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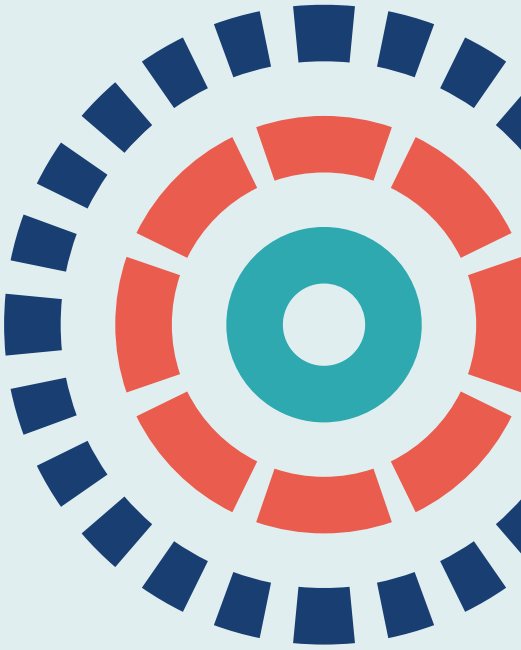

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Social norms interventions to change clinical behaviour in health workers: a systematic review and meta-analysis

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Abstract

Social norms interventions to change clinical behaviour in health workers: a systematic review and meta-analysis

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Background: A social norms intervention seeks to change the clinical behaviour of a target health worker by exposing them to the values, beliefs, attitudes or behaviours of a reference group or person. These low-cost interventions can be used to encourage health workers to follow recommended professional practice.

Objective: To summarise evidence on whether or not social norms interventions are effective in encouraging health worker behaviour change, and to identify the most effective social norms interventions.

Design: A systematic review and meta-analysis of randomised controlled trials.

Data sources: The following databases were searched on 24 July 2018: Ovid MEDLINE (1946 to week 2 July 2018), EMBASE (1974 to 3 July 2018), Cumulative Index to Nursing and Allied Health Literature (1937 to July 2018), British Nursing Index (2008 to July 2018), ISI Web of Science (1900 to present), PsycINFO (1806 to week 3 July 2018) and Cochrane trials (up to July 2018).

Participants: Health workers took part in the study.

Interventions: Behaviour change interventions based on social norms.

Outcome measures: Health worker clinical behaviour, for example prescribing (primary outcome), and patient health outcomes, for example blood test results (secondary), converted into a standardised mean difference.

Methods: Titles and abstracts were reviewed against the inclusion criteria to exclude any that were clearly ineligible. Two reviewers independently screened the remaining full texts to identify relevant papers. Two reviewers extracted data independently, coded for behaviour change techniques and assessed quality using the Cochrane risk-of-bias tool. We performed a meta-analysis and presented

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forest plots, stratified by behaviour change technique. Sources of variation were explored using metaregression and network meta-analysis.

Results: A total of 4428 abstracts were screened, 477 full texts were screened and findings were based on 106 studies. Most studies were in primary care or hospitals, targeting prescribing, ordering of tests and communication with patients. The interventions included social comparison (in which information is given on how peers behave) and credible source (which refers to communication from a well-respected person in support of the behaviour). Combined data suggested that interventions that included social norms components were associated with an improvement in health worker behaviour of 0.08 standardised mean differences (95% confidence interval 0.07 to 0.10 standardised mean differences) ($n = 100$ comparisons), and an improvement in patient outcomes of 0.17 standardised mean differences (95% confidence interval 0.14 to 0.20) ($n = 14$), on average. Heterogeneity was high, with an overall I^2 of 85.4% (primary) and 91.5% (secondary). Network meta-analysis suggested that three types of social norms intervention were most effective, on average, compared with control: credible source (0.30 standardised mean differences, 95% confidence interval 0.13 to 0.47); social comparison combined with social reward (0.39 standardised mean differences, 95% confidence interval 0.15 to 0.64); and social comparison combined with prompts and cues (0.33 standardised mean differences, 95% confidence interval 0.22 to 0.44).

Limitations: The large number of studies prevented us from requesting additional information from authors. The trials varied in design, context and setting, and we combined different types of outcome to provide an overall summary of evidence, resulting in a very heterogeneous review.

Conclusions: Social norms interventions are an effective method of changing clinical behaviour in a variety of health service contexts. Although the overall result was modest and very variable, there is the potential for social norms interventions to be scaled up to target the behaviour of a large population of health workers and resulting patient outcomes.

Future work: Development of optimised credible source and social comparison behaviour change interventions, including qualitative research on acceptability and feasibility.

Study registration: This study is registered as PROSPERO CRD42016045718.

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List of abbreviations

A&F	audit and feedback
AHP	allied health professional
ANCOVA	analysis of covariance
BCT	behaviour change technique
BNI	British Nursing Index
CENTRAL	Cochrane Central Register of Controlled Trials
CI	confidence interval
CINAHL	Cumulative Index to Nursing and Allied Health Literature
GP	general practitioner
HDAS	Healthcare Databases Advanced Search
ICC	intraclass correlation coefficient
MeSH	medical subject heading
NIHR	National Institute for Health Research
PABAK	prevalence-adjusted and bias-adjusted kappa
PPI	patient and public involvement
PRISMA	Preferred Reporting items for Systematic Reviews and Meta-Analyses
RCT	randomised controlled trial
RQ	research question
SMD	standardised mean difference
SSC	Study Steering Committee
TIDieR	Template for Intervention Description and Replication

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Plain English summary

It is important to encourage health workers to perform clinical behaviours appropriately for efficient use of health service resources and improved patient health outcomes. Sometimes health workers do not follow recommended practice, for example when blood tests are not ordered when required or when the wrong medication is prescribed. Social norms interventions are approaches that are used by health services with the aim of changing the future clinical behaviour of health workers; this approach works by exposing a health worker to the beliefs, thoughts, opinions or behaviours of their peers. For example, an e-mail sent to a doctor stating how often their colleagues prescribe antibiotics compared with their own number of prescriptions is an example of the behaviour change technique social comparison. A communication from a well-respected person in support of the behaviour is an example of credible source. This study aimed to summarise all of the evidence on using social norms interventions to change the clinical behaviours of health workers.

The researchers found 106 relevant studies. Most of the studies focused on doctors, although other health workers were also involved. Commonly targeted behaviours were the prescribing of medicines, ordering of tests and managing of health conditions. Social norms interventions can have a moderate effect on the clinical behaviour of health workers and can also improve patient health outcomes, but the magnitude of the effect varies greatly between studies. Both social comparison and credible source were found to be effective ways of changing clinical behaviours of health workers and improving patient health outcomes. The effectiveness of social comparison could be boosted when combined with a prompt, such as a computer pop-up that gives a reminder about antibiotic prescribing guidelines when a general practitioner tries to prescribe antibiotics.

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Scientific summary

Background

Health workers routinely carry out behaviours that affect patient diagnoses, care, treatment and recovery. Many of these behaviours have clear guidelines for best practice. Examples include appropriate ordering of diagnostic tests, appropriate prescription of antibiotics and regular recall of patients with long-term conditions. Health workers face many challenges when following evidence-based professional practice, such as lack of time, competing demands and requests from patients. There is evidence that social influences are important in clinical practice. One proposed solution has been to implement behaviour change interventions based on social or peer norms. Social norms are the implicit or explicit rules that a group uses to determine values, beliefs, attitudes and behaviours. A social norms intervention seeks to change the clinical behaviour of a target health worker by exposing them to the values, beliefs, attitudes or behaviours of a reference group or person. These social norms interventions can form part of an audit and feedback initiative, or may be developed as another behaviour change intervention. These are often interventions with reach: they can be implemented across multiple health workers and settings at a low cost, so there is the potential for large absolute gain.

The Behaviour Change Technique taxonomy v1 is a list, drawn up by an international team of experts, of 93 distinct behaviour change techniques that are used in behaviour change interventions. There are five behaviour change techniques that we believe involve social norms, and we have used these to classify components of social norms interventions:

1. social comparison – draw attention to others' performance to allow comparison with the person's own performance
2. information about others' approval – provide information about whether other people approve or disapprove of the behaviour that the person is doing or will do
3. credible source – provide verbal or visual communication from a credible source in favour of or against the behaviour to persuade the target to change behaviour
4. social reward – arrange praise, commendation, applause or thanks if, and only if, there has been effort and/or progress in performing the behaviour
5. social incentive – inform that praise, commendation, applause or thanks will be delivered if, and only if, there has been effort and/or progress in performing the behaviour.

A systematic review of the evidence was required to establish whether or not social norms interventions are effective in the modification of the behaviour of health workers, and what factors influence their effectiveness.

Objectives

The overall aim was to conduct a systematic review to assess the impact of social norms behaviour change techniques compared with controls (alternative interventions, no intervention or comparison of one social norm behaviour change technique with one or more other social norms behaviour change techniques) on compliance with evidence-based professional practice among health workers. The review addressed two research questions:

1. What is the effect of social norms interventions on the clinical behaviour of health workers and resulting patient outcomes?
2. Which contexts, modes of delivery and behaviour change techniques are associated with the effectiveness of social norms interventions on health worker clinical behaviour change?

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Methods

Design

This study design was a systematic review and meta-analysis.

Identification of studies

Studies were eligible for the review if the population was health-care workers who were targeted by a social norms intervention that sought to change their clinical behaviour by exposing them to the values, beliefs, attitudes or behaviours of a reference person or group. Only randomised controlled trials were eligible for inclusion in the review, including cluster, factorial, parallel, crossover and stepped-wedge trials. A search strategy was developed using an extensive iterative scoping process. Searches were undertaken in MEDLINE, EMBASE, Cumulative Index to Nursing and Allied Health Literature, British Nursing Index, ISI Web of Science, PsycINFO and Cochrane trials on 24 July 2018. Titles and abstracts were reviewed against the inclusion criteria to exclude any that were clearly ineligible. Two reviewers independently screened all of the remaining full texts to identify relevant papers.

Data collection

The data that were extracted from eligible studies included trial design, outcome measurement, results, intervention description, details of the context and mode of delivery data. Behaviour change techniques in the intervention and control arms were coded using the Behaviour Change Techniques taxonomy v1. An assessment of study quality was undertaken using the Cochrane risk-of-bias tool. All data were extracted independently by two researchers using prespecified data collection forms. Any disagreements were resolved through discussion, moderated by a third researcher or discussed at a research team meeting. Training was provided and the processes were piloted to encourage consistency. In the protocol we had envisaged that we would contact authors for additional information; we were not able to do this owing to the size of the review. We made some effort to search for companion papers, such as protocols or process evaluations, in cases where there was missing information in the main paper on key items, such as the intervention description or the outcomes; however, this did not fully replace contact with the authors.

Data analysis

In the meta-analysis, we included those studies that reported a primary outcome measure (clinical behaviour of a health worker) or a secondary outcome (patient outcome) that could be converted into a standardised mean difference. The approach that we took to utilise the five social norms behaviour change techniques in the analysis was to subtract the control arm behaviour change techniques from those in the intervention arm, to identify the active ingredients being tested in the trial.

To assess the effect of social norms interventions on the behaviour of health workers, we performed a fixed-effects meta-analysis and presented forest plots, stratified by behaviour change technique. Sources of variation in terms of the type of social norm, context and mode of delivery that were explored using forest plots and metaregression; network meta-analysis was undertaken to rank the effectiveness of the social norms interventions. We adopted a fixed-effects approach to meta-analysis, which we considered to yield a summary of the evidence in these trials (i.e. the average effect) rather than an estimate of a common underlying treatment effect. We also reported a random-effects analysis. We performed sensitivity analyses including only studies with a low risk of bias, excluding continuous outcomes reported as 'mean percentage' that were $< 20\%$ or $> 80\%$, including only studies in which the standard deviation was not imputed and using alternative values of imputed intraclass correlation coefficient. We investigated the impact of publication bias in the reported studies using a funnel plot.

Patient and public involvement

A member of the public played a full and active role in the independent Study Steering Committee, bringing a patient and carer perspective to the meetings. Six members of the public attended

workshops, in which we discussed the relevance of the review to patients and carers; they provided feedback on the study design and discussed dissemination.

An independent Study Steering Committee provided encouragement and wise counsel throughout the project.

Results

In total, 7980 studies were identified using database searches, 4428 abstracts were screened, 477 full-text papers were screened, 116 studies were included and the findings are based on 106 studies.

Study and intervention characteristics

There were 100 comparisons suitable for meta-analysis, which tested social comparison ($n = 79$), credible source ($n = 7$) and social reward ($n = 2$) against the control. Some studies tested more than one social norms intervention together: social comparison and credible source ($n = 6$), social comparison and social reward ($n = 2$) and multiple social norms interventions (more than two) together ($n = 4$). Over half of the included trials were conducted in North America; most studies were set in primary care and hospitals, targeting doctors. A broad range of behaviours were targeted, including prescribing, managing conditions and test ordering. Two-thirds of the trials were cluster randomised controlled trials. The interventions were delivered in a variety of formats. Delivery timing varied in that one-third of interventions were delivered on one occasion and the rest were delivered on multiple occasions. Most of the interventions were delivered by someone outside the specific organisation, often an investigator, and three-quarters aimed to increase, rather than decrease, the target behaviour. There was a lack of clarity in reporting some of the intervention characteristics in up to one-third of the studies.

Overall results

Overall, combined data suggested that interventions that included social norms components were associated with an improvement in health worker behaviour (primary outcome) of 0.08 standardised mean differences (95% confidence interval 0.07 to 0.10) ($n = 100$ comparisons), and an improvement in patient outcomes (secondary outcome) of 0.17 standardised mean differences (95% confidence interval 0.14 to 0.20) ($n = 14$), on average. There was a large amount of heterogeneity, with an overall I^2 of 85.4% for the primary outcome and 91.5% for the secondary outcome. Some studies reported substantially higher or lower effect sizes than these summary statistics for social norms interventions, and this heterogeneity was investigated by examining the effect of variation in behaviour change technique, context and mode of delivery using forest plots, metaregression and network meta-analysis.

Results by social norms behaviour change techniques

The network meta-analysis suggested that the three types of social norms intervention were most effective, on average, compared with the control: credible source (standardised mean difference 0.30, 95% confidence interval 0.13 to 0.47), social comparison combined with social reward (standardised mean difference 0.39, 95% confidence interval 0.15 to 0.64) and social comparison combined with prompts and cues (standardised mean difference 0.33, 95% confidence interval 0.22 to 0.44). Social comparison delivered on its own (standardised mean difference 0.05, 95% confidence interval 0.03 to 0.08), social comparison with social support (unspecified) (standardised mean difference 0.10, 95% confidence interval 0.04 to 0.16) and social comparison with credible source (standardised mean difference 0.08, 95% confidence interval 0.03 to 0.12) were all effective, on average, compared with control. There was no evidence to suggest that social reward (standardised mean difference 0.03, 95% confidence interval −0.08 to 0.13) was effective, although this was based on a small number of studies. We did not find studies that examined the effect of the other two social norms.

Results by context and mode of delivery

The meta-analysis suggested that social norms interventions were effective with a variety of types of health workers, and that they may be less effective with nurses and allied health professionals than with

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doctors. They have been successful across a wide range of clinical behaviours, including prescribing, tests and management and communication around health conditions, but may be less effective with hand-washing and referrals. They appeared equally effective in primary and secondary care, but may be less effective in community and care home settings. The effect appeared to be reasonably consistent across different types of reference group, including peers, senior persons, patients and mixed populations. Social norms interventions were, on average, slightly more effective at reducing behaviours (e.g. reducing antibiotic prescriptions) than increasing them (e.g. increasing hand-washing). Interventions appeared similarly effective regardless of who delivered them; there was some indication that interventions delivered by supervisors were less effective. The effect was similar regardless of whether the intervention came from an internal or external source. Delivering the intervention once was sufficient: there was no evidence of an increased effect from more frequent delivery. All methods of delivery of social norms interventions were effective apart from face to face: delivery by website appeared to be the most effective method. The number of studies in some of these categories was low, so the findings on context and mode of delivery are tentative.

Risk of bias

The risk of bias was high for the blinding of participants and personnel; therefore, we cannot rule out the possibility of response bias. Using a funnel plot, we found some evidence that the review may be missing some unpublished negative trials or may include more positive trials than justified owing to selective outcome reporting. When we looked only at the trials at low risk of bias for each key domain in sensitivity analyses, the overall treatment effect changed very little, suggesting that the results were robust and not strongly influenced by the trials at high/unclear risk of bias.

Conclusions

Implications for health care

A social norms intervention seeks to change the clinical behaviour of a target health worker by exposing them to the values, beliefs, attitudes or behaviours of a reference group or person. Social norms interventions were frequently used by health-care organisations as a way of improving how health care was delivered. This review of the literature suggests that the overall result is modest and very variable, but that there is the potential for social norms interventions to be scaled up to target behaviour change in large populations, and that when optimally designed these interventions can have a large effect on the target behaviour and resulting patient outcomes. The most effective social norms interventions were providing approval of the desired behaviour from a credible source, and social comparison combined with social reward or another recognised behaviour change technique, prompts and cues. These interventions can be effective in a variety of NHS contexts.

Recommendations for research:

1. Credible source has been identified as an effective intervention component. It is not commonly used and many people responsible for behaviour change policy may not be familiar with it. Additional work is required to develop credible source interventions for use in the NHS. As a first step, a narrative synthesis of the trials using credible source in this review, together with the qualitative papers, process evaluations and protocols associated with those trials, would provide a more detailed picture of the credible source interventions that are associated with more successful outcomes.
2. Social comparison is currently used more frequently in the NHS than credible source. We identified a high level of heterogeneity in the effectiveness of social comparison. We have started to unravel this heterogeneity, and research suggests that social comparison can successfully be enhanced by the addition of social reward, prompts and cues or another recognised behaviour change techniques, social support (unspecified), but further research would provide more depth to these findings.

3. Qualitative work with health workers, managers and policy-makers is needed to understand the acceptability and feasibility of credible source, social comparison and social reward interventions and to understand who the most credible sources are.
4. The review included some large factorial trials that tested several behaviour change interventions simultaneously; this design can be an efficient way of exploring different components of behaviour change interventions and their interactions. Some trials used novel methods to minimise bias, such as 'attention' controls in which participants were given the identical behaviour change intervention for an alternative target behaviour: this type of design is to be encouraged.
5. The quality of trial reporting was mixed and in many cases it was difficult to extract the necessary information required in this review. Researchers should use appropriate reporting guidelines, such as TIDier (Template for Intervention Description and Replication) and CONSORT. The methodological quality of trials was also mixed, and this needs to be addressed in future studies.
6. Trials were excluded from the review when the intervention did not target a specific behaviour. We plan to undertake a separate review of those studies that did not include a target behaviour to assess whether or not the effects of those interventions vary from the effects found in the current review.

Study registration

This study is registered as PROSPERO CRD42016045718.

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Chapter 1 Background

Parts of this chapter have been reproduced from our review protocol.[1,2] This is an Open Access article distributed in accordance with the terms of the Creative Commons Attribution (CC BY 4.0) license, which permits others to distribute, remix, adapt and build upon this work, for commercial use, provided the original work is properly cited. See: http://creativecommons.org/licenses/by/4.0/. The text below includes minor additions and formatting changes to the original text.

Health workers routinely carry out behaviours that affect patient diagnoses, care, treatment and recovery. Many of these behaviours have clear guidelines for best practice. Examples include appropriate ordering of diagnostic tests,[3,4] appropriate prescription of antibiotics,[5,6] regular recall of patients with long-term conditions,[7] hand-washing[8] and choice of wound dressings.[9] Health workers face many challenges when following evidence-based professional practice, such as lack of time, competing demands and requests from patients. The issue of implementing best practice findings from clinical research to practice is termed the second translational gap,[10] and can have significant impacts on patient and population health. Although there are no reliable published estimates, to our knowledge, of how well health professionals follow best clinical practices overall, we can draw on a couple of illustrative examples. In England, the USA and Canada it is estimated that 37%, 27% and 66% of patients with high blood pressure have their condition controlled, respectively, and health professionals can support improvement through prescribing medication, regular review of patients and lifestyle advice.[11] In England alone, 700 quality-adjusted life-years could be saved annually through just a 15% increase in this figure.[11] One out of 20 hospital admissions are caused by adverse drug events,[12] and approximately half of these globally are believed to be preventable, owing to lapses in best practice in terms of prescribing or monitoring behaviours by clinicians.[13] There is evidence that social influences are important in clinical practice.[14,15]

Social norms interventions

One proposed solution has been to implement behaviour change interventions based on social or peer norms.[16] Social norms are the implicit or explicit rules that a group uses to determine values, beliefs, attitudes and behaviours. A social norms intervention seeks to change the clinical behaviour of a target health worker by exposing them to the values, beliefs, attitudes or behaviours of a reference group or person. These social norms interventions can form part of an audit and feedback (A&F) initiative,[17–19] or may be developed as another behaviour change intervention.[20] These are often interventions with reach: they can be implemented across multiple health workers and settings at low cost, so there is the potential for large absolute gain. We use the term target to refer to a health worker at whom a social norms intervention is aimed, with a view to changing their clinical behaviour. We use the term reference group or reference person to mean a person or group of people whose values, beliefs or behaviours are exposed to the target.

The ability of social norms to affect behaviour has been considered within several behaviour change theories and theoretical frameworks. For example, 'subjective norm' is a construct within the theory of planned behaviour,[21] which describes subjective norm as an individual's perceptions of whether valued others think one should perform a behaviour, combined with a motivation to comply with others' beliefs. The theory of normative social behaviour[22] proposes that behaviour can be changed through normative mechanisms, and has made distinctions between descriptive norms (beliefs concerning the prevalence of a behaviour) and injunctive norms (beliefs concerning what one feels they ought to do based on others' expectations, linked to social approval). A descriptive norms message provides the target with information about the behaviour of others in the reference group. Examples of descriptive norms interventions include giving the target information about the behaviour of a reference person or group, or comparison of the target's behaviour with the behaviours of a reference person or group. An injunctive norms message provides the target with information about the values,

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beliefs or attitudes of the reference group, conveying social approval or disapproval. Examples of injunctive norms interventions include providing the target with information about whether or not the behaviour has the approval/disapproval of the reference group or person; exposure (actual or promised) of the target's behaviour to a reference group; and praise, commendation, applause or thanks (actual or promised) from a reference group or person.

The theoretical domains framework[23] (which has drawn its domains and their content from multiple theories of behaviour change) includes a 'social influences' domain, which includes several normative constructs: social norms, social comparisons, group norms, descriptive norms and injunctive norms. The social influences domain goes beyond social norms to include a broader range of social concepts, such as emotional and practical support, demonstrating a behaviour and changing the social environment. The idea of using social norms as a behavioural intervention is present across disciplines (politics, economics, psychology and health) and there is variation between disciplines in how social norms are described.

Behaviour change techniques

The behaviour change technique (BCT) taxonomy v1 (the current version) is a list of 93 distinct BCTs that are used in behaviour change interventions.[24] A BCT is 'a technique . . . proposed to be an active ingredient'[24] of a behavioural intervention that contributes to behaviour change. We have chosen to identify and classify social norms intervention components in terms of the BCT taxonomy v1 because, based on international consensus, the taxonomy defines and labels all active ingredients of interventions. It incorporates previous behaviour change taxonomies and has involved significant effort from leaders in the field, and considerable investment from the Medical Research Council and the National Institute for Health Research (NIHR) in developing the taxonomy. We believe that this is the most reliable tool currently available that can define BCTs. The names of BCTs that are included in the taxonomy have been italicised whenever they are used in this report.

The BCT taxonomy groups BCTs into categories, and none of the categories directly relate to social norms. This is perhaps surprising, given that the concept of social norms occurs in so many theories of behaviour change, including the Theoretical Domain Framework, but extensive work by a panel of experts resulted in the hierarchy of the taxonomy, and clearly it needs to meet the needs of a large and diverse community of researchers. An earlier version of the taxonomy had a 'social influence' category,[23] which does not appear in the current version.[24] The BCT taxonomy v1[24] includes five BCTs that we believe involve social norms: social comparison (6.2), information about others' approval (6.3), credible source (9.1), social reward (10.4) and social incentive (10.5).[24] The numbers in brackets follow the labelling of the BCTs in the BCT taxonomy v1. We have discussed this selection of social norms BCTs carefully, both within the research team and with our independent Study Steering Committee (SSC) of international experts.

Social comparison

'Draw attention to others' performance to allow comparison with the person's own performance. Note: being in a group setting does not necessarily mean that social comparison is actually taking place.'[24]

'Example: Show the doctor the proportion of patients who were prescribed antibiotics for a common cold by other doctors and compare with their own data.'[24]

Information about others' approval

'Provide information about what other people think about the behaviour. The information clarifies whether others will like, approve or disapprove of what the person is doing or will do.'[24]

'Example: Tell the staff at the hospital ward that staff at all other wards approve of washing their hands according to the guidelines.'[24]

Credible source

'Present verbal or visual communication from a credible source in favour of or against the behaviour. Note: code this BCT if source generally agreed on as credible e.g. health professionals, celebrities or words used to indicate expertise or leader in field and if the communication has the aim of persuading.'[24]

'Example: Present a speech given by a high status professional to emphasise the importance of not exposing patients to unnecessary radiation by ordering x-rays for back pain.'[24]

The following two social norm BCTs have been amended slightly to ensure that the definition is sufficiently tight to allow us to identify and delineate interventions. Further details of the reasons for change are available in the protocol.[2]

Social reward

The original definition of social reward was 'Arrange verbal or non-verbal reward if and only if there has been effort and/or progress in performing the behaviour (includes 'Positive reinforcement'). Examples: Congratulate the person for each day they eat a reduced fat diet'.[24]

Our new tighter definition is as follows: arrange praise, commendation, applause or thanks if and only if there has been effort and/or progress in performing the behaviour (includes 'positive reinforcement'). Example: arrange for a family doctor to be sent a thank you note for each week that they reduce their level of antibiotic prescribing.

Social incentive

The original definition for social incentive was 'Inform that a verbal or non-verbal reward will be delivered if and only if there has been effort and/or progress in performing the behaviour (includes 'positive reinforcement'). Examples: Inform that they will be congratulated for each day that they eat a reduced fat diet.'[24]

Our new tighter definition is as follows: inform that praise, commendation, applause or thanks will be delivered if and only if there has been effort and/or progress in performing the behaviour (includes 'positive reinforcement'). Example: promise a family doctor in advance that they will be sent a thank you note for each week that they reduce their level of antibiotic prescribing.

Why it is important to undertake this research

There are health service contexts in which modification of the behaviour of health workers may have a beneficial effect on patient diagnosis, care and treatment, and on the costs of health care. These contexts include situations in which health workers are expected to follow evidence-based professional practice, such as prescribing, ordering tests, choosing treatments and adhering to guidelines. There are challenges in implementing recommended practice findings from clinical research into practice, referred to as the second translational gap.[10] Providing social norms interventions to health workers may help overcome these barriers to implementing recommended practice through a number of ways, including persuading them that they should change their individual behaviour, working collaboratively with their peers to develop action plans and change the organisation of care, observing good practice from other organisations and gaining support from senior managers.[16] This systematic review will summarise evidence on the use of social norms interventions to influence clinicians to implement recommended clinical behaviours. In advance of starting this review, our pilot work indicated that there were > 90 trials investigating the use of social norms interventions. A systematic review of the evidence was required to establish whether or not these interventions are effective, and what factors influence their effectiveness.

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Health workers frequently receive A&F, which involves 'providing a recipient with a summary of their performance over a specified period of time'.[17] Social norms interventions are sometimes included as one component of A&F, such as when the health worker is shown information about their own performance and also a comparison with their peers.[18,19] A&F has already been shown to be effective in changing health worker behaviour, but with large variation in outcomes depending on the context and the intervention design.[25] There is a need to understand the components for successful A&F.[17,26] The effects or mechanisms of the 'social influence' constituents of A&F have been identified in a systematic review as topics for further research.[17] As noted earlier, interventions based on social influence include social norms interventions; however, social influence is a broader concept that covers emotional and practical social support, changes to the social environment and modelling of behaviour.[23] Our review may contribute to this important research agenda by systematically examining the evidence for using social norms interventions with health workers.

Prior to starting the review and during its implementation we spoke to members of the public about this proposal and asked which aspects of the research were important and relevant to them. They told us that the research might contribute to cost savings to the NHS by reducing waste (e.g. waste of prescriptions or tests) without reducing patients' quality of care, and provide opportunities for standardisation (e.g. use of social norms interventions to encourage nurses to use standard wound dressings when appropriate rather than ordering multiple types), which would affect costs. They identified the potential for social norms methods to be used in the curriculum for training health professionals. Patient safety is very important: patients suffer if antibiotics are wrongly prescribed and there is broader concern about antibiotic resistance. Social norms approaches could be applied to other health worker behaviours and could lead to changes in ways of thinking. Changes in health worker behaviour may lead to changes in patient behaviour too, for example patients may copy the health worker's example of hand-washing. Patients told us that it would be interesting to extend this research in the future to how patients perceive staff behaviour and how health workers are influenced by social norms of patients, for example asking for/not wanting antidepressants or making comments about hand-washing. 'Maybe the review will lead to broader research including patients in the social comparison equation. That seems important to me' (PPI group member). Patients felt that they could have a role in social norms interventions, for example by reminding health workers to wash their hands or telling the general practitioner (GP) that they do not expect to be prescribed antibiotics for a cold; however, they were cynical about whether or not doctors would listen to patients when they present best practice (example was given of a relative who had better care in Australia, but the doctor in the UK did not want to hear about it). In response to this observation, we made sure to record any studies in the review that considered the role of patients in social norms interventions.

Scoping review

Prior to starting the systematic review, we conducted a scoping review. The purpose of the scoping review was to test out the search and screening procedures for the planned systematic review and provide information to help estimate the number of eligible studies and the amount of work involved. A systematic literature search on social influences (carried out on 9 November 2016) revealed a total of 3644 potentially eligible abstracts for our systematic review, after removing duplicates. Screening of these titles/abstracts generated 264 titles that met our initial screening criteria regarding study type, population and intervention. Reading the full text of 100 out of the 264 screened abstracts resulted in 42 being excluded, 51 being included and seven requiring further information. Among the 51 included papers, there were 35 unique trials. From this we estimated that there would be at least 135 articles and 93 unique trials in our review.

Before the scoping review we discussed our plans widely, including with the members of the SSC. This led us to revise the search strategy from the earlier work, aligning the search and coding framework more closely to social norms BCTs in the BCT taxonomy v1.[24] We also made a decision very early in the

project to use the term 'social norms interventions' rather than 'social influences'. This was because 'social norm' is a more specific term for the interventions we are interested in, whereas 'social influence' is used elsewhere in the literature as a broader term encompassing a wide array of behaviour change strategies, such as emotional or practical social support from others, restructuring the social environment and modelling or demonstrating behaviour.[23,27]

Aim and research questions

The overall aim was to conduct a systematic review to assess, among health workers, the impact of social norms BCTs compared with controls (alternative interventions, no intervention or comparison of one social norms BCT with one or more other social norms BCTs) with compliance to evidence-based professional practice. The review addressed two research questions:

1. What is the effect of social norms interventions on the clinical behaviour of health workers, and resulting patient outcomes?
2. Which contexts, modes of delivery and behaviour change techniques are associated with the effectiveness of social norms interventions on health worker clinical behaviour change?

These questions were explored using forest plots and metaregression; network meta-analysis was undertaken to rank the effectiveness of the social norms interventions.

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Chapter 2 Methods

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Changes to the protocol

The published protocol differs from the funding proposal in the ways listed below, and these changes were approved by NIHR during the early months of the project:

- Change in terminology – 'social norms' replaces 'social influence'. The justification for this was twofold. First, the term 'social influence' is a domain within the Theoretical Domains Framework[23] and encompasses a broad range of social concepts, such as emotional and practical support, demonstrating a behaviour and changing the social environment, as well as social norms; it is not specific enough for the purpose of this review. Second, 'social norms' better captures the core mechanism by which we expected the interventions to have an effect.
- We added to our inclusion criteria a requirement that included studies must state a behaviour that is being targeted for change. This was not a fundamental change from the earlier version, but was stated more clearly than previously.
- Change from 'health professional' to 'health worker'. This is a clarification rather than a change to the original inclusion criteria. It was always our intention to include all staff providing health care, and this change of terminology makes clear that not all health workers have professional qualifications.

Inclusion criteria

The inclusion criteria for the review were based on the population, types of intervention and study designs, as follows.

Population

The population of interest was health workers (including managers) responsible for patient care in a health-care setting. Health workers in training were included, but only if they were in a health-care setting (i.e. not in campus or laboratory environments). Any health-care setting was eligible, including primary care, secondary care, care homes, nursing homes and patients' own homes. Interventions taking place in simulated environments were not eligible for inclusion.

Interventions

A social norms intervention seeks to change the clinical behaviour of a target health worker by exposing them to the values, beliefs, attitudes or behaviours of a reference person or group. We looked for the five BCTs that we considered to have a social norms element to them: 6.2. social comparison, 6.3. information about others' approval, 9.1. credible source, 10.4. social reward and 10.5. social incentive. However, we were open to including studies that met all other inclusion criteria and had a social norms element, even if they did not include any of these five BCTs.

Included studies must have stated a clinical behaviour of health workers that was targeted for change through the use of social norms. If the behaviour was not specified, it was not possible to determine which aspects of an intervention were relevant to the anticipated behaviour change. Indeed, the BCT taxonomy v1 coding guidance states that the target behaviour needs to be specified and BCTs must

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target that behaviour for BCTs to be coded.[28] Clinical behaviour here is defined as any behaviour that is performed within a (non-simulated) environment that affects patient diagnosis, care, treatment or recovery. We have reported the number of studies identified by our search that met all other inclusion criteria but did not mention a target behaviour.

Comparators

All comparators were eligible for inclusion, including alternative interventions, no intervention or comparison of one social norms BCT with one or more other social norms BCTs.

Study designs

Only randomised controlled trials (RCTs) were included in the review. All designs of RCTs (cluster, factorial, parallel, cross over and stepped wedge) were eligible for inclusion. The justification for restricting the review to RCTs was that the review is concerned with the effectiveness of social norms, and RCTs are the best method for assessing the effectiveness of an intervention.

We included both published and unpublished research. Studies had to be reported in English because the research team had no resource for translation from other languages.

Search strategy

The search strategy was developed using an extensive iterative scoping process, involving the whole team including an information specialist (Jane Roberts). Lists of possible search terms were suggested by team members; these were developed into search strategies by Jane Roberts, who then ran preliminary searches. A sample of the titles and abstracts were reviewed closely by Sarah Cotterill and Mei Yee Tang and discussed by the wider team. This review involved consideration of whether searches were too inclusive or too restrictive, and examination of resulting abstracts to look for potential additional search terms.

The searches were based on three groups of terms: population, interventions and study design.

Population

A list of population terms was developed by looking at Cochrane reviews[25,29] that included a similar population of health workers, augmented by job roles included in the UK national workforce data set produced by NHS Digital.[30]

Interventions

Social norms interventions are not described consistently in the literature, and different terms are used in various academic disciplines. This presented us with the challenge of finding appropriate search terms to make sure that we would discover the full range of literature on this topic. We were aware that many studies involving A&F contain a social comparison element;[25] therefore, we looked at the search terms that were used in a previous systematic review of A&F.[25] We omitted anything relating solely to 'audit', as this was not relevant for this review.

During the scoping phase, various feedback terms were tried out. The use of 'feedback' alone produced many irrelevant papers, such as those relating to educational feedback and electronic feedback. The final search, following extensive trial and error in the piloting phase, included 'feedback' when used alongside other relevant terms (audit, monitoring, peer, performance, data, individualised, web, personalised, comparative, team, practitioner, practice and clinical or social). We also included 'benchmark'. We included some overall terms that are used in the literature on social norms: 'norm' used close to 'social', 'descriptive', 'peer' or 'subjective'; 'social influence'; 'benchmarking'; 'social or peer comparison'; and 'social competition'. Terms that appeared in behavioural economics literature were included: 'social proof', 'image motivation' and 'warm glow'.

Additional search terms were developed for each of the five social norms BCTs by looking at the text used to describe them in the BCT taxonomy v1,[24,31] extensive discussion in the team and examining relevant articles. Additional terms for information about others' approval and credible source included 'positive reinforcement', 'congratulate', 'praise' and 'commendation'. Terms for social reward and social incentive included 'social', 'verbal' and 'non-verbal' alongside 'incentive' or 'reward'. Finally, the search included terms to describe theories that are used to explain interventions based on social norms: the Theory of Planned Behaviour,[32] the Theory of Reasoned Action,[33] the Theoretical Domains Framework,[34] Social Cognitive Theory,[35] and the Theory of Normative Social Behaviour.[22]

Study design

The search for RCTs was taken directly from the Cochrane RCT search described in the *Cochrane Handbook for Systematic Reviews of Interventions*.[36] This was translated into other relevant databases.

The search was developed in MEDLINE and then adapted for other databases. Terms relating to the same concept (e.g. different types of health workers) were combined using the Boolean operator 'OR' and different concepts (e.g. health workers and social norms) were combined using 'AND'. The search strategy was tailored for the different electronic databases using medical subject headings (MeSH) where appropriate, wildcard symbols and truncations (see *Appendix 1*). Backward- and forward-citation searching was not conducted owing to time and resource constraints.

Published literature was systematically searched on 24 July 2018 in electronic databases relevant to health and social care: Ovid MEDLINE, Ovid EMBASE, Healthcare Databases Advanced Search (HDAS) – Cumulative Index to Nursing and Allied Health Literature (CINAHL), HDAS British Nursing Index (BNI), Cochrane Central Register of Controlled Trials (CENTRAL), Ovid PsycINFO and Web of Science (see *Appendix 1* for search strategies and *Appendix 1*, *Table 15*, for the results).

Data collection

Study selection

The process for identifying studies for review followed the stages of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[37]

All references generated from the search were managed in Covidence (Melbourne, VIC, Australia): an online screening and data extraction tool for systematic reviews. All reviewers were provided with instructions for both the title and the abstract, and full-text screening stages (see *Appendix 2*). At the title and abstract screening stage there was an initial learning phase (305 studies), during which the coders worked steadily through the task, applying the inclusion criteria to the papers and stopping after small batches to discuss any discrepancies as they went along. Disagreements and uncertainties were discussed with the wider research team. This process enabled the main coder to build up a high level of consistency. For the remaining studies, one reviewer (MYT) independently screened all of the titles and abstracts against the inclusion criteria, and another researcher (SC, SR or JW) screened a sample of 20% of the records. These were randomly selected using a random integer generator (www.random.org; accessed 1 September 2020). By the time that 20% of the records (493 studies) had been screened, there was very little difference between the decisions of the two coders, and we were confident that the main coder could make the exclusion decisions with reliability. Inter-rater reliability on these 493 studies was good[38] (kappa = 0.68). Where there was any hesitation on her part about whether to include or exclude, she erred on the side of inclusion and continued to discuss any uncertainties with the wider team.

All of the studies at the full-text stage were independently screened by two researchers from the screening team (MYT, SC or SR). The two reviewers screened the papers concurrently using Covidence, and were not aware of the other person's recommendation until after they had entered

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their own. The screening involved reading the full-text paper and deciding whether or not the paper met the eligibility criteria (a population of health workers in a health-care setting, a social norms intervention targeted at clinical behaviour change and a RCT). If the study was excluded, the reviewer entered a reason for exclusion. Any disagreements over the recommendation to exclude or the reason for exclusion were flagged up by Covidence and the two reviewers met to discuss. If they were unable to come to a consensus, there was moderation by a third researcher or discussion at a team meeting.

Data extraction and management

For efficiency, data extraction was conducted in three stages: stage 1 involved extraction of all data apart from the details of the intervention, stage 2 was the BCT coding (carried out by a different team concurrently with stage 1) and stage 3 was carried out later, because it relied on data collected during the BCT coding (e.g. we needed to identify which aspects of the intervention were based on social norms to assess the frequency or format of the social norms intervention). Data from included studies were extracted using data extraction forms derived from the Cochrane Effective Practice and Organisation of Care data collection form.[39]

Stage 1 data extraction

See extraction form in *Appendix 3*, *Tables 16* and *17*.

Data were independently extracted by two researchers from the data extraction team (MYT, LH, SR and SC). Any disagreements were referred to a third researcher for consideration or discussed at a research team meeting.

Data extracted were:

- setting of the trial (e.g. primary)
- country in which trial was conducted
- design of trial
- aim of the trial
- unit of allocation
- primary outcome
- secondary outcomes
- time points
- statistical analysis
- inclusion/exclusion criteria (and whether or not the inclusion criteria targeted participants based on low target performance)
- methods of recruitment
- number of randomised clusters, if randomised RCT
- subgroups measured (both health workers and patients)
- target behaviour
- total number of patients and health workers randomised
- type of health worker targeted by the intervention
- withdrawals and exclusions (after randomisation)
- number of participants (both patients and health workers) randomised to group
- number of clusters randomised to group, if cluster RCT
- type of control
- outcomes
- quality assessment (risk of bias).

Stage 2 data extraction: coding of behaviour change techniques

See the BCT extraction form in *Appendix 5*, *Table 19*.

Specific BCTs were independently double coded using the BCT taxonomy v1[24] by at least two researchers. A BCT extraction form was produced to guide the process. Each study's intervention descriptions from all of the relevant papers (e.g. protocol, process evaluation and main findings) were collated by Mei Yee Tang and transposed to the BCT extraction form so that the second coder (RP, SC or JR) could have the information required for BCT coding available in the one document for each study. All coders had access to the full papers on Covidence, so that they were able to find further relevant information that could help them with the coding task. Following coding, for each study Mei Yee Tang transferred the BCT codes and information extracted by both coders onto a single final BCT extraction form. As part of this process, any discrepancies were highlighted by Mei Yee Tang and the disagreements were resolved through discussion or by the moderation of another coder.

For each study, BCTs were separately coded for all arms (i.e. the control arm and all intervention arms). Mei Yee Tang coded BCTs for all studies, which were then independently double coded by another trained coder within the research team (SC, RP or JR). BCT coders also recorded the target population, target behaviour, whether or not guidelines were provided as part of the intervention and the direction of change in the behaviour that was desired.

Training

All coders completed online training on the coding of BCTs (www.bct-taxonomy.com/; accessed 1 September 2020) and attended a workshop facilitated by co-applicant Rachael Powell and study steering committee member Marie Johnson prior to starting the coding process. To ensure that all coders were familiar with the BCT coding process and coded consistently, a random sample (using www.random.org; accessed 1 September 2020) of three studies was selected for coding by all coders (MYT, RP, SC and JR). All coders coded the three intervention descriptions independently before meeting to discuss any issues that arose. This practice exercise with all BCT coders was repeated again on another four randomly selected studies. The two practice sessions helped to refine the coding process and revise the BCT extraction form (see *Appendix 5*, *Table 19*). A decision log was kept throughout the BCT coding process to record any decisions that were made to ensure the consistency of coding. Details are provided in *Appendix 6*.

Behaviour change techniques inter-rater reliability

Inter-rater reliability for each of the BCTs that were present at least once across all intervention arms was assessed using the prevalence-adjusted and bias-adjusted kappa (PABAK) statistic (see *Appendix 7*, *Table 20*), which adjusts for both the prevalence and the occurrence of BCTs.[40] In circumstances in which prevalence is low, the widely used chance-corrected kappa statistic is likely to underestimate reliability as it is highly dependent on prevalence.[41] To calculate the PABAK, the kappaetc module in Stata® I/C 14.0 (StataCorp LP, College Station, TX, USA) was used to produce the Brennan–Prediger statistic.[42,43]

Stage 3 data extraction: trial and intervention characteristics

See the stage 3 data extraction form in *Appendix 4*, *Table 18*.

Information relating to trial and intervention characteristics [focused on the social norms element(s) only] was extracted during stage three of data extraction using Microsoft Excel® (Microsoft Corporation, Redmond, WA, USA) by Sarah Cotterill and Mei Yee Tang:

- Did the inclusion criteria target participants based on low target performance?
- Frequency and intensity of intervention.
- Format of intervention.
- Source of the intervention (i.e. the person delivering the intervention).
- Was this person delivering the intervention internal or external to the target person's organisation?
- Reference group/person used as the comparison/source of approval.
- Type of comparison.

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The processes of the third stage of data extraction, along with the accompanied instructions, were refined through piloting (see *Appendix 4* for the final version). Six studies were independently extracted by Sarah Cotterill and Mei Yee Tang. The instructions were refined during this pilot phase and some categories were added to ensure that extraction was as consistent as possible. The piloting process was repeated until a high level of agreement was reached between the two coders.

In the protocol, we had envisaged that we would contact authors for additional information if the data needed to calculate effect sizes were not adequately reported in the paper. We were not able to do this owing to time constraints, but we made efforts to search for additional papers, including process evaluations and protocols. Once all of the data were extracted, they were transferred to Stata for analysis.

Assessment of risk of bias

As part of the first stage of data extraction, risk of bias for each included study was independently assessed by the data extractors (LH, MYT, SC and SR) using The Cochrane Collaboration tool for assessing risk of bias[36] across a range of criteria: selection bias, performance bias, detection bias, attrition bias, reporting bias, selective outcome reporting and other biases. Included studies were classified as having a high, low or unclear risk of bias for each criterion. All risk-of-bias criteria were added as part of the data extraction form in Covidence. Where disagreements occurred, a discussion between the two extractors took place to resolve the disagreement or a third data extractor would be brought in when an agreement could not be reached. Percentages of high/low/unclear judgements for each risk-of-bias criterion across included studies were calculated and reported as a bar chart to provide a summary of the risk of bias across criteria domains (see *Figure 2*). Text summaries across each criteria of bias were produced in line with The Cochrane Collaboration's guidance for large reviews.[36] Judgements for each risk-of-bias criterion for all included studies were reported (see *Appendix 15*, *Figure 20*).

Data analysis

Outcomes and prioritisation

The primary outcome for the review was compliance of the health worker with the desired behaviour at the time point closest to 6 months post intervention. We expected studies to report different behaviours (e.g. prescribing, hand-washing and test ordering) and we expected studies to measure those behaviours in different ways. We converted any observed measure of health worker behaviour into a standardised mean difference (SMD) between groups in terms of compliance with the desired behaviour. Common examples included the mean number of times a behaviour was performed per health worker or the mean rate of behaviour (e.g. percentage of the population for whom antibiotic items were dispensed). At times, compliance was reported as a binary outcome, such as compliance versus non-compliance on a single occasion, and was expressed either in a binary format or using an odds ratio.

We used the methods of Chinn[44] to convert binary outcomes to a SMD with associated standard errors (see *Appendix 8* for the formula).

If several measures of compliance were reported in sufficient detail to enable the analysis of a trial, we used the following criteria to select the outcome for the primary analysis, in decreasing order of importance: (1) observed measure rather than self-report, (2) appropriate adjustment for clustering, (3) continuous measure, (4) final score rather than percentage change or change from baseline, (5) described as the primary outcome, (6) used to calculate the sample size and (7) reported first.

The secondary outcome for the review was patient health-related outcomes that were likely to result from targeting the health worker behaviour. These were converted to a SMD using a similar approach.

Some trials incorporated baseline measurements into their analyses. This was carried out either by adjusting for baseline values of the outcome measure or of other prognostic variables in an analysis of covariance (ANCOVA), or by reporting outcomes as changes from baseline. We have prioritised ANCOVA-adjusted estimates of the treatment effect where relevant or those from logistic regression, given that these are generally more precise. Change scores cannot be pooled through conversion to SMDs.

Missing data

Our preferred approach to dealing with missing data was to take steps to try to obtain them. We searched for companion papers by author searching and citation searching. Contacting trial authors was not possible owing to limited resources and the large number of studies. We imputed estimates of standard deviations where necessary by using any available information, such as *p*-values, confidence intervals (CIs), ranges or standard errors of baseline data, by pooling standard deviations from other similar studies that use the same type of outcome or by searching for trials that used the same outcome. Where necessary, for cluster randomised trials we imputed a value of the intraclass correlation coefficient (ICC) by pooling across similar studies.

Unit of analysis issues

Where any of the studies in the review were cluster randomised trials, we extracted both raw summary measures (e.g. means and numbers having had the event) and adjusted standard errors from appropriately analysed trials. Where it was not possible to obtain the adjusted SMD and its standard error directly, the methods that were used to calculate the SMD and standard error are shown in *Appendix 9*, *Table 21*.

Several studies had more than two relevant arms (e.g. two different social norms interventions and a control group). In each case, we extracted data on any comparison that was relevant to our primary research question, while avoiding double counting where possible. Where relevant, we combined study arms that contained identical BCTs. In cases with two different social norms interventions and a single control arm, where possible we divided the number of health-care workers in the control arm approximately evenly between the comparisons to avoid double counting, while retaining the correct intervention effect. In studies with more than one candidate control arm, we chose the comparison that provided the more pure test of social norms (e.g. social norms intervention + X vs. X is a more pure test of social norms than social norms intervention + X vs. usual care).

Where a study was a factorial trial analysed appropriately using linear or logistic regression, we extracted the covariate and standard error that best assessed the effect of social norms BCTs, for example a covariate comparing all arms containing a social norms BCT with all arms without.

Analysis of skewed data

If the primary outcome data were heavily skewed, meta-analyses based on SMDs of the untransformed data would be expected to produce biased estimates. In some cases, compliance was reported as ‘mean per cent compliance’ or similar, and there is a likelihood that this outcome is skewed when close to 0% or 100% owing to it being bounded. We removed data likely to be skewed (where mean compliance was close to 0% or 100%) in a sensitivity analysis.

Utilising the behaviour change technique coding in the analysis

The approach we took to utilising the BCTs in the meta-analysis was to create an Excel file of all the trials, listing the intervention and control BCTs on separate rows. We subtracted the control arm BCTs from the intervention arm BCTs to identify the BCTs that would be expected to be responsible for the differences between the two arms.

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Using the five types of comparison (extracted during the BCT coding process), listed in *Box 1*, allowed us to separate out three different tests of social norms:

1. 'Pure' test of social norms intervention alone (comparisons 1 and 2, see *Box 1*).
   This involved trials with social norms BCT(s) in the intervention arm and no BCTs in the control arm (comparison 1). These trials were the purest test of social norms interventions: the BCTs being tested were those found in the intervention arm. For trials in which an intervention arm including a social norms BCT combined with other BCTs was tested against a control arm containing the same other BCTs (comparison type 2), the control arm BCTs were subtracted from the intervention arm to reveal the BCTs that would be expected to account for differences in outcome. For example, if the study tested social comparison and instructions on how to perform the behaviour (intervention arm) against instructions on how to perform the behaviour (control arm), the comparison type would be 'social comparison'.
2. 'Complex' test of a social norms intervention alongside one or more other BCTs (comparison 3, see *Box 1*)
   This involved trials in which an intervention arm including a social norms BCT combined with other BCTs was tested against a control arm containing none of the same BCTs (comparison 3). The control arm was deducted from the intervention arm to reveal the test involved in the comparison. For example, if the study tested a complex intervention such as credible source, feedback on behaviour, social support unspecified and behavioural practice/rehearsal (intervention arm) against social support unspecified and behavioural practice/rehearsal (control group), the comparison would be 'credible source' and 'feedback on behaviour' versus control.
3. Social norms intervention occurring in both arms (comparisons 4 and 5; see *Box 1*)
   In some studies, two different social norms interventions were compared (comparison 4) or the same social norms intervention appeared in both arms (comparison 5). Where social norms interventions occurred in both arms of a trial, the study did not provide useful information for the meta-analysis, because these trials do not test the effect of social norms interventions, but they were potentially useful to the review as follows:

   - Any study that directly compared one social norms BCT against another (e.g. social comparison vs. credible source) could potentially be included in the network meta-analysis.
   - Any study that compared the same social norms BCT in both arms, with the addition of other BCTs (e.g. with the addition of social support in one of the arms) or comparing differing modes of delivery (e.g. social comparison delivered in person or by e-mail) could potentially be included in the metaregression.
   - Any study where social norms BCT(s) were delivered in both arms as a control intervention, for the purpose of testing a separate intervention, in which the social norm was a minor part were not included in any analysis.

BOX 1 Types of comparison

Comparison
Comparison 1: social norms BCT vs. any control.
Comparison 2: social norms BCT + X vs. X.
Comparison 3: social norms BCT + X vs. any control.
Comparison 4: social norms BCT type A vs. social norms BCT type B.
Comparison 5: social norms BCT + X vs. social norms BCT + Y.

In summary, the information extracted for the analysis describes the BCTs that were tested in the study rather than all of the BCTs that make up the intervention. In some cases (comparison 1) the content of the comparison is the same as the content of the intervention arm, but in most cases (comparison 2 and 3) the content of the comparison is what is left of the intervention when the control arm is taken away. We regard this as the part of the intervention that was actively tested in the trial. A limitation of this approach is that we may have missed some interaction effects.

Feedback on behaviour

Early on in our coding, we observed that the BCT 'feedback on behaviour' was often found to be presented alongside a social norms BCT. The implementation of three social norms BCTs (social comparison, social incentive and social reward) would seem to be greatly facilitated by combination with 'feedback on behaviour'. Social comparison, defined as 'draw attention to others' performance to allow comparison with the person's own performance',[24] does not by definition require feedback on the target's own behaviour to be provided, but providing such feedback (e.g. performance data) would be expected to facilitate comparison. Social reward, 'arrange verbal or non-verbal reward if and only if there has been effort and/or progress in performing the behaviour',[24] and social incentive, 'inform that a verbal or non-verbal reward will be delivered if and only if there has been effort and/or progress in performing the behaviour',[24] similarly do not require feedback on the target's behaviour to be provided (e.g. the behaviour could be monitored by others without feedback to make the reward/incentive process clear to a target), but feedback on the behaviour fits very well with these social norms BCTs and might be expected to facilitate the action of these BCTs.

Because of the high prevalence of feedback on behaviour (present in 88/100 comparisons), we combined 'feedback on behaviour' with the social norms BCT with which it appeared for the purpose of primary analyses: in the forest plots we have listed each social norm with or without feedback. However, it was important to unpick the separate effects of feedback on behaviour: this was examined as part of the metaregression. As a sensitivity analysis, we examined the overall effects of social norms interventions with and without feedback on behaviour.

Data synthesis

Criteria for study data to be meta-analysed

We included in a meta-analysis those studies that report a primary outcome measure (clinical behaviour of a health worker) or secondary outcome (patient outcome) that can be converted into a SMD.

Planned approach for meta-analysis

Research question (RQ) 1: what is the effect of social norms interventions on the clinical behaviour of health workers, and the resulting patient outcomes?

The comparisons used in the analysis to answer RQ1 are shown in *Appendix 10*, *Table 22*. We stratified the studies in the forest plot according to the type of comparison (see *Utilising the behaviour change technique coding in the analysis*) and the type of target behaviour, and pooled estimates across strata. The aim of this was to provide some initial insight into whether or not, and how, treatment effects vary systematically in trials using different social norms techniques, while remaining aware of the likely confounding by other trial characteristics. We considered I^2 and tau when interpreting heterogeneity, but did not use it as the basis for analytic decisions. We preferred a fixed-effects approach rather than a random-effects approach to meta-analysis, which we consider to yield a summary of the evidence in these trials (i.e. the average effect), rather than an estimate of a common underlying treatment effect. However, we also reported a random-effects analysis.

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Research question 2: which contexts, modes of delivery and BCTs are associated with health worker clinical behaviour change? To address this research question, we followed steps 1 to 3.

Step 1 – we explored sources of variation using forest plots and narrative description. In addition to those comparisons used in RQ1, we included the following types of comparison in a narrative description: (1) social norms intervention A versus social norms intervention B and (2) social norms intervention + X versus social norms intervention + Y, where X and Y are any BCT or combination of BCTs, and A and B are either two different types of social norms BCT or the same social norms BCT delivered by two different methods.

Step 2 – we undertook an exploratory analysis using multivariable metaregression to investigate sources of heterogeneity and explain variation in the results. Metaregression is an appropriate regression method in which weights are assigned to studies/subgroups based on the standard error of the treatment effect. *Appendix 11*, *Table 23*, shows the predictor variables together with anticipated parameterisations that we included in the metaregression analyses. Although controlling for multiple predictors at once is desirable, in practice this was governed by the number of trials and the observed distributions of the variables. We allowed for trials from the different comparisons to enter into a single metaregression given that we anticipated we would be able to control for comparators and co-interventions in the regression. We had intended to categorise the control conditions, but were unable to do this robustly.

Step 3 – we used network meta-analysis to explore which social norms BCT, combination of social norms BCTs or combination of social norms BCT with other BCTs, if any, appears most effective. We considered two broad approaches for network meta-analysis, and made the decision to employ type (a) after consultation with our SSC.

- Network meta-analysis
  We examined data from all trials to look at the most commonly occurring combinations of social norms BCTs, either alone or alongside other BCTs. We built and examined a network diagram including social norms BCTs and commonly occurring combinations of social norms BCTs with other BCTs, plus control. Decisions about whether or not to 'lump together' BCTs or combinations of BCTs into categories were made after careful discussion by the project team. The justifications were recorded. The geometry of the network diagram was evaluated and no revisions were required to achieve a connected network. Fixed-effects and random-effects network meta-analyses were fitted in Stata.
- Multi-components-based network meta-analysis.[45]
  Each intervention in the review would have been considered as a combination of BCT components. We would include all social norms BCTs along with other commonly found BCTs in a components-based network plot. This type of analysis ideally requires all available trials that test the BCT components of interest; our search strategy was not appropriate for this as we were focusing on the social norms components only. We therefore decided not to pursue this approach.

The results from direct and indirect evidence were compared to check for consistency. Trials grouped by comparison were examined to assess transitivity. Metaregression did not identify any clear potential effect modifiers; therefore, although we planned in the protocol to include these in the model, this did not happen.

Additional analyses

We carried out the following sensitivity analyses for the primary outcome:

- include only studies with a low risk of bias (for the key domains of allocation concealment, sequence generation, attrition, selective outcome reporting and other sources of bias)

- exclude continuous outcomes reported as 'mean percentage' that were < 20% or > 80%, as these are unlikely to come from a normal distribution
- include only studies in which the standard deviation was not imputed
- using alternative values of imputed ICC
- studies with and without feedback on behaviour.

Publication bias

We aimed to minimise the impact of reporting biases by performing a comprehensive search for eligible studies. We investigated the impact of publication bias in the reported studies using a funnel plot.

Patient and public involvement

We recruited members of the public from two sources: (1) PRIMER (Primary Care Research in Manchester Engagement Resource: https://sites.manchester.ac.uk/primer/about-primer/; accessed 1 September 2020), a public involvement group in the Centre for Primary Care, University of Manchester, and (2) an advertisement on Citizen Scientist, which is based at Salford Royal NHS Foundation Trust and promotes research and patient and public involvement (PPI) opportunities for members of the public. We advertised for anyone aged > 18 years who had used any type of NHS service: we were not looking for people with any particular condition or experiences.

Mr Manoj Mistry has been involved in the review from the start. He has a wealth of past experience of involvement in research and was an invaluable part of the review. He had input into the proposal before we submitted the funding bid and he was a member of the SSC, bringing a patient and carer perspective to the meetings. He attended all three SSCs and played a full and active role in the committee's discussions.

Two PPI events were planned for this study. The first event took place in August 2018 at the University of Manchester. The aim of the first event was to discuss how the review would be relevant to members of the public, and to get feedback on the overall design of the review. Six members of the public (two female, four male), including Mr Manoj Mistry, participated in the workshop, and they discussed with us the relevance of the review for patients and carers. They felt that patients can have a role in changing health worker behaviour, for example by reminding health workers to wash their hands or telling the GP that they do not expect to be prescribed antibiotics for a cold, although they were cynical about whether or not doctors would listen to patients when they present potential best practice (example given of a relative who had better care in Australia, but the doctor in the UK did not want to hear about it). In response to this observation, we made sure to record whether or not any studies in the review considered patients' role in social norms interventions (e.g. use of the information about others' approval BCT, where the approval came from patients) (see *Appendix 12*, *Table 24*, for a short report of the meeting).

We had feedback from four public contributors on the *Plain English summary*, and Mr Manoj Mistry has reviewed this description and account of our PPI activity.

A second PPI workshop took place in October 2019 at the University of Manchester to discuss how best to disseminate the findings to a wider audience. Four of the original group members (including Mr Manoj Mistry) attended. We presented the preliminary findings from the SOCIAL study and asked the group what they considered to be the most important messages from a public perspective. We also asked the group to suggest suitable language for presenting the findings to a lay audience. They suggested that the main messages should be that the study provides evidence that social norms interventions can encourage the medical community to change behaviour, leading to better outcomes for patients.

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One or two things make social norms interventions even more effective:

- right message (i.e. the use of different social norms BCTs)
- right place (i.e. context)
- right method (i.e. mode of delivery).

Authority of the message sender is crucial.

Messages from all sources are important, including those from patients.

We plan to follow this approach when we write summary materials for a lay audience. There was concern (from some) about the term 'behaviour change'. Alternatives were 'influence' or 'improve', but they did not all agree. The group wanted us to avoid being preachy or patronising or using a telling-off approach to health workers: they talked about health workers being 'encouraged' by social norms interventions, rather than 'directed'. The group felt that social norms messages would also be useful with people who teach and mentor students and young professionals. The lack of effect for face-to-face delivery of social norms interventions was viewed as surprising.

Chapter 3 Results

Identification of included studies

Of the 7980 studies identified using database searches, 3552 were identified as duplicates leaving 4428 separate studies to be screened. Of these, 3951 were discarded as irrelevant to the research questions under consideration, leaving 477 to be assessed for eligibility by full-text review of publications. Of these, 361 were excluded as ineligible for various reasons, as described in *Figure 1*. There were 116 studies that met the inclusion criteria, and 106 of these contributed findings to the review. Some of the 106 studies had more than one trial arm, and there were a total of 117 comparisons that tested the effect of social norms on the clinical behaviour of health workers. The remaining 10 studies met all of the inclusion criteria but did not provide usable outcome data: two reported the overall effect but did not compare the results between groups,[46,47] six reported results unclearly or incompletely,[48–53] one trial was discontinued before completion[54] and one did not report results on our primary or secondary outcomes.[55] Searches for companion papers were unsuccessful and authors were not contacted owing to limited time. A brief description of the studies is provided in *Appendix 13*, *Table 25*.

Characteristics of included studies

Study characteristics

A detailed summary of study characteristics is shown in *Table 1*. Over half of the included trials were conducted in North America (Canada: $n = 15$, 14.2%; USA: $n = 45$, 42.5%) and the most common settings were primary care ($n = 57$, 53.8%) and hospitals (including both inpatient and outpatient: $n = 31$, 29.3%). GPs were the most frequently targeted type of health worker ($n = 45$, 42.5%), with

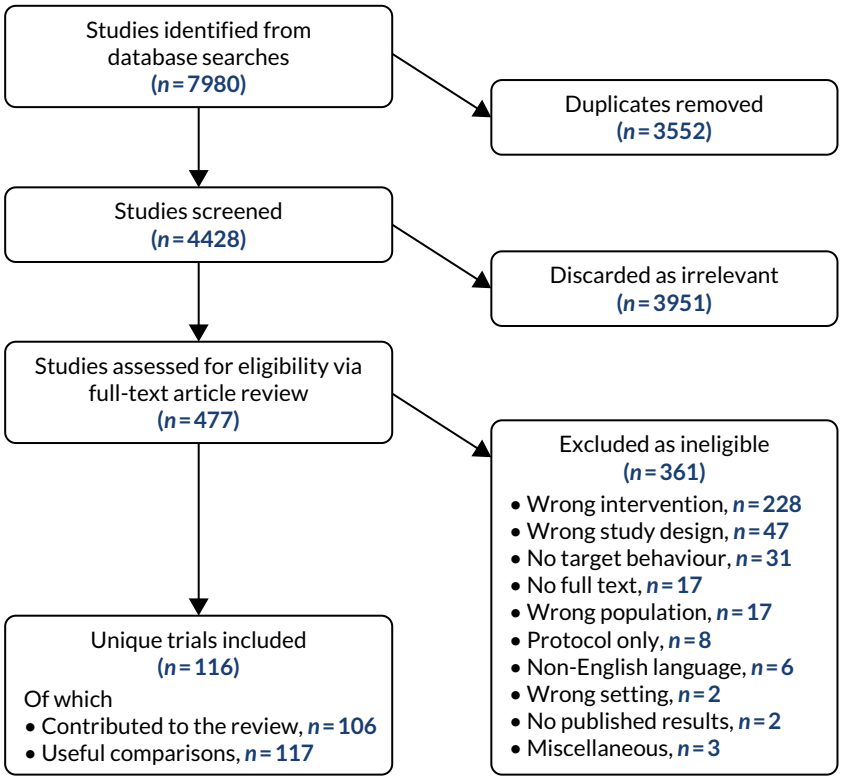

FIGURE 1 The PRISMA flow chart of the SOCIAL review.

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TABLE 1 Characteristics of included studies

Study characteristic ($n = 106$)	Frequency	%
Country		
Australia	8	7.5
Canada	15	14.2
Denmark	4	3.8
UK	13	12.3
Netherlands	6	5.7
USA	45	42.5
Other/multiple	15	14.2
Setting		
Primary (GP/general practice nurses)	57	53.8
Hospital (inpatient and outpatient)	31	29.3
Community	4	3.8
Care/nursing home	4	3.8
Mixed	7	6.6
Other	3	2.8
Type of health worker		
Doctor (primary care)	45	42.5
Doctor (secondary care)	19	17.9
Other (nurse/dentist/AHP/pharmacist)	7	6.6
Mixture/whole team	35	33.0
Target behaviour		
Prescribing (including vaccinations)	40	37.7
Hand-washing/hygiene	4	3.8
Tests/assessments	21	19.8
Referrals	3	2.8
Management communications	25	23.6
Other	2	1.9
Multiple behaviours	11	10.4
Type of trial		
Cluster RCT	69	65.1
Factorial	4	3.8
RCT	28	26.4
Stepped wedge	4	3.8
Matched pairs, cluster RCT	1	0.9
Targeted at low baseline performance?[a]		
No	103	97.2
Yes	2	1.9
Unclear	1	0.9

TABLE 1 Characteristics of included studies (*continued*)

Intervention characteristic ($n = 117$)	Frequency	%
Source		
Peer	6	5.1
Investigators	83	70.9
Supervisor/senior colleague	2	1.7
Patient	1	0.9
Respected source	15	12.8
Other	1	0.9
Not reported	9	7.7
Internal/external delivery[b]		
Internal	17	14.5
External	81	69.2
Unclear/not reported	19	16.2
Reference group		
Peer	97	82.9
Professional body	1	0.9
Senior person	9	7.7
Patient(s)	1	0.9
Multiple	4	3.4
Unclear/not reported	5	4.3
Direction of change		
Increase	85	72.6
Decrease	30	25.6
Maintenance	0	0.0
Unclear	2	1.7
Format		
Face-to-face meeting	16	13.7
E-mail	10	8.5
Written (paper)	29	24.8
Separate computerised	10	8.5
Mixed	18	15.4
Unclear/not reported	34	29.1
Frequency		
Only once	35	29.9
Twice	10	8.5
More than twice	45	38.5
Unclear/not reported	27	23.1

AHP, allied health professional.
a Does the inclusion criteria target participants based on low target performance?
b Is the person delivering the intervention internal or external to the target person's organisation?

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many studies also targeting a mixture of health workers ($n = 35$, 33.0%). In terms of target behaviour, 40 studies (37.7%) aimed to change prescribing behaviours (including vaccinations), with 25 (23.6%) concerned with the overall management of conditions/communications (e.g. being friendly during consultations) and 21 (19.8%) focusing on arranging, conducting or administering tests/assessments (e.g. performing HbA_{1c} testing). Of the 106 trials that contributed findings to the review, the majority ($n = 70$, 66%) were cluster RCTs, with 31 RCTs (29.2%), four stepped-wedge designs (3.8%) and one two-arm matched-cluster RCT. The majority of trials ($n = 103$, 97.2%) did not explicitly target participants with a low target performance. This is surprising, because the literature on social norms strongly suggests that social comparison is more likely to be successful if it is addressed to low performers: telling a high performer that they are already doing more than their peers does not motivate them to improve.[56,57] It is possible that some of the trials took place in contexts where the performance of all the health professionals was generally low at baseline, so they did not need to specifically seek out low performers to target, but no information was provided to support such an assumption. A complete list of all trials and their characteristics is included in *Appendix 14*, *Table 26*.

Intervention characteristics

Details of intervention characteristics are shown in *Table 1*. Of the 117 comparisons, many were delivered using a written (paper) format ($n = 29$, 24.8%) or utilised a mixed format (e.g. face to face and written) ($n = 18$, 15.4%). Participants in 45 (38.5%) interventions received the intervention more than twice, whereas 10 comparisons delivered the intervention twice (8.5%) and 35 (29.9%) delivered the intervention only once. In the majority of comparisons, the investigators were the source of the intervention ($k = 83$, 70.9%) and the intervention was delivered by someone external to the target health worker's organisation ($k = 81$, 69.2%). In 97 (82.9%) of the comparisons, the reference group/person was the target health worker's peer. In terms of the desired direction of change, 85 (72.6%) studies aimed to increase the behaviour. There was a lack of clarity in reporting across many intervention characteristics within the included studies. For example, in 34 (29.1%) interventions, the format was unclear or not reported and the frequency of the intervention was unclear or not reported in 27 (23.1%) comparisons.

Description of the behaviour change techniques

The frequency of specific social norms BCTs occurring within the 100 comparisons that tested social norms interventions against a control are shown in *Table 2*. We found tests of social comparison ($n = 79$), credible source ($n = 7$) and social reward ($n = 2$) against control. Some studies tested more than one social norms BCT together: social comparison and credible source ($n = 6$), social comparison and social reward ($n = 2$) and multiple social norms BCTs (more than two) together ($n = 4$). The social norms interventions often occurred alongside other BCTs, and 22 different techniques were identified (see *Table 2*).

TABLE 2 Frequency of behaviour change techniques occurring in comparisons

Behaviour change technique	*n*
Social norms BCTs	
6.2 Social comparison	90
9.1 Credible source	18
10.4 Social reward	5
6.3 Information about others' approval	4
10.5 Social incentive	1
Other BCTs	
2.2 Feedback on behaviour	88
3.1 Social support (unspecified)	25

TABLE 2 Frequency of behaviour change techniques occurring in comparisons (*continued*)

Behaviour change technique	*n*
4.1 Instruction on how to perform the behaviour	20
7.1 Prompts/cues	19
5.1 Information about health consequences	18
1.2 Problem-solving	12
1.1 Goal-setting (behaviour)	9
8.1 Behavioural practice/rehearsal	5
1.4 Action planning	4
6.1 Demonstration of the behaviour	4
1.3 Goal-setting (outcome)	3
2.3 Self-monitoring of behaviour	2
2.7 Feedback on outcome(s) of behaviour	2
12.5 Adding objects to the environment	2
1.7 Review outcome goals	1
2.1 Monitoring of behaviour by others without feedback	1
5.3 Information about social and environmental consequences	1
8.2 Behaviour substitution	1
9.2 Pros and cons, final	1
10.3 Non-specific reward, final	1
12.1 Restructuring the physical environment	1
10.1 Material incentive (behaviour)	1

The table totals more than 100 because some interventions included multiple BCTs. There are 100 eligible comparisons.

The 117 comparisons belonged to the three comparison categories as follows (*Table 3*):

- Pure comparisons. There were 36 comparisons that offered a 'pure' test of social norms interventions. Most of these tested social comparison (33 comparisons). There were far fewer comparisons testing credible source ($n = 3$), social reward ($n = 1$), social comparison and credible source together ($n = 2$), or social comparison and social reward together ($n = 2$).
- Comparisons involving other BCTs. Social comparison was combined with social support (unspecified) ($n = 7$), prompts and cues ($n = 5$), information about health consequences ($n = 4$) and instruction on how to perform the behaviour and prompts/cues (combined) ($n = 5$). Combined interventions involving social comparison with more than two other BCTs or where the combination occurred only once in the study were combined into one group: social comparison and other BCTs ($n = 25$). Credible source did not occur more than once with any one particular BCT, so there is one category of credible source with other BCTs ($n = 4$) and another of social comparison and credible source with other BCTs ($n = 4$). There was one example of social reward with other BCTs ($n = 1$). Where more than two social norms BCTs occurred together, they were combined in a category ($n = 4$).
- Social norms BCTs in both arms. There were 17 comparisons in which both arms involved social norms interventions (*Table 4*).

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TABLE 3 Social norms comparison types

Social norms interventions comparison types	*n* (%)
Pure comparisons	
Social comparison	33 (28)
Credible source	3 (3)
Social reward	1 (1)
Social comparison and credible source	2 (2)
Social comparison and social reward	2 (2)
Comparisons involving other BCTs	
Social comparison and social support (unspecified)	7 (6)
Social comparison and prompts/cues	5 (4)
Social comparison and information about on health consequences	4 (3)
Social comparison and instruction on how to perform the behaviour & prompts/cues	5 (4)
Social comparison and other BCTs	23 (21)
Credible source and other BCTs	4 (3)
Social comparison and credible source and other BCTs	6 (3)
Social reward and other BCTs	1 (1)
Multiple social norms BCTs and other BCTs	4 (3)
Social norms BCTs in both arms	
Social norms BCTs both arms	17 (15)
Total (*n*)	117

TABLE 4 Comparisons that involve social norms interventions in both arms

Comparison type	Frequency
Same social norms intervention in both arms, testing some other intervention ($n = 11$)	
Credible source and feedback on behaviour vs. credible source and feedback on behaviour with other BCTs	1
Social comparison vs. social comparison and goal-setting	1
Social comparison and feedback vs. social comparison and feedback plus information about others' approval and other BCTs	1
Social comparison and feedback vs. social comparison and feedback with other BCTs	7
Social comparison and feedback vs. social comparison and feedback with a patient-level intervention	1
Comparison of two social norms interventions ($n = 2$)	
Credible source and social comparison and feedback on behaviour and other BCTs vs. social comparison and feedback on behaviour	1
Social comparison and credible source and feedback on behaviour vs. credible source	1
Testing different variants of the same social norms intervention ($n = 4$)	
Social comparison vs. social comparison, no other BCTs	2
Credible source vs. credible source	1
Social comparison and feedback and social support (unspecified) vs. social comparison and Feedback plus social support (unspecified)	1
Total	17

Variation in trial characteristics by type of social norms intervention

Table 5 shows the key trial characteristics by the type of comparison. In total, 33 different comparisons were a pure test of 'social comparison' and these were quite varied in terms of type of target behaviour, type of health-care worker and type of setting; similarly, those trials that tested social comparison alongside other BCTs were also quite varied. There were 13 comparisons that tested 'credible source' alone or with other BCTs and four that included social reward, and again these were spread over a range of behaviours, contexts and settings. Reassuringly, there is no clear pattern to suggest that the use of BCTs was restricted to particular behaviours, contexts or settings, and this is consistent with the regression results, which suggested that the results were consistent after adjustment.

Outcome measures

Using the criteria described in *Chapter 2*, *Outcomes and prioritisation*, we selected a single primary outcome measure of compliance with desired behaviour for each relevant comparison. Of the 117 comparisons used in the review, 32 (27%) provided an odds ratio, 42 (35%) provided raw binary data and 43 (37%) provided mean with standard deviation (standard deviations were imputed where necessary).

Risk of bias

A summary of each risk-of-bias item across the included studies ($n = 106$) is shown in *Figure 2*. Individual risk-of-bias assessments for all of the included studies can be found in *Appendix 15*, *Figure 20*.

Allocation

In terms of random sequence generation, methods were deemed sufficient to produce comparable groups for the majority of studies ($n = 78$, 73.6%) and were, therefore, considered to be at low risk of bias. Only one study was rated to be at high risk of bias, and this was because of the original randomisation being rejected because of a perceived lack of balance between groups. All other studies ($n = 27$) were rated as unclear because of insufficient information to permit a judgement. The majority of studies were also rated to be at low risk of bias for allocation concealment ($n = 78$, 73.6%), primarily because of recruitment and consent being conducted before randomisation took place. Three studies were rated to be at high risk of bias because randomisation took place before recruitment and/or obtaining consent. The remaining studies ($n = 25$) were considered unclear because there was insufficient information available, or because recruitment/consent had occurred post randomisation and it was unclear whether or not participants were aware of their allocation at the time of enrolment/consent.

Blinding

Many of the studies were cluster trials, randomised at the hospital or clinic level, making the blinding of participants and personnel impractical. Owing to this clustering, most studies were rated to be at high risk of bias ($n = 85$). Fourteen studies were considered to be at low risk of bias owing to participants/personnel being unaware of the study aims and hypothesis, intervention content and existence of other groups/interventions, or being unaware that they were taking part in a trial. Studies rated as unclear ($n = 7$) lacked clarity in reporting the blinding of participants and whether or not participants were aware of the intervention or study aims and outcomes. For blinding of outcome assessment, most studies ($n = 80$) obtained data from electronic health records, online reports or databases or routinely collected data, in which the outcome assessors were blind to group allocations and were, therefore, rated to be at low risk of bias. Eight studies were judged to be at high risk of bias where participants selected consecutive patient records to contribute to the outcome assessment (so could have selected groups based on good practice), where participants selected the patients and collected the data or

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TABLE 5 Key trial characteristics by social norm comparison type

Trial characteristic	Social norm comparison category, *n* (%)													
	Social comparison	Credible source	Social reward	Social comparison and credible source	Social comparison and social reward	Social comparison and social support (unspecified)	Social comparison and prompts and cues	Social comparison and information on health consequences	Social comparison and instructions and prompts/cues	Social comparison and others BCTs	Credible source and other BCTs	Social comparison and credible source and other BCTs	Social reward and other BCTs	Multiple social norms and other BCTs
Comparisons with primary outcome data (*n*)	33	3	1	2	2	7	5	4	5	25	4	4	1	4
Target behaviour														
Prescribing	15 (45)		1 (100)	1 (50)	2 (100)	2 (29)	1 (20)	3 (75)	1 (20)	11 (44)	1 (25)	1 (25)		1 (25)
Hand/hygiene												1 (25)	1 (100)	1 (25)
Tests	7 (21)					1 (14)	3 (60)	1 (25)	3 (60)	4 (16)	1 (25)	1 (25)		
Referrals										2 (8)		1 (25)		
Manage conditions	5 (15)	3 (100)		1 (50)		2 (29)			1 (20)	5 (20)	2 (50)			2 (50)
Other						12 (14)				1 (4)				
Multiple	6 (18)					1 (14)	1 (20)			2 (8)				
Type of HCP														
Doctor: GP	16 (48)			1 (50)	2 (100)	4 (57)	2 (40)	1 (25)	4 (80)	11 (44)	2 (50)	1 (25)		1 (25)
Doctor: secondary	4 (12)	3 (100)				1 (14)	1 (20)	1 (20)		2 (12)	1 (25)	1 (25)		1 (25)
Other HCP	4 (12)		1 (100)							1 (4)	0 (0)			1 (25)
Mixed/team	9 (27)			1 (50)		2 (29)	2 (40)	2 (40)	1 (20)	10 (40)	2 (50)	2 (50)	1 (100)	1 (25)
Setting														
Primary	18 (55)			1 (50)	2 (100)	4 (57)	4 (80)	1 (25)	5 (100)	17 (68)	2 (50)	1 (25)		1 (25)
Hospital	6 (18)	3 (100)				2 (29)	1 (20)	2 (50)		6 (24)	2 (50)	2 (50)	1 (100)	2 (50)
Community	1 (3)		1 (100)	1 (50)										1 (25)
Care/nursing	0 (0)					1 (14)		1 (25)		1 (4)		1 (25)		
Mixed	7 (21)													
Other	1 (3)													

HCP, health-care professional.

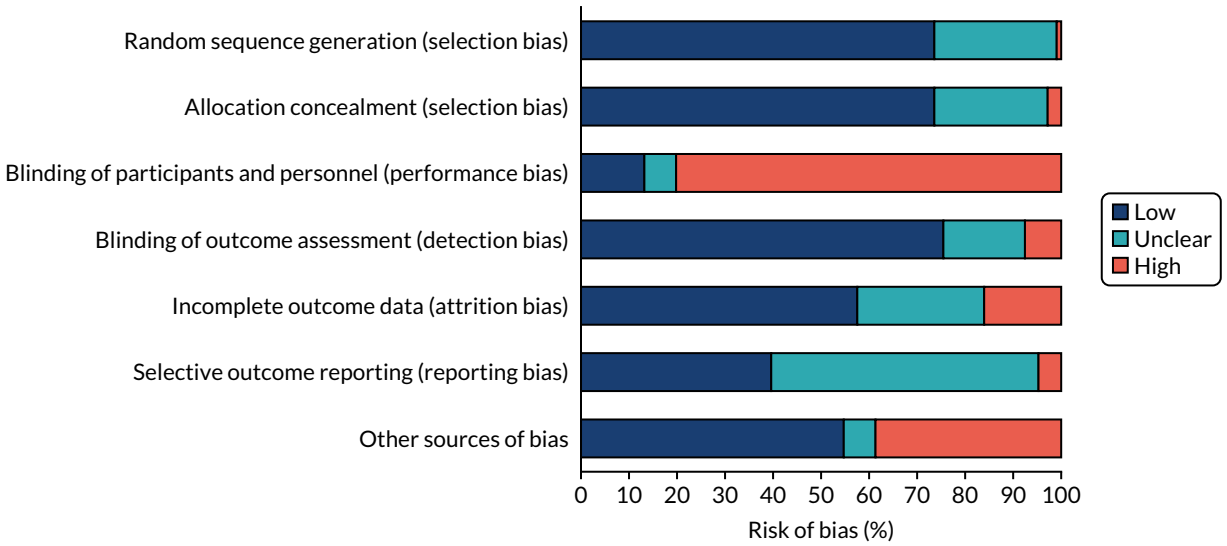

FIGURE 2 Review authors' judgements about each risk-of-bias item presented as percentages across all included studies ($n = 106$).

where outcome measures were recorded by participants. The remaining studies ($n = 18$) were judged to be unclear because of a lack of information or lack of clarity in terms of whether or not outcome assessors were blinded to allocation.

Incomplete outcome data

Over half of the included studies ($n = 61$) were considered to be at low risk of bias for incomplete outcome data for the following reasons: no drop-outs/low attrition, attrition evenly distributed across groups, drop-out reasons unlikely to be connected to interventions, analysis conducted on intention-to-treat basis and different patients before and after. Seventeen studies were rated to be at high risk of bias as they had large numbers of drop-outs, a lack of discussion of drop-out reasons, unequal (or unreported) attrition across groups or reasons for drop-outs being related to the intervention. The remaining studies ($n = 28$) were judged to be unclear as a result of insufficient or unclear reporting of attrition.

Selective reporting

Where outcomes appeared to have been reported as stated in the protocol (or where there was only one outcome and this was adequately reported), studies were judged to be at low risk of bias for selective outcome reporting ($n = 42$). Five studies had made changes from the planned outcomes in the protocol, or had ambiguously reported the primary outcome at registration (enabling multiple interpretations), and were, therefore, considered to be at high risk of bias. Studies that had no available protocol and had multiple outcomes, or several ways of reporting outcomes, were categorised as being unclear ($n = 59$).

Other potential sources of bias

No potential other sources of bias were identified for over half of the included studies ($n = 58$). A small number of studies ($n = 7$) were rated as unclear for reasons including a lack of clarity in whether or not adjustments were made for clustering in the analysis, an unclear unit of analysis for some statistical tests and only summary trial methods and data reported. The remaining studies ($n = 41$) were judged to be at high risk of bias for the following reasons: no adjustment for clustering in analyses; poor reporting (particularly of outcome data, therefore making interpretation difficult); potential problems with the study design (e.g. stepped-wedge, step-wise regression); concerns over analysis processes (e.g. extreme values replaced or excluded); important baseline differences between groups or large differences in participant numbers across arms; and analysis within rather than between groups.

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Effects of interventions: health worker behaviour (primary outcome)

Overall effect

There were 100 comparisons suitable for meta-analysis. *Figure 3* shows the SMD summarised by type of BCT comparison in a fixed-effects meta-analysis. From this plot we can see that, as expected, there is a large amount of heterogeneity with an overall I^2-value of 85.4%. Overall, combined data suggest that, on average, interventions that include social norms components were associated with a modest improvement of 0.08 SMD (95% CI 0.07 to 0.10). Forest plots showing each individual study in the review, by the social norm BCT used in the study, are in *Appendix 17*, *Figures 22–26*.

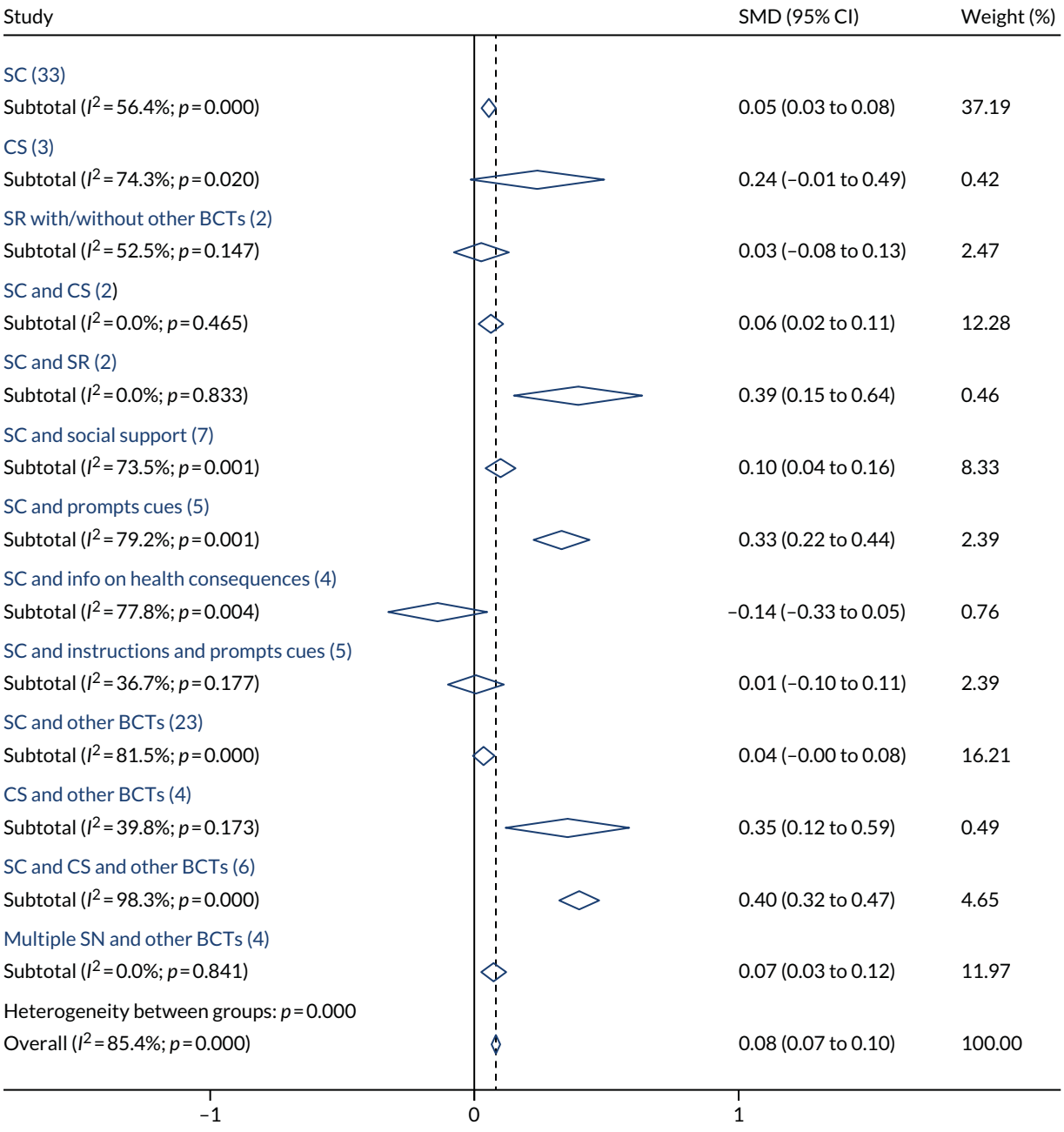

FIGURE 3 Fixed-effects forest plot summarised by type of comparison. CS, credible source; SC, social comparison; SR, social reward. Note that SR (one comparison) and SR and other BCTs (one comparison) have been combined in this graph to improve presentation.

The I^2 is interpreted as a measure of the proportion of variability owing to heterogeneity between studies. This can be calculated only when two or more studies are included in the same subgroup/meta-analysis, as can the *p*-value alongside I^2 that tests the null hypothesis that $I^2 = 0$. Note that I^2 is related to precision and rapidly approaches 100% when the number of studies is large.[58] τ^2 is an alternative measure of heterogeneity, calculated only during a random-effects meta-analysis, and can be interpreted as the between-study variance.

Note that most trials in this review were randomised at a cluster level and the unit of analysis may be patient, health-care worker or a larger unit, such as clinic or hospital. With that in mind, it is impossible to report '*N*' for each trial in any consistent way. In the meta-analysis, the weights were calculated based on the standard error of the SMD extracted from the individual trials, which has been adjusted for clustering where necessary. The number of comparisons is reported for each subgroup in brackets on all forest plots. Forest plots showing the effect in every individual study, summarised by social norms intervention, are included in *Appendix 1* (see *Figures 22–26*).

Figure 4 shows the SMD, summarised by the type of BCT comparison in a random-effects meta-analysis. Similar conclusions can be drawn when looking at the random-effects result compared with the fixed-effects result; however, using weights from a random-effects meta-analysis suggests a larger overall SMD (0.16, 95% CI 0.11 to 0.21, $I^2 = 85.4\%$, $\tau^2 = 0.043$) and a wider CI, because the random-effects meta-analysis attributes more weight to smaller trials.

Illustration of standardised mean differences

For this review, we converted all measures of the effectiveness of health worker behaviour into a common scale: the SMD (standardised effect size). SMDs can be difficult to interpret. To illustrate how the observed average standardised effect sizes translate into real health-care scenarios, we have converted the SMD into a risk difference (difference in percentage points) for a range of typical baseline compliance rates (*Table 6*). This was carried out in two steps: (1) transforming the SMD into an odds ratio using a method suggested in the Cochrane handbook[36] section 12.6.3, and (2) transforming the odds ratio into a risk difference, using a method proposed by Grant.[59]

Investigation of social norms behaviour change techniques

Note that owing to the high prevalence of the BCT feedback on behaviour (present in 88/100 comparisons), in the forest plots we have combined feedback on behaviour with the social norms BCT with which it appeared; that is we have listed each social norms BCT with or without feedback. Later we examine the separate effect of feedback on behaviour as part of the metaregression and as a sensitivity analysis.

We summarised the SMDs by the type of social norms comparison (see *Figure 3*). There is little consistency in SMDs when looking at the different types of social norms interventions being tested, with subgroup CIs that do not overlap each other and that are inconsistent with the overall effect. Interventions including credible source appear to have larger effect sizes on average than other social norms interventions, and this is true for both credible source on its own ($n = 3$) (SMD 0.24, 95% CI −0.01 to 0.49) and credible source combined with other BCTs ($n = 4$) (SMD 0.35, 95% CI 0.12 to 0.59), although the CIs are wide. Credible source combined with social comparison ($n = 2$) had an average effect of 0.06 SMD (95% CI 0.02 to 0.11), and credible source combined with social comparison and various other BCTs ($n = 6$) appeared to be the most effective of all, with a SMD of 0.40 (95% CI 0.32 to 0.47). Comparisons that were a 'pure' test of social comparison (with or without feedback, $n = 33$) appeared to have a small effect (SMD 0.05, 95% CI 0.03 to 0.08), and the size of the effect is similar when social comparison is combined with various other BCTs ($n = 23$) (SMD 0.04, 95% CI −0.00 to 0.08). Social comparison appeared to be very effective when combined with prompts/cues ($n = 5$) (SMD 0.33, 95% CI 0.22 to 0.44), but ineffective when combined with both prompts/cues and instruction on how to perform the behaviour ($n = 5$) (SMD 0.01, 95% CI −0.10 to 0.11). Social reward appeared to be very effective when combined with social comparison ($n = 2$) (SMD 0.39, 95% CI 0.15 to 0.64), but only

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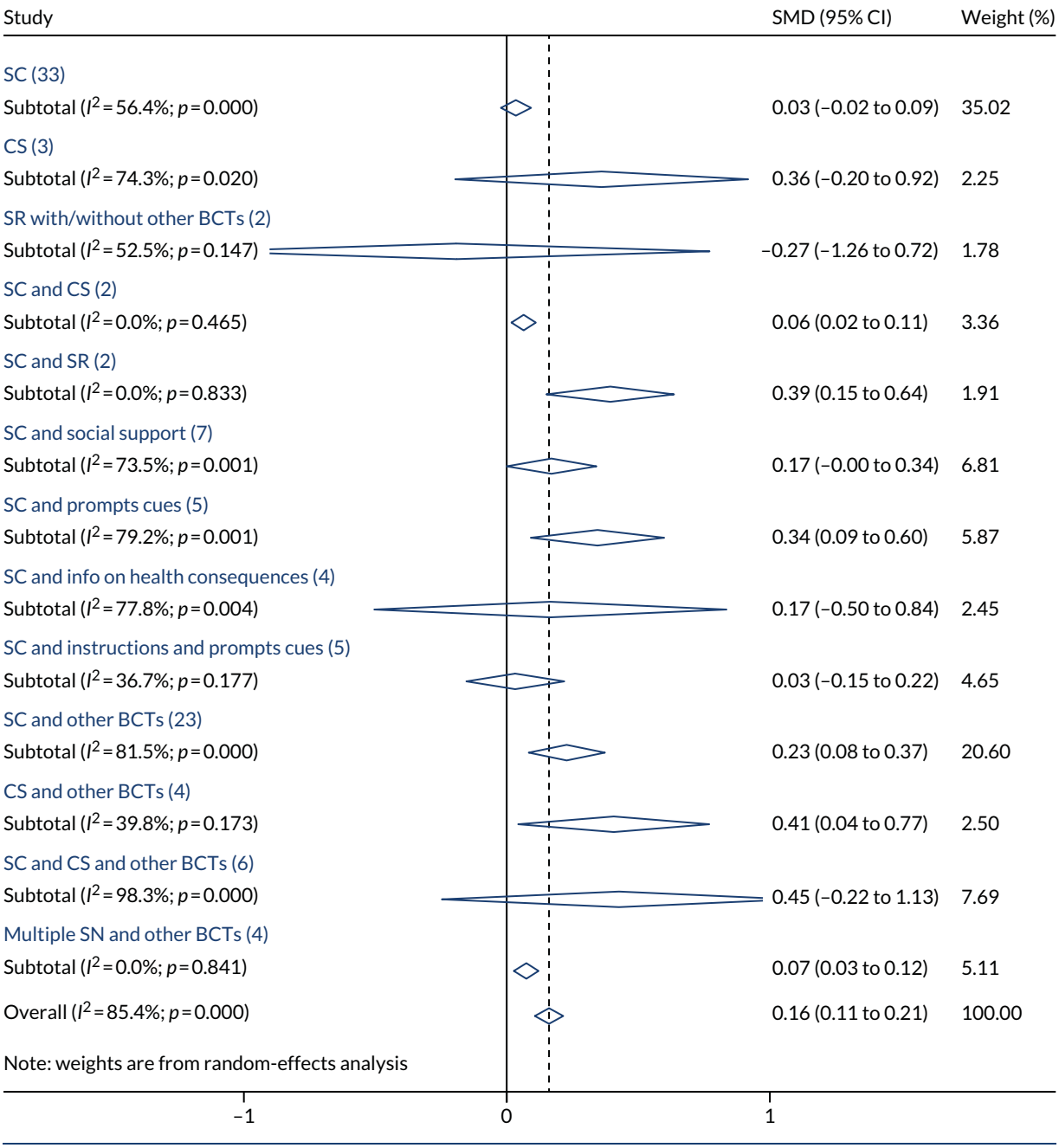

FIGURE 4 Random-effects forest plot summarised by type of comparison. CS, credible source; SC, social comparison; SR, social reward.

one study looked at social reward on its own and found a negative effect. We need to interpret these observations cautiously owing to the large amount of heterogeneity and the differences in contexts and settings.

In an attempt to ease interpretation, *Figure 5* shows a re-categorisation of *Figure 3*. In this plot, all comparisons that test each of the social norms BCTs (social comparison, credible source and social reward), whether alone or alongside other BCTs, have been combined. Trials that combine two or more social norms BCTs have been put together in one group. As before, comparisons that test credible source ($n = 7$), either alone or in combination with other BCTs, appear to be the most effective on average (SMD 0.30, 95% CI 0.13 to 0.47). The effect of social comparison ($n = 77$) appears to be very small (SMD 0.06, 95% CI 0.04 to 0.8). There is little evidence to suggest that social reward is effective

TABLE 6 Illustration of SMDs

Typical baseline compliance	Expected improvement (percentage points)		Illustration
	Social norms interventions on average 0.08 SMD	Credible source interventions on average 0.3 SMD	
20%	2	10	In a population in which the appropriate tests are ordered 20% of the time, we would expect a social norms intervention, on average, to increase the rate of compliance by 2 percentage points to 22%
40%	4	13	In a population in which prescribing guidelines are being adhered to 40% of the time, we would expect a credible source intervention, on average, to increase the rate of compliance by 13 percentage points to 53%
60%	3	12	In a population in which recommended referrals are being made 60% of the time, we would expect a social norms intervention, on average, to increase the rate of referral by 3 percentage points to 63%
80%	2	10	In a population in which the rate of antibiotic prescribing is 80%, we would expect a credible source intervention, on average, to reduce the rate of prescribing by 10 percentage points to 70%

Note that these values were chosen for illustrative purposes only.

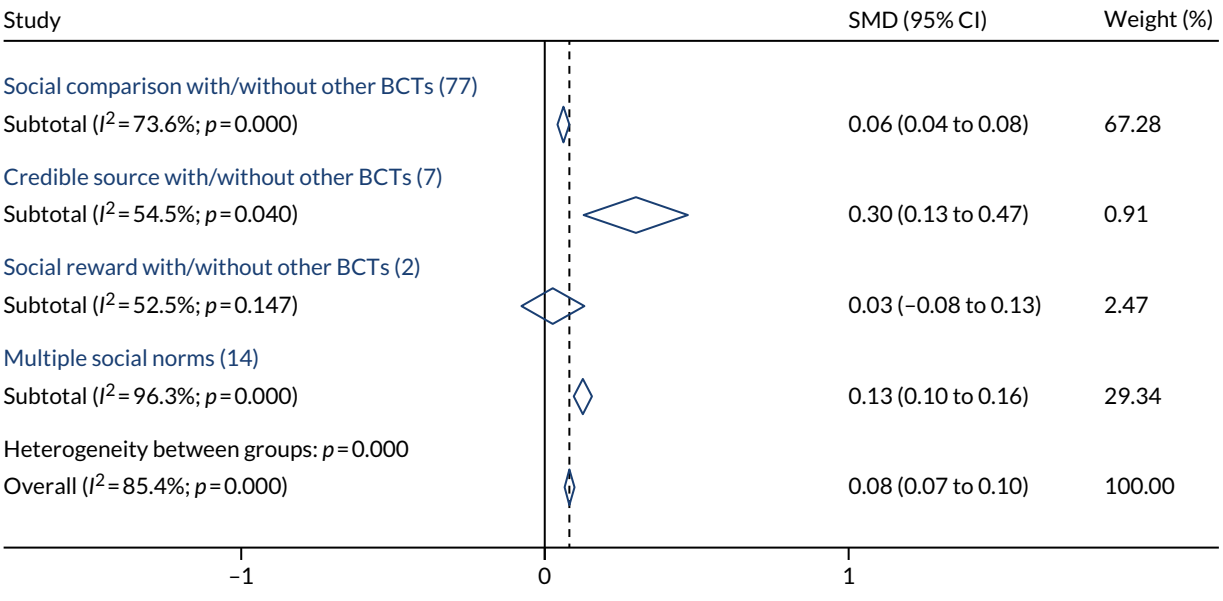

FIGURE 5 Fixed-effects forest plot summarised by alternative categorisation of BCTs.

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(SMD 0.03, 95% CI −0.08 to 0.13), but this is based on only two trials. Trials involving a mixture of more than one social norms BCT ($n = 14$) have a larger than average effect (SMD 0.13, 95% CI 0.10 to 0.16).

Illustrative case studies

The purpose of this review is to offer a structured summary across all of the 106 studies, but we have included some illustrative case studies (*Table 7*) to provide a concrete example of each of the three intervention types that were found to be the most effective (credible source and social comparison, social comparison with prompts/cues, social comparison and social reward).

Variation in context and mode of delivery

We have summarised the SMD in various contexts and modes of delivery to examine where, how and with whom social norms interventions are most likely to be effective.

Type of health-care worker

Figure 6 shows the SMD summarised by the type of health-care worker in a fixed-effects meta-analysis. The effect of social norms interventions appears to be quite consistent when comparing GPs with doctors in secondary care as the type of health-care worker targeted (not shown), with an overall effect with doctors ($n = 68$) of 0.08 SMD (95% CI 0.07 to 0.10). We found no evidence that social norms interventions were effective with nurses or allied health professionals (AHPs) (SMD −0.01, 95% CI −0.12 to 0.11), although the number of comparisons was small ($n = 5$). The effect with other health workers, many of which were mixed groups such as doctors/nurses or nurses/AHPs ($n = 27$), was 0.08 SMD (95% CI 0.07 to 0.10).

Target behaviour

Figure 7 shows the SMD summarised by the type of target behaviour in a fixed-effects meta-analysis. Interventions targeting prescribing behaviour ($n = 40$) appeared to be the most effective, on average (SMD 0.11, 95% CI 0.09 to 0.13). The effect of social norms interventions appeared to be reasonably consistent across other types of target behaviour, including test ordering ($n = 21$) and management of/communication about conditions ($n = 23$). Social norms interventions appear to be less effective with hand-washing ($n = 3$, SMD 0.04, 95% CI −0.05 to 0.13) and referrals ($n = 3$, SMD −0.08, 95% CI −0.23 to 0.07), but the number of studies is small.

We have not presented a forest plot summarising the SMD by whether or not the participants were targeted based on low baseline performance, because there were only two trials that did this.

Health-care setting

Figure 8 shows the SMD summarised by health-care setting in a fixed-effects meta-analysis. The effect of social norms interventions appeared to be slightly lower in primary care settings (SMD 0.07, 95% CI 0.05 to 0.09) ($n = 56$) than in hospital settings (SMD 0.12, 95% CI 0.07 to 0.18) ($n = 27$), but both are consistent with the overall effect. Trials taking place in community settings ($n = 4$) and care/nursing home settings ($n = 4$) appear to be less effective on average; however, both CIs do overlap with the overall effect. Trials conducted in mixed settings ($n = 9$) appear to be more effective on average (SMD 0.35, 95% CI 0.27 to 0.42).

Reference group

The reference group is the person or persons that the target is compared with or receives approval from. *Figure 9* shows the SMD summarised by the type of reference group within the trials. The effect of social norms interventions appeared to be reasonably consistent across different types of reference group, with most CIs overlapping, and there was general consistency of each group with the overall effect. Most trials ($n = 84$, 82.9%) had peers as the reference group (SMD 0.08, 95% CI 0.06 to 0.10). Only one trial had patients as the reference group; the effect was consistent with other studies (SMD 0.10, 95% CI −0.17 to 0.37) but the CI was wide because of the low weight in the review.

TABLE 7 Case studies: summary descriptions of interventions, for example studies of the three intervention types found to be the most effective

Details of study	Outcome measure, SMD (95% CI)	Control arm	Intervention description (BCTs coded)
Credible source and social comparison			
Hallsworth *et al.* (2016)[60] RCT Doctor (primary care) Aim: to reduce the number of unnecessary prescriptions of antibiotics by GPs in England	The rate of antibiotic items dispensed per 1000 population 0.13 (0.03 to 0.29)	Delayed intervention (after the end of the trial) No BCTs were coded	A letter was sent to GPs from the Chief Medical Officer. The letter stated that the practice was prescribing antibiotics at a rate higher than 80% of practices in its NHS local area team, and used three concepts from the behavioural sciences. The first was social norms information about how the recipient's practice's prescribing rate compared with other practices in the local area. Second, the letter was addressed from a high-profile figure, with the assumption that this would increase the credibility of its content. Finally, the letter presented three specific, feasible actions that the recipient could do to reduce unnecessary prescriptions of antibiotics: giving patients advice on self-care, offering a delayed prescription and talking about the issue with other prescribers in his or her practice. The letter was accompanied by a copy of the patient-focused 'Treating your infection' leaflet, which acted to reinforce the message of the letter by supporting delayed or reduced prescribing (9.1 credible source, 6.2 social comparison, 2.2 feedback on behaviour, 4.1 instruction on how to perform the behaviour)
Social comparison and prompts/cues			
Vellinga *et al.* (2016)[61] Arm A Cluster RCT Doctor (GP) Aim: to increase the number of first-line antimicrobial prescriptions for suspected UTIs in adult patients	Adherence to guidelines for antimicrobial prescribing in primary care 0.55 (0.32 to 0.77)	Phase 1: a coding workshop – routine coding for UTIs using standardised codes were demonstrated. The purpose of this was to facilitate the generation of electronic A&F reports (not available to control until after the trial). Control practices then provided 'usual care' for the remainder of the intervention No BCTs were coded	Arm A: phase 1 – a coding workshop (same as control). Phase 2: interactive workshops were designed to promote changes in antimicrobial prescribing for the treatment of UTIs by presenting an overview of prescribing and antimicrobial resistance, discussing the role of the GP in the spread of AMR. A computer prompt was developed for use within the selected general practice management software system. This prompt summarised the recommendations for first-line antimicrobial treatment and appeared on the computer screen when the GP entered the International Classification of Primary Care code (U71) for 'cystitis, urinary infection, other'. This prompt also reminded the GP to collect patients' mobile telephone numbers. Electronic A&F reports were available to download by GPs. These reports provided the practice with information on antimicrobial prescribing for UTIs in comparison with the aggregated information from the other practices participating in the intervention (7.1 prompts/cues, 2.2 feedback on behaviour, 6.2 social comparison)

continued

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TABLE 7 Case studies: summary descriptions of interventions, for example studies of the three intervention types found to be the most effective (*continued*)

Details of study	Outcome measure, SMD (95% CI)	Control arm	Intervention description (BCTs coded)
Social comparison and social reward			
Persell *et al.* (2016)[62] 2 × 2 × 2 factorial Doctor (GP) Aim: to reduce inappropriate antibiotic prescribing for ARIs	Physician rate of oral antibiotic prescribing for non-antibiotic-appropriate ARIs, acute sinusitis/pharyngitis and all other diagnoses of respiratory infection 0.44 (–0.06 to 0.94)	Intervention 1 (accountable justifications): clinicians received electronic health record alerts summarising the treatment guidelines corresponding to the ARI diagnosis for which the antibiotic was being written, prompted the clinician to enter a free-text justification for prescribing an antibiotic, and informed the clinician that the free-text justification provided would be included in the patient's medical record in which it would be visible to other clinicians. Clinicians were also informed that if no free-text justification was entered, a default statement 'No justification for prescribing antibiotics was given' would appear in the record. If the antibiotic order was cancelled, no justification was required, and no default text appeared. Alerts were suppressed for patients with comorbid chronic conditions that exempted these patients from clinical guidelines (4.1 instruction on how to perform the behaviour, 7.1 prompts/cues). Intervention 2 (suggested alternatives): when entering an ARI diagnosis for a patient, clinicians received a computerised alert containing multiple non-antibiotic prescription and non-prescription medication choices as well as educational materials that could be printed and given to the patient (7.1 prompts/cues)	Intervention 3 (peer comparison): clinicians received e-mailed monthly performance feedback reports that included the clinician's individual antibiotic prescribing rates for non-antibiotic-appropriate ARIs and, as a benchmark, the antibiotic prescribing rate for clinicians who were in the 10th percentile within the clinic (i.e. the lowest rates of inappropriate antibiotic prescribing). If clinicians were among the 10% of their peers with the lowest prescribing rates, the e-mailed reports told clinicians 'You are a top performer.' If clinicians were not among the 10% best, the e-mailed report told clinicians 'You are not a top performer. You are prescribing too many unnecessary antibiotics.' The proportion of 'Top Performers' could be > 10% of clinicians if > 10% of clinicians had an inappropriate antibiotic prescribing rate of zero (2.2 feedback on behaviour, 6.2 social comparison, 10.4 social reward)

AMR, antimicrobial resistance; ARI, acute respiratory infection; UTI, urinary tract infection.

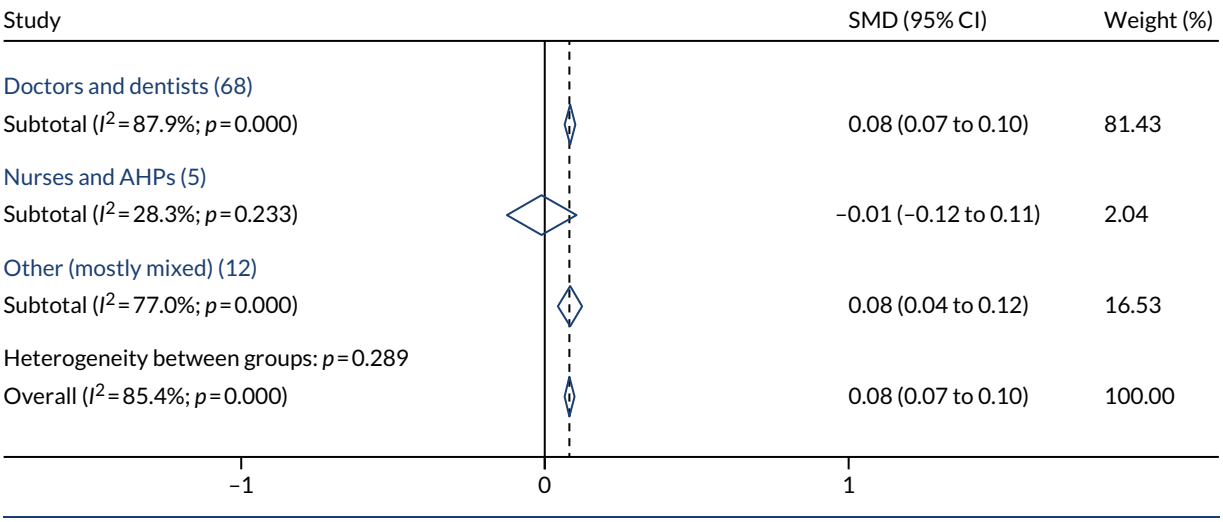

FIGURE 6 Fixed-effects forest plot summarised by type of health-care worker.

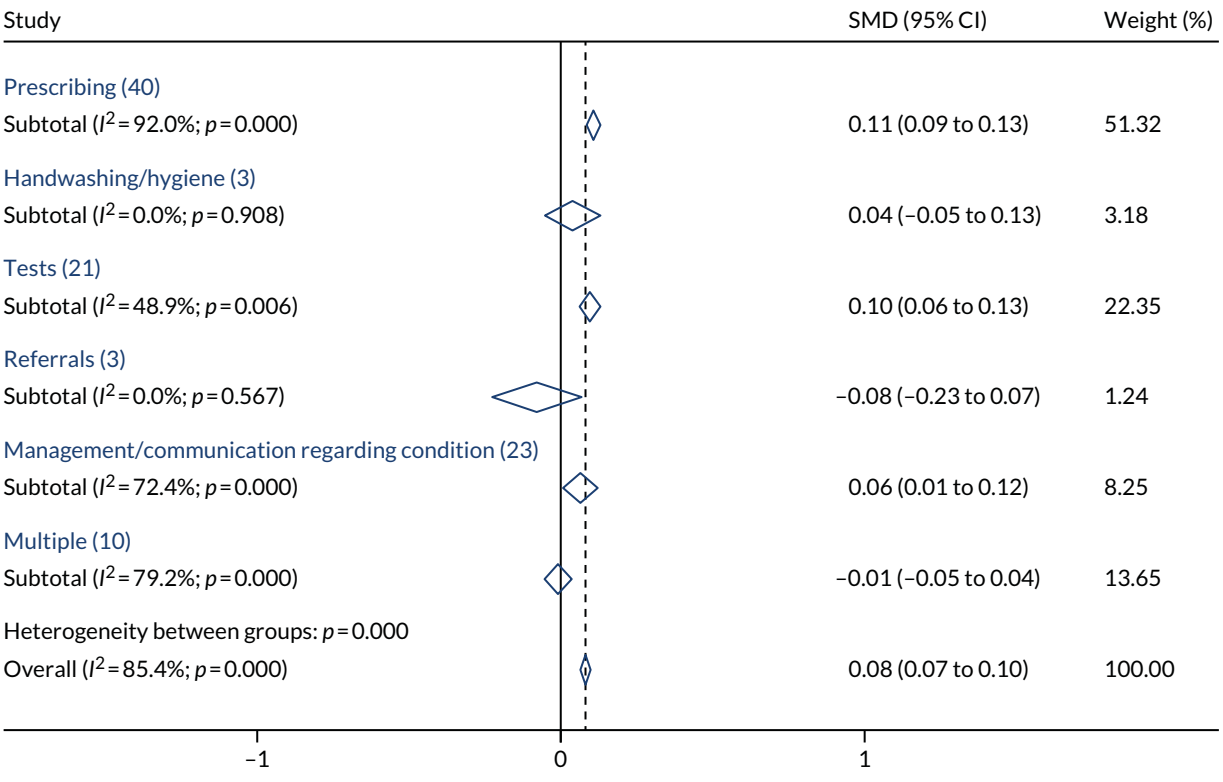

FIGURE 7 Fixed-effects forest plot summarised by target behaviour.

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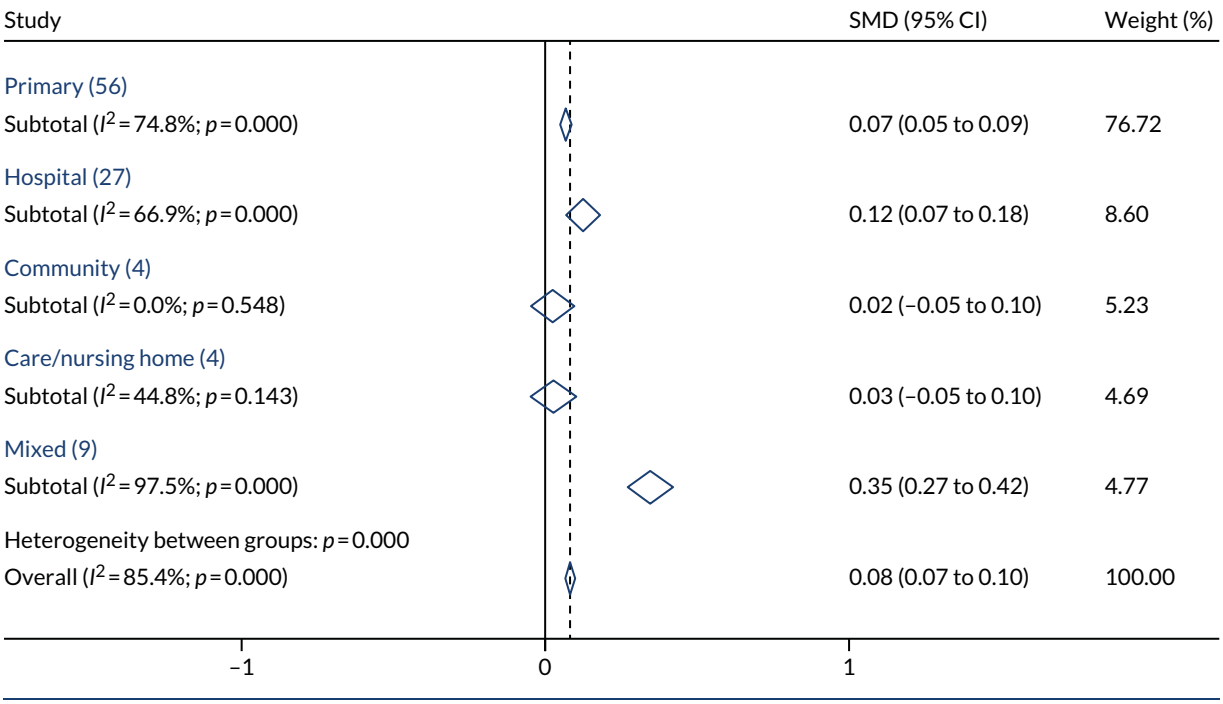

FIGURE 8 Fixed-effects forest plot summarised by health-care setting.

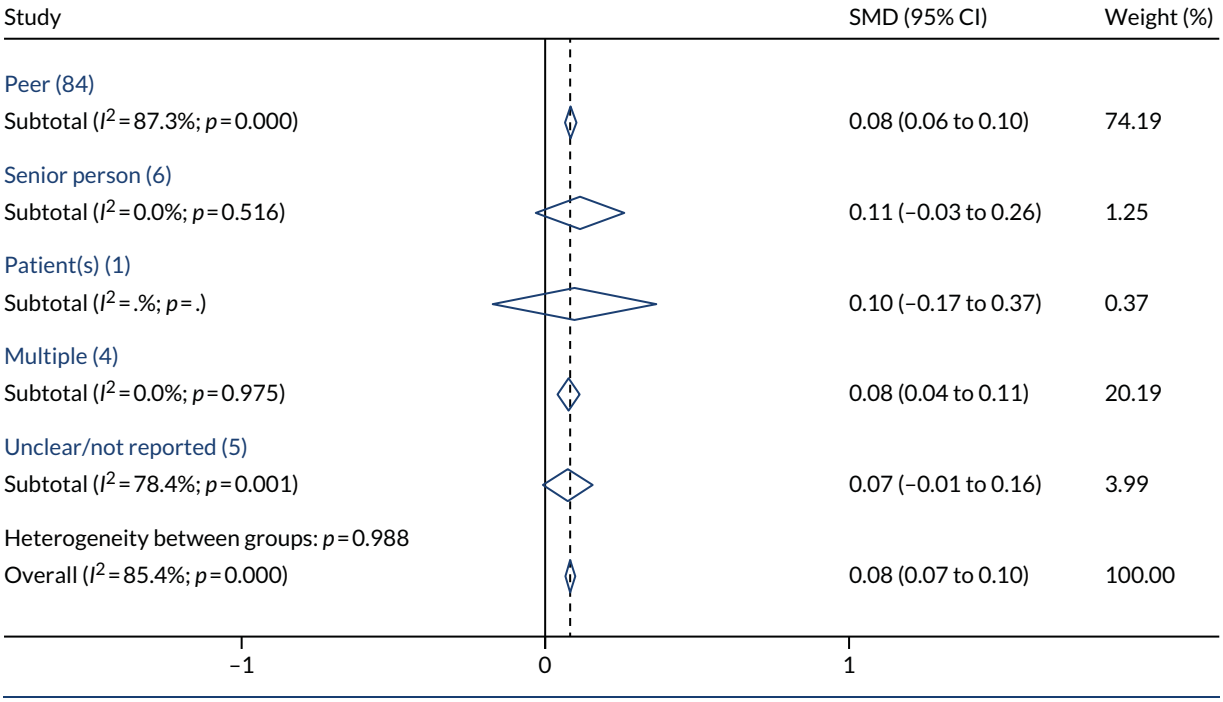

FIGURE 9 Fixed-effects forest plot summarised by reference group.

Benchmarks

When social comparison interventions are delivered, they sometimes include a benchmark: this may be a peer-related benchmark, such as the top 10% or 20% of performers among their peer group, or it may be an external benchmark, such as a performance target set by a royal college. If no benchmark is set, the social comparison usually reports the average performance among peers. The downside of the average approach is that the above-average performers will receive feedback suggesting that they are already performing better than their peers, which may lead them to reduce their effort.[56] *Figure 10* shows the SMD summarised by the type of benchmark that was used. Only trials involving social comparison have been included, because benchmarking is not relevant to the other social norms interventions. The effect of social norms interventions appeared to be reasonably consistent, regardless of whether a peer benchmark (13 studies: SMD 0.06, 95% CI 0.02 to.011) or the average performance (67 studies: SMD 0.11, 95% CI 0.09 to 0.13) was included: the CIs overlap and there is general consistency of each group with the overall effect.

Source of the intervention

Figure 11 shows the SMD summarised by the source of the intervention (i.e. the person delivering the intervention) in a fixed-effects meta-analysis. The effect of social norms interventions appeared to be consistent across the different sources, with the exception of supervisor/senior colleague ($n = 2$), which appeared to be, on average, less effective (SMD −0.28, 95% CI −0.56 to 0.01). In most trials, the source of the intervention was the investigator ($n = 72$) (SMD 0.08, 95% CI 0.06 to 0.10) or a respected source ($n = 11$) (SMD 0.09, 95% CI 0.03 to 0.16). The credible sources that were found in the literature included:

- nurses in management positions who encouraged change in various behaviours to improve hospital stroke care[63]
- a 'highly respected senior clinician' who persuaded doctors of the harms and limited diagnostic benefit of X-ray for lower back pain[64]
- maternal–fetal medicine specialists, perinatologists or obstetricians who were influential with colleagues, who championed the use of corticosteroids to colleagues in antenatal care[65]
- nurse facilitators with master's degrees and specialist training who promoted changes in preventative care in general practices[66]
- opinion leaders nominated by a peer for their expertise in obstetric care[67] or breast cancer surgery[68]
- a clinical co-ordinator regarded as a 'credible role model' in managing patients with congestive heart failure[69]
- a letter to poorly performing GPs from the Chief Medical Officer about their rates of antibiotic prescribing.[60]

The other categories occurred infrequently and we should interpret these results with caution owing to some wide CIs.

Direction of change targeted

Figure 12 shows the SMD summarised by the intended direction of change in the behaviour in a fixed-effects meta-analysis. The social norms intervention appeared to be, on average, slightly less effective when the intervention was aimed at increasing a behaviour ($n = 70$) (e.g. more hand-washing) (SMD 0.06, 95% CI 0.04 to 0.09) than when it was aimed at decreasing a behaviour ($n = 28$) (e.g. prescription of antibiotics) (SMD 0.10, 95% CI 0.08 to 0.12), but both CIs are consistent with the overall effect.

Frequency of the intervention

Figure 13 shows the SMD summarised by the frequency/intensity of the interventions in a fixed-effects meta-analysis. The effect of the social norms interventions appeared to be, on average, most effective when the intervention was delivered only once ($n = 28$) (SMD 0.25, 95% CI 0.21 to 0.30). It appeared to be less effective, on average, when delivered more frequently ($n = 47$) (SMD 0.06, 95% CI 0.04 to 0.08).

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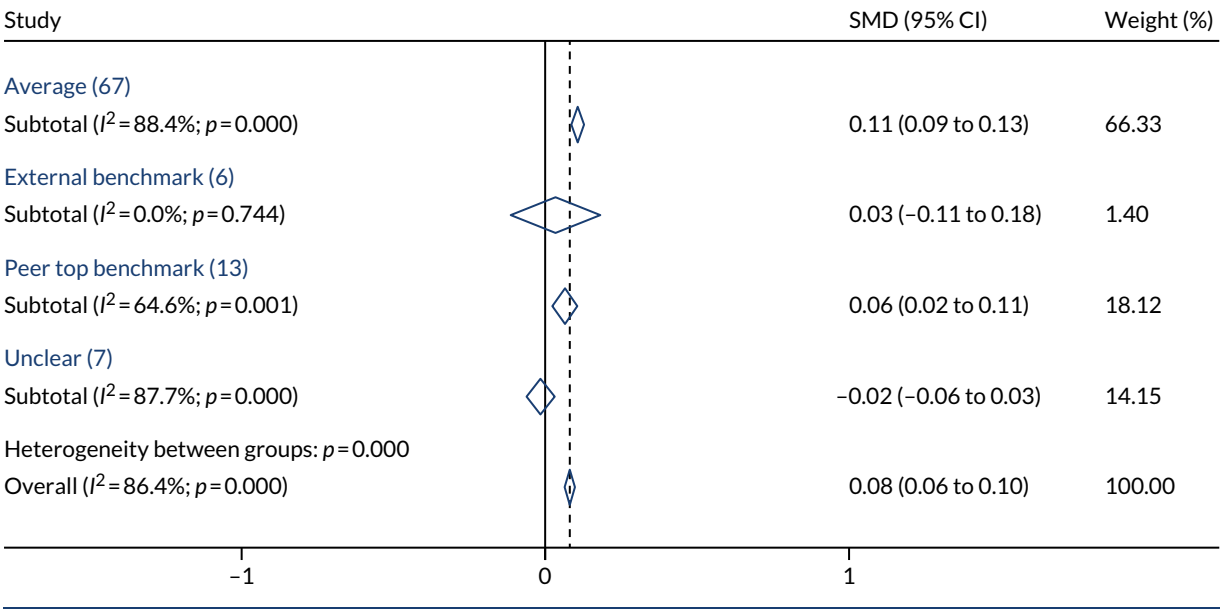

FIGURE 10 Fixed-effects forest plot summarised by benchmark.

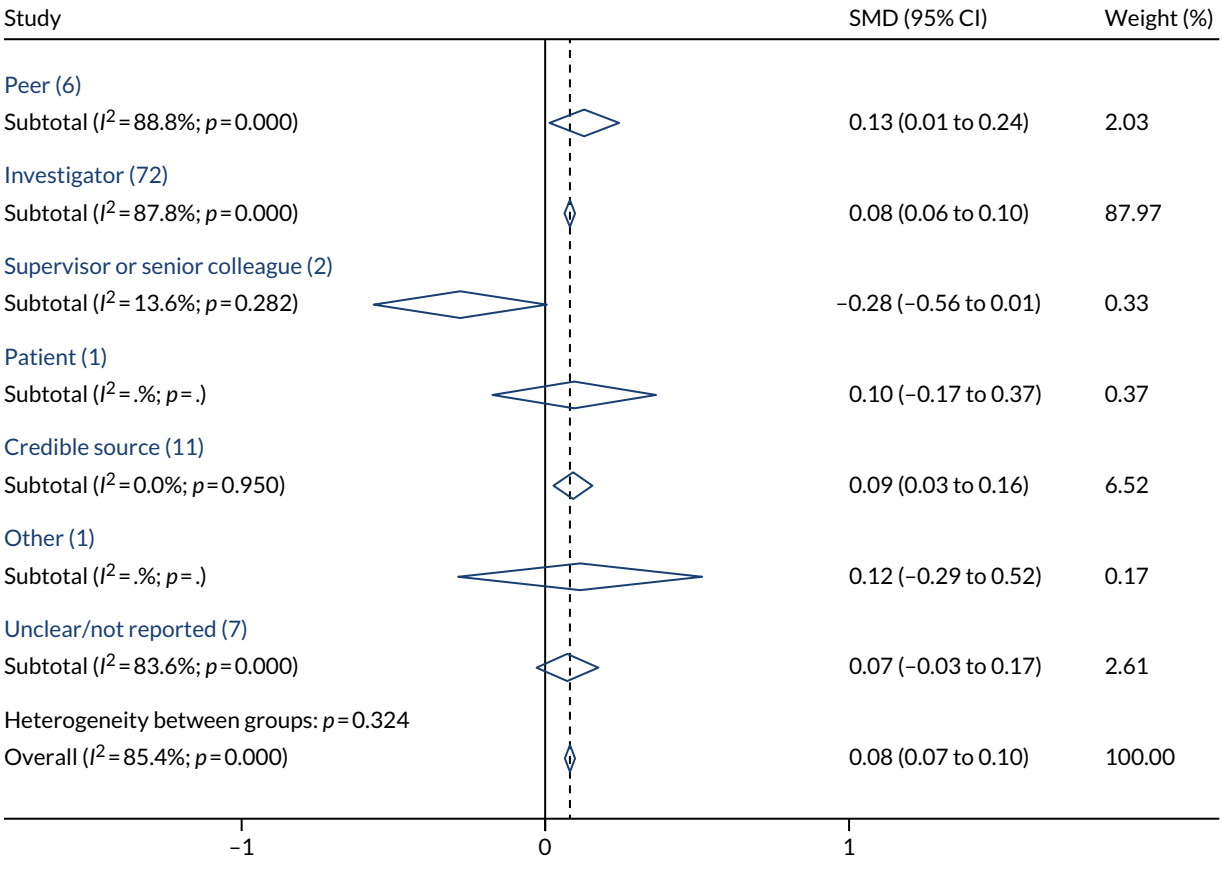

FIGURE 11 Fixed-effects forest plot summarised by source of intervention.

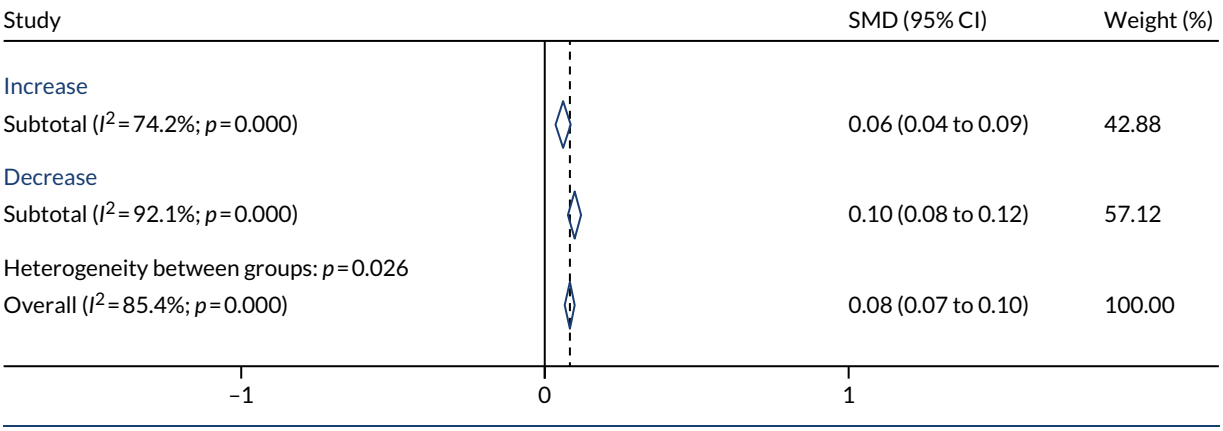

FIGURE 12 Fixed-effects forest plot summarised by the direction of change targeted.

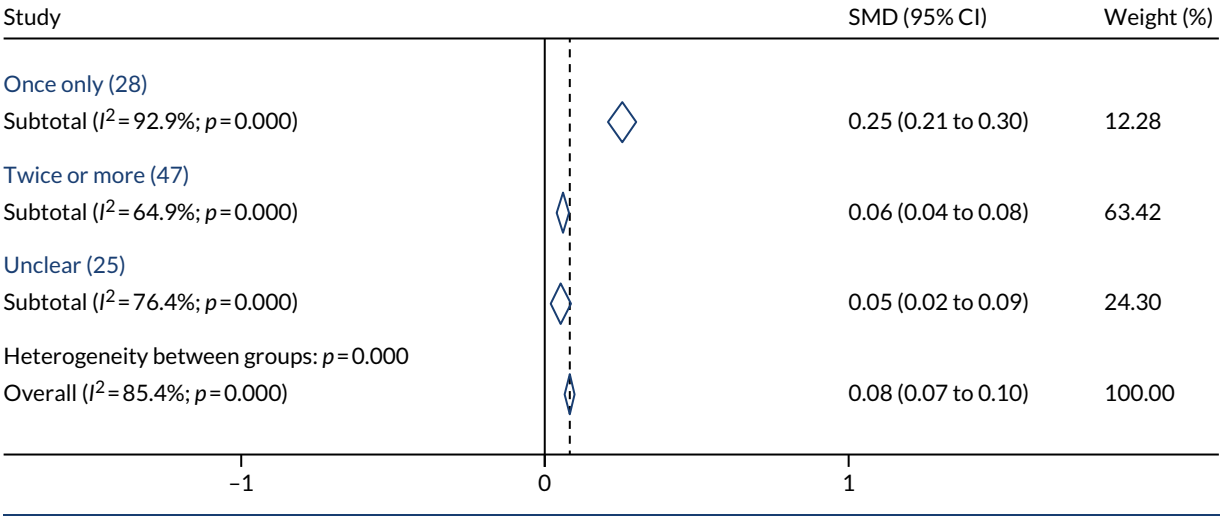

FIGURE 13 Fixed-effects forest plot summarised by frequency of the intervention.

Format of the intervention

Figure 14 shows the SMD summarised by the format of the intervention. Trials delivered via computerised methods whereby the intervention was posted on a website or other computerised format that was not integrated into the health-care worker's workflow ($n = 8$) appeared to be more effective than average (SMD 0.23, 95% CI 0.15 to 0.31). By contrast, interventions delivered face to face ($n = 14$) appeared to be ineffective, on average, with a SMD of −0.01 (95% CI −0.06 to 0.03). Trials with an e-mailed ($n = 9$), written ($n = 25$) or a mixed format ($n = 14$) appeared to be reasonably consistent with each other and with the overall effect.

Person delivering the intervention

Figure 15 shows the SMD summarised by whether the person who delivered the intervention was internal or external to the target's organisation in a fixed-effects meta-analysis. Most ($n = 68$) interventions were delivered by an external person, often the investigator. The effect of social norms interventions, on average, seemed to be consistent across internal sources ($n = 17$) (SMD 0.11, 95% CI 0.05 to 0.17) and external sources ($n = 68$) (SMD 0.08, 95% CI 0.06 to 0.10). However, this should be interpreted cautiously given the wide CIs for internal sources.

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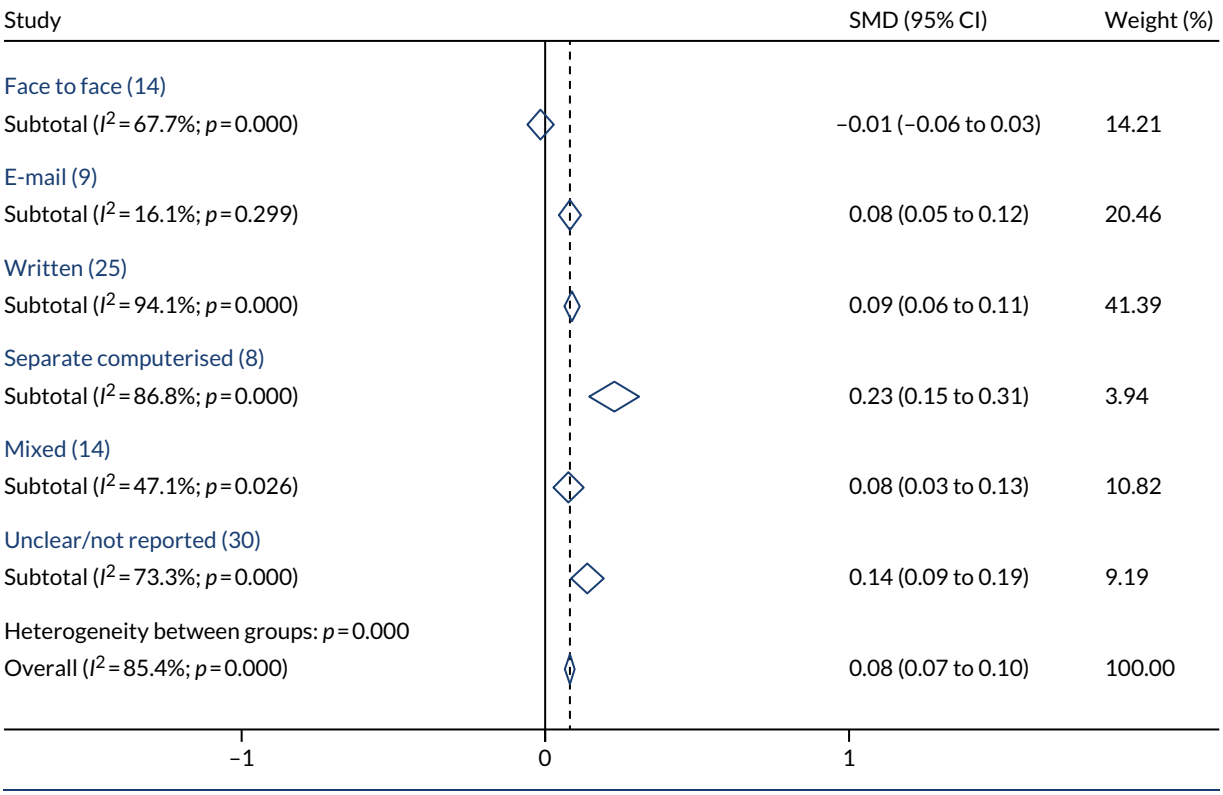

FIGURE 14 Fixed-effects forest plot summarised by format of intervention.

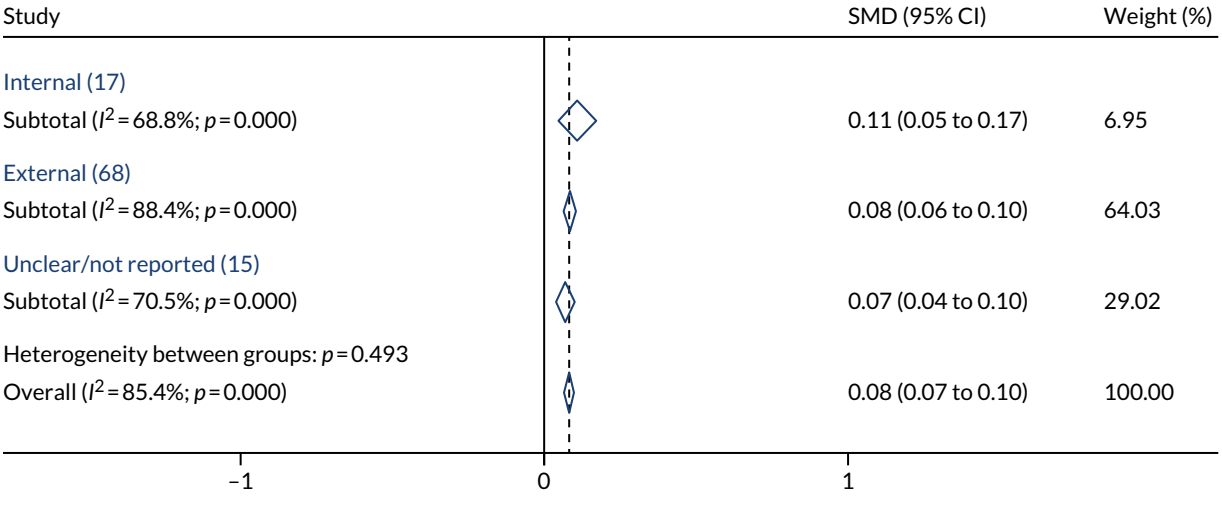

FIGURE 15 Fixed-effects forest plot summarised by person delivering the intervention.

Studies with social norms behaviour change techniques in both arms

There were 17 comparisons in which both arms involved social norms interventions. These are summarised in *Appendix 16*, *Figure 21*. Most of these involved social comparison in both arms, with feedback on behaviour[20,70–77] or without feedback[18] (n = 10), and typically they were studies that tested some other combination of BCTs in the intervention arm, but had A&F offered as part of usual care in both arms. One study tested a combination of BCTs in the intervention arm, but had credible source in both arms as part of usual care.[78] None of these studies offered any interesting insights for the review because they were designed to test the effect of other interventions.

Only two studies had a different social norms BCT in each arm, which offered a head-to-head comparison. One study tested the effect of credible source, social comparison and feedback on behaviour and other BCTs against social comparison and feedback, with an estimated SMD of 1.30 (95% CI 0.50 to 2.10),[79] suggesting that credible source with other BCTs has a high effect compared with social comparison and feedback. Another study found no evidence of a difference between social comparison, credible source and feedback, and credible source alone, with an estimated SMD of 0.29 (95% CI −0.39 to 0.98).[80]

There were four studies that examined the effect of different variants of social comparison ($n = 3$) or credible source ($n = 1$). Wright *et al.*[81] offered formal educational sessions led by a highly regarded surgeon (credible source) to both arms of the trial, and offered one-to-one 'academic detailing' by the highly regarded surgeon to a local opinion leader. The addition of academic detailing was effective compared with the educational sessions alone (SMD 0.32, 95% CI 0.08 to 0.56). Kiefe *et al.*[82] found that providing social comparison where the average performance for the top 10% of the physicians was reported was more effective than social comparison reporting the mean performance of other physicians (SMD 0.25, 95%CI 0.13 to 1.37). Schneider *et al.*[83] similarly tested benchmarked social comparison (best 10% of GPs) with the median performance, and found no evidence of an effect (SMD 0.03, 95% CI −0.05 to 0.56). There was no evidence of a difference in outcome when a similar social comparison intervention was provided to each arm, where the intervention arm was given the information in a work book and the control arm received a graphical computer slide show (SMD −0.04, 95% CI −0.52 to 0.44).[84]

Investigation of behaviour change techniques, settings and contexts, using metaregression

Metaregression: social norms behaviour change techniques and other behaviour change techniques (with feedback on behaviour behaviour change techniques)

For metaregression, we used all of the 100 comparisons that tested the effect of social norms BCTs with two additional comparisons[79,80] that had different social norms BCTs in each arm. Metaregression allows us to examine the effect of all social norms BCTs plus other common BCTs simultaneously in the same analysis, by using binary covariates for the presence/absence of each BCT in the intervention being tested. When all of the social norms BCTs and other commonly used BCTs are included together in a metaregression (*Table 8*), only credible source stands out as being clearly effective, which suggests that using credible source in an intervention improves compliance with the desired behaviour by an average SMD of 0.29 (95% CI 0.08 to 0.50). Note that there is a large amount of heterogeneity, and that after taking into account the effect of BCTs the residual variation owing to heterogeneity is 85.4%.

Metaregression: social norms and other behaviour change techniques (without feedback on behaviour behaviour change techniques)

Social comparison and feedback on behaviour commonly appear together in the same intervention; therefore, including both of these in the same metaregression would probably cause multicollinearity problems. Repeating the regression reported in *Table 8* but excluding feedback on behaviour gives similar results (*Table 9*), but suggests that social comparison may also have an effect, improving compliance with desired behaviour by an average SMD of 0.12 (95% CI 0.00 to 0.23). The effect of credible source remains fairly consistent (SMD 0.31, 95% CI 0.10 to 0.52). This result is similar to that seen in the forest plots. There is no evidence from this metaregression to suggest that adding other BCTs alongside social comparison or credible source offers any additional improvement once the effect of the social norms BCTs has been taken into account; however, these BCTs were seen only in a small number of trials and the heterogeneity is substantial (residual $I^2 = 85\%$; $\tau^2 = 0.10$), so we must interpret this observation cautiously.

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TABLE 8 Results of the metaregression of SMDs for compliance in the desired behaviour using all social norms BCTs plus other commonly used BCTs

Covariate (BCT code)	Effect, SMD (95% CI)	*p*-value
Social norm BCTs		
Social comparison (6.2)	0.01 (−0.25 to 0.26)	0.96
Credible source (9.1)	0.29 (0.08 to 0.51)	0.01
Social reward (10.4)	0.06 (−0.38 to 0.51)	0.77
Information about others' approval (6.3)	−0.07 (−0.65 to 0.50)	0.80
Social incentive (10.5)	−0.27 (−1.28 to 0.73)	0.59
Other BCTs		
Feedback on behaviour (2.2)	0.14 (−0.15 to 0.42)	0.35
Information about health consequences (5.1)	−0.10 (−0.35 to 0.15)	0.42
Prompts/cues (7.1)	0.05 (−0.17 to 0.27)	0.67
Social support (unspecified) (3.1)	0.07 (−0.14 to 0.28)	0.52
Instruction on how to perform the behaviour (4.1)	−0.05 (−0.27 to 0.17)	0.65

Metaregression: contexts and settings

When including the chosen regression coefficients for factors connected to context and settings, either independently or simultaneously with a constant term, there is no clear evidence that any of these factors are related to treatment effect (*Table 10*). Very little variability has been explained by the inclusion of these covariates (residual $I^2 = 85.6\%$; $\tau^2 = 0.11$). The metaregression conducted was a random-effects metaregression, whereas earlier exploratory forest plots were fixed effect; fixed-effect metaregression is not recommended as a valid method[85] because it assumes that all heterogeneity can be explained by the regression covariates, and it leads to a high risk of type 1 errors. The difference between random-effect and fixed-effect analyses explains, in part, why subgroups that appeared quite separate on forest plots do not lead to statistically significant covariates in the metaregression. Metaregression is also subject to low power and overfitting, and although we have 102 comparisons included, this may not be sufficient to lead to stable covariate estimates.

TABLE 9 Results of the metaregression of SMDs for compliance in the desired behaviour using social norm BCTs plus other commonly used BCTs, excluding feedback on behaviour (2.2)

Covariate (BCT code)	Effect, SMD (95% CI)	*p*-value
Social norm BCTs		
Social comparison (6.2)	0.12 (0.00 to 0.23)	0.06
Credible source (9.1)	0.31 (0.10 to 0.52)	0.01
Social reward (10.4)	0.15 (−0.26 to 0.55)	0.48
Information about others' approval (6.3)	−0.17 (−0.71 to 0.37)	0.54
Social incentive (10.5)	−0.06 (−0.95 to 0.83)	0.90
Other BCTs		
Information about health consequences (5.1)	−0.10 (−0.35 to 0.15)	0.43
Prompts/cues (7.1)	0.07 (−0.14 to 0.28)	0.50
Social support (unspecified) (3.1)	0.10 (−0.10 to 0.30)	0.34
Instruction on how to perform the behaviour (4.1)	−0.05 (−0.27 to 0.18)	0.69

TABLE 10 Results of metaregression of SMDs for compliance in the desired behaviour using context, format and settings

Setting/context	Single variable regression, SMD (95% CI)	Multivariable regression, SMD (95% CI)
Health-care worker		
Doctor vs. other	−0.02 (−0.21 to 0.16)	−0.04 (−0.24 to 0.16)
Behaviour		
Prescribing vs. tests	0.10 (−0.12 to 0.33)	0.12 (−0.12 to 0.36)
Management/communication vs. tests	0.08 (−0.18 to 0.34)	0.08 (−0.21 to 0.38)
Other vs. tests	−0.10 (−0.36 to 0.17)	−0.11 (−0.42 to 0.20)
Setting		
Secondary care vs. primary care	0.03 (−0.17 to 0.23)	0.02 (−0.20 to 0.25)
Other vs. primary care	−0.01 (−0.24 to 0.22)	−0.05 (−0.30 to 0.20)
Direction of change required		
Increase vs. decrease	−0.01 (−0.19 to 0.18)	0.00 (−0.23 to 0.23)
Format		
Face to face vs. written	0.04 (−0.23 to 0.32)	0.07 (−0.24 to 0.37)
Computer (including e-mails) vs. written	0.07 (−0.19 to 0.33)	0.07 (−0.21 to 0.34)
Mixed/unclear vs. written	0.09 (−0.12 to 0.30)	0.10 (−0.13 to 0.34)

Investigation of behaviour change techniques, settings and contexts, using network meta-analysis

Network meta-analysis is a suitable method to rank the social norm BCTs from most effective to least effective. For the network meta-analysis, we used all of the 100 comparisons that tested the effect of social norm BCTs with two additional comparisons[79,80] that had different social norm BCTs in each arm. Some regrouping was carried out to the social norm categories to reduce the number of categories and avoid small groups: all comparisons testing social reward with or without other BCTs were combined, all comparisons testing credible source with or without other BCTs were combined and all comparisons testing social comparison and credible source with or without other BCTs were combined. The number of comparisons available for each of the social norm BCTs is shown in *Table 11*, and the diagram of how they are networked in shown in *Figure 16*.

Network meta-analysis gives similar effect sizes and CIs to those seen in the meta-analysis (see *Figure 3*), but also allows us to rank the social norms interventions from best to worst (*Table 12*). The evidence from 102 tests of social norm BCTs suggests that the most effective interventions contain social comparison and social reward (SMD 0.39, 95% CI 0.15 to 0.64), social comparison and prompts/cues (SMD 0.33, 95% CI 0.22 to 0.44) or credible source (SMD 0.30, 95% CI 0.13 to 0.47). Social comparison on its own (SMD 0.05, 95% CI 0.03 to 0.08) or combined with social support (unspecified) (SMD 0.10, 95% CI 0.04 to 0.16) or other BCTs (SMD 0.04, 95% CI 0.00 to 0.08) all appear to be more effective than control, on average, in improving compliance with the desired behaviour; however, they were associated with a very modest effect size. The use of credible source and social comparison together (SMD 0.16, 95% CI 0.12 to 0.20), and other combinations of two or more social norm BCTs together (SMD 0.07 95% CI 0.03 to 0.12), similarly have a modest effect on behavioural outcomes. There is no evidence to suggest that social reward (SMD 0.03, 95% CI −0.08 to 0.13), social comparison, instruction on how to perform the behaviour and prompts/cues (SMD 0.01, 95% CI −0.10 to 0.11), or social comparison and information about health consequences (SMD −0.14, 95% CI −0.33 to 0.05) offer benefit above control; however, in all cases the CIs were wide and we cannot rule out a modest effect.

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TABLE 11 Number of comparisons for each social norm BCT used in network meta-analysis

Intervention group	Type of control group		Total
	0. Control	1. Social comparison	
1. Social comparison	33	N/A	33
2. Credible source	7	0	7
3. Social reward	2	0	2
4. Social comparison and credible source	8	2	10
5. Social comparison and social reward	2	0	2
6. Social comparison and social support (unspecified)	7	0	7
7. Social comparison and prompts/cues	5	0	5
8. Social comparison and information about health consequences	4	0	4
9. Social comparison and instruction on how to perform the behaviour and prompts/cues	5	0	5
10. Social comparison and other BCTs	23	0	23
11. Other multiple social norm BCTs	4	0	4
Total	100	2	102

N/A, not applicable.
Note that numbering follows that used in *Figure 16*.

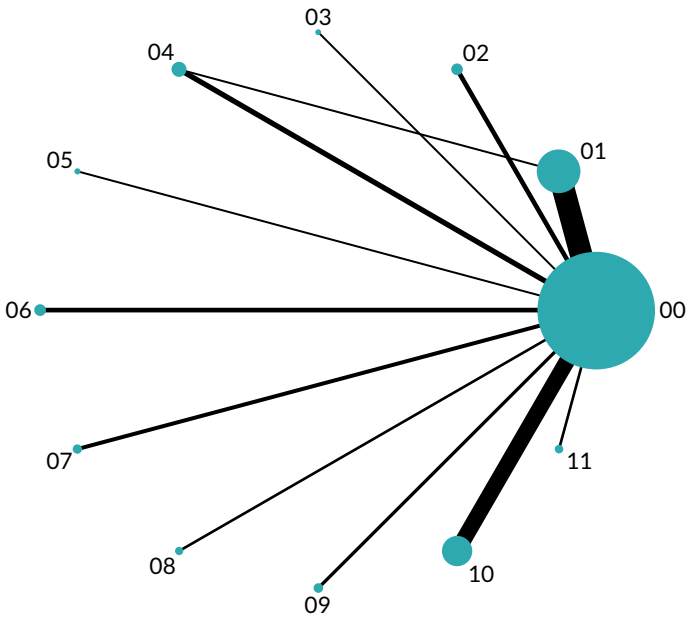

FIGURE 16 Network diagram to showing the available comparisons. 0, any control; 1, social comparison; 2 credible source; 3, social reward; 4, social comparison and credible source; 5, social comparison and social reward; 6, social comparison and social support (unspecified); 7, social comparison and prompts/cues; 8, social comparison and information about health consequences; 9, social comparison and instruction on how to perform the behaviour and prompts/cues; 10, social comparison and other BCTs; 11, other multiple social norm BCTs.

TABLE 12 Intervention effects calculated from network meta-analysis, ordered by effect size

Effect	Effect, SMD (95% CI)	Probability of being the best intervention (%)
Social comparison and social reward vs. control	0.39 (0.15 to 0.64)	59.2
Social comparison and prompts/cues vs. control	0.33 (0.22 to 0.44)	22.2
Credible source vs. control	0.30 (0.13 to 0.47)	18.6
Social comparison and credible source vs. control	0.16 (0.12 to 0.20)	0.0
Social comparison and social support (unspecified) vs. control	0.10 (0.04 to 0.16)	0.0
Other multiple social norm BCTs vs. control	0.07 (0.03 to 0.12)	0.0
Social comparison vs. control	0.05 (0.03 to 0.08)	0.0
Social comparison and other BCTs vs. control	0.04 (0.00 to 0.08)	0.0
Social reward vs. control	0.03 (–0.08 to 0.13)	0.0
Social comparison, instruction[a] and prompts/cues vs. control	0.01 (–0.10 to 0.11)	0.0
Social comparison and information on health consequences vs. control	–0.14 (–0.33 to 0.05)	0.0

a Instruction on how to perform the behaviour.

Sensitivity analyses

Tables 13 and *14* show that our main conclusion is robust: there is little change in our average SMD when we impute alternative values for the ICC when required, exclude trials in which the standard deviation was imputed, remove trials reporting mean per cent compliance in which the mean compliance was close to 0% or 100%, or include trials at only low risk of bias on each domain. Note that we decided before analysis not do a sensitivity analysis on 'risk of bias due to blinding', as we believe blinding to be difficult/impossible in social norm interventions and, as expected, it was rarely seen; however, we must bear in mind that our review is at risk of bias owing to this lack of blinding.

TABLE 13 Sensitivity analysis for overall result, fixed effects

Analysis	Effect, SMD (95% CI)	Number of comparisons
Full data set	0.08 (0.07 to 0.10)	100
Using imputed ICC = 0.2 instead of 0.1	0.08 (0.06 to 0.10)	100
Using imputed ICC = 0.05 instead of 0.1	0.09 (0.07 to 0.10)	100
Removing trials with imputed SDs	0.09 (0.07 to 0.10)	94
Removing trials reporting mean per cent compliance close to 0% or 100%[a]	0.07 (0.05 to 0.08)	77
Keeping only trials at low risk of bias owing to allocation concealment	0.11 (0.09 to 0.13)	72
Keeping only trials at low risk of bias owing to sequence generation	0.08 (0.06 to 0.10)	74
Keeping only trials at low risk of bias owing to selective outcome reporting	0.09 (0.07 to 0.11)	41
Keeping only trials at low risk of bias owing to attrition	0.10 (0.08 to 0.12)	57
Keeping only trials at low risk of bias owing to other biases	0.09 (0.07 to 0.11)	59
Removing trials in which 'feedback on desired behaviour' was not part of the tested intervention	0.08 (0.07 to 0.10)	88

SD, standard deviation.
a Trials using mean per cent compliance and reporting mean per cent compliance < 20% or > 80%.

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TABLE 14 Sensitivity analysis for overall result, random effects

Analysis	Effect, SMD (95% CI)	Number of comparisons
Full data set	0.16 (0.11 to 0.22)	100
Using imputed ICC = 0.2 instead of 0.1	0.16 (0.10 to 0.21)	100
Using imputed ICC = 0.05 instead of 0.1	0.16 (0.11 to 0.21)	100
Removing trials with imputed SDs	0.18 (0.12 to 0.23)	94
Removing trials reporting mean per cent compliance close to 0% or 100%[a]	0.12 (0.07 to 0.16)	77
Keeping only trials at low risk of bias owing to allocation concealment	0.18 (0.12 to 0.25)	72
Keeping only trials at low risk of bias owing to sequence generation	0.17 (0.10 to 0.23)	74
Keeping only trials at low risk of bias owing to selective outcome reporting	0.22 (0.13 to 0.31)	41
Keeping only trials at low risk of bias owing to attrition	0.18 (0.13 to 0.24)	57
Keeping only trials at low risk of bias owing to other biases	0.13 (0.09 to 0.18)	59
Removing trials in which 'feedback on desired behaviour' was not part of the tested intervention	0.17 (0.12 to 0.23)	88

SD, standard deviation.
a Trials using mean per cent compliance and reporting mean per cent compliance < 20% or > 80%.

In an additional unplanned sensitivity analysis, we excluded comparisons that did not include feedback on behaviour alongside the social norm BCT being tested. Conclusions would be similar whether or not comparisons that included feedback on behaviour were included.

Publication bias

There is some evidence of funnel plot asymmetry, with several SMDs lying on the right-hand side outside the predicted funnels (*Figure 17*). This means that the review may be missing some unpublished negative trials, or may include more positive trials than justified owing to selective outcome reporting. We should review the results cautiously in the light of the risk of outcome reporting bias, especially when we look at the magnitude of the extreme positive trials in relation to the overall treatment effect.

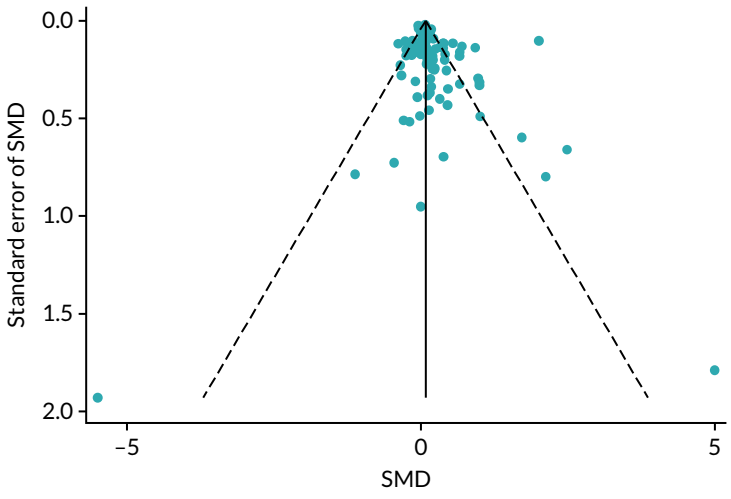

FIGURE 17 Funnel plot: the intervention effect estimates from individual studies against the standard error.

Effects of interventions: patient health outcomes (secondary)

Figure 18 shows the SMD among patient outcomes (14 comparisons), grouped by type of BCT comparison, in a fixed-effects meta-analysis. Only a subset of comparison types is represented compared with the results for primary (health worker behaviour) outcomes, given that not all studies reported a patient outcome. As for health worker behaviour outcomes, heterogeneity is high with an overall $I^2 = 91.5\%$. Combined data from these 14 comparisons suggest that interventions with a social norm component were associated with an improvement in patient outcomes of 0.17 SMD (95% CI 0.14 to 0.20), on average. However, this is strongly influenced by those studies testing social comparison, in particular Bentz *et al.*[87] (weight 46%) with an estimated SMD of 0.36 (95% CI 0.32 to 0.40) and Beck *et al.*[86] (weight 31%) with an estimated SMD of 0.00 (95% CI −0.05 to 0.05). Estimates consistent with a null effect were found for all studies testing social comparison combined with social support (unspecified), prompts/cues, instruction on the behaviour plus prompts/cues or other BCTs. A larger positive effect of 0.86 SMD (95% CI 0.29 to 1.44) is found for the test of a credible source intervention, but this is from one small study (weight 0.3%).[67] These results for patient outcomes should be interpreted cautiously owing to a large amount of heterogeneity among studies, and to the small number of studies in some groups.

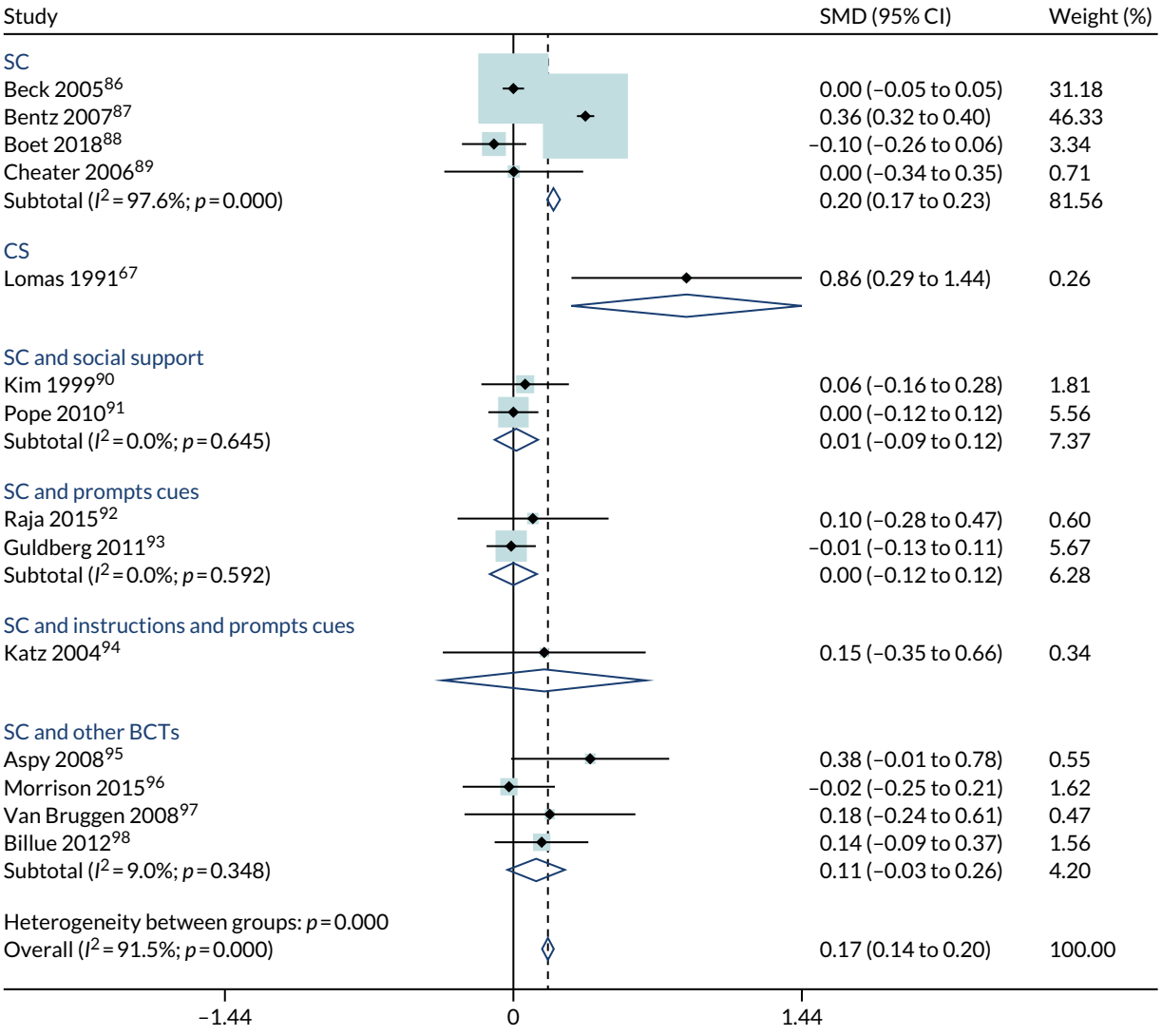

FIGURE 18 Patient outcomes: fixed effects summarised by type of comparison (15 comparisons). CS, credible source; SC, social comparison; SR, social reward.

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Both the patient outcomes and the target behaviours varied across the studies. To illustrate the findings, we offer some examples of studies included in the review. Ivers *et al.*[18] targeted GP behaviour in arranging testing and prescribing for people with diabetes, and the patient outcome was mean systolic blood pressure. Aspy *et al.*[95] targeted primary care physicians, encouraging them to offer a mammogram to appropriate women patients, and the patient outcome was the proportion of eligible patients who had a mammogram. Lomas *et al.*[67] targeted secondary care doctors, encouraging them to reduce the offer of caesareans to women who had previously had caesareans, and the patient outcome was the proportion of vaginal births. Billue *et al.*[98] targeted GP behaviour in intensifying medication for a range of health conditions, and the patient outcome was the proportion of patients with controlled diabetes. In studies in which there was more than one health outcome, we chose the study's primary outcome, and if that was not clear, we chose the first outcome that was reported.

Figure 19 shows the SMD among patient outcomes (14 comparisons), grouped by type of BCT comparison, using a random-effects meta-analysis. As for the fixed-effects analysis, only a subset of comparison types is represented compared with the results for primary outcomes, given that not all studies reported a patient outcome.

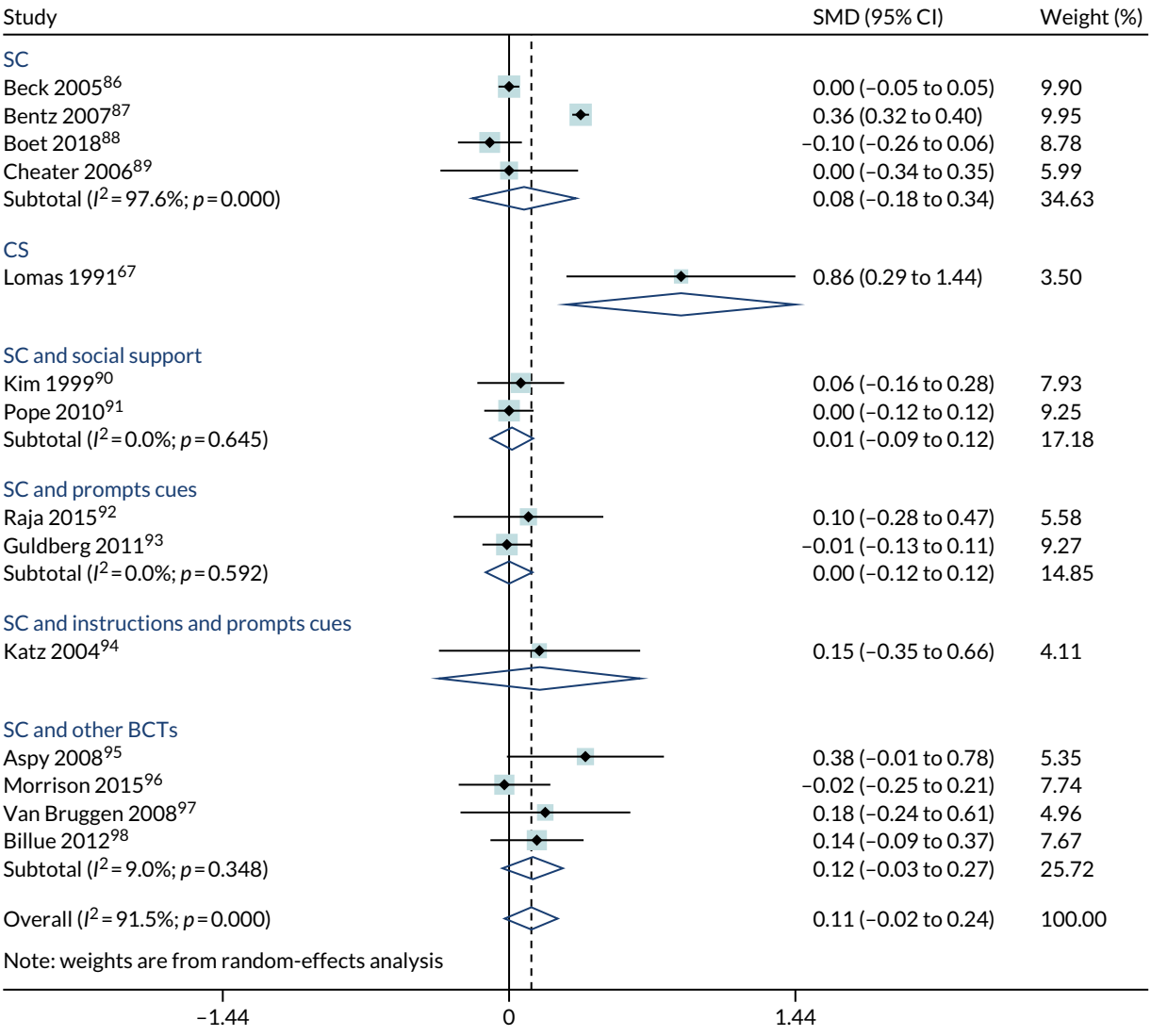

FIGURE 19 Patient outcomes: random effects grouped by type of comparison (14 comparisons). CS, credible source; SC, social comparison; instructions, instruction on how to perform the behaviour; social support, social support (unspecified).

The overall estimate of effect is less precise and slightly attenuated compared with the corresponding fixed-effects analysis, with an overall estimated SMD of 0.11 (95% CI −0.02 to 0.24). The results for 12 out of the 14 comparisons are consistent with no effect, exceptions were Lomas *et al.*'s[67] (weight 3.5%) test of a credible source intervention, with an estimated SMD of 0.86 (95% CI 0.29 to 1.44) and Bentz *et al.*'s[87] (weight 10%) test of a pure social comparison intervention, with an estimated SMD of 0.36 (95% CI 0.32 to 0.40). However, the overall estimated group SMD for pure social comparison interventions is 0.08 (95% CI −0.18 to 0.34), consistent with no effect. As for the corresponding fixed-effects analysis, the results should be interpreted cautiously owing to a high amount of heterogeneity and relatively few comparisons in each group.

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Chapter 4 Discussion

Summary of findings

Social norms interventions can be an effective approach to changing the clinical behaviour of health workers. Interventions that include a social norms component were associated with an improvement in health worker behaviour outcomes of 0.08 SMD (95% CI 0.07 to 0.10) ($n = 100$ comparison). To illustrate the size of this effect, if, among GPs, the baseline rate of conducting annual reviews and blood tests for people with diabetes was 40%, a SMD of 0.08 would be equivalent to a 4% increase, from 40% to 44%, in the conduct of the annual reviews. Social norms interventions were associated with an improvement in patient outcomes of 0.17 SMD (95% CI 0.14 to 0.20) ($n = 14$ comparisons), on average. There was a large amount of heterogeneity, with some studies reporting substantially higher or lower effects for social norm interventions. This heterogeneity was investigated by examining the effect of variation in BCT, context and mode of delivery, by using forest plots, metaregression and network meta-analysis.

Social norm behaviour change techniques

There were three types of social norms intervention that were the most effective, on average, in changing health worker behaviour: social comparison together with social reward (SMD 0.39, 95% CI 0.15 to 0.64), social comparison together with prompts/cues (SMD 0.33, 95% CI 0.22 to 0.44), and credible source, either alone or in combination with other BCTs (SMD 0.30, 95%CI 0.13 to 0.47).

Other interventions had a more modest effect, but still appeared to be better than control: social comparison when delivered on its own (SMD 0.05, 95% CI 0.03 to 0.08), with social support (unspecified) (SMD 0.10, 95% CI 0.04 to 0.16) or with other BCTs (SMD 0.04, 95% CI 0.00 to 0.08). Combining credible source with social comparison (SMD 0.16, 95% CI 0.12 to 0.20), and other combinations of two or more social norm BCTs (SMD 0.07 95% CI 0.03 to 0.12) also had a modest average effect.

Interventions involving social reward or information about others' approval appeared to be ineffective, but this is based on a very small numbers of trials. There was only one trial of social incentive, which showed no evidence of an effect.

These findings were consistent across forest plots, regression and network meta-analysis.

Concomitant behaviour change techniques

We examined whether or not the addition of other BCTs with the social norm BCTs was associated with any improvement in effect. The most frequently occurring BCT was feedback on behaviour (found in 88/100 comparisons); more often than not, health workers were provided with feedback on their own behaviour at the same time as they received interventions telling them about the behaviour of others or the approval of others. It was not possible in this study for us to completely untangle the effect of social comparison and feedback, but the sensitivity analysis suggests that the effect is similar whether or not feedback on behaviour is delivered alongside social comparison.

Interventions that tested social comparison with the addition of social reward ($n = 2$) or prompts/cues ($n = 5$) were more effective than social comparison alone, but when social comparison was delivered alongside prompts/cues plus information about health consequences ($n = 4$) or instructions on how

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to perform the behaviour and prompts/cues ($n = 5$) the intervention was ineffective. It may be that prompts and cues enhance social comparison when the behaviour is well understood by the recipient, but the prompts were ineffective when there was a need for instructions or education. Social comparison with social support (unspecified) ($n = 7$) was effective in changing health worker behaviour and had a similar size of effect to social comparison alone. However, these additional BCTs occurred in a relatively small number of trials, too small to show any additive effect in the metaregression.

Contexts

We explored the contexts in which social norms interventions were delivered. We found that social norms interventions were effective with different types of health workers. However, they may be less effective with nurses and AHPs than with doctors, although the number of studies with nurses and AHPs was low. Social norms interventions have been successful in targeting a wide range of clinical behaviours, including prescribing, tests, and management and communication around health conditions, but may be ineffective with hand-washing and referrals. They were equally effective in primary and secondary care, but may be less effective in community and care home settings, although the number of studies in those settings was low. The effect of social norms interventions appears to be reasonably consistent across different types of reference group (peers, senior persons, patients and mixed populations). Social norms interventions appear to be, on average, slightly more effective at reducing behaviours (e.g. reducing antibiotic prescriptions) than increasing them (e.g. increasing hand-washing).

Modes of delivery

Interventions appear equally effective regardless of who delivers them; there is some indication that interventions delivered by supervisors were less effective, but the number of such studies was small. The effect is similar regardless of whether the intervention comes from an internal or external source, although the number of interventions from internal sources was low. Delivering the intervention once is sufficient: there was no evidence of an increased effect from more frequent delivery. All methods of delivery of social norms interventions were effective apart from face to face; delivery by website appeared to be the most effective method.

In summary, the review provides robust evidence that social norms interventions were effective in changing the clinical behaviour of health workers: credible source, social comparison and social reward were all found to be more effective than control. Credible source was found to be very effective. Social comparison is very effective when combined with social reward or prompts/cues, but there is still an effect when social comparison is delivered on its own or with social support (unspecified), credible source or other BCTs. Social norms interventions have been implemented in a variety of contexts and we did not find strong evidence that the effectiveness varies by context. In terms of modes of delivery, delivering the intervention once was sufficient and sending the intervention by website or other computerised format was the most effective.

Quality of the evidence

Across some domains (e.g. random sequence generation, allocation concealment and blinding of outcome assessment), the majority of trials (> 70%) were judged to be at low risk of bias. The risk of bias was high for the blinding of participants and personnel, with 80% high risk, owing to the nature of the interventions used and preponderance of cluster trials in the review. When we looked at only the trials at low risk of bias for each key domain in a sensitivity analyses, our overall treatment effect changed very little, suggesting that the results were robust and not strongly influenced by the trials at high/unclear risk of bias; we cannot rule out the possibility of response bias owing to lack of blinding.

Strengths and limitations

The review was carefully designed and executed to minimise bias. The selection of studies, data extraction and BCT coding were all undertaken by two independent coders, and any discrepancies were resolved by discussion or involvement of a third coder: this reduces the risk of errors or inconsistencies in the review. All coders received appropriate training. A strength of the review is that the review team thought long and hard about the choice of data to extract: we wanted to avoid the danger of extracting so much data that we would risk spurious findings. We concentrated on those features that were considered relevant in earlier reviews, and those that seemed to have particular relevance to the topic.[16,17,25] Despite this, it is possible that we failed to extract some important design features. Another strength is that we did not exclude any studies on the basis of their choice of outcomes, and we converted any available outcome into a SMD: this meant that we were able to use all of the available evidence and summarise it all together in one analysis.

Trials were excluded from the review where the intervention did not target a specific behaviour, for example we would exclude a trial if the intervention was aimed at a health worker with the intention of reducing patient blood pressure, but did not make explicit to the health worker what behaviour(s) were expected of them to achieve the reduction. These exclusions occur because the focus of this review is the behaviour change of health workers. If a behaviour is not specified, it is not possible to determine whether or not an intervention actually targeted that behaviour, and change in that behaviour (our primary outcome) cannot be assessed. This approach is consistent with that of the BCT taxonomy v1;[24] to identify an intervention component as a BCT using the BCT taxonomy, a crucial requirement is that the intervention component in question targets the behaviour that the intervention aims to address. There is a potential risk that we have excluded some studies that may have added to the review where there was a target behaviour and an intervention that did target that behaviour, but we were unable to determine this because of poor reporting. In the future we plan to undertake a separate review of those studies that did not include a target behaviour.

The large number of studies retrieved prevented us from requesting additional information from authors. There were 10 studies without suitable outcome measures that we could not include in the meta-analysis. The size of the review makes it unlikely that the missing 10 studies would have had an effect on the review outcome, particularly as many of them were small studies. There were studies for which we imputed missing information relating to the outcomes, such as ICCs and standard deviations. Sensitivity analyses suggest that the missing information has not had a significant impact on the review.

The primary approach to meta-analysis was based on a fixed-effects approach.[99] The fixed-effects analysis summarises the evidence in these trials, rather than estimating a common underlying treatment effect.[100] We are aware that this topic is highly contested, and we have also presented random effects for the most important analyses, as planned. In every one of our analyses, both the fixed-effects and the random-effects approaches produced a result in the same direction, with the fixed-effects approach resulting in a lower effect for the intervention (SMD 0.08 vs. 0.16): this is because of the random-effects approach giving greater weight to smaller studies. We believe that we would have come to similar conclusions, regardless, whether we had chosen fixed effects or random effects as our primary analysis.

In this review, we combined different types of outcomes in the same analysis in an attempt to provide an overall summary of all of the available evidence on social norms interventions in a single review. The trials used came from a variety of different contexts and settings, and utilised different trial designs and units of analysis. This has led to a very heterogeneous review, and we acknowledge the limitations of this approach. The magnitude of effects for the most promising behaviour change interventions were approximately 0.3 SMDs, which, relative to the between-study variability ($\tau^2 = 0.2$), does seem to indicate an important effect.

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All of the meta-analysis was undertaken on the basis of comparisons: we subtracted the BCTs in the control arm from those in the intervention arm to obtain a list of BCTs that were actively tested in each study. The active ingredient that we were testing was what was left of the intervention when the control arm was taken away. We consider this the most suitable approach to examine the effect of the various social norm BCTs; however, a limitation of this approach is that we may have missed some interaction effects. A few of the studies were complex in the sense that both arms contained multiple BCTs. In these cases, we simplified them to the core comparison of interest for the review. One example is a study by Boet *et al.*[88] that tested social comparison (with feedback on outcome of the behaviour and instruction on how to perform the behaviour) against a control group that received the same components (feedback on outcome of the behaviour and instruction on how to perform the behaviour) but without social comparison. This was coded as social comparison versus control. Another example is a study by Bentz *et al.*[94] that tested social comparison [with social support (unspecified), feedback on behaviour, instruction on how to perform the behaviour and prompts/cues] against a control group that received all the same techniques, but without the social comparison and feedback on behaviour. This was coded as social comparison vs. control. These complex interventions and controls represent a minority of the trials: most studies were much simpler. An issue with overly complex interventions and controls is that it makes it very difficult to isolate which ingredients, among many, are contributing to the overall effect.

We used the BCT taxonomy v1[24] to code all of the BCTs that were included within the intervention or control arms of the trials. The BCT taxonomy is based on a significant body of research, but it is unlikely to be fully comprehensive; the authors acknowledge and anticipate that extension or modification could be appropriate in the future. It is, therefore, possible that on occasion BCTs that do not yet feature in the BCT taxonomy could have been presented alongside social norm BCTs and were missed during the BCT coding exercise.

The asymmetry of the funnel plot suggests that the review may have missed some unpublished negative trials. Unpublished studies were eligible for the review, but our search strategy was not successful in finding them. We did not have the resources to contact authors of included studies to ask them if they knew of other relevant but unpublished material. It is possible that there are unpublished documents that we did not include. We only considered studies written in English, which may have also excluded some relevant studies from the review. We selected a single behaviour outcome from every trial using published trial reports; it is possible that this put the review at risk of selective outcome reporting, although we tried to minimise this by using a prespecified selection hierarchy. A sensitivity analysis including only those trials with either a relevant prespecified primary outcome or a single relevant behavioural outcome suggested that the results were robust to selective outcome reporting.

Discussion of findings in relation to the literature

A Cochrane systematic review[25] summarised 140 studies and examined the effect of A&F on health worker behaviour and patient health outcomes. The authors found that A&F led to a small improvement on average (weighted median adjusted per cent change relative to control was 1.3%, interquartile range 1.3% to 28.9% in continuous outcomes), but there is a wide variation in effect. The review authors and others have recommended future research to explore this variation and, in particular, to identify factors relating to the intervention design, context and the recipient.[17] The results of our review make a contribution to this agenda by suggesting aspects of the design of A&F interventions that are associated with positive outcomes: (1) making it clear that a credible source approves of the desired behaviour; (2) feedback on an individual's behaviour is likely to be more effective if it is accompanied by drawing attention to the behaviour of their peers; (3) complex interventions involving multiple social norms seem to be effective; and (4) social comparison seems to be enhanced by the use of prompts and cues, such as providing lists of patients with suboptimal management[101] or sending guideline-based recommendations

with test results[102] to support decision making, or computerised pop-ups when particular codes are entered into an electronic system,[61] but the benefit of prompts and cues may hold only when the health worker understands how to do the behaviour. The effect of social norms interventions seemed to be reasonably consistent across the contexts we explored: social norms interventions worked across a range of health professionals, behaviours and settings. By contrast to an earlier review of A&F,[25] delivering the intervention once appeared to be sufficient and sending the intervention by website or other computerised format was most effective. Our results align with findings from a recent synthesis of qualitative literature on A&F,[16] which found that letting health professionals know how their performance relates to that of their peers (social comparison) and providing opportunities for peer discussion [social support (unspecified)] were valuable in changing behaviour.

A recent overview of systematic reviews on promoting professional behaviour change in health care summarised 67 reviews and found that the most effective interventions were educational outreach using academic detailing, A&F feedback and reminders.[103] Using normalisation process theory as a theoretical lens, the authors concluded that interventions that seek to 'restructure and reinforce new practice norms' (opinion leaders, educational meetings and materials/guidelines) and those that 'associate practice norms with peer and reference group behaviours' (academic detailing, A&F) are most likely to be successful in changing clinical behaviour, and that combining the two approaches together may be particularly effective by creating clear rules of conduct and encouraging individuals to follow their peers.[103] Interventions that seek to change attitudes were found to be less likely to be successful. The importance given to peer and reference group behaviours in this previous study certainly justifies our efforts to identify which social norms interventions are associated with success. We found a lack of clarity around terms that are commonly used in the literature about health worker behaviour change. An example is academic detailing, where a target health worker receives individual support or advice from someone else with expertise in that area. We found that academic detailing appeared frequently as a technique but its precise content was usually not specified. We agreed to treat academic detailing like other 'packages' in the BCT taxonomy v1 that are not well-defined (e.g. cognitive–behavioural therapy or counselling) and code it as social support (unspecified). This is based on the idea that the health worker is getting some unspecified support, but we cannot precisely pin it down. If the paper included a detailed description of the content of the academic detailing, we added other BCT codes, if indicated, such as credible source if the person delivering the intervention was a credible source who provided approval of the behaviour. Similarly, opinion leaders occurred fairly frequently, sometimes without clarity of what was involved, and were coded only as credible source when we felt that it clearly met the definition in the BCT taxonomy v1.

The BCT taxonomy v1[24] was used in this review to classify the BCTs in the intervention and control arms of the included studies: we categorised both the social norm techniques and the accompanying techniques. Four coders (two experienced health psychologists, one health services researcher and one librarian) were provided with a half-day of training by experts and an online course (www.bct-taxonomy.com/), and managed to achieve fairly high levels of inter-rater consistency, which adds to the evidence[40] that the taxonomy is a consistent and reliable tool for classifying BCTs. Social norms are not explicitly considered as a category of BCTs in the BCT taxonomy. Instead, social norms appear across three categories: comparison of behaviour, comparison of outcomes and reward or threat. This might seem surprising given how often social norms appear in various behaviour change theories,[21–23] but the structure of the BCT taxonomy was determined through a careful process involving 18 experts grouping BCTs according to their 'similar active ingredients',[24] with an aim of creating a structure that facilitates use rather than one that is theory based. We defined a social norms intervention as one seeking to change the clinical behaviour of a target health worker by exposing them to the values, beliefs, attitudes or behaviours of a reference group or person, and we then selected BCTs from the taxonomy that met this definition, involving one of the BCT taxonomy developers in that discussion. This classification worked well for our purposes, but the use of this group of social norm BCTs by other research teams would strengthen the evidence for its utility.

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Implications for policy and practice

Our research provides strong evidence from many studies to suggest the following implications for policy and practice:

- Social norms interventions targeting health workers are effective in both changing the clinical behaviour of health workers and improving outcomes for patients, and should continue to be implemented (102 studies).
- Social comparison, where a target health worker is provided with information about the clinical behaviour of their peers, allowing them to make a comparison with their own behaviour, is, on average, effective and should continue to be implemented. It is effective both on its own and as part of a complex intervention, and is more effective than simply providing feedback on the target's behaviour (81 studies).
- Credible source (where the target health worker understands that a clinical behaviour has the approval of someone they regard as a credible source) is, on average, effective and should continue to be implemented. It is effective both on its own and as part of a complex intervention (15 studies).
- Social comparison can be enhanced by the use of prompts/cues, such as providing lists of patients to support decision-making (such as those who have test results that warrant investigation), or computerised pop-ups when particular codes are entered into an electronic system. The benefit of prompts and cues may not apply when the behaviour is not well understood by the health worker or they need to learn new skills to undertake it (10 studies).
- Social norms interventions can be used to good effect across a wide range of health contexts:
    - They are effective in changing the behaviour of doctors (68 studies) and other health workers (12 studies).
    - They can be used successfully to change a variety of behaviours, such as prescribing (40 studies), ordering and conducting tests (21 studies), managing long-term conditions and improving communication with patients (23 studies).
    - They are suitable for use in both increasing behaviour (e.g. more frequent contact with patients or increase in blood testing for a particular condition) (70 studies) or reducing behaviour (e.g. fewer prescriptions for antibiotics or reduction in the number of unwarranted blood tests) (28 studies).
    - They can be used successfully in both primary (56 studies) and hospital care (27 studies).
- Mode of delivery:
    - The source of the intervention can be internal or external.
    - Formats including e-mail (9 studies), written (25 studies), web based (8 studies) and mixed (14 studies) have all been used successfully.

Our review provides weaker evidence to suggest the following implications for policy and practice:

- By contrast to earlier research, our study found that delivering the intervention once (28 studies) appeared to be more effective than delivering the intervention multiple times (47 studies). However, this finding could also be explained by other differences between studies. For example, it is plausible that multiple-time delivery would be used when the desired behaviour is difficult or associated with intractable problems.
- Sending the intervention by website or other computerised format may be more effective (8 studies) than more costly written (25 studies) or face-to-face methods (14 studies).

Recommendations for further research

1. Credible source has been identified as an effective intervention component, but was included in only 18% of the comparisons identified in this review. For this reason, it seems not to be commonly used for changing clinical behaviours and people responsible for behaviour change policy in this setting may not be familiar with it. Additional work is needed to develop credible source interventions for use in the NHS. As a first step, a narrative synthesis of the trials using credible source in this review, together with the qualitative papers, process evaluations and protocols associated with those trials, would provide a more detailed picture of the credible source interventions that are associated with more successful outcomes.
2. Social comparison is currently used more frequently in the NHS than credible source. We identified a high level of heterogeneity in the effectiveness of social comparison. We have started to unravel this heterogeneity and this research suggests that social comparison can successfully be enhanced by the addition of social reward, prompts/cues or social support (unspecified), but further research would provide more depth to these findings.
3. Qualitative work with health workers, managers and policy-makers is needed to understand the acceptability and feasibility of credible source, social comparison and social reward interventions and to understand who the most credible 'credible sources' are.
4. The authors of the BCT taxonomy v1 anticipate that it will be subject to future revision. On the basis of this study we would welcome the creation of a new category 'social norms', bringing together the five BCTs used in this study. However, we recognise that the taxonomy is used for many purposes and across disciplines, so other perspectives will need to be considered.
5. The methodological quality of trials was mixed. The review included some large factorial trials that tested several behaviour change interventions simultaneously; this design can be an efficient way of exploring different components of behaviour change interventions and their interactions. Some trials used novel methods to minimise bias such as 'attention' controls in which participants were given the identical behaviour change intervention for an alternative target behaviour: this type of design is to be encouraged.
6. The quality of trial reporting was mixed and in many cases it was difficult to extract the necessary information required in this review. Poor trial reporting needs to be addressed in future trials of social norms interventions with health professionals. When assessing the risk of bias, we identified 45 (42.5%) studies with incomplete outcome data and, although a few studies had explicitly changed outcomes since the protocol ($n = 5$, 4.7%), many more reported multiple outcomes and did not have a published protocol ($n = 59$, 55.7%), making it impossible to assess whether or not there had been selective outcome reporting. Use of guidelines, such as SPIRIT[104] and CONSORT,[105] would lead to improvement. In addition, the reporting of the details of interventions was poor. In 34 (29.1%) studies, the format of the intervention was unclear or not reported, and the frequency of the intervention was unclear or not reported in 27 (23.1%) interventions. This poor reporting of interventions in behavioural public policy research has been reported elsewhere,[106] and could be addressed by consistent use of the Template for Intervention Description and Replication (TIDieR) framework[107,108] and the BCT Taxonomy.[24]
7. Trials were excluded from the review where the intervention did not target a specific behaviour. We plan to undertake a separate review of those studies that did not include a target behaviour, to assess whether or not the effects of those interventions vary from the effects found in the current review.

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Chapter 5 Conclusions

Social norms interventions are an effective method of changing the clinical behaviour of health workers and have a positive effect on patient outcomes. Although the overall result is modest and very variable, there is the potential for social norms interventions to be applied at a large scale. The most effective social norms interventions are providing communication in favour of the desired behaviour from a credible source, and social comparison combined with prompts/cues. These interventions can be effective in a variety of NHS contexts.

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Contributions of authors

Sarah Cotterill (https://orcid.org/0000-0001-5136-390X) (Senior Lecturer, Health Services Research and Statistics) conceived of the idea for the review and managed the project. She led the writing of the funding proposal and the study protocol, and was involved in screening, data extraction and BCT coding. She attended research group meetings that directed the research. She helped to prepare the data for analysis and undertook descriptive analysis. She led the drafting of the final report and the response to reviewer comments.

Mei Yee Tang (https://orcid.org/0000-0002-3116-6025) (Research Associate, Psychology) was employed as a researcher throughout the project. She contributed to the protocol and was involved in screening, data extraction and BCT coding. She attended research group meetings that directed the research. She was involved in drafting the final report and responding to reviewer comments and approved the final version.

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Elizabeth Howarth (https://orcid.org/0000-0003-3462-3946) (Research Associate, Statistics) was involved in data extraction and conducted the meta-analysis of patient health outcomes. She was involved in drafting the final report and approved the final version.

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Jane Roberts (https://orcid.org/0000-0003-3878-0404) (Librarian, Information Retrieval) wrote the search strategies and ran the searches. She was involved in BCT coding. She was involved in drafting the final report and approved the final version.

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Publications

Cotterill S, Powell R, Rhodes S, Roberts J, Tang MY, Wilkinson J. *The Impact of Social Norms Interventions on Clinical Behaviour Change among Health Workers: Protocol for a Systematic Review*. PROSPERO 2016:CRD42016042718. URL: www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42016042718 (accessed 3 September 2020).

Cotterill S, Powell R, Rhodes S, Brown B, Roberts J, Tang MY, Wilkinson J. The impact of social norms interventions on clinical behaviour change among health workers: protocol for a systematic review and meta-analysis. *Syst Rev* 2019;**8**:176.

Data-sharing statement

All data requests should be submitted to the corresponding author for consideration. Access to available anonymised data may be granted following review.

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Appendix 1 Search strategies

TABLE 15 Results of the database searches

Database	Number of results	Date of search
Ovid MEDLINE	1486	23 July 2018
Ovid EMBASE	2134	24 July 2018
HDAS CINAHL	943	24 July 2018
HDAS BNI	286	24 July 2018
Cochrane CENTRAL	584 trials (1999 total)	24 July 2018
Ovid PsycINFO	470	24 July 2018
Web of Science	2112, 2120	19 July 2018 and 30 July 2018

Database: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations

Date range searched: 1946 to week 2 July 2018.

Date searched: 23 July 2018.

Search strategy

1. (anaesthetist* or anesthetist* or audiologist* or cardiologist* or chiropodist* or clinician* or consultant* or cadet* or counsellor* or dentist* or dermatologist* or dietician* or Doctor* or GP or GPs or gynaecologist* or gynecologist* or matron* or midwife or midwives or neurologist* or nurse* or nutritionist* or obstetrician* or oncologist* or optometrist* or orthodontist* or orthoptist* or orthotist* or osteopath* or paediatrician* or pediatrician* or paramedic* or pathologist* or pharmacist* or phlebotomist* or physician* or physiologist* or physiotherapist* or podiatrist* or practice manager* or practice staff or practitioner* or prosthetist* or psychiatrist* or psychologist* or psychotherapist* or radiographer* or radiologist* or registrar* or rheumatologist* or surgeon* or therapist* or urologist* or anesthesiologist* or prescriber* or sonographer*).ab,ti. (1,380,041)
2. exp Health Personnel/ (462,248)
3. exp CONSULTANTS/ (6476)
4. ((ambulance or associate or audiology or cardiology or chiropody or clinical or dental or dermatology or family or gynaecology or gynecology or health or healthcare or "health care" or hospital or house or medical or midwifery or neurology or nursing or nutrition or obstetrics or oncology or optometry or orthodontic or paediatric* or pediatric* or pathology or pharmacy or physiology or physiotherapy or podiatry or psychiatry or psychology or "public health" or radiolog* or rheumatology or surgical or therapy or trainee or urology or respiratory or magnetic resonance imaging) adj2 (assistant* or cadet* or director* or manager* or officer* or personnel or practice or practitioner* or professional* or provider or receptionist* or resident* or scientist* or secretar* or specialist* or staff or technician* or technologist or visitor* or worker*)).ab,ti. (499,319)
5. 1 or 2 or 3 or 4 (1,895,700)
6. benchmark*.ab,ti. (30,808)
7. ((audit or monitoring or peer or performance or data or individualised or individualized or web or personalised or personalized or compar* or team or practitioner or practice or clinical or social) adj2 feedback).ab,ti. (6421)

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8. FEEDBACK, PSYCHOLOGICAL/ (3122)
9. ((social or descriptive or peer or subjective) adj2 (norm or norms)).ab,ti. (5654)
10. social influence.ab,ti. (1497)
11. Social Norms/ (747)
12. BENCHMARKING/ (12,165)
13. ((social or peer*) adj2 comparison*).ab,ti. (1649)
14. social competition.ab,ti. (109)
15. social proof.ab,ti. (17)
16. image motivation.ab,ti. (8)
17. warm glow.ab,ti. (27)
18. ((social or verbal or non-verbal or nonverbal or non verbal) adj2 (incentive or incentives or reward or rewards)).ab,ti. (637)
19. positive reinforcement.ab,ti. (1439)
20. "congratul*".ab,ti. (505)
21. praise.ab,ti. (1720)
22. commendation.ab,ti. (68)
23. Reinforcement, Social/ (1036)
24. credible source.ab,ti. (100)
25. Peer Influence/ (273)
26. theory of planned behavio?r.ab,ti. (2518)
27. theory of reasoned action.ab,ti. (453)
28. theoretical domains framework.ab,ti. (249)
29. social cognitive theory.ab,ti. (1344)
30. "theory of normative social behavio?r*".ab,ti. (21)
31. 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 (64,961)
32. randomized controlled trial.pt. (463,949)
33. controlled clinical trial.pt. (92,495)
34. "randomiz*".ab,ti. (447,770)
35. "randomis*".ab,ti. (89,649)
36. placebo.ab. (187,269)
37. Clinical Trials as Topic/ (184,102)
38. randomly.ab,ti. (288,777)
39. trial.ti. (180,410)
40. RCT.ab,ti. (15,807)
41. 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 (1,188,749)
42. exp Animals/ (21,630,632)
43. Humans/ (17,157,286)
44. 42 not (42 and 43) (4,473,346)
45. 41 not 44 (1,094,500)
46. 5 and 31 and 45 (1486)

Database: Ovid EMBASE

Date range searched: 1974 to 3 July 2018.

Date searched: 24 July 2018.

Search strategy

1. (anaesthetist* or anesthetist* or audiologist* or cardiologist* or chiropodist* or clinician* or consultant* or cadet* or counsellor* or dentist* or dermatologist* or dietician* or Doctor* or GP or

GPs or gynaecologist* or gynecologist* or matron* or midwife or midwives or neurologist* or nurse* or nutritionist* or obstetrician* or oncologist* or optometrist* or orthodontist* or orthoptist* or orthotist* or osteopath* or paediatrician* or pediatrician* or paramedic* or pathologist* or pharmacist* or phlebotomist* or physician* or physiologist* or physiotherapist* or podiatrist* or practice manager* or practice staff or practitioner* or prosthetist* or psychiatrist* or psychologist* or psychotherapist* or radiographer* or radiologist* or registrar* or rheumatologist* or surgeon* or therapist* or urologist* or anesthesiologist* or prescriber* or sonographer*).ab,ti. (1,960,089)
2. exp health care personnel/ (1,342,608)
3. ((ambulance or associate or audiology or cardiology or chiropody or clinical or dental or dermatology or family or gynaecology or gynecology or health or healthcare or "health care" or hospital or house or medical or midwifery or neurology or nursing or nutrition or obstetrics or oncology or optometry or orthodontic or paediatric* or pediatric* or pathology or pharmacy or physiology or physiotherapy or podiatry or psychiatry or psychology or "public health" or radiolog* or rheumatology or surgical or therapy or trainee or urology or respiratory or magnetic resonance imaging) adj2 (assistant* or cadet* or director* or manager* or officer* or personnel or practice or practitioner* or professional* or provider or receptionist* or resident* or scientist* or secretar* or specialist* or staff or technician* or technologist or visitor* or worker*)).ab,ti. (679,603)
4. 1 or 2 or 3 (2,881,143)
5. "benchmark*".ab,ti. (36,669)
6. ((audit or monitoring or peer or performance or data or individualised or individualized or web or personalised or personalized or compar* or team or practitioner or practice or clinical or social) adj2 feedback).ab,ti. (8968)
7. psychological feedback/ (148)
8. ((social or descriptive or peer or subjective) adj2 (norm or norms)).ab,ti. (6586)
9. social influence.ab,ti. (1678)
10. social norm/ (1918)
11. benchmarking/ (2281)
12. ((social or peer*) adj2 comparison*).ab,ti. (1938)
13. social competition.ab,ti. (114)
14. social proof.ab,ti. (18)
15. image motivation.ab,ti. (8)
16. warm glow.ab,ti. (36)
17. 17 ((social or verbal or non-verbal or nonverbal or non verbal) adj2 (incentive or incentives or reward or rewards)).ab,ti. (786)
18. positive reinforcement.ab,ti. (1856)
19. "congratul* ".ab,ti. (592)
20. praise.ab,ti. (1997)
21. commendation.ab,ti. (82)
22. *credible source*.ab,ti. (110)
23. peer pressure/ (1879)
24. theory of planned behavio?r.ab,ti. (2951)
25. theory of reasoned action.ab,ti. (485)
26. theoretical domains framework.ab,ti. (343)
27. social cognitive theory.ab,ti. (1564)
28. "theory of normative social behavio?r* ".ab,ti. (19)
29. 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 (67,494)
30. randomized controlled trial/ (511,149)
31. "randomized controlled trial (topic)"/ (149,003)
32. controlled clinical trial/ (460,071)
33. "randomiz*".ab,ti. (651,632)
34. "randomis*".ab,ti. (134,394)
35. placebo.ab. (267,600)

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36. "clinical trial (topic) "/ (94,526)
37. randomly.ab,ti. (385,072)
38. trial.ti. (253,539)
39. RCT.ab,ti. (29,215)
40. 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 (1,652,219)
41. exp animal/ (24,606,612)
42. human/ (19,708,224)
43. 41 not (41 and 42) (4,898,388)
44. 40 not 43 (1,521,835)
45. 4 and 29 and 44 (2134)

Database: Cumulative Index to Nursing and Allied Health Literature (searched via Healthcare Databases Advanced Search)

Date range searched: 1937 to July 2018.

Date searched: 24 July 2018.

Search strategy

1. (anaesthetist* OR anesthetist* OR audiologist* OR cardiologist* OR chiropodist* OR clinician* OR consultant* OR cadet* OR counsellor* OR dentist* OR dermatologist* OR dietician* OR Doctor* OR GP OR GPs OR gynaecologist* OR gynecologist* OR matron* OR midwife OR midwives OR neurologist* OR nurse* OR nutritionist* OR obstetrician* OR oncologist* OR optometrist* OR orthodontist* OR orthoptist* OR orthotist* OR osteopath* OR paediatrician* OR pediatrician* OR paramedic* OR pathologist* OR pharmacist* OR phlebotomist* OR physician* OR physiologist* OR physiotherapist* OR podiatrist* OR practice manager* OR practice staff OR practitioner* OR prosthetist* OR psychiatrist* OR psychologist* OR psychotherapist* OR radiographer* OR radiologist* OR registrar* OR rheumatologist* OR surgeon* OR therapist* OR urologist* OR anesthesiologist* OR prescriber* OR sonographer*).ti,ab (685,003)
2. exp "HEALTH PERSONNEL"/ (460,134)
3. exp CONSULTANTS/ (6768)
4. exp COUNSELORS/ (2836)
5. ((ambulance OR associate OR audiology OR cardiology OR chiropody OR clinical OR dental OR dermatology OR family OR gynaecology OR gynecology OR health OR healthcare OR "health care" OR hospital OR house OR medical OR midwifery OR neurology OR nursing OR nutrition OR obstetrics OR oncology OR optometry OR orthodontic OR paediatric* OR pediatric* OR pathology OR pharmacy OR physiology OR physiotherapy OR podiatry OR psychiatry OR psychology OR "public health" OR radiolog* OR rheumatology OR surgical OR therapy OR trainee OR urology OR respiratory OR magnetic resonance imaging) ADJ2 (assistant* OR cadet* OR director* OR manager* OR officer* OR personnel OR practice OR practitioner* OR professional* OR provider OR receptionist* OR resident* OR scientist* OR secretar* OR specialist* OR staff OR technician* OR technologist OR visitor* OR worker*)).ti,ab (306,659)
6. (1 OR 2 OR 3 OR 4 OR 5) (1,102,321)
7. (benchmark*).ti,ab (7103)
8. ((audit OR monitoring OR peer OR performance OR data OR individualised OR individualized OR web OR personalised OR personalized OR compar* OR team OR practitioner OR practice OR clinical OR social) ADJ2 feedback).ti,ab (4258)
10. ((social OR descriptive OR peer OR subjective) ADJ2 (norm OR norms)).ti,ab (3664)
11. ("social influence").ti,ab (647)
12. "SOCIAL NORMS"/ (777)
13. BENCHMARKING/ (6186)

14. ((social OR peer*) ADJ2 comparison*).ti,ab (1032)
15. ("social competition").ti,ab (6)
16. ("social proof").ti,ab (14)
17. ("image motivation").ti,ab (2)
18. ("warm glow").ti,ab (8)
19. ((social OR verbal OR non-verbal OR nonverbal OR non verbal) ADJ2 (incentive OR incentives OR reward OR rewards)).ti,ab (214)
20. ("positive reinforcement").ti,ab (364)
21. (congratul*).ti,ab (754)
22. (praise).ti,ab (1230)
23. (commendation).ti,ab (78)
24. exp "REINFORCEMENT (PSYCHOLOGY)"/ (7087)
25. ("*credible source*").ti,ab (35)
26. "PEER PRESSURE"/ (774)
27. ("theory of planned behavio?r").ti,ab (746)
28. ("theory of reasoned action").ti,ab (377)
29. ("theoretical domains framework").ti,ab (186)
30. ("social cognitive theory").ti,ab (1035)
31. ("theory of normative social behavio?r*").ti,ab (0)
33. ("randomized controlled trial").pt (83,342)
34. ("clinical trial").pt (86,031)
35. (randomiz*).ti,ab (145,263)
36. (randomis*).ti,ab (36,299)
37. (placebo).ab (40,900)
38. exp "CLINICAL TRIALS"/ (241,787)
39. (randomly).ti,ab (64,596)
40. (trial).ti (80,310)
41. (RCT).ti,ab (13,964)
42. (33 OR 34 OR 35 OR 36 OR 37 OR 38 OR 39 OR 40 OR 41) (373,368)
43. exp ANIMALS/ (79,723)
44. HUMAN/ (1,706,502)
45. 43 NOT (43 AND 44) (72,224)
46. 42 NOT 45 (369,810)
47. (7 OR 8 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29 OR 30 OR 31) (32,595)
48. (6 AND 46 AND 47) (943)

Database: British Nursing Index (searched via HDAS)

Date range searched: 2008 to July 2018.

Date searched: 24 July 2018.

Search strategy

1. (anaesthetist* OR anesthetist* OR audiologist* OR cardiologist* OR chiropodist* OR clinician* OR consultant* OR cadet* OR counsellor* OR dentist* OR dermatologist* OR dietician* OR Doctor* OR GP OR GPs OR gynaecologist* OR gynecologist* OR matron* OR midwife OR midwives OR neurologist* OR nurse* OR nutritionist* OR obstetrician* OR oncologist* OR optometrist* OR orthodontist* OR orthoptist* OR orthotist* OR osteopath* OR paediatrician* OR pediatrician* OR paramedic* OR pathologist* OR pharmacist* OR phlebotomist* OR physician* OR physiologist*

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OR physiotherapist* OR podiatrist* OR practice manager* OR practice staff OR practitioner* OR prosthetist* OR psychiatrist* OR psychologist* OR psychotherapist* OR radiographer* OR radiologist* OR registrar* OR rheumatologist* OR surgeon* OR therapist* OR urologist* OR anesthesiologist* OR prescriber* OR sonographer*).ti,ab (249,905)

2. "MEDICAL PERSONNEL"/ OR DENTISTS/ OR "NURSE PRACTITIONERS"/ OR NURSES/ OR "NURSING ASSISTANTS"/ OR PARAMEDICS/ OR PHARMACISTS/ OR "PHYSICIAN ASSISTANTS"/ OR PHYSICIANS/ OR "VISITING NURSES"/ OR "SCHOOL NURSES"/ OR "FAMILY PHYSICIANS"/ OR HOSPITALISTS/ OR SURGEONS/ OR "SURGEONS GENERAL"/ (90,414)
3. ((ambulance OR associate OR audiology OR cardiology OR chiropody OR clinical OR dental OR dermatology OR family OR gynaecology OR gynecology OR health OR healthcare OR "health care" OR hospital OR house OR medical OR midwifery OR neurology OR nursing OR nutrition OR obstetrics OR oncology OR optometry OR orthodontic OR paediatric* OR pediatric* OR pathology OR pharmacy OR physiology OR physiotherapy OR podiatry OR psychiatry OR psychology OR "public health" OR radiolog* OR rheumatology OR surgical OR therapy OR trainee OR urology OR respiratory OR 'magnetic resonance imaging') ADJ2 (assistant* OR cadet* OR director* OR manager* OR officer* OR personnel OR practice OR practitioner* OR professional* OR provider OR receptionist* OR resident* OR scientist* OR secretar* OR specialist* OR staff OR technician* OR technologist OR visitor* OR worker*)).ti,ab (104,652)
4. (1 OR 2 OR 3) (315,078)
5. (benchmark*).ti,ab (1473)
6. ((audit OR monitoring OR peer OR performance OR data OR individualised OR individualized OR web OR personalised OR personalized OR compar* OR team OR practitioner OR practice OR clinical OR social) ADJ2 feedback).ti,ab (788)
8. ((social OR descriptive OR peer OR subjective) ADJ2 (norm OR norms)).ti,ab (554)
9. ("social influence").ti,ab (80)
11. BENCHMARKS/ (124)
12. ((social OR peer*) ADJ2 comparison*).ti,ab (120)
13. ("social competition").ti,ab (0)
14. ("social proof").ti,ab (5)
15. ("image motivation").ti,ab (0)
16. ("warm glow").ti,ab (1)
17. ((social OR verbal OR non-verbal OR nonverbal OR 'non verbal') ADJ2 (incentive OR incentives OR reward OR rewards)).ti,ab (24)
18. ("positive reinforcement").ti,ab (50)
19. (congratul*).ti,ab (146)
20. (praise).ti,ab (367)
21. (commendation).ti,ab (16)
22. (" credible source").ti,ab (14)
23. "PEER RELATIONSHIPS"/ (111)
24. ("theory of planned behavio?r").ti,ab (194)
25. ("theory of reasoned action").ti,ab (63)
26. ("theoretical domains framework").ti,ab (26)
27. ("social cognitive theory").ti,ab (238)
28. ("theory of normative social behavio?r*").ti,ab (0)
30. ("controlled clinical trial").pt (103)
31. ("clinical trial").pt (1993)
32. (randomiz*).ti,ab (10,533)
33. (randomis*).ti,ab (13,753)
34. (placebo).ab (4521)
35. "CLINICAL TRIALS"/ (11,795)
36. (randomly).ti,ab (7058)

37. (trial).ti (10,477)
38. (RCT).ti,ab (854)
39. (30 OR 31 OR 32 OR 33 OR 34 OR 35 OR 36 OR 37 OR 38) (36,001)
40. (5 OR 6 OR 8 OR 9 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28) (4166)
41. (4 AND 39 AND 40) (0) (Will not run on the hdas interface. Error occurs.)
42. (39 AND 40) (286) (As a compromise have run the 'BCT' terms and the RCT filter instead)

Database: Cochrane Central Register of Controlled Trials

Date range searched: up to July 2018.

Date searched: 24 July 2018.

Search strategy

#1. (anaesthetist* or anesthetist* or audiologist* or cardiologist* or chiropodist* or clinician* or consultant* or cadet* or counsellor* or dentist* or dermatologist* or dietician* or Doctor* or GP or GPs or gynaecologist* or gynecologist* or matron* or midwife or midwives or neurologist* or nurse* or nutritionist* or obstetrician* or oncologist* or optometrist* or orthodontist* or orthoptist* or orthotist* or osteopath* or paediatrician* or pediatrician* or paramedic* or pathologist* or pharmacist* or phlebotomist* or physician* or physiologist* or physiotherapist* or podiatrist* or practice manager* or practice staff or practitioner* or prosthetist* or psychiatrist* or psychologist* or psychotherapist* or radiographer* or radiologist* or registrar* or rheumatologist* or surgeon* or therapist* or urologist* or anesthesiologist* or prescriber* or sonographer*) (151,905)
#2. MeSH descriptor: [Health Personnel] explode all trees (8572)
#3. MeSH descriptor: [Consultants] explode all trees (38)
#4. ((ambulance or associate or audiology or cardiology or chiropody or clinical or dental or dermatology or family or gynaecology or gynecology or health or healthcare or "health care" or hospital or house or medical or midwifery or neurology or nursing or nutrition or obstetrics or oncology or optometry or orthodontic or paediatric* or pediatric* or pathology or pharmacy or physiology or physiotherapy or podiatry or psychiatry or psychology or "public health" or radiolog* or rheumatology or surgical or therapy or trainee or urology or respiratory or "magnetic resonance imaging") adj2 (assistant* or cadet* or director* or manager* or officer* or personnel or practice or practitioner* or professional* or provider or receptionist* or resident* or scientist* or secretar* or specialist* or staff or technician* or technologist or visitor* or worker*)) (1579)
#5. #1 or #2 or #3 or #4 (154,716)
#6. benchmark* (1170)
#7. ((audit or monitoring or peer or performance or data or individualised or individualized or web or personalised or personalized or compar* or team or practitioner or practice or clinical or social) adj2 feedback) (466)
#8. MeSH descriptor: [Feedback, Psychological] this term only (471)
#9. ((social or descriptive or peer or subjective) adj2 (norm or norms)) (89)
#10. "social influence" (219)
#11. MeSH descriptor: [Social Norms] this term only (53)
#12. MeSH descriptor: [Benchmarking] this term only (122)
#13. ((social or peer*) adj2 comparison*) (866)
#14. "social competition" (3)
#15. "social proof" (3)
#16. "image motivation" (1)
#17. "warm glow" (1)

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#18. ((social or verbal or non-verbal or nonverbal or "non verbal") adj2 (incentive or incentives or reward or rewards)) (167)
#19. "positive reinforcement" (214)
#20. congratul* (39)
#21. praise (189)
#22. commendation (2)
#23. MeSH descriptor: [Reinforcement, Social] this term only (71)
#24. "*credible source*" (10)
#25. MeSH descriptor: [Peer Influence] this term only (18)
#26. "theory of planned behavio?r" (196)
#27. "theory of reasoned action" (70)
#28. "theoretical domains framework" (33)
#29. "social cognitive theory" (673)
#30. "theory of normative social behavio?r*" (0)
#31. #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 (4154)
#32. #5 and #31 (1999)

Database: Ovid PsycINFO

Date range searched: 1806 to week 3 July 2018.

Date searched: 24 July 2018.

Search strategy

1. (anaesthetist* or anesthetist* or audiologist* or cardiologist* or chiropodist* or clinician* or consultant* or cadet* or counsellor* or dentist* or dermatologist* or dietician* or Doctor* or GP or GPs or gynaecologist* or gynecologist* or matron* or midwife or midwives or neurologist* or nurse* or nutritionist* or obstetrician* or oncologist* or optometrist* or orthodontist* or orthoptist* or orthotist* or osteopath* or paediatrician* or pediatrician* or paramedic* or pathologist* or pharmacist* or phlebotomist* or physician* or physiologist* or physiotherapist* or podiatrist* or practice manager* or practice staff or practitioner* or prosthetist* or psychiatrist* or psychologist* or psychotherapist* or radiographer* or radiologist* or registrar* or rheumatologist* or surgeon* or therapist* or urologist* or anesthesiologist* or prescriber* or sonographer*).ab,ti. (475,811)
2. exp Health Personnel/ (125,953)
3. exp CLINICIANS/ (9108)
4. exp psychologists/ (30,765)
5. exp therapists/ (30,979)
6. exp counselors/ (12,843)
7. ((ambulance or associate or audiology or cardiology or chiropody or clinical or dental or dermatology or family or gynaecology or gynecology or health or healthcare or "health care" or hospital or house or medical or midwifery or neurology or nursing or nutrition or obstetrics or oncology or optometry or orthodontic or paediatric* or pediatric* or pathology or pharmacy or physiology or physiotherapy or podiatry or psychiatry or psychology or "public health" or radiolog* or rheumatology or surgical or therapy or trainee or urology or respiratory or magnetic resonance imaging) adj2 (assistant* or cadet* or director* or manager* or officer* or personnel or practice or practitioner* or professional* or provider or receptionist* or resident* or scientist* or secretar* or specialist* or staff or technician* or technologist or visitor* or worker*)).ab,ti. (158,838)
8. 1 or 2 or 3 or 4 or 5 or 6 or 7 (599,269)
9. "benchmark*".ab,ti. (7399)

10. ((audit or monitoring or peer or performance or data or individualised or individualized or web or personalised or personalized or compar* or team or practitioner or practice or clinical or social) adj2 feedback).ab,ti. (6239)
11. ((social or descriptive or peer or subjective) adj2 (norm or norms)).ab,ti. (10,209)
12. social influence.ab,ti. (4465)
13. Social Norms/ (7479)
14. ((social or peer*) adj2 comparison*).ab,ti. (4744)
15. social competition.ab,ti. (198)
16. social proof.ab,ti. (57)
17. image motivation.ab,ti. (10)
18. warm glow.ab,ti. (74)
19. ((social or verbal or non-verbal or nonverbal or non verbal) adj2 (incentive or incentives or reward or rewards)).ab,ti. (1033)
20. positive reinforcement.ab,ti. (2681)
21. "congratul* ".ab,ti. (1056)
22. praise.ab,ti. (3944)
23. commendation.ab,ti. (134)
24. Social Reinforcement/ (1531)
25. *credible source*.ab,ti. (96)
26. Peer Pressure/ (713)
27. theory of planned behavio?r.ab,ti. (4094)
28. theory of reasoned action.ab,ti. (1226)
29. theoretical domains framework.ab,ti. (48)
30. social cognitive theory.ab,ti. (2727)
31. "theory of normative social behavio?r* ".ab,ti. (31)
32. 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 (53,015)
33. clinical trial.md. (21,174)
34. "randomiz* ".ab,ti. (65,985)
35. "randomis* ".ab,ti. (8914)
36. placebo.ab. (36,895)
37. Clinical Trials/ (10,978)
38. randomly.ab,ti. (66,420)
39. trial.ti. (26,281)
40. RCT.ab,ti. (3557)
41. 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 (167,864)
42. 8 and 32 and 41 (470)

Database: Web of Science

Searching the following indexes:

- Science Citation Index Expanded (1900 – present).
- Social Sciences Citation Index (1900 – present).
- Arts & Humanities Citation Index (1975 – present).
- Conference Proceedings Citation Index- Science (1990 – present).
- Conference Proceedings Citation Index- Social Science & Humanities (1990 – present).
- Book Citation Index– Science (2005 – present).
- Book Citation Index– Social Sciences & Humanities (2005 – present).
- Emerging Sources Citation Index (2015 – present).

Date searched: 19 July and 30 July 2018.

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Search strategy

#	Results	Search terms
# 34	2112	#33 AND #26 AND #3 Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 33	1,359,758	#32 OR #31 OR #30 OR #29 OR #28 OR #27 Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 32	17,590	TS = RCT Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 31	353,646	TI = trial Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 30	338,102	TS = randomly Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 29	236,066	TS = placebo Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 28	92,236	TS = randomis* Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 27	746,089	TS = randomiz* Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 26	237,058	#25 OR #24 OR #23 OR #22 OR #21 OR #20 OR #19 OR #18 OR #17 OR #16 OR #15 OR #14 OR #13 OR #12 OR #11 OR #10 OR #9 OR #8 OR #7 OR #6 OR #5 OR #4 Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 25	1	TS = "theory of normative social behavio?r*" Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 24	3388	TS = "social cognitive theory" Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 23	329	TS = "theoretical domains framework" Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 22	1215	TS = "theory of reasoned action" Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years

#	Results	Search terms
# 21	2173	TS = "theory of planned behavio?r" Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 20	1895	TS = "Peer influence" Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 19	139	TS = "*credible source*" Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 18	534	TS = "social reinforcement" Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 17	260	TS = commendation Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 16	9477	TS = "praise" Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 15	1232	TS = congratul* Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 14	1795	TS = "positive reinforcement" Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 13	1917	TS = ((social or verbal or non-verbal or nonverbal or "non verbal") NEAR/2 (incentive or incentives or reward or rewards)) Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 12	460	TS = "warm glow" Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 11	26	TS = "image motivation" Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 10	66	TS = "social proof" Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 9	381	TS = "social competition" Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 8	5791	TS = ((social or peer*) NEAR/2 comparison*) Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years

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#	Results	Search terms
# 7	6870	TS = "social influence' Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 6	15,835	TS = ((social or descriptive or peer or subjective) NEAR/2 (norm or norms)) Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 5	19,569	TS = ((audit or monitoring or peer or performance or data or individualised or individualized or web or personalised or personalized or compar* or team or practitioner or practice or clinical or social) NEAR/2 feedback) Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 4	167,874	TS = benchmark* Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 3	1,755,025	#2 OR #1 Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 2	583,153	TS = ((ambulance or associate or audiology or cardiology or chiropody or clinical or dental or dermatology or family or gynaecology or gynecology or health or healthcare or "health care" or hospital or house or medical or midwifery or neurology or nursing or nutrition or obstetrics or oncology or optometry or orthodontic or paediatric* or pediatric* or pathology or pharmacy or physiology or physiotherapy or podiatry or psychiatry or psychology or "public health" or radiolog* or rheumatology or surgical or therapy or trainee or urology or respiratory or "magnetic resonance imaging") NEAR/2 (assistant* or cadet* or director* or manager* or officer* or personnel or practice or practitioner* or professional* or provider or receptionist* or resident* or scientist* or secretar* or specialist* or staff or technician* or technologist or visitor* or worker*)) Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years
# 1	1,399,895	TS = (anaesthetist* or anesthetist* or audiologist* or cardiologist* or chiropodist* or clinician* or consultant* or cadet* or counsellor* or dentist* or dermatologist* or dietician* or Doctor* or GP or GPs or gynaecologist* or gynecologist* or matron* or midwife or midwives or neurologist* or nurse* or nutritionist* or obstetrician* or oncologist* or optometrist* or orthodontist* or orthoptist* or orthotist* or osteopath* or paediatrician* or pediatrician* or paramedic* or pathologist* or pharmacist* or phlebotomist* or physician* or physiologist* or physiotherapist* or podiatrist* or practice manager* or practice staff or practitioner* or prosthetist* or psychiatrist* or psychologist* or psychotherapist* or radiographer* or radiologist* or registrar* or rheumatologist* or surgeon* or therapist* or urologist* or anesthesiologist* or prescriber* or sonographer*) Indexes = SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan = All years

Appendix 2 The SOCIAL systematic review: screening instructions

Title and abstracts

1a. All studies will be ordered by title. To be included, a paper has to meet all of the inclusion criteria outlined below. If in any doubt, include the paper into the next stage of full-stage screening for a more detailed examination.

i. Study type: the review includes RCTs, including a range of designs (cluster, factorial, parallel, crossover and stepped wedge).

- If the title/abstract says 'randomised' and no further information – include.
- If the title/abstract states e.g. 'allocated' or 'assigned to groups' – include.
- If in any doubt about whether or not it is a RCT – include.

ii. Population:

- health workers responsible for patient care in a health-care setting
- health workers in training will be included (but only if they are in a health-care setting, not in a campus environment).

iii. Intervention:

- Aims to change clinical behaviour of health workers. Clinical behaviour here is defined as any behaviour that is carried out within a (non-simulated) clinical environment/setting.
- A social norms intervention:
  - A social norms intervention seeks to change the clinical behaviour of a target health worker by exposing them to the values, beliefs, attitudes or behaviours of a reference group or person. The intervention could be either descriptive norms or injunctive norms based.
  - A descriptive norms message provides the target with information about the behaviour of the reference person/others in the reference group. Examples inlcude:
    - giving the target information about the behaviour of a reference person or group
    - comparison of the target's behaviour with the behaviours of a reference person or group.
  - An injunctive norms message provides the target with information about the values, beliefs or attitudes of the reference person/group, conveying social approval or disapproval.
    - Providing the target with information about whether or not the behaviour has the approval/disapproval of the reference group or person.
    - Exposure of the target's behaviour to a reference group.
    - Offer to expose the target's behaviour to a reference group.
    - Praise, commendation, applause or thanks from a reference group or person.
    - Promise of praise, commendation, applause or thanks from a reference group or person.

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1b. Any papers (e.g. protocols and process evaluations) linked to trials that are not the main trial paper but fulfil the criteria outlined above will also be included and kept in a separate folder on Covidence (see 2 below), to flag that the main trials for these papers need to be located and further examined at full-text screening.
Any relevant systematic reviews identified at the title and abstract stage will also be kept in a folder on Covidence to identify any other relevant studies that may be eligible for inclusion into the present review.

2. The review will be set up in Covidence (www.covidence.org): an online screening and data extraction tool for systematic reviews.

- All of the references generated from the database searches will have any duplicates removed and be imported into Covidence. All of these references will be displayed in 'Screen references' under 'Title and abstract screening'.
- As per the protocol, one reviewer (MYT) will independently screen all of the titles and abstracts. Under 'Review settings', the number of 'Reviewers required for screen' will be '1'.
- In the first instance, SC/JW/SR will also double screen 'X number/proportion' of studies. These will be randomly selected using a random integer generator (www.random.org; accessed 1 September 2020).
- A second reviewer (JW) will screen a sample of 20% of the records. These will be randomly selected using a random integer generator (www.random.org; accessed 1 September 2020).
- All of the inclusion criteria outlined in (1) will be added to Covidence, so will be shown at the top of the page as reminders of the criteria that need to be fulfilled to be included to the next stage of full-text stage screening.
- A decision will be made for each paper by selecting 'No', 'Maybe' or 'Yes' on Covidence next to the paper.

Full-text screening

- All studies should be ordered by title on Covidence. To be included, a paper has to meet all of the inclusion criteria outlined below:

i. Study type: RCT (cluster, factorial, parallel, crossover and stepped wedge).
ii. Population:

- Health workers responsible for patient care in a health-care setting.
- Health workers in training will be included (but only if they are in a health-care setting, not in a simulated or campus environment).

iii. Intervention:

- Aims to change clinical behaviour of health workers. Clinical behaviour here is defined as any behaviour that is carried out within a (non-simulated) clinical environment/setting.
- A social norms intervention:

  - A social norms intervention seeks to change the clinical behaviour of a target health worker by exposing them to the values, beliefs, attitudes or behaviours of a reference group or person. The intervention could be either descriptive norms or injunctive norms based.
  - A descriptive norms message provides the target with information about the behaviour of the reference person/others in the reference group. Examples include:

    - giving the target information about the behaviour of a reference person or group
    - comparison of the target's behaviour with the behaviours of a reference person or group.

- An injunctive norms message provides the target with information about the values, beliefs or attitudes of the reference person/group, conveying social approval or disapproval.
    - providing the target with information about whether or not the behaviour has the approval/disapproval of the reference group or person
    - exposure of the target's behaviour to a reference group
    - offer to expose the target's behaviour to a reference group
    - praise, commendation, applause or thanks from a reference group or person.
    - promise of praise, commendation, applause or thanks from a reference group or person.
- We anticipate that the reference person or group could include:
    - people with the same profession or occupation as the target
    - people employed by the same organisation (unit of employment) as the target
    - people who deliver, administer, manage, commission or make policy on health services
    - professional bodies such as royal colleges, trade unions.

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Appendix 3 Stage one data extraction guidance

TABLE 16 Data extraction guidance document: stage one

Section	Field	Notes	Codes
Identification	Setting		1 Primary (GP and general practice nurses) 2 Hospital: inpatient 3 Hospital: outpatient 4 Mental health 5 Community (district nursing, pharmacy, opticians, podiatry) 6 Care/nursing home 7 Other If other add free text
	Country	Free text	
Methods	Design	For stepped wedge choose 'other' and enter 'stepped wedge' Most trials in this review can be considered cluster randomised – and the most important bit of information is the unit of allocation that is captured elsewhere; however, we need to be consistent. For a trial in which the unit of allocation is the health worker and data are collected at a patient level, we should class the trial as 'cluster randomised'	
	Unit of allocation		
	Primary outcome	Describe selected behaviour compliance outcome	
	Secondary outcomes	Describe selected patient outcome	
	Time points	List all reported, including baseline, in months since randomisation (for compliance with target behaviour)	
	Statistical analysis	Brief description of statistical analysis, including any adjustment for clustering. Note any problems/errors	
Population	Target behaviour (short summary)		1 Prescribing 2 Hand-washing 3 Test ordering 4 Referrals 5 Other 6 Unclear If other add free text after the number

continued

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TABLE 16 Data extraction guidance document: stage one (*continued*)

Section	Field	Notes	Codes
	Target behaviour (full)	Add free-text description, as described in the paper, e.g. 'Prescribing of antibiotics'	
	Total number randomised	Report the number of patients and number of health workers	
	Type of health worker	The profession of the person who was the target of the intervention	1 Nurse 2 Doctor: GP 3 Doctor: secondary care 4 Pharmacist 5 AHP 6 Other If other add free text after the number
Interventions	Number of participants randomised to group	Both patients and health professionals where relevant	
	Number of clusters randomised to group	Only cluster RCTs	
	Description	Copy and paste ALL details given by the authors about the intervention. Please include details from any of the study papers Flag or paste link(s) to supplementary material(s), where appropriate	
	Type of control		6 Variation of SN 7 Usual practice 8 Attention control 9 Concomitant intervention 10 Unsure 11 Other (add details)
Outcomes		See note below on extracting outcomes Use 'add note' to add extra information e.g. ICC, adjusted values Choose time point closest to 6 months	
Quality Assessment		See Cochrane Handbook, chapter 8[36] Rate risk of bias (note 2 below) in relation to compliance with target behaviour See also section 16.3.2 of the Cochrane Handbook 'Assessing risk of bias in cluster-randomised trials'[36]	Please use 'other sources of bias' to make a judgement on methods of analysis in the case of cluster RCTs

SN, social norms.

Aim: standardised mean difference and standard error (adjusted for clustering if necessary).

TABLE 17 Guidance on extracting outcome data

Scenario	What to extract	Aim
Scenario 1: individually randomised, numerical outcome	Extract mean and standard deviation by group	Calculate SMD and standard error in Stata
Scenario 2: individually randomised, binary outcome	Extract number having event and totals by group	$\text{SMD} = \frac{\sqrt{3}}{\pi} \ln \text{OR}$ Standard error SMD $= \sqrt{3}/\pi \times$ standard error log OR
Scenario 3: cluster randomised, numerical outcome	Extract mean and standard deviation by group. Extract detail required to calculate 'design effect' – e.g. ICC, adjusted and unadjusted standard errors	Calculate SMD and standard error in Stata Multiply standard error by the variance inflation factor
Scenario 4: cluster randomised, binary outcome	Extract number having event and totals by group. Extract detail required to calculate 'design effect' – e.g. ICC, adjusted and unadjusted standard errors	Calculate SMD and standard error as above Multiply standard error by the variance inflation factor

OR, odds ratio.

$$\text{Design effect} = 1 + (M-1)\,\text{ICC}, \quad (1)$$

where M is average cluster size.

$$\text{Variance inflation factor} = \text{square root of design effect}. \quad (2)$$

Where ICC is not given, either (a) use ICC from a similar study or (b) use ratio of adjusted/unadjusted standard errors to estimate the variance inflation factor.

(See section 16.3.6 of Cochrane Handbook.)[36]

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Appendix 4 Stage three data extraction form (with guidance provided to the data extractors)

Use −1 throughout for not applicable and −2 for not reported

Only code arms that have social norms as part of the intervention: code any arms without social norms as −1 throughout.

TABLE 18 Data extraction guidance document: stage three

Section	Field	Notes	Codes
Trial information	1. Does inclusion criteria target participants based on low target performance?		0. No 1. Yes 9. Unclear
Intervention information	2. Frequency and intensity of intervention	Mixed total of all the times that any social norm element of the intervention was delivered	1. Once only 2. Twice 3. More than twice 9. Unclear/not reported
	3. Format	Focus on the social norm elements	1. Face-to-face meeting 2. E-mail 3. Written (paper) 4. Integrated computerised (part of existing system) 5. Separate computerised (e.g. website) 6. Other (add free text) 7. Mixed 8. Unclear/not reported
	4. Source of the intervention (i.e. the person delivering the intervention)	Focus on the social norm elements. If the source is unclear, err on the side of interpreting this as the investigator	1. Peer 2. Investigator 3. Employer 4. professional body 5. Supervisor or senior colleague 6. Patient 7. *Credible source* 8. Other (add free text) 9. Unclear/not reported
	5. Is the person delivering the intervention internal or external to the target person's organisation?	Focus on the social norm elements. If the source is the investigator, assume this is external unless says otherwise	1. Internal 2. External 9. Unclear/not reported

continued

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TABLE 18 Data extraction guidance document: stage three (*continued*)

Section	Field	Notes	Codes
	6. Reference group/person	Group/person used as (a) the comparison (social comparison) or (b) source of approval (other BCTs) If the intervention includes more than one type of social norm and the reference groups are different, code as 'multiple' If researchers intervene with one person and then that person intervenes with HCPs, code as that person	1. Peer 2. Professional body 3. Senior person (e.g. manager, policy-maker, commissioner) 4. Patient(s) 5. Other 6. Multiple 9. Unclear/not reported If other add free text
	Does the author explicitly describe this as SN?		0. No 1. Yes
	Direction of change in behaviour that is desired		1. Increase 2. Decrease 3. Maintenance 4. Unclear

HCP, health-care professional; SN, social norms intervention.

Appendix 5 Behaviour change techniques coding template form

TABLE 19 Behaviour change techniques coding template form

Target population: **Target behaviour:**			
Arm	**MYT BCTs**	**Initials BCTs**	**Final agreed BCTs**
Control (Name)			
If guidelines present	**Guideline unspecified (delete as appropriate):** Yes/No (list BCTs below) **Guideline BCTs (list)**:	**Guideline unspecified (delete as appropriate):** Yes/No (list BCTs below)	**Guideline unspecified (delete as appropriate):** Yes/No (list BCTs below)
Intervention 1 (Name)			
If guidelines present	**Guideline unspecified (delete as appropriate):** Yes/No (list BCTs below) **Guideline BCTs (list)**:	**Guideline unspecified (delete as appropriate):** Yes/No (list BCTs below)	**Guideline unspecified (delete as appropriate):** Yes/No (list BCTs below)
Section	**Field**	**Notes**	**Codes (delete as appropriate)**
Methods	**Type of comparison**	**Type 1** SN vs. any control This could be social norm vs. current practice, social norm vs. nothing, social norm vs. a non-social norm BCT **Type 2** SN + X vs. X This is any trial where it is the social norms element that is being tested E.g. social comparison with audit vs. audit alone E.g. credible source with education vs. education alone **Type 3** SN + X vs. any control This is any trial where the social norms element packaged with other BCTs is being tested	1. SN vs. any control 2. SN + X vs. X 3. SN + X vs. any control 4. SN type A vs. SN type B 5. SN + X vs. SN + Y

continued

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TABLE 19 Behaviour change techniques coding template form (*continued*)

Target population: **Target behaviour:**			
		E.g. social norms with education and audit vs. usual practice E.g. multifaceted intervention with social norms element v nothing **Type 4** Either two different social norm interventions or the same social norm interventions packaged in different ways E.g. social comparison vs. social reward Social comparison via e-mail vs. social comparison face to face **Type 5** The social comparison element is identical in each arm, but the other interventions differ E.g. social comparison with reminders vs. social comparison without reminders E.g. credible source with education vs. credible source without education	
Interventions	**Does the author explicitly describe this as SN?**		0 No 1 Yes
	Is SN a substantial part (type 3 above)?		0 No 1 Yes 2 Unsure
	Concomitant intervention (type 2, 3 or 5 above)		0 No 1 Yes
	Direction of change in behaviour that is desired		1. Increase 2. Decrease 3. Maintenance 4. Unclear

SN, social norms intervention.

Appendix 6 Behaviour change technique coding decision log

It was agreed that all coders would do the following.

Code academic detailing as 3.1. social support (unspecified). We found that 'academic detailing' appeared quite frequently, and often its precise content was not specified. We agreed to treat academic detailing like other 'packages' in the BCT taxonomy v1 that are not well defined (e.g. cognitive–behavioural therapy or counselling) and code it as 'social support (unspecified)'. This is based on the idea that the health professional is getting some unspecified support, but we cannot precisely pin it down. If the paper included a detailed description of the content of the academic detailing we added other BCT codes, if indicated. We discussed this with Marie Johnson, member of our steering committee, and author of the BCT taxonomy v1.

Guidelines were coded for BCTs, as with other text describing interventions. If BCTs could not be identified within guidelines, these were coded as 'Guidelines (unspecified)'.

Where health workers were provided with a list of patients for the purpose of prompting them to a clinical behaviour (e.g. a list of patients with high blood pressure and not on recommended medication), these were coded as 7.1. prompts/cues.

Forced choices (such as when a GP gets a pop-up box when trying to prescribe antibiotics and has to choose between specified options) were coded as 7.1. prompts/cues.

Continuing medical educational credits were not coded as 10.3. non-specific reward unless there was evidence that the credits are contingent on progress towards performing the behaviour (e.g. rather than completion of educational modules).

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Appendix 7 Inter-rater agreement for behaviour change technique coding (PABAK)

TABLE 20 PABAK agreement between trained coder pairs for BCTs present at least once in the included unique arms[a]

BCT label (ordered according to frequency)	*N* in which BCT was present across the included unique arms[a]	PABAK	95% CI
Social norm BCTs			
6.2. Social comparison	117	0.92	0.87 to 0.97
9.1. Credible source	24	0.83	0.76 to 0.91
6.3. Information about others' approval	10	0.96	0.92 to 1.00
10.4. Social reward	5	0.97	0.93 to 1.00
10.5. Social incentive	1	0.99	0.97 to 1.00
All other identified BCTs (present at least once)			
2.2. Feedback on behaviour	130	0.79	0.71 to 0.87
4.1. Instruction on how to perform the behaviour	48	0.65	0.55 to 0.75
3.1. Social support (unspecified)	41	0.83	0.75 to 0.90
7.1. Prompts/cues	29	0.79	0.71 to 0.87
5.1. Information about health consequences	26	0.80	0.72 to 0.88
1.2. Problem-solving	17	0.86	0.79 to 0.93
12.5. Adding objects to the environment	14	0.88	0.82 to 0.94
1.1 Goal-setting (behaviour)	10	0.91	0.85 to 0.97
2.7. Feedback on outcome(s) of behaviour	10	0.87	0.80 to 0.93
6.1. Demonstration of the behaviour	6	0.97	0.93 to 1.00
8.1. Behavioural practice/rehearsal	5	0.98	0.96 to 1.00
1.3. Goal-setting (outcome)	4	0.95	0.91 to 0.99
1.4. Action planning	4	0.91	0.86 to 0.97
2.3. Self-monitoring of behaviour	4	0.93	0.88 to 0.98
12.1. Restructuring the social environment	3	0.98	0.96 to 1.00
12.2. Restructuring the social environment	3	0.97	0.93 to 1.00
5.3. Information about social and environmental consequences	3	0.98	0.96 to 1.00
1.7. Review outcome goal(s)	2	0.97	0.93 to 1.00
10.1. Material incentive (behaviour)	2	0.98	0.96 to 1.00
2.1. Monitoring of behaviour by others without feedback	2	0.96	0.92 to 0.99
9.2. Pros and cons	2	0.97	0.94 to 1.00
1.9. Commitment	1	0.99	0.97 to 1.00

continued

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TABLE 20 PABAK agreement between trained coder pairs for BCTs present at least once in the included unique arms[a] (*continued*)

BCT label (ordered according to frequency)	*N* in which BCT was present across the included unique arms[a]	PABAK	95% CI
10.3. Non-specific reward	1	0.98	0.96 to 1.00
2.5. Monitoring of behaviour without feedback	1	Ratings do not vary	
3.2. Social support (practical)	1	0.97	0.93 to 1.00
8.2. Behaviour substitution	1	0.99	0.97 to 1.00

a 229 unique included arms.

Appendix 8 Formula for converting binary outcomes to standardised mean differences

$$\text{SMD} = \frac{\sqrt{3}}{\pi} \ln \text{OR} \tag{3}$$

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Appendix 9 Methods used to calculate standardised mean difference and standard error, where appropriate

TABLE 21 Methods used to calculate SMD and standard error, where appropriate

Scenario	What was extracted	Method
Scenario 1: cluster randomised, numerical outcome	Mean and standard deviation by group	Calculate SMD and standard error
	Detail required to calculate 'design effect' – e.g. ICC	Multiply standard error by the variance inflation factor to account for clustering
Scenario 2: cluster randomised, binary outcome	Number having event and totals by group	$\text{SMD} = \frac{\sqrt{3}}{\pi} \ln \text{OR}$
	Detail required to calculate 'design effect' – e.g. ICC	Standard error SMD $= \sqrt{3}/\pi \times$ standard error log OR Multiply standard error by the variance inflation factor to account for clustering

OR, odds ratio.

$$\text{Design effect} = 1 + (M-1)\ \text{ICC}, \tag{4}$$

where M is average cluster size.

Variance inflation factor = square root of design effect.

(See section 16.3.6 of Cochrane Handbook.)[36]

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Appendix 10 Comparisons used in the analysis for research question 1

TABLE 22 Types of comparison used in the analysis for research question 1

Scenario	Interventions		Controls
1	Social norm intervention	vs.	Any control
2	Social norm intervention + X	vs.	X
3	Social norm intervention + X	vs.	Any control

Where X is any BCT or combination of BCTs.

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Appendix 11 Predictor variables to be included in the metaregression

TABLE 23 Predictor variables to be included in the metaregression, with anticipated parameterisations

Covariate	Parameterisation
Social intervention techniques	
Social comparison	Binary (0 = No, 1 = Yes)
Information about others' approval	Binary (0 = No, 1 = Yes)
Credible source	Binary (0 = No, 1 = Yes)
Social incentive	Binary (0 = No, 1 = Yes)
Social reward	Binary (0 = No, 1 = Yes)
Timing of outcome measurement	Continuous (months)
Who delivers the intervention?	
Internal	Categorical variable (it may be necessary to combine categories depending on frequencies of each in the data set)
External	
Unclear	
Frequency of intervention	
Once	Categorical variable
More than once	
Format of the intervention	
Active (e.g. face to face, telephone)	Categorical variable
Inactive (e.g. e-mail, letter)	
Mixed	
Not clear	
Type of health worker	Categorical variable
Type of behaviour	
Prescribing	Categorical
Hand-washing	
Test ordering	
Referrals	
Other/mixed	
Baseline performance	Continuous (proportion meeting standard)
Concomitant interventions	
None	Categorical
Other BCT	
Other active	

continued

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TABLE 23 Predictor variables to be included in the metaregression, with anticipated parameterisations (*continued*)

Covariate	Parameterisation
Direction of change required	
Increase	Categorical
Decrease	
Maintenance	
Unclear	
Control group	
None/usual care	Categorical
Attentional control	
Active control	
Other BCT	
Risk of bias	
Low risk	Categorical
Unclear risk	
Reference group	
Health-care worker	Categorical
Other	
Who is intervention directed at:	
Individual	Categorical
Team	
Unclear	

Appendix 12 Summary of the first patient and public involvement workshop, August 2018

TABLE 24 Summary of the first PPI workshop, August 2018

Summary of PPI discussion	How suggestions were addressed
Doctors may be influenced by feedback from their peers on best practice, but they often they will not listen to patients when they present potential best practice (example given of a relative who had better care in Australia, but the doctor in the UK did not want to hear about it). Patients can have a role, e.g. by reminding health workers to wash their hands or by telling the GP that they do not expect to be prescribed antibiotics for a cold	If studies included patients as a reference group, we recorded that and considered whether it was effective
Social norms feedback could come from within the same organisation, within the region or from a wider national source. If health workers get feedback from only their own organisation, it may mean that they are not being exposed to current best practice and innovation from elsewhere	We recorded the source of the feedback, and considered which sources are the most effective
In medical school, future doctors are exposed to the most up-to-date ideas, but after that they may learn only about the practices that are adopted locally	
We may expect to see differences in the results of the feedback if it is given by a peer at the same level or one from a higher level/more experienced	
When providing social norms feedback it is important that there is benchmarking against good practice: do not want to change behaviour unless it will lead to patient benefit. There is no use in telling health workers about the behaviour of their peers unless either (a) there is already evidence that the behaviour is known to lead to positive outcomes for patients or (b) the outcome for patients will be measured	We recorded whether or not the social norms intervention is accompanied by provision of information (but were unable to assess whether or not the information is evidence based) We reported what proportion of studies reported on patient outcomes and assessed whether or not social norms interventions are effective on patient outcomes
Any change in behaviour will be most effective if it is long term, not just short term	We have not been able to consider long-term effects
Will the review include studies involving volunteers, as well as paid health-care workers?	We included volunteers if they were involved in providing health care in a health-care setting

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Appendix 13 Studies that have no suitable outcome data

TABLE 25 Studies with no suitable outcome data

Study (first author and year)	Description of study	Issue with the outcome data
Bar-Zeev 2017[46]	Stepped-wedge cluster trial examining the effect of a complex intervention involving social comparison compared with usual care on health providers' management of smoking during pregnancy	We located the main trial results paper,[109] a stepped-wedge trial that did not report the control and intervention phases separately, so the trial outcomes were not a controlled test of the intervention www.sciencedirect.com/science/article/pii/S0306460318309663
Brunette 2015[48]	Cluster RCT examining whether face-to-face or video delivery of a combined educational outreach and social comparison is more effective in increasing prescriptions for smoking cessation among prescribers	The mean difference at 6 months can be read from a graph, but neither the *n* nor the SD were clearly reported, so not usable
Colon-Emeric 2013[49]	Cluster RCT examining whether or not social comparison with social support (unspecified) is more effective than usual care in promoting falls-prevention behaviour among nursing home workers	The outcome was not reported in sufficient detail; the only information is that baseline scores improved for all groups combined, with no significant difference between intervention and control facilities
Forrest 2013[50]	Factorial cluster RCT comparing the effect of social comparison and 'clinical decision support' on adherence to treatment guidelines by physicians	This was a factorial study that was not reported appropriately. We were unable to extract reliable outcome data: there may be a mistake in the headings in table 3. Percentage difference between groups is reported. There are unit of analysis issues
Hampshire 1999[51]	Cluster RCT comparing the effect of social comparison with or without problem-solving on the provision of child health surveillance in primary care	No useful numerical results reported
Wadland 2007[52]	Cluster RCT comparing the effect of social comparison with prompts and cues on referral to a smoking cessation quit line by primary care physicians	No useful numerical results reported
Michael 2018[47]	RCT examining the effect of social comparison compared with usual care on prescription of opioids by emergency medicine physicians	Results not presented by intervention and control group
Paul 2017[54]	Cluster RCT examining the effect of social comparison with social support (unspecified) compared with usual care on management of diabetes by GPs	The trial was discontinued because of a lack of response from GPs
Szczepura 1994[55]	Cluster RCT testing the effect of different ways of presenting feedback (including social comparison) on immunisation and prevention behaviours in general practice	No numerical results reported on health worker behaviour or patient outcomes

continued

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TABLE 25 Studies with no suitable outcome data (*continued*)

Study (first author and year)	Description of study	Issue with the outcome data
Wattal 2015[53]	Cluster RCT testing the effect of social comparison on prescribing of antibiotics by hospital doctors	Table 1 is the average dose at all measurement periods (pre and post) so it does not show the effect of the intervention. Table 2 does show the effect, but it is divided into subgroups. We considered combining the subgroups and taking the mean immediately prior to intervention and mean 6 months later, but there was also no SD

SD, standard deviation.

Appendix 14 Study and intervention characteristics of each included comparison

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TABLE 26 Study and intervention characteristics of each included comparison

	Study characteristics						Intervention characteristics						
Study (first author and year)	Country	Setting	Type of health worker	Target behaviour	Type of trial	Low target performance?	Format	Frequency	Source	Internal/ external delivery	Reference group	BCTs	Direction of change
Aspy 2008[95]	USA	Primary	Doctor: GP	Tests	Cluster RCT	No	Mixed	More than twice	Investigator	External	Peer	SC and other BCTs	Increase
Awad 2006[110] Arm A	Other/ multiple	Primary	Mixed or team	Prescribing	RCT	No	Unclear/not reported	Only once	Unclear/not reported	Unclear/not reported	Peer	SC	Increase
Awad 2006[110] Arm B	Other/ multiple	Primary	Mixed or team	Prescribing	RCT	No	Unclear/not reported	Only once	Unclear/not reported	Unclear/not reported	Peer	SC and other BCTs	Increase
Baker 1997[73]	UK	Primary	Doctor: GP	Management/ communication regarding condition	Cluster RCT	No	Unclear/not reported	Only once	Unclear/not reported	Unclear/not reported	Peer	SN in both arms	Increase
Barnett 2014[111] Arm A	UK	Primary	Doctor: GP	Prescribing	Cluster RCT	No	E-mail	More than twice	Investigator	Unclear/not reported	Multiple	SC and CS	Increase
Barnett 2014[111] Arm B	UK	Primary	Doctor: GP	Prescribing	Cluster RCT	No	E-mail	More than twice	Investigator	Unclear/not reported	Multiple	Multiple SNs and other BCTs	Increase
Baskerville 2001[66]	Canada	Primary	Doctor: GP	Management/ communication regarding condition	RCT	No	Mixed	Unclear/not reported	Unclear/not reported	Unclear/not reported	Unclear/not reported	CS and other BCTs	Increase
Beck 2005[86]	Canada	Hospital	Other HCP	Prescribing	Cluster RCT	No	Written	Only once	Investigator	Unclear/not reported	Unclear/not reported	SC	Increase
Beidas 2017[112]	USA	Community	Other HCP	Prescribing	RCT	No	E-mail	Only once	Supervisor or senior colleague	Internal	Senior person	SR	Increase
Bentz 2007[87]	USA	Primary	Mixed or team	Management/ communication regarding condition	Cluster RCT	No	Written	More than twice	Investigator	Internal	Peer	SC	Increase
Bhatia 2017[113]	Other/ multiple	Mixed	Mixed or team	Tests	Cluster RCT	No	Mixed	More than twice	Investigator	External	Peer	SC	Decrease
Bhattacharyya 2010[114]	Canada	Mixed	Mixed or team	Prescribing	Cluster RCT	No	Unclear/not reported	Unclear/not reported	Investigator	Internal	Peer	SC	Increase

	Study characteristics						Intervention characteristics						
Study (first author and year)	Country	Setting	Type of health worker	Target behaviour	Type of trial	Low target performance?	Format	Frequency	Source	Internal/ external delivery	Reference group	BCTs	Direction of change
Billue 2012[98]	USA	Primary	Doctor: GP	Prescribing	Cluster RCT	No	Separate computerised	Twice	Investigator	External	Peer	SC and other BCTs	Increase
Boet 2018[88]	Canada	Hospital	Doctor: secondary care	Management/ communication regarding condition	Cluster RCT	No	E-mail	More than twice	Investigator	External	Peer	SC	Increase
Braybrook 1996[84]	UK	Primary	Doctor: GP	Prescribing	RCT	No	Mixed	Only once	Investigator	External	Professional body	SN in both arms	Decrease
Brinkman 2007[115]	USA	Hospital	Doctor: secondary care	Management/ communication regarding condition	RCT	No	Unclear/not reported	Unclear/not reported	Investigator	External	Multiple	Multiple SN and other BCTs	Increase
Brown 2018[116]	Australia	Hospital	Doctor: secondary care	Referrals	Stepped wedge	No	Mixed	Only once	Credible source	Internal	Senior person	SC and CS and other BCTs	Increase
Buntinx 1993[117]	Other/ multiple	Mixed	Mixed or team	Tests	RCT	No	Unclear/not reported	Only once	Investigator	External	Peer	SC	Increase
Butler 2012[118]	UK	Primary	Mixed or team	Prescribing	Cluster RCT	No	Face to face	Only once	Investigator	External	Peer	SC and other BCTs	Decrease
Cánovas 2009[119]	Other/ multiple	Primary	Doctor: GP	Multiple	RCT	No	Unclear/not reported	Unclear/not reported	Investigator	External	Peer	SC	Increase
Carney 2012[19]	USA	Hospital	Other HCP	Tests	RCT	No	Separate computerised	Unclear/not reported	Investigator	External	Peer	SC and other BCTs	Decrease
Cheater 2006[89] Arm A	UK	Primary	Other HCP	Multiple	Cluster RCT	No	Written	Unclear/not reported	Investigator	External	Peer	SC	Increase
Cheater 2006[89] Arm B	UK	Primary	Other HCP	Multiple	Cluster RCT	No	Written	Unclear/not reported	Investigator	External	Peer	SC	Increase
Colon-Emeric 2007[120]	USA	Care/nursing home	Mixed or team	Prescribing	Cluster RCT	No	Written	More than twice	Investigator	Unclear/not reported	Peer	SC and social support	Increase
Curtis 2005[121]	USA	Other	Doctor: GP	Prescribing	RCT	No	Written	Twice	Investigator	External	Peer	SC	Increase
Curtis 2007[122]	USA	Mixed	Mixed or team	Multiple	Cluster RCT	No	Separate computerised	Unclear/not reported	Investigator	External	Peer	SC	Increase

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TABLE 26 Study and intervention characteristics of each included comparison (*continued*)

	Study characteristics						Intervention characteristics						
Study (first author and year)	Country	Setting	Type of health worker	Target behaviour	Type of trial	Low target performance?	Format	Frequency	Source	Internal/ external delivery	Reference group	BCTs	Direction of change
Desveaux 2016[77]	Canada	Care/nursing home	Mixed or team	Prescribing	Cluster RCT	No	Separate computerised	More than twice	Investigator	External	Peer	SN in both arms	Decrease
Eccles 2001[123] Arm A	UK	Mixed	Doctor: GP	Tests	Factorial	No	Unclear/not reported	Twice	Investigator	External	Peer	SC	Decrease
Eccles 2001[123] Arm B	UK	Mixed	Doctor: GP	Tests	Factorial	No	Unclear/not reported	Twice	Investigator	External	Peer	SC	Decrease
Elouafkaoui 2016[124]	UK	Community	Other HCP	Prescribing	Cluster RCT	No	Unclear/not reported	More than twice	Investigator	External	Peer	SC	Decrease
Eltayeb 2005[125]	Other/ multiple	Primary	Mixed or team	Prescribing	RCT	No	Unclear/not reported	More than twice	Investigator	External	Peer	SC	Decrease
Ferguson 2003[126]	USA	Hospital	Doctor: secondary care	Prescribing	Cluster RCT	No	Unclear/not reported	Unclear/not reported	Investigator	External	Peer	SC	Increase
Fiks 2017[127]	USA	Primary	Doctor: GP	Management/ communication regarding condition	Cluster RCT	No	Mixed	Twice	Investigator	External	Peer	SC and social support	Increase
Foster 2007[128]	UK	Primary	Doctor: GP	Management/ communication regarding condition	RCT	No	Written	Only once	Investigator	External	Peer	SC and other BCTs	Increase
Foy 2004[129]	UK	Hospital	Doctor: secondary care	Referrals	Matched pairs cluster RCT	No	Unclear/not reported	Unclear/not reported	Investigator	External	Peer	SC and other BCTs	Increase
French 2013[64]	Australia	Primary	Doctor: GP	Tests	Cluster RCT	No	Mixed	Unclear/not reported	Credible source	Internal	Peer	CS and other BCTs	Decrease
Fuller 2012[130]	UK	Hospital	Mixed or team	Hand-washing/ hygiene	Stepped wedge	Unclear	Mixed	More than twice	Investigator	External	Unclear/not reported	SR and other BCTs	Increase
Gerber 2013[131]	USA	Primary	Doctor: GP	Prescribing	Cluster RCT	No	Mixed	More than twice	Investigator	External	Peer	SC and other BCTs	Decrease
Gjelstad 2006[132]	Other/ multiple	Primary	Doctor: GP	Prescribing	Cluster RCT	No	Written	Unclear/not reported	Investigator	Internal	Peer	SC and social support	Decrease

	Study characteristics						Intervention characteristics						
Study (first author and year)	Country	Setting	Type of health worker	Target behaviour	Type of trial	Low target performance?	Format	Frequency	Source	Internal/ external delivery	Reference group	BCTs	Direction of change
Goff 2002[133]	USA	Primary	Doctor: GP	Prescribing	Cluster RCT	No	Unclear/not reported	More than twice	Unclear/not reported	Unclear/not reported	Peer	SC and instructions and prompts/ cues	Increase
Guadagnoli 2000[68]	USA	Hospital	Doctor: secondary care	Management/ communication regarding condition	Cluster RCT	No	Face to face	Unclear/not reported	Credible source	Internal	Peer	CS	Increase
Guldberg 2011[93]	Denmark	Primary	Doctor: GP	Multiple	Cluster RCT	No	Separate computerised	More than twice	Investigator	External	Peer	SC and prompts/cues	Increase
Hallsworth 2016[60]	UK	Primary	Doctor: GP	Prescribing	RCT	Yes	Written	Only once	Credible source	External	Peer	SC and other BCTs	Decrease
Hayashino 2016[134]	Other/ multiple	Primary	Doctor: GP	Multiple	Cluster RCT	No	Written	More than twice	Investigator	External	Peer	SC	Increase
Hayes 2002[69]	USA	Hospital	Doctor: secondary care	Management/ communication regarding condition	Cluster RCT	No	Face to face	Unclear/not reported	Credible source	Unclear/not reported	Unclear/not reported	CS	Increase
Heller 2001[135]	Australia	Hospital	Mixed or team	Multiple	Cluster RCT	No	Mixed	Unclear/not reported	Credible source	Unclear/not reported	Multiple	SC	Unclear
Hemkens 2017[136]	Other/ multiple	Primary	Doctor: GP	Prescribing	RCT	No	Mixed	More than twice	Investigator	External	Peer	SC	Decrease
Herbert 2004[137]	Canada	Primary	Doctor: GP	Prescribing	Cluster RCT	No	Written	Unclear/not reported	Investigator	External	Peer	SC	Increase
Horbar 2004[138]	USA	Hospital	Mixed or team	Prescribing	Cluster RCT	No	Unclear/not reported	Unclear/not reported	Investigator	External	Peer	SC and other BCTs	Increase
Houston 2015[139]	USA	Primary	Mixed or team	Referrals	Cluster RCT	No	Separate computerised	Unclear/not reported	Investigator	External	Peer	SC and other BCTs	Increase
Howe 1996[140]	UK	Primary	Doctor: GP	Management/ communication regarding condition	RCT	No	Unclear/not reported	Only once	Investigator	External	Peer	SC and other BCTs	Increase

continued

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TABLE 26 Study and intervention characteristics of each included comparison (*continued*)

	Study characteristics						Intervention characteristics						
Study (first author and year)	Country	Setting	Type of health worker	Target behaviour	Type of trial	Low target performance?	Format	Frequency	Source	Internal/ external delivery	Reference group	BCTs	Direction of change
Huis 2013[20]	Netherlands	Hospital	Other HCP	Hand-washing/ hygiene	Cluster RCT	No	Unclear/not reported	Twice	Investigator	External	Peer	SN in both arms	Increase
Hysong 2012[75]	USA	Primary	Mixed or team	Management/ communication regarding condition	Factorial	No	Separate computerised	More than twice	Investigator	External	Peer	SN in both arms	Increase
Ivers 2003[18]	Canada	Primary	Doctor: GP	Multiple	Cluster RCT	No	Written	More than twice	Investigator	External	Peer	SN in both arms	Increase
Katz 2004[94]	USA	Primary	Mixed or team	Management/ communication regarding condition	Cluster RCT	No	Unclear/not reported	Only once	Investigator	External	Peer	SC and instructions and prompts/ cues	Increase
Kaufman 2016[141]	USA	Hospital	Doctor: secondary care	Prescribing	Cluster RCT	No	E-mail	More than twice	Investigator	Unclear/not reported	Peer	SC	Decrease
Kennedy 2015[142]	Canada	Care/nursing home	Mixed or team	Prescribing	Cluster RCT	No	Unclear/not reported	Unclear/not reported	Investigator	External	Peer	SC and CS and other BCTs	Increase
Kiefe 2001[82]	USA	Other	Mixed or team	Prescribing	RCT	No	Written	Unclear/not reported	Investigator	External	Peer	SN in both arms	Increase
Kim 1999[90]	USA	Primary	Doctor: GP	Multiple	Cluster RCT	No	Written	Only once	Other	Unclear/not reported	Peer	SC and social support	Increase
Koff 2016[71]	USA	Hospital	Mixed or team	Hand-washing/ hygiene	RCT	No	E-mail	More than twice	Investigator	Unclear/not reported	Peer	SN in both arms	Increase
Kogan 2003[143]	USA	Mixed	Mixed or team	Management/ communication regarding condition	Cluster RCT	No	Written	Only once	Supervisor or senior colleague	Internal	Peer	SC	Increase
Lakshminarayan 2010[63]	USA	Hospital	Mixed or team	Management/ communication regarding condition	Cluster RCT	No	Unclear/not reported	Unclear/not reported	Credible source	Internal	Senior person	CS and other BCTs	Increase

	Study characteristics						Intervention characteristics						
Study (first author and year)	Country	Setting	Type of health worker	Target behaviour	Type of trial	Low target performance?	Format	Frequency	Source	Internal/ external delivery	Reference group	BCTs	Direction of change
Leviton 1999[65]	USA	Hospital	Doctor: secondary care	Prescribing	Cluster RCT	No	Face to face	Only once	Credible source	External	Senior person	CS and other BCTs	Increase
Liddy 2011[144]	Canada	Primary	Doctor: GP	Multiple	Stepped wedge	No	Face to face	Unclear/not reported	Investigator	External	Peer	SC and other BCTs	Increase
Lim 2018[145]	Other/ multiple	Primary	Doctor: GP	Prescribing	Cluster RCT	No	Written	More than twice	Investigator	External	Peer	SC	Decrease
Lomas 1991[67]	Canada	Hospital	Doctor: secondary care	Management/ communication regarding condition	Cluster RCT	No	Mixed	More than twice	Peer	Internal	Unclear/not reported	CS	Unclear
MacLean 2009[102]	USA	Primary	Mixed or team	Tests	Cluster RCT	No	Written	More than twice	Investigator	Internal	Peer	SC and prompts/cues	Increase
Mayne 2014[146] Arm A	USA	Primary	Mixed or team	Prescribing	Cluster RCT	No	Unclear/not reported	More than twice	Investigator	External	Peer	SC and other BCTs	Increase
Mayne 2014[146] Arm B	USA	Primary	Mixed or team	Prescribing	Cluster RCT	No	Unclear/not reported	More than twice	Investigator	External	Peer	SC & other BCTs	Increase
McClellan 2003[147]	Australia	Community	Mixed or team	Management/ communication regarding condition	Cluster RCT	No	Mixed	Unclear/not reported	Credible source	External	Peer	SC and CS	Increase
McCluskey 2016[148]	USA	Primary	Doctor: GP	Tests	Cluster RCT	No	Face to face	Only once	Investigator	External	Peer	SC and instructions and prompts/ cues	Increase
McPhee 1989[149]	USA	Hospital	Doctor: secondary care	Tests	RCT	No	Face to face	More than twice	Investigator	External	Peer	SC and information on health consequences	Increase
Meeker 2016[150]	USA	Primary	Doctor: GP	Prescribing	Cluster RCT	No	E-mail	More than twice	Investigator	External	Peer	SC and SR	Decrease
Metlay 2007[151]	USA	Hospital	Doctor: secondary care	Prescribing	Cluster RCT	No	Unclear/not reported	Only once	Investigator	External	Peer	SC and information on health consequences	Decrease

continued

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TABLE 26 Study and intervention characteristics of each included comparison (*continued*)

	Study characteristics						Intervention characteristics						
Study (first author and year)	Country	Setting	Type of health worker	Target behaviour	Type of trial	Low target performance?	Format	Frequency	Source	Internal/ external delivery	Reference group	BCTs	Direction of change
Mold 2008[70]	USA	Primary	Mixed or team	Management/ communication regarding condition	RCT	No	Unclear/not reported	Only once	Investigator	External	Peer	SN in both arms	Increase
Mold 2014[152] Arm A	USA	Primary	Doctor: GP	Management/ communication regarding condition	Cluster RCT	No	Face to face	More than twice	Peer	Internal	Peer	SC	Increase
Mold 2014[152] Arm B	USA	Primary	Doctor: GP	Management/ communication regarding condition	Cluster RCT	No	Face to face	More than twice	Peer	Internal	Peer	SC	Increase
Morrison 2015[96]	Canada	Hospital	Mixed or team	Management/ communication regarding condition	Stepped wedge	No	Unclear/not reported	More than twice	Unclear/not reported	Unclear/not reported	Peer	SC and other BCTs	Increase
Mourad 2011[74]	Netherlands	Other	Mixed or team	Multiple	Cluster RCT	No	Mixed	Twice	Investigator	External	Peer	SN in both arms	Increase
O'Connell 1999[153]	Australia	Primary	Doctor: GP	Prescribing	Cluster RCT	No	Written	Twice	Investigator	External	Peer	SC	Decrease
O'Connor 2009[154] Arm A	USA	Primary	Doctor: GP	Tests	RCT	No	Unclear/not reported	More than twice	Investigator	External	Peer	SC and instruction on how to perform the behaviour and prompts/ cues	Increase
O'Connor 2009[154] Arm B	USA	Primary	Doctor: GP	Tests	RCT	No	Unclear/not reported	More than twice	Investigator	External	Peer	SC and instructions and prompts/ cues	Increase
Patel 2018[155]	USA	Primary	Doctor: GP	Prescribing	Cluster RCT	No	Unclear/not reported	Unclear/not reported	Investigator	External	Peer	SC	Increase
Peiris 2015[101]	Australia	Primary	Mixed or team	Tests	Cluster RCT	No	Unclear/not reported	Unclear/not reported	Investigator	External	Peer	SC and prompts/cues	Increase

	Study characteristics						Intervention characteristics						
Study (first author and year)	Country	Setting	Type of health worker	Target behaviour	Type of trial	Low target performance?	Format	Frequency	Source	Internal/ external delivery	Reference group	BCTs	Direction of change
Persell 2016[62]	USA	Primary	Doctor: GP	Prescribing	Factorial	No	E-mail	More than twice	Investigator	External	Peer	SC and SR	Decrease
Pimlott 2003[156]	Canada	Primary	Doctor: GP	Prescribing	RCT	No	Written	More than twice	Investigator	External	Peer	SC and information on health consequences	Decrease
Pope 2010[91]	Canada	Hospital	Doctor: secondary care	Other	RCT	No	Face to face	Only once	Investigator	External	Peer	SC and social support (unspecified)	Increase
Quinley 2004[72]	USA	Primary	Doctor: GP	Prescribing	Cluster RCT	Yes	Written	Only once	Investigator	External	Peer	SN in both arms	Increase
Raasch 2000[157]	Australia	Primary	Doctor: GP	Tests	RCT	No	Mixed	Only once	Peer	External	Peer	SC and social support (unspecified)	Increase
Raja 2015[92]	USA	Hospital	Doctor: secondary care	Tests	RCT	No	E-mail	More than twice	Unclear/not reported	Internal	Peer	SC and prompts/cues	Increase
Rask 2001[78]	USA	Primary	Mixed or team	Tests	Cluster RCT	No	Written	Only once	Credible source	External	Senior person	SN in both arms	Increase
Sandbaek 1999[158]	Denmark	Primary	Doctor: GP	Management/ communication regarding condition	RCT	No	Written	Unclear/not reported	Investigator	External	Peer	SC and other BCTs	Increase
Sauaia 2000[80]	USA	Hospital	Mixed or team	Management/ communication regarding condition	Cluster RCT	No	Mixed	Twice	Credible source	Unclear/not reported	Peer	SN in both arms	Increase
Schneider 2008[83]	Other/ multiple	Primary	Doctor: GP	Management/ communication regarding condition	Cluster RCT	No	Unclear/not reported	Unclear/not reported	Unclear/not reported	Unclear/not reported	Peer	SN in both arms	Increase
Soleymani 2014[159]	Other/ multiple	Mixed	Mixed or team	Prescribing	RCT	No	Written	Only once	Investigator	External	Peer	SC and other BCTs	Decrease
Søndergaard 2002[160] Arm B	Denmark	Primary	Doctor: GP	Prescribing	Cluster RCT	No	Written	More than twice	Investigator	External	Peer	SC	Increase

continued

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TABLE 26 Study and intervention characteristics of each included comparison (*continued*)

	Study characteristics						Intervention characteristics						
Study (first author and year)	Country	Setting	Type of health worker	Target behaviour	Type of trial	Low target performance?	Format	Frequency	Source	Internal/ external delivery	Reference group	BCTs	Direction of change
Søndergaard 2003[161]	Denmark	Primary	Doctor: GP	Prescribing	Cluster RCT	No	Written	Only once	Investigator	External	Peer	SC	Decrease
Soumerai 1998[79]	USA	Hospital	Doctor: secondary care	Prescribing	Cluster RCT	No	Face to face	Only once	Credible source	External	Senior person	SN in both arms	Increase
Stewardson 2016[162] Arm A	Other/ multiple	Hospital	Mixed or team	Hand-washing/ hygiene	Cluster RCT	No	Face to face	More than twice	Credible source	Internal	Senior person	SC and CS and other BCTs	Increase
Stewardson 2016[162] Arm B	Other/ multiple	Hospital	Mixed or team	Hand-washing/ hygiene	Cluster RCT	No	Face to face	More than twice	Patient	External	Patient(s)	Multiple SN and other BCTs	Increase
Thomas 2006[163]	UK	Primary	Doctor: GP	Tests	Factorial	No	Written	More than twice	Investigator	External	Peer	SC	Decrease
Tjia 2015[164] Arm B	USA	Care/nursing home	Mixed or team	Prescribing	Cluster RCT	No	Unclear/not reported	Only once	Investigator	External	Peer	SC and other BCTs	Decrease
Tjia 2015[164] Arm A	USA	Care/nursing home	Mixed or team	Prescribing	Cluster RCT	No	Unclear/not reported	Only once	Investigator	External	Peer	SC and information on health consequences	Decrease
Trietsch 2017[165]	Netherlands	Primary	Doctor: GP	Multiple	Cluster RCT	No	Face to face	More than twice	Investigator	External	Peer	SC and other BCTs	Decrease
van Bruggen 2008[97]	Netherlands	Primary	Mixed or team	Tests	Cluster RCT	No	Unclear/not reported	Only once	Unclear/not reported	Unclear/not reported	Peer	SC and other BCTs	Increase
Vellinga 2016[61] Arm A	Other/ multiple	Primary	Doctor: GP	Prescribing	Cluster RCT	No	Separate computerised	Only once	Investigator	External	Peer	SC and prompts/cues	Increase
Vellinga 2016[61] Arm B	Other/ multiple	Primary	Doctor: GP	Prescribing	Cluster RCT	No	Separate computerised	Only once	Investigator	External	Peer	SC and other BCTs	Increase
Verstappen 2003[166] Arm A	Netherlands	Primary	Doctor: GP	Tests	RCT	No	Mixed	More than twice	Credible source	External	Senior person	SC and CS and other BCTs	Decrease
Verstappen 2003[166] Arm B	Netherlands	Primary	Doctor: GP	Tests	RCT	No	Written	More than twice	Investigator	External	Peer	SC	Decrease

	Study characteristics						Intervention characteristics						
Study (first author and year)	Country	Setting	Type of health worker	Target behaviour	Type of trial	Low target performance?	Format	Frequency	Source	Internal/ external delivery	Reference group	BCTs	Direction of change
Voorn 2017[167]	Netherlands	Hospital	Doctor: secondary care	Other	Cluster RCT	No	E-mail	Twice	Investigator	External	Peer	SC and other BCTs	Decrease
Wang 2018[168]	Other/ multiple	Hospital	Mixed or team	Management/ communication regarding condition	Cluster RCT	No	Separate computerised	More than twice	Peer	Internal	Peer	SC and social support	Increase
Watkins 2004[169]	USA	Hospital	Doctor: secondary care	Tests	RCT	No	Unclear/not reported	Only once	Investigator	External	Peer	SC and other BCTs	Increase
Weitzman 2009[76]	Other/ multiple	Primary	Doctor: GP	Tests	Cluster RCT	No	Face to face	Only once	Investigator	External	Peer	SN in both arms	Increase
Winickoff 1984[170]	USA	Hospital	Doctor: secondary care	Tests	Cluster RCT	No	Written	More than twice	Investigator	Internal	Peer	SC	Increase
Winslade 2016[171]	Canada	Community	Other HCP	Management/ communication regarding condition	RCT	No	Written	Only once	Investigator	External	Peer	Multiple SN and other BCTs	Increase
Wright 2006[81]	Canada	Hospital	Doctor: secondary care	Tests	Cluster RCT	No	Mixed	More than twice	Credible source	External	Senior person	SN in both arms	Increase
Young 2002[172]	Australia	Primary	Doctor: GP	Management/ communication regarding condition	Cluster RCT	No	Face to face	Only once	Peer	Unclear/not reported	Peer	SC and other BCTs	Increase

CS, credible source; HCP, health-care professional; SC, social comparison; SN, social norms; SR, social reward.

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Appendix 15 Risk-of-bias judgements across each domains for each included study

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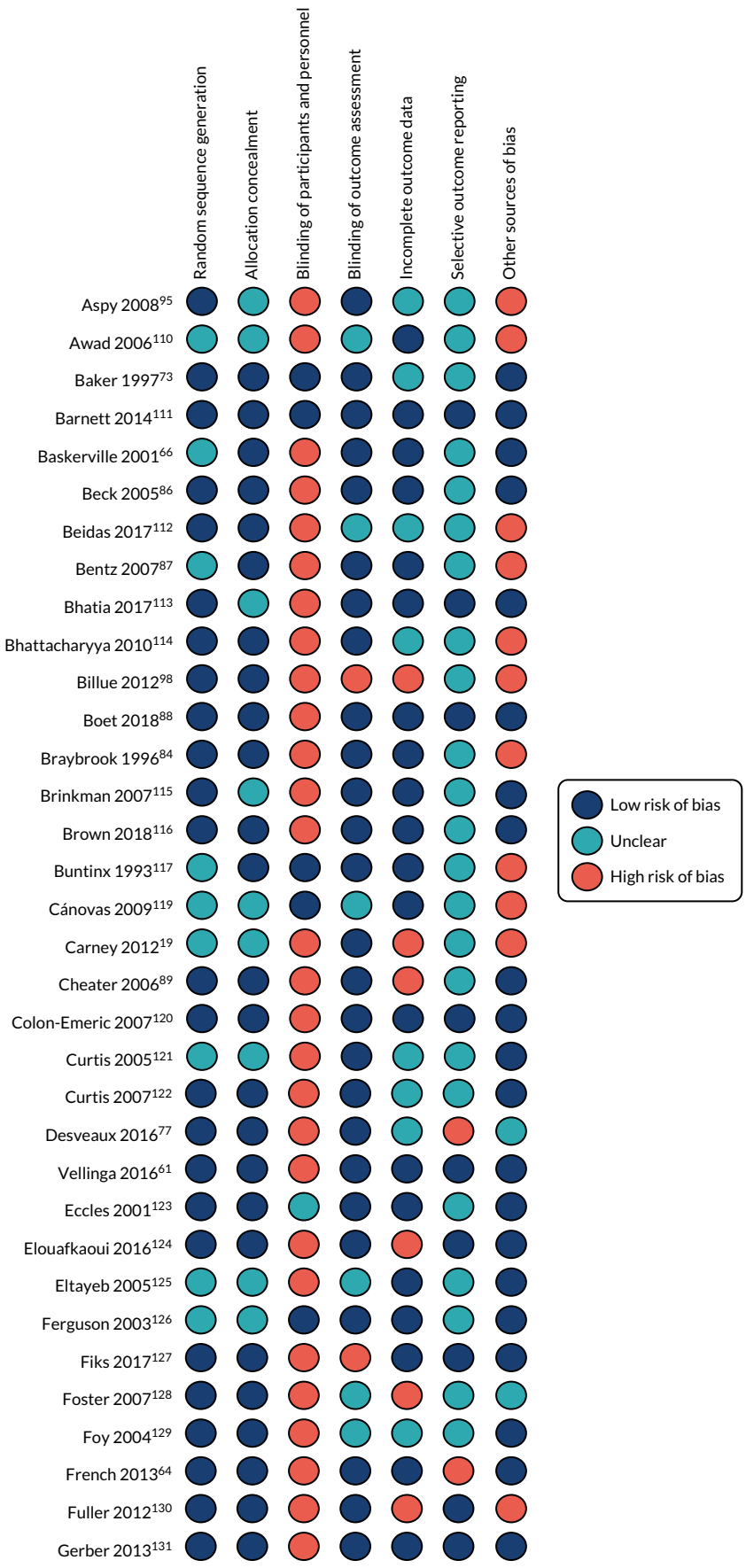

FIGURE 20 Risk-of-bias judgements across each domains for each included study. (*continued*)

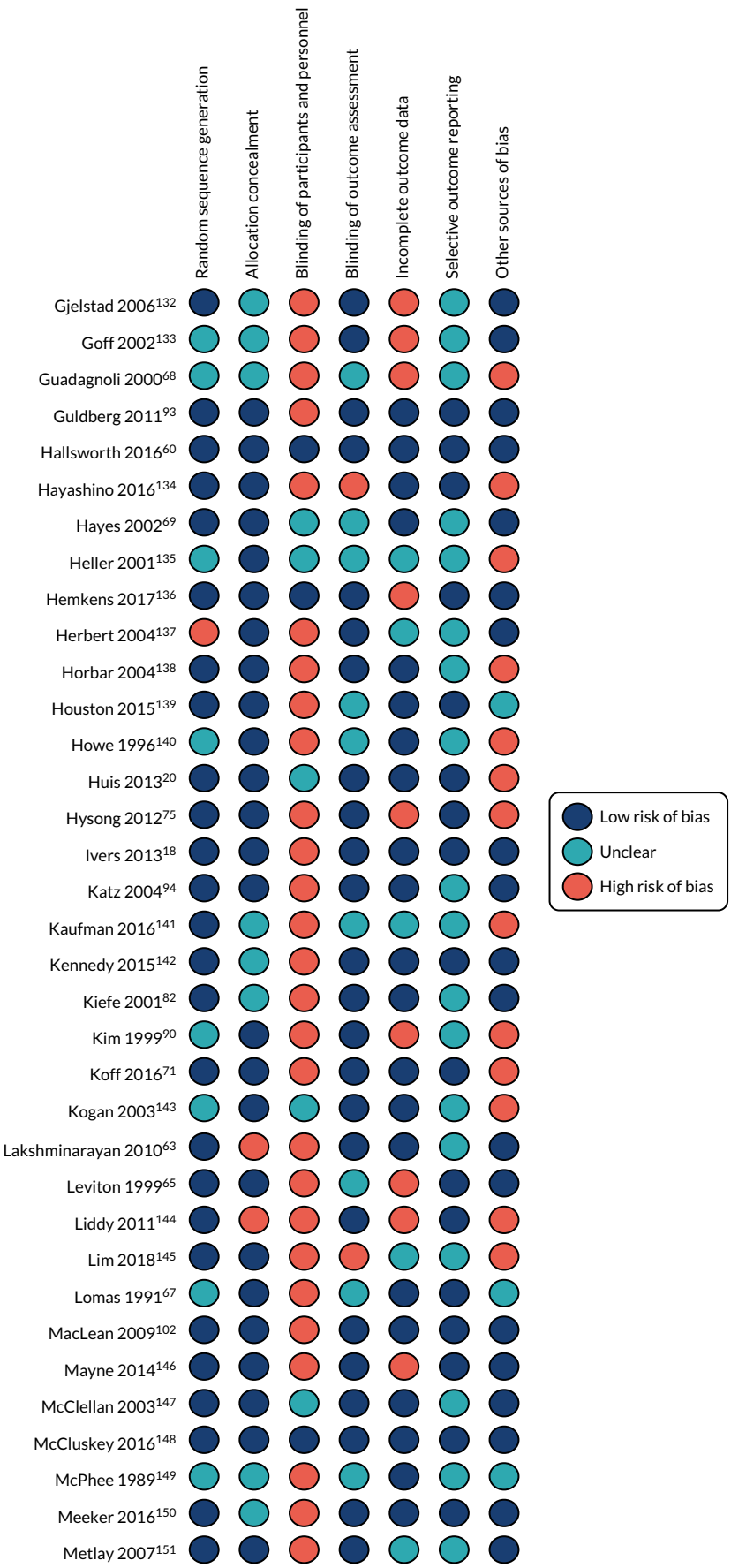

FIGURE 20 Risk-of-bias judgements across each domains for each included study. (*continued*)

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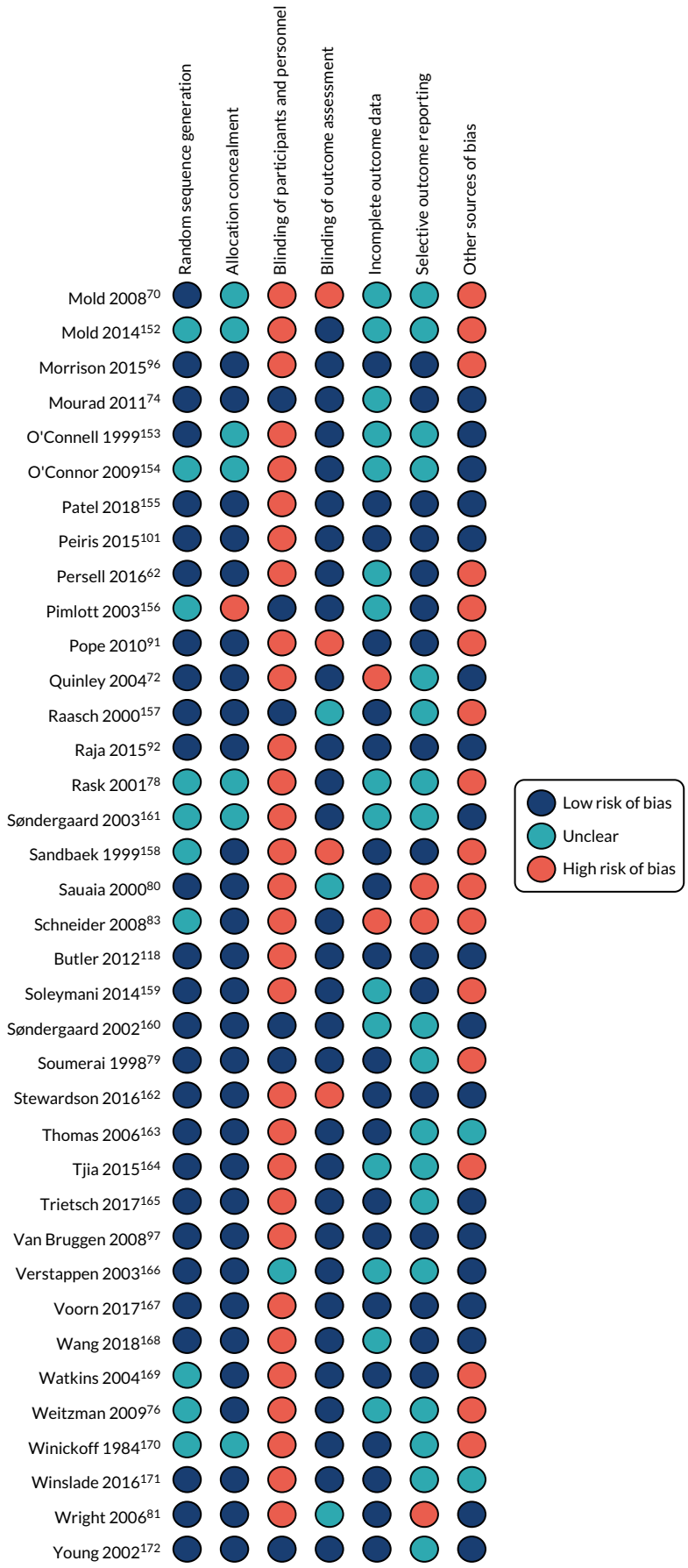

FIGURE 20 Risk-of-bias judgements across each domains for each included study.

Appendix 16 Studies with social norm interventions in both arms: forest plot

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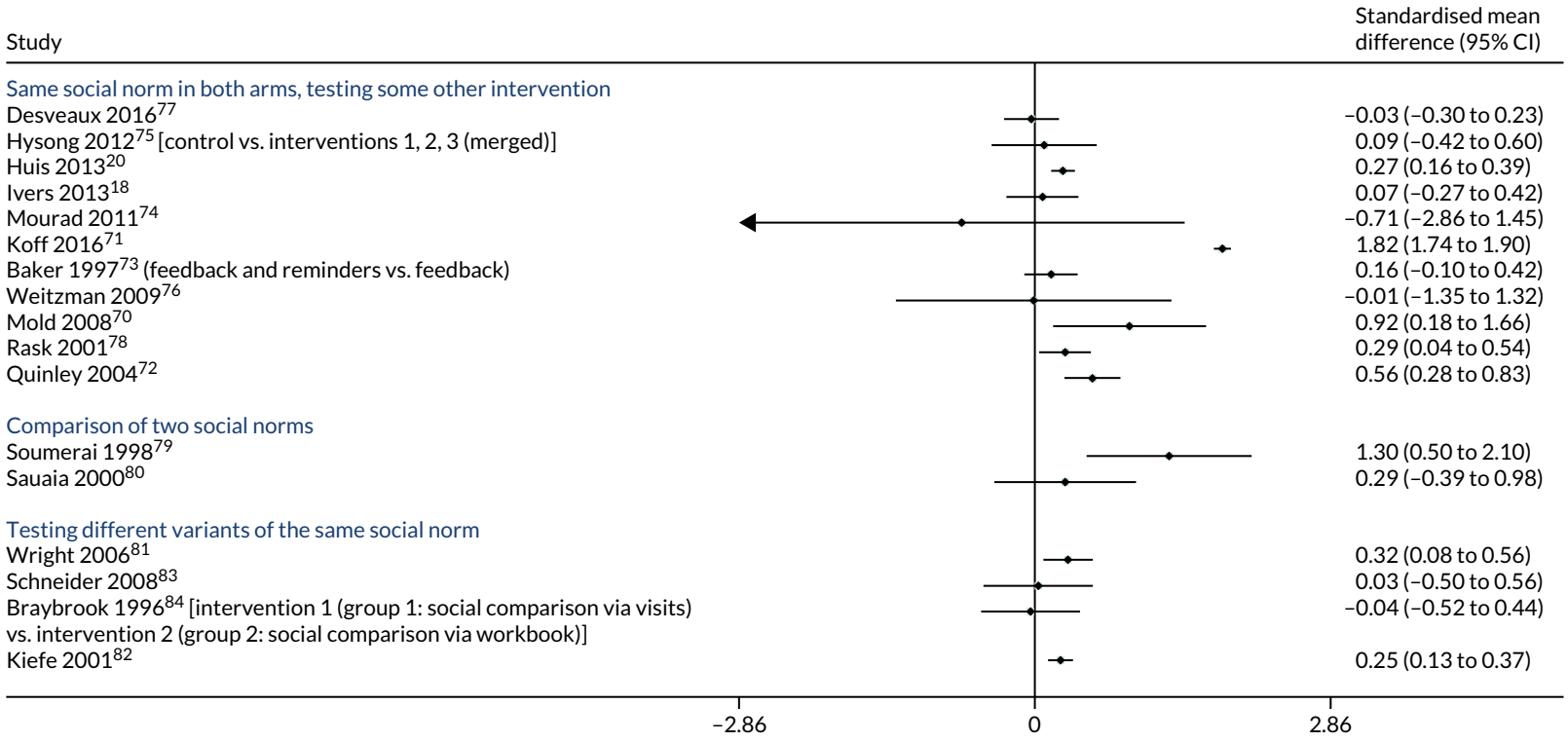

FIGURE 21 Fixed-effects forest plot showing studies with social norm interventions in both arms.

Appendix 17 Forest plots showing individual studies, by social norms behaviour change techniques

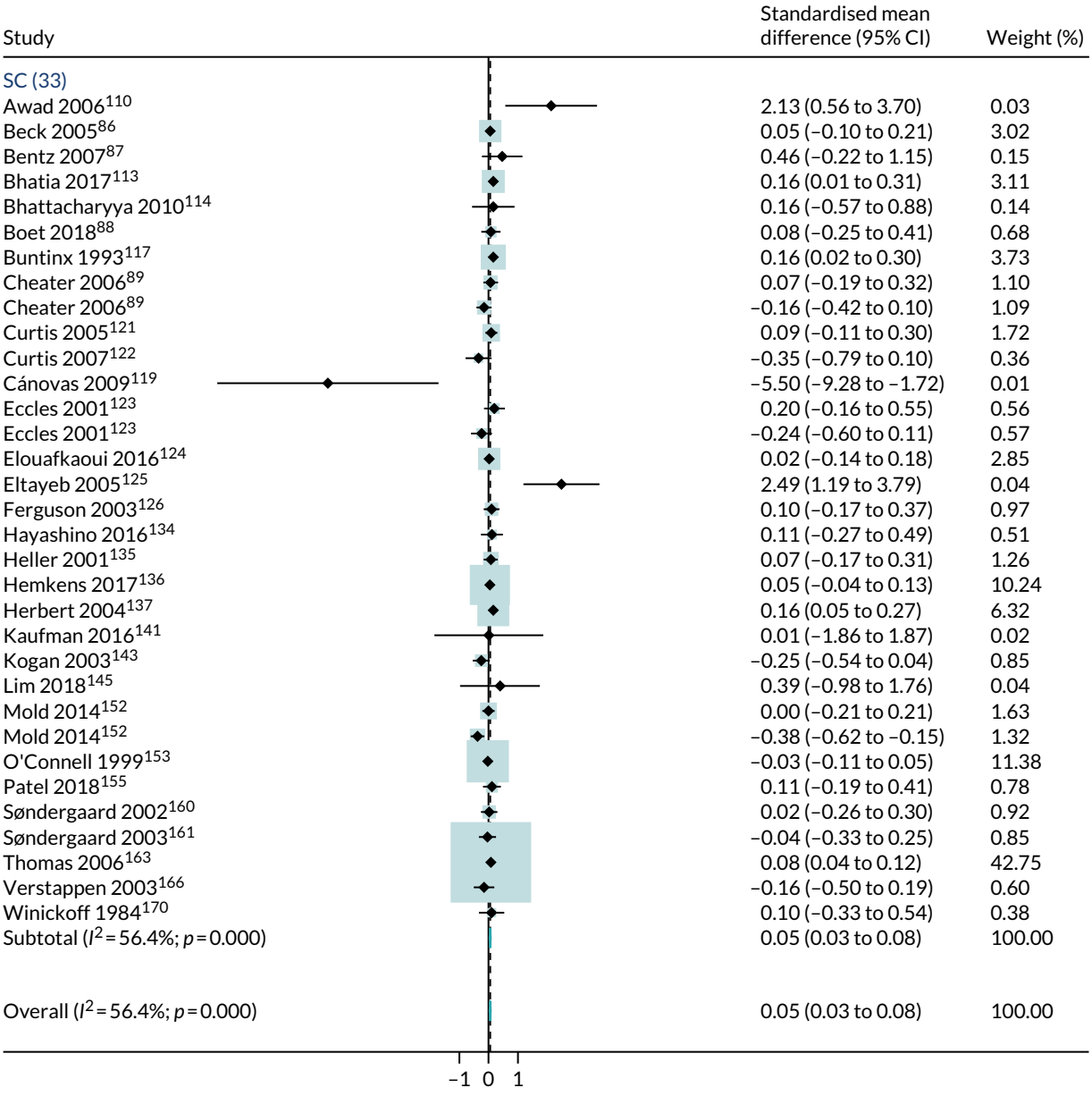

FIGURE 22 Fixed-effects meta-analysis of trials testing social comparison with or without feedback on behaviour.

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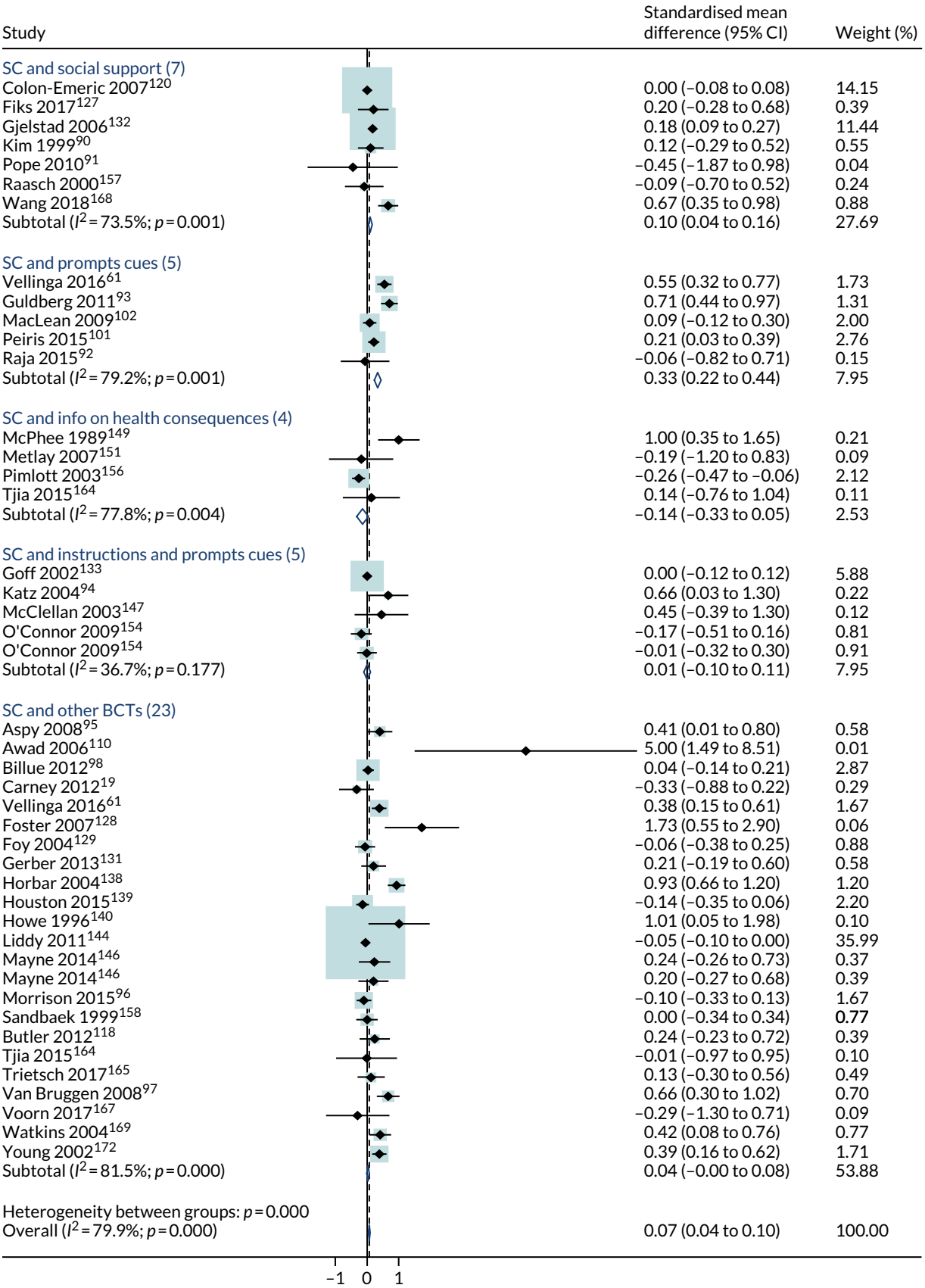

FIGURE 23 Fixed-effects meta-analysis of trials testing social comparison with other BCTs.

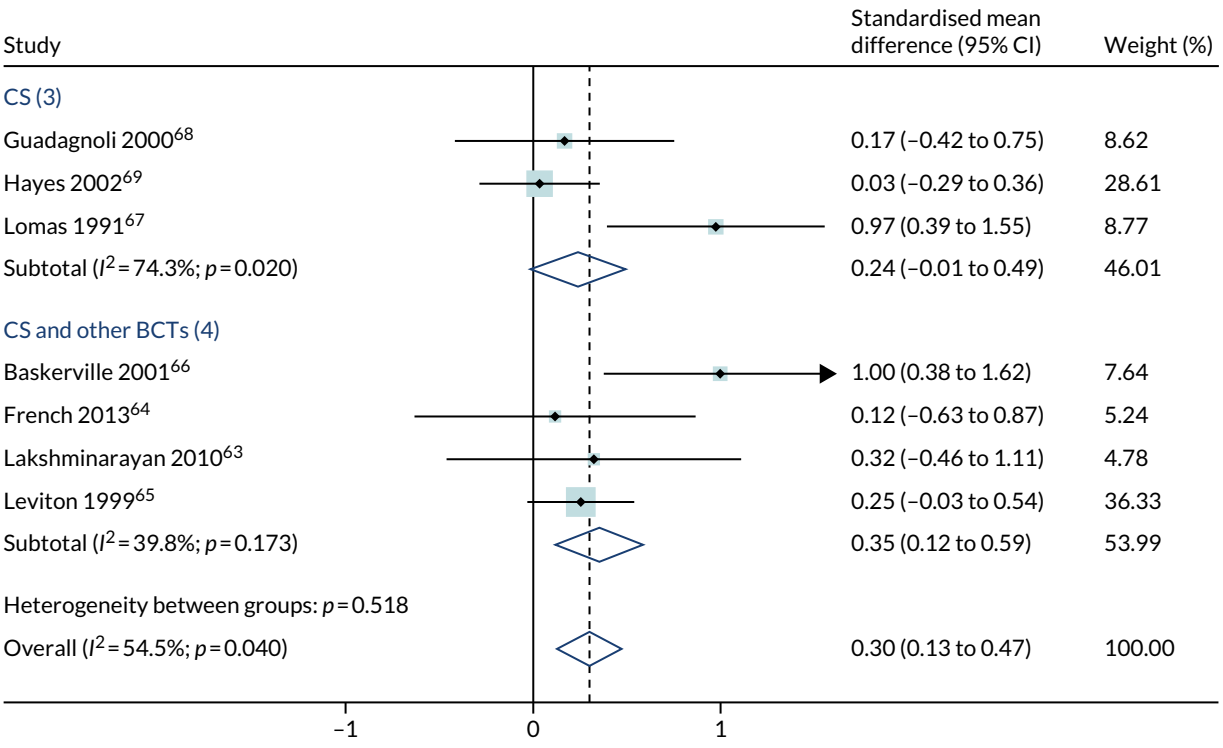

FIGURE 24 Fixed-effects meta-analysis of trials testing credible source.

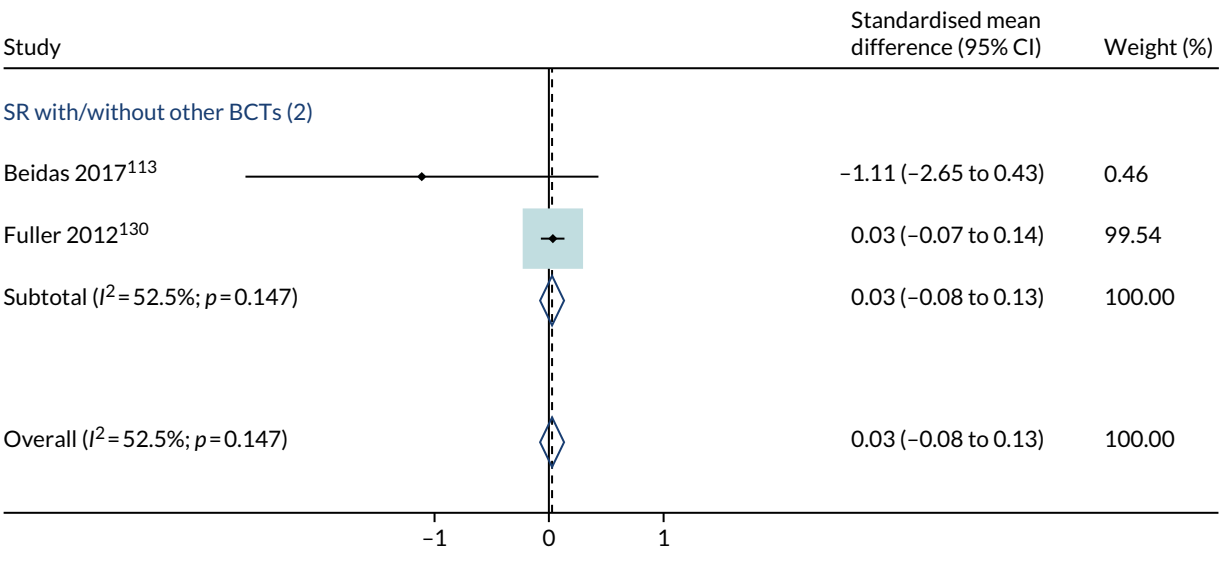

FIGURE 25 Fixed-effects meta-analysis of trials testing social reward.

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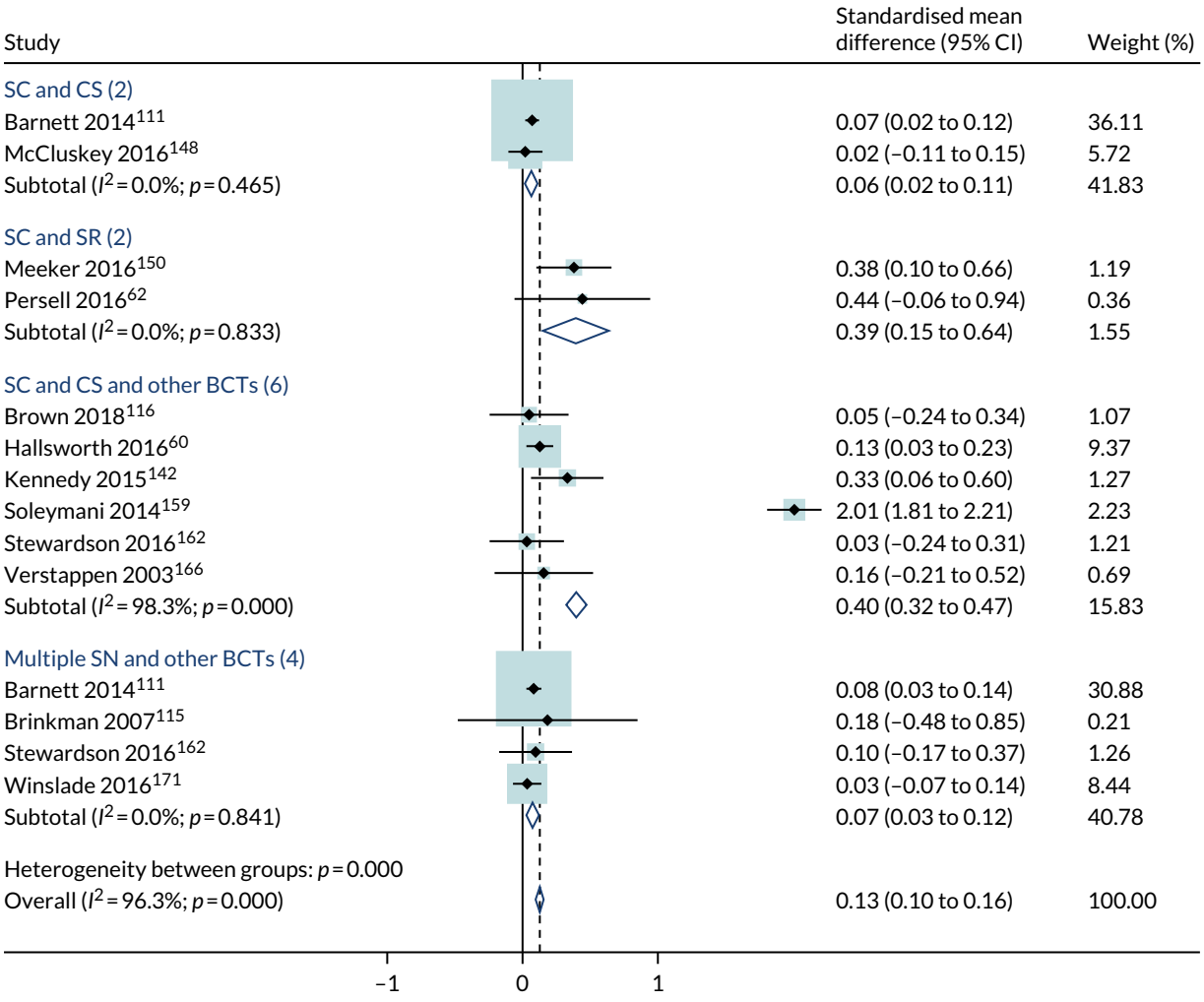

FIGURE 26 Fixed-effects meta-analysis of trials testing multiple social norm BCTs.

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