Context and Resources but could also have used Training, Restriction or Environmental Restructuring
- enablement to target Social Influences, but could also have used Restriction, Environmental Restructuring or Modelling

High Impact targeted all 6 key TDF domains using:

- education, training and enablement to target Knowledge and Memory, Attention and Decision Making.

- 5education to target Beliefs about Consequences and Social Professional Role and Identity but could also have used Persuasion, Incentivisation, Coercion and Modelling
- training and enablement to target Environmental Context and Resources but could also have used Restriction and Environmental Restructuring.
- enablement to target social influences, but could also have used Restriction, Environmental Restructuring or Modelling

Catheter Care targeted all 6 key TDF domains using:

- education, training and enablement to target Knowledge and Memory, Attention and Decision Making
- training and enablement to target Environmental Context and Resources but could also have used Restriction and Environmental Restructuring.
- modelling and enablement to target Social Influences but could also have used Restriction and Environmental Restructuring
- education and modelling to target Beliefs about Consequences and Social Professional Role and Identity but could also have used Persuasion, Incentivisation and Coercion

HOUDINI targeted all 6 key TDF domains using:

- education and enablement to target Knowledge and Memory, Attention and Decision Making but could also have used the intervention function Training
- enablement to target environmental context and resources but could also have used training, Restriction or Environmental Restructuring
- enablement to target social influences, but could also have used Restriction, Environmental Restructuring or Modelling
- education to target Beliefs about Consequences and Social Professional Role and Identity but could also have used Persuasion, Incentivisation Coercion and Modelling

Catheter Passport targeted all 6 key TDF domains using:

- education and enablement to target Knowledge and Memory, Attention and Decision Making but could also have used the intervention function Training
- enablement to target Environmental Context and Resources but could also have used Training, Restriction or Environmental Restructuring
- modelling and enablement to target social influences, but could also have used Restriction, and Environmental Restructuring
- modelling and education to target Beliefs about Consequences and Social Professional Role and Identity but could also have used Persuasion, Incentivisation, and Coercion

Overall, each of the 11 interventions appeared to be using intervention functions which were appropriate for targeting the key domains. Seven of the interventions used intervention functions which targeted all 6 domains and therefore do not need further refinement of intervention functions. Four of the interventions used interventions functions which only targeted 4 or 5 of the 6 domains. This analysis does not conclude that all functions should definitely have been included in interventions but, where interventions may be performing sub-optimally, may signpost to other theoretically relevant functions to explore when refining interventions.

Each intervention was assessed based on its BCT content and use of intervention functions. It is important to highlight that certain interventions appeared to target fewer domains when looking at their BCT content compared to the intervention functions they used. This is because analysis is based on matrices pairing BCTs with TDF domains, and intervention functions with TDF domains. It is likely to be the BCT content which is of most importance when determining whether interventions are addressing relevant influences on behaviour and we would recommend assessing interventions based on BCT content rather than intervention function.

Appendix W also provides summary tables for each of the 11 interventions linking intervention functions used and policy categories. Here each intervention is seen to use one policy category with 9 interventions being delivered as guidelines, one intervention being delivered as service provision (Safety Thermometer) and one intervention being delivered as Legislation (HSC Act 2008). Each national intervention is shown to use a relevant policy category although any new interventions may want to consider using different policy categories not already covered by the 11 interventions listed here.

The previous CAUTI report did not gather information on the specific barriers addressed by each of the 11 national interventions and this analysis was not within the scope of the current project however we present 2 examples to indicate what additional analyses may provide.

To provide more detail on the extent to which national interventions target key domains. Table 6 shows raw data extracted from 2 interventions, Catheter Care and HOUDINI. The raw data presented here is a selection of data presented as an example. The data have been grouped according to the BCT they deliver and, where relevant, influences within key domains are attached to excerpts to indicate the influences targeted by the intervention. The influences listed in Table 6 are taken from a full list of all influences on CAUTI-related behaviour from the previous CAUTI report and consist of 50 influences including 35 barriers. This list is a more comprehensive version than the one used earlier in this report which only considered the most frequent influences on behaviour which included 22 barriers. This full list is provided in Appendix X.

As expected, for BCTs judged as having high theoretical congruence, for example, ‘Self-monitoring (behaviour)’ and ‘Information about health consequences’. At least 3 themes (barriers) within key domains are targeted by the data. For BCTs judged to have low theoretical congruence, the raw data did not target any themes (barriers) within key domains.

At a broad level for these 2 interventions we can conclude that as well as being theoretically congruent (the extent to which BCTs target theoretically relevant TDF domains), overall the BCTs are thematically congruent (that is, they target specific themes (barriers) identified within domains). However, there are some exceptions. For example, the BCT ‘Demonstration of the behaviour’ is delivered in Catheter Care as “observe model or manikin being catheterised” and “observe catheterisation performed by others on actual patients.” Whilst this BCT is linked to the key domain, Social Influences, the way it is delivered in this intervention indicates it relates more to Increasing Skills, a domain to which this BCT is also linked. So, whilst it is theoretically congruent, it is not thematically congruent.

This analysis shows that analysing theoretical congruence (the extent to which BCTs target theoretically relevant influences on behaviour) at the domain level is helpful at a broad level in highlighting the extent to which nationally adopted interventions target key influences on behaviour but analysis at the thematic level (rather than theoretical domain level) can provide greater detail.

Table 6. The extent to which nationally adopted interventions target themes within key domains: the examples of Catheter Care and HOUDINI (themes are derived from previous report and appendix)

Intervention	BCT (Theoretical congruence)	How BCT is delivered (Text within brackets ending in [x] are themes judged to be targeted by the intervention)	Key domains All themes within key domains (Themes ending in [x] are themes targeted by the intervention)
Catheter Care	Self-monitoring (behaviour) (High)	You need to record clearly, accurately, and correctly any relevant information in the ongoing catheter care records. (Adhering to guidelines improve patient care [x]). 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 (Convenience and ease of monitoring [x]). Drainage equipment documentation should include any problems related to lifestyle or daily activities (Patient safety and injury [x]).	Beliefs about Consequences: • convenience and ease of monitoring [x] • perceived severity of CAUTI • lack of perceived benefits to interventions targeting CAUTI • patient safety and injury [x] • improved patient hygiene • avoiding damage to medical equipment • adhering to guidelines improve patient care [x] • certain types of infections are more harmful than others in catheterised patients • pros and cons of reusable catheters
Catheter Care	Self-monitoring (outcomes behaviour) (High)	Ongoing observations documentation should include, if a problem occurs: the health status of the patient (well or unwell or seriously ill), if the patient febrile, temperature (over 39°C, are blood	Beliefs about Consequences:

Intervention	BCT (Theoretical congruence)	How BCT is delivered (Text within brackets ending in [x] are themes judged to be targeted by the intervention)	Key domains All themes within key domains (Themes ending in [x] are themes targeted by the intervention)
		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 (Patient safety and injury [x]), if the individual patient in any form of discomfort or pain (Patient safety and injury [x]).	• convenience and ease of monitoring • perceived severity of CAUTI • lack of perceived benefits to interventions targeting CAUTI • patient safety and injury [x] • improved patient hygiene • avoiding damage to medical equipment • adhering to guidelines improve patient care • certain types of infections are more harmful than others in catheterised patients • pros and cons of reusable catheters
Catheter Care	Social support (practical) (High)	Undertake supervised catheterisation on actual patients (this relates more to increasing Beliefs about Capabilities (which this BCT is also linked to and which is not a key domain) rather than the key domains this BCT needs to target which are Social Influences and Social professional role and identity [x]).	Social Influences: • requests from patients and their carers • lack of peer support and buy-in • physicians dictate nurses' practice

Intervention	**BCT** **(Theoretical congruence)**	**How BCT is delivered** **(Text within brackets ending in [x] are themes judged to be targeted by the intervention)**	**Key domains** **All themes within key domains (Themes ending in [x] are themes targeted by the intervention)**
			• cultural norms regarding standard catheterisation practice for specific patient groups • local champions • challenging unnecessary urinary catheterisation requests Social Professional Role and Identity: • having a hospital epidemiologist in post • acceptance of responsibility for urinary catheterisation decision making • CAUTI guidelines not perceived as relevant across • hospital departments • nurses leading change in urinary catheterisation practice
Catheter Care	Information about health consequences (High)	Some general principles relating to documentation apply. These include confidentiality, legibility and that documents can be photocopied.	Knowledge:

Intervention	BCT (Theoretical congruence)	How BCT is delivered (Text within brackets ending in [x] are themes judged to be targeted by the intervention)	Key domains All themes within key domains (Themes ending in [x] are themes targeted by the intervention)
		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 • 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 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)	• lack of knowledge of clinical guidelines and local procedural documents [x] • lack of information regarding placement and duration of catheter insertion • lack of awareness of the risks associated with use of urinary catheters [x] • lack of awareness of the link between UTIs and the use of urinary catheters • lack of standardised CAUTI education • lack of knowledge of how to manage patients without catheterisation • knowledge of how to manage bacterial infections resulting from urinary catheterisation • awareness of different types of urinary catheters available

Intervention	BCT (Theoretical congruence)	How BCT is delivered (Text within brackets ending in [x] are themes judged to be targeted by the intervention)	Key domains All themes within key domains (Themes ending in [x] are themes targeted by the intervention)
		(Lack of knowledge of clinical guidelines and local procedural documents [x]). 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. (Improved patient hygiene; Convenience and ease of monitoring; Lack of awareness of the risks associated with use of urinary catheters [x[). [Perform TWOC at home because it] reduces the risk of cross infection by not bringing them back into a hospital ward environment (Not attributing urinary infections to catheterisation due to the delay between infection onset and catheterisation [x]).	• not attributing urinary infections to catheterisation due to the delay between infection onset and catheterisation [x] Beliefs about Consequences: • convenience and ease of monitoring [x] • perceived severity of CAUTI • lack of perceived benefits to interventions targeting CAUTI • patient safety and injury • improved patient hygiene [x] • avoiding damage to medical equipment • adhering to guidelines improve patient care • certain types of infections are more harmful than others in catheterised patients • pros and cons of reusable catheters

Intervention	**BCT** **(Theoretical congruence)**	**How BCT is delivered** **(Text within brackets ending in [x] are themes judged to be targeted by the intervention)**	**Key domains** **All themes within key domains (Themes ending in [x] are themes targeted by the intervention)**
Catheter Care	Information about social environmental consequences (High)	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 (Lack of knowledge of clinical guidelines and local procedural documents [x]).	Knowledge: • lack of knowledge of clinical guidelines and local procedural documents [x] • lack of information regarding placement and duration of catheter insertion • lack of awareness of the risks associated with use of urinary catheters • lack of awareness of the link between UTIs and the use of urinary catheters • lack of standardised CAUTI education • lack of knowledge of how to manage patients without catheterisation • knowledge of how to manage bacterial infections resulting from urinary catheterisation • awareness of different types of urinary catheters available

Intervention	BCT (Theoretical congruence)	How BCT is delivered (Text within brackets ending in [x] are themes judged to be targeted by the intervention)	Key domains All themes within key domains (Themes ending in [x] are themes targeted by the intervention)
			• not attributing urinary infections to catheterisation due to the delay between infection onset and catheterisation Beliefs about Consequences: • convenience and ease of monitoring • perceived severity of CAUTI • lack of perceived benefits to interventions targeting CAUTI • patient safety and injury • improved patient hygiene • avoiding damage to medical equipment • adhering to guidelines improve patient care • certain types of infections are more harmful than others in catheterised patients • pros and cons of reusable catheters
Catheter Care	Information about emotional consequences	Where to perform a TWOC and why:	Knowledge:

Intervention	BCT (Theoretical congruence)	How BCT is delivered (Text within brackets ending in [x] are themes judged to be targeted by the intervention)	Key domains All themes within key domains (Themes ending in [x] are themes targeted by the intervention)
	(Medium)	at home, if possible, as it is more relaxed for the patient (Lack of knowledge of clinical guidelines and local procedural documents [x]).	• lack of knowledge of clinical guidelines and local procedural documents [x] • lack of information regarding placement and duration of catheter insertion • lack of awareness of the risks associated with use of urinary catheters • lack of awareness of the link between UTIs and the use of urinary catheters • lack of standardised CAUTI education • lack of knowledge of how to manage patients without catheterisation • knowledge of how to manage bacterial infections resulting from urinary catheterisation • awareness of different types of urinary catheters available

Intervention	BCT (Theoretical congruence)	How BCT is delivered (Text within brackets ending in [x] are themes judged to be targeted by the intervention)	Key domains All themes within key domains (Themes ending in [x] are themes targeted by the intervention)
			• not attributing urinary infections to catheterisation due to the delay between infection onset and catheterisation
Catheter Care	Demonstration of behaviour (Medium)	Observe model or manikin being catheterised. Observe catheterisation performed by others on actual patients (these extracts appear to relate more to increasing Skills (which this BCT is also linked to) rather than the key domain this BCT needs to target which is Social Influences [x]).	Social Influences: • requests from patients and their carers • lack of peer support and buy-in • physicians dictate nurses' practice • cultural norms regarding standard catheterisation practice for specific patient groups • local champions • challenging unnecessary urinary catheterisation requests
Catheter Care	Credible source (Medium)	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	Beliefs about Consequences: • convenience and ease of monitoring • perceived severity of CAUTI • lack of perceived benefits to interventions targeting CAUTI [x]

Intervention	BCT (Theoretical congruence)	How BCT is delivered (Text within brackets ending in [x] are themes judged to be targeted by the intervention)	Key domains All themes within key domains (Themes ending in [x] are themes targeted by the intervention)
		a factual knowledge of the current European and national legislation, national guidelines, organisational policies and protocols in accordance with clinical or corporate governance which affect your work practice in relation to the care of individuals using urinary catheters. (Lack of perceived benefits to interventions targeting CAUTI [x].)	• patient safety and injury • improved patient hygiene • avoiding damage to medical equipment • adhering to guidelines improve patient care • certain types of infections are more harmful than others in catheterised patients • pros and cons of reusable catheters
Catheter Care	Identification of self as a role model (Medium)	Become a competent mentor for others (local champions [x]).	Social Influences: • requests from patients and their carers • lack of peer support and buy-in • physicians dictate nurses' practice • cultural norms regarding standard catheterisation practice for specific patient groups • local champions [x]

Intervention	BCT (Theoretical congruence)	How BCT is delivered (Text within brackets ending in [x] are themes judged to be targeted by the intervention)	Key domains All themes within key domains (Themes ending in [x] are themes targeted by the intervention)
			• challenging unnecessary urinary catheterisation requests
Catheter care	Monitoring of the behaviour by others without feedback (Low)		No key domains linked to this BCT
Catheter care	Instruction on how to perform the behaviour (Low)		No key domains linked to this BCT
Catheter Care	Behavioural practice or rehearsal (Low)		No key domains linked to this BCT
HOUDINI	Restructuring the social environment (High)	This intervention allows nurses to remove catheters without asking for a physician written order (Physicians dictate nurses' practice [x]).	Social Influences: • requests from patients and their carers • lack of peer support and buy-in • physicians dictate nurses' practice [x] • cultural norms regarding standard catheterisation practice for specific patient groups • local champions

Intervention	BCT (Theoretical congruence)	How BCT is delivered (Text within brackets ending in [x] are themes judged to be targeted by the intervention)	Key domains All themes within key domains (Themes ending in [x] are themes targeted by the intervention)
			• challenging unnecessary urinary catheterisation requests Environmental Context and Resources: • limited and inconsistent documentation and records • transitions of care • lack of time to perform alternatives to urinary catheterisation • lack of staff • unavailability of medical alternatives to urinary catheterisation • cost of alternatives to urinary catheterisation • choice and availability of urinary catheters • lack of resources (general)
HOUDINI	Instruction on how to perform the behaviour (Low)		No key domains linked to this BCT

Discussion

Summary of key findings

This project extended previous work to assess how national interventions to reduce CAUTI could be optimised.

The rapid review identified 37 effective research interventions. All interventions were multi-faceted and contained some sort of educational component for health professionals either in the form of evidence-based guidelines or training. Many interventions contained protocols, audits, specific skills training for staff, changes to the electronic medical record system, CAUTI champions and provision of alternatives to catheters.

Research interventions were delivered through a broad range of BCTs and intervention functions, but quite a limited range of policy categories. Research interventions, as a whole, used 8 medium and 10 highly congruent BCTs. BCTs addressed all of the 6 key TDF domains (particularly Environmental Context and Resources, Social Influences, and Social Professional Role and Identity). These domains were previously identified as key areas to address.

Research interventions were used to propose additional intervention components which addressed the 6 key TDF domains. These intervention components were refined through input from stakeholders and the expert steering group. Seven intervention components met the prioritisation criteria indicating that they would be most feasible to implement.

Content analysis of each of the national interventions showed that at least half the BCTs identified in 7 of the 11 interventions target key influences on CAUTI-related behaviours. These were:

- NICE catheter audit tools
- Safety Thermometer
- EPIC 3
- high impact interventions
- Catheter Care
- HOUDINI
- Catheter Passport

The relevant BCT content of the other 4 interventions was less than half: HSC Act 2008, NICE QS90, NICE QSG1 and DH PHE 2013.

Each of the national interventions utilised intervention functions which targeted at least 4 of the 6 key domains indicating that intervention function (for example, mechanism of delivery such as education, training, enablement) did not need to change substantially. All national interventions

used one policy category but there was a heavy reliance on guidelines and new interventions may wish to consider different policy categories.

Recommendations for practice: overview of prioritised intervention components

This work makes recommendations for practice by highlighting new intervention components which can address barriers to desired behaviour, by highlighting barriers which are not well addressed by interventions and by discussing how further work could contribute to optimising interventions.

Barriers addressed by prioritised intervention components

Prioritised intervention components targeted a number of barriers within key TDF domains. Two intervention components were prioritised by stakeholders across all 3 settings. The first intervention component encourages a closer collaboration between health care professionals working in different settings at the crucial point of patient transfer between different settings. The second intervention component promotes working closely with patients and their families, by making sure that they are involved in discussions about catheter care and are able to make an informed choice about catheter use. Here, stakeholders have highlighted 2 issues which can be considered as system wide and common across healthcare professionals and settings. In addition, stakeholders have highlighted the important role of patients in reducing CAUTI although patients were not a focus of this report.

Two further intervention components were prioritised by stakeholders across 2 settings. The first intervention component aims to ensure a standardised approach by ensuring that healthcare professionals in different settings adhere to the same guidelines when managing patients with catheters. This intervention component was prioritised in primary and community and secondary care settings. The second intervention component focused on ensuring that information about catheter use is recorded in a similar way across different settings, thus allowing documentation to be shared between healthcare professionals working in different settings. This intervention component was prioritised by stakeholders in secondary and care home settings. Both these intervention components were rated fairly well by participants in the survey but did not quite meet the criteria for prioritisation indicating that they may be seen as less important in the third setting.

Three further intervention components were prioritised by stakeholders for a specific setting. The intervention component addressing staff beliefs and knowledge about risks associated with use of catheters was prioritised by stakeholders in care homes only. This might be because healthcare professionals working in this setting often manage long-term catheters and would benefit from training to a greater extent than colleagues in primary and community and secondary care. However, it is worth noting that this intervention also scored relatively high in secondary care (77% of participants; 57% of maximum APEASE score) and primary care (81% of participants; 57% of maximum APEASE score).These scores imply that participants felt

health professionals across settings could benefit from training in knowledge about risks associated with catheters. The second intervention component was the introduction of CAUTI champions including nurses and doctors who would support their peers in managing patients' catheter requests and provide practical support. This intervention component was prioritised by stakeholders only in secondary care setting. This is perhaps because the role of clinical champions is more established in secondary care than in other settings. The third intervention component was prioritised by stakeholders in secondary care only and involved provision of bladder scanners complemented by staff training. Bladder scanners are available in some secondary care settings so participants may have rated this as a suggestion that these should be more widely available. Participants appear to have felt scanners were unsuitable for primary care (40% of maximum APEASE score) or care home settings (25% of maximum APEASE score).

The prioritised intervention components used a number of BCTs not used in the national interventions. A number of prioritised intervention components used at least one new theoretically congruent BCT not previously used to address the relevant barrier, thus addressing missed opportunities.

Barriers not addressed

Six barriers remain unaddressed by the prioritised intervention components. Although intervention components were developed to address these barriers the intervention components were either deemed unfeasible by the expert steering group or they were not prioritised by the survey participants. This suggests that the stakeholders either did not feel these barriers were relevant to CAUTI-related behaviours or that they were unable to identify feasible ways of overcoming these barriers. It is worth noting that 5 of these barriers were only identified in one or 2 studies identified in the previous CAUTI report and therefore addressing these barriers may not be essential in achieving health professional behaviour change (7).

Optimising national interventions

The majority of BCT content of 7 of the 11 national interventions showed to be relevant in addressing barriers to healthcare professional behaviour to reduce CAUTI. There are various ways these data could be interpreted to inform future work. These 7 interventions are likely to better target influences on behaviour than the remaining 4 interventions and thus these interventions could be prioritised for optimisation. As such, the 7 new intervention components identified in this work could be considered by intervention developers of these 7 interventions to see whether these intervention components could be added. This work ideally needs to be carried out by person who wrote each intervention but could also be carried out by individuals who are familiar with the entire content and delivery method for each. However, policy makers may wish all 11 national interventions to continue and therefore researchers may want to consider how the 4 interventions (with less than 50% of BCTs addressing key influences) could be optimised to increase the proportion of relevant BCT content. Given that 9 out of 11 national interventions are guidelines, it is likely that interventions may be somewhat restricted in the

amount and type of BCTs which can be incorporated in their content. Policy makers may decide, rather than optimising existing interventions, to develop a new intervention which could be delivered using a policy category not already utilised, and using associated intervention functions and BCTs where necessary.

Strengths and limitations

This study combined a systematic, theoretically guided approach using behavioural science tools with extensive feedback from healthcare professionals in order to identify new ways to address barriers to reducing CAUTI. It demonstrates the potential usefulness of theoretical frameworks in identifying missed and seized opportunities in interventions. It also highlights that whilst theory can come up with potential intervention components, these need to be appraised by key stakeholders in order to make sure that they are feasible to implement in context. Feedback from stakeholders with an interest and expertise in managing CAUTI in the 3 settings and individuals with experience in influencing national policy was crucial in making sure that intervention components have the highest chance of being adopted.

While the combined approach of theory and stakeholder feedback was useful, it also highlighted a number of challenges. Intervention components suggested by stakeholders did not always target the 6 key TDF domains and relevant barriers or used BCTs which were not theoretically congruent with the TDF domain. This is not surprising given that stakeholders were not trained in theoretical approaches to the development of interventions. In such instances it is difficult to make an assessment over which source of evidence should be given priority. We have erred towards prioritising the views of stakeholders in this report given that their expertise is specific to CAUTI and that theoretical frameworks apply to any behaviour. It is important to note that matrices linking BCTs and TDF and new behavioural science tools are constantly developing as new data become available. BCTs which previously were not linked with certain TDF domains may become linked based on new data and vice versa. It is also recognised that TDF and BCT pairings may differ according to different types of behaviour (5) and as a result, some pairings may not be relevant or appropriate in the context of CAUTI.

Each national intervention in RQ5 was assessed based on its BCT content and use of intervention functions. It is important to highlight that certain interventions appeared to target fewer domains when looking at their BCT content compared to the intervention functions they used. This is because analysis is based on matrices pairing BCTs with TDF domains, and intervention functions with TDF domains. It is likely to be the BCT content which is of most importance when determining whether interventions are addressing relevant influences on behaviour and we would recommend assessing interventions based on BCT content rather than intervention function.

There is an assumption in our analyses that more, rather than fewer, BCTs which address relevant influences on behaviours in an intervention is better. Whilst this is logical there is no evidence, which we are aware of, of the optimal amount of BCTs necessary to change a behaviour. It is important to note that all research interventions were effective but none

contained all the BCTs which were possible to include across all of the 6 key domains. It may be that national interventions can be effective at changing behaviour if they cover a proportion of relevant BCTs for key domains rather than all of them but this needs to be assessed by assessing behaviour within the specific healthcare context.

The analysis of effective research interventions is based on data provided in the published articles. We were not able to contact authors of studies in order to obtain more data about the specific intervention content or the proposed mechanisms within each intervention due to limited resources. As a result we may have missed some of the detail of the content of research interventions and it is possible that research interventions may have used a wider range of BCTs than reported here. We were encouraged to identify 27 BCTs across the 37 interventions and to see a reasonable level of detail when describing interventions in publications. When including papers in our rapid review we were not able to complete a quality assessment of the included studies due to limited resources. This is an important limitation when it comes to considering the interventions shown to be effective in existing research.

The majority of papers reporting effective interventions were based in the US and thus the evidence on effectiveness may be limited in its transferability to the UK context. The inclusion of stakeholders in this work sought to consider such evidence whilst developing recommendations for the UK context.

Barriers and facilitators discussed here are based on evidence from secondary care and there was limited to no evidence on whether the same influences on behaviour are present in primary and community care and care home settings. The current project partially addresses this limitation by gathering feedback from stakeholders in all 3 settings. Although we have not conducted in-depth interviews with stakeholders in these settings, they have provided some insight into the key barriers when suggesting intervention components during the focus group and then later by appraising intervention components and their feasibility. It would be important, however, to further explore barriers and facilitators in primary and community care and care home settings, perhaps as part of further implementation work (described below).

Next steps

This project extended previous work to assess how national interventions to reduce CAUTI could be optimised. This was achieved by identifying 7 new intervention components, which target key influences on behaviour, deemed as relevant and feasible for implementation in all 3 settings. These intervention components could be either added to national interventions by working with intervention owners or designers or could be further developed as stand-alone interventions.

However, while we were able to identify to what extent each of the national interventions target key influences on CAUTI-related behaviour based on BCT by TDF pairings, we were not able to assess whether specific barriers within each of the TDF domains were addressed. This would require further extensive analysis, involving examining whether the way each of the BCTs was

delivered within an intervention addresses relevant barriers. Two examples of how to do this within individual interventions are provided here to guide future work. It is this type of analysis which would be of most benefit when deciding how to optimise any individual intervention however this is a large amount of work per intervention and policy makers may wish to assess whether they want to look at all national interventions in detail or whether they want to concentrate on assessing a smaller number.

There is limited research evidence on patient views of urinary catheters (52) and it is important to gather feedback from patients and carers to make sure that intervention components are well received by them where relevant. Interventions targeted at patient behaviour were beyond the scope of this work but should also be considered.

Conclusions

This project explored how national interventions targeted at healthcare professionals aimed at reducing CAUTI could be improved for primary and community care, secondary care and care home settings. We identified new intervention components by studying research interventions which have shown to be effective at changing CAUTI-related behaviour. By drawing on behavioural theory and tools as well as expert stakeholder views and experiences, we identified 7 intervention components which were assessed as relevant and feasible for implementation. These intervention components could either be added to national interventions by working with intervention owners or designers or could be further developed as stand-alone interventions. Further work is needed to identify to what extent specific barriers (rather than just key TDF domains) were addressed by each of the national interventions. This would allow policy makers to identify whether all barriers to CAUTI-related behaviour are being targeted by national interventions.

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List of appendices

To access the appendices, return to the Reducing catheter-associated urinary tract infections landing page and open the relevant attachment.

Appendix	Title
Appendix A	National CAUTI interventions
Appendix B	Search terms in the rapid review
Appendix C	Merged matrices showing links between Theoretical Domains Framework and behaviour change techniques
Appendix D	List of the most frequent barriers and facilitators identified in the previous CAUTI report
Appendix E	Prisma flowchart
Appendix F	Key characteristics of the 37 research interventions
Appendix G	The BCTs intervention functions policy categories and TDF domains identified in each of the 37 research interventions
Appendix H	Frequency of intervention functions policy categories and BCTs in research and national interventions
Appendix I	Theoretical congruence between BCTs in the 37 research interventions and TDF domains
Appendix J	Seized and missed opportunities for research interventions by intervention function
Appendix K	Seized and missed opportunities for research interventions by policy category
Appendix L	Intervention components presented to stakeholders during the workshop (based on the previous CAUTI work and rapid review)
Appendix M	Intervention components suggested or endorsed by the stakeholders
Appendix N	Summary of notes from the stakeholder focus groups
Appendix O	Final list of intervention components following stakeholders project team and steering group feedback
Appendix P	Relevance and APEASE scores for all intervention components in primary or community care
Appendix R	Relevance and APEASE scores for all intervention components in secondary care
Appendix S	Relevance and APEASE scores for all intervention components in care homes
Appendix T	Intervention components excluded based on stakeholders' feedback

Appendix	Title
Appendix U	Theoretical congruence between BCTs and TDF domains for each of the national interventions
Appendix V	Theoretical congruence between BCTs and TDF domains in national interventions
Appendix W	Seized and missed opportunities for intervention functions and policy categories for each of the national interventions
Appendix X	Full list of barriers and facilitators identified in the previous CAUTI report

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