Comparison of four methods for assessing the importance of attitudinal beliefs: An international Delphi study in intensive care settings

Author

Francis, Jill J, Duncan, Eilidh M, Prior, Maria E, MacLennan, Graeme, Marshall, Andrea P, Wells, Elisabeth C, Todd, Laura, Rose, Louise, Campbell, Marion K, Webster, Fiona, Eccles, Martin P, Bellingan, Geoff, Seppelt, Ian M, Grimshaw, Jeremy M, Cuthbertson, Brian H

Published

2014

Journal Title

British Journal of Health Psychology

Version

Accepted Manuscript (AM)

DOI

10.1111/bjhp.12066

Title

Comparison of four methods for assessing the importance of attitudinal beliefs: An international Delphi study in intensive care settings

Running Head

Methods for assessing importance of beliefs

Authors

Francis JJ[1,2], Duncan EM[1,2], Prior ME[2], MacLennan G[2], Marshall AP[3], Wells EC[4], Todd L[5], Rose L[6], Campbell MK[2], Webster F[5], Eccles MP[7], Bellingan G[8], Seppelt IM[9], Grimshaw JM[10,11], Cuthbertson BH[12], for the SuDDICU study groups.

1 Health Psychology Group, University of Aberdeen, UK
2 Health Services Research Unit, University of Aberdeen, UK
3 Research Centre for Clinical and Community Practice Innovation, Griffith University, Southport, Australia and Gold Coast Hospital, Southport, Australia
4 Centre for the Study of Social and Legal Responses to Violence, University of Guelph, Canada
5 Department of Family and Community Medicine, University of Toronto, Canada
6 Lawrence S. Bloomberg Faculty of Nursing, University of Toronto, Canada
7 Institute of Health and Society, University of Newcastle upon Tyne, UK
8 Intensive Care Unit, University of College London Hospital, UK
9 George Institute for Global Health, University of Sydney, Australia
10 Clinical Epidemiology Program, Ottawa Hospital Research Institute, Canada
11 Department of Medicine, University of Ottawa, Canada
12 Department of Critical Care Medicine, Sunnybrook Health Sciences Centre and Department of Anesthesia, University of Toronto, Canada

*Requests for reprints should be addressed to Jill Francis, City University London, C332 Tait Building, Northampton Square, London EC1V 0HB, United Kingdom (e-mail: Jill.Francis.1@city.ac.uk).

Word count: 4,471

Statement of Competing Interests

Jill Francis is an Associate Editor of the British Journal of Health Psychology. It is understood that the anonymity of the peer review process safeguards against any influence that might follow from this.

Acknowledgements

This project was funded by the UK NIHR Health Technology Assessment programme and will be published in full in the Health Technology Assessment journal series. Visit the HTA programme website for more details www.hta.ac.uk/2299. The views and opinions expressed therein are those of the authors and do not necessarily reflect those of the Department of Health.

The Health Services Research Unit is core funded by the Chief Scientist Office of the Scottish Government Health Directorates. Views expressed are those of the authors and do not necessarily reflect the view of the Chief Scientist Office. JMG holds a Canada Research Chair in Health Knowledge Transfer and Uptake.

We acknowledge the support of the Canadian Institutes of Health Research operating grant support, the Australian Intensive Care Foundation (ICF) and the Australian and New Zealand College of Anaesthetists. The SuDDICU collaboration is a collaboration that includes the Canadian Critical Care trials group (CCTG) and the Australian and New Zealand Intensive Care Society Clinical Trials Group (ANZICS CTG) and this study was supported by the CCCTG and the ANZICS CTG.

Statement of contribution

What is already known on this subject?

- Attitudinal beliefs (specific beliefs about the consequences of performing an action) are key to designing interventions to change intentions and behaviour.
- The literature reports four methods for assessing the importance of attitudinal beliefs: frequency of elicitation in interviews; importance ratings in questionnaires; and strength of prediction (bivariate and multivariate) of global attitude scores.
- The congruence between these measures of importance is not known.

What does this study add?

- Four indices of importance were examined in a multi-professional, international study about the use of Selective Digestive Decontamination to prevent infection in intensive care settings
- Three indices were correlated with one another.
- The method used to assess importance produced different subsets of the most important beliefs. Selection of the most important beliefs should use multiple assessment methods.
- This evidence suggests that multiple regression approaches may not be robust for assessing belief importance.

Keywords: belief importance; attitude; behaviour change; measurement

Classifications:
Behaviour change;
Health professional behaviour
Psychological interventions
Social cognition models

Abstract (250 words)

Objectives

Behaviour change interventions often target 'important' beliefs. The literature proposes four methods for assessing importance of attitudinal beliefs: elicitation frequency, importance ratings and strength of prediction (bivariate and multivariate). We tested congruence between these methods in a Delphi study about Selective Decontamination of the Digestive tract (SDD). SDD improves infection rates among critically ill patients, yet uptake in intensive care units is low internationally.

Methods

A Delphi study involved three iterations ('rounds'). Participants were 105 intensive care clinicians in the UK, Canada and Australia/New Zealand. In Round 1, semi-structured interviews were conducted to elicit beliefs about delivering SDD. In Rounds 2 and 3, participants completed questionnaires, rating agreement and importance for each belief-statement (9-point Likert scales). Belief importance was assessed using: elicitation frequency; mean importance ratings; and prediction of global attitude (Pearson's correlations; beta-weights). Spearman's correlations between indices were computed.

Results

Participants generated 14 attitudinal beliefs. Indices had adequate variation (frequencies: 4-94); mean importance ratings: 4.93-8.00; Pearson's correlations: $\pm$0.09 to $\pm$0.54; beta-weights: $\pm$0.01 to $\pm$0.30). *SDD increases antibiotic resistance* was the most important belief according to three methods and was ranked second by beta-weights (behind O*verall, SDD benefits the patients to whom it is delivered*). Spearman's correlations were significant for importance ratings with frequencies and correlations. However, other indices were unrelated. The top four beliefs differed according to the measure used.

Conclusions

Results provided evidence of congruence across three methods for assessing belief importance. Beta-weights were unrelated to other indices, suggesting that they may not be a robust method.

Comparison of four methods for assessing the importance of attitudinal beliefs: An international Delphi study in intensive care settings.

Background

Beliefs about the positive and negative consequences of performing a specified behaviour (i.e., attitudinal beliefs) are widely thought to influence the likelihood that the behaviour will be performed (Michie et al., 2005). In social cognition models, such beliefs are proposed to be the precursors of attitude, which is one of the important predictors of intention and behaviour (Fazio, 1989; Fishbein & Ajzen, 1975) . Introducing strategies to change attitude is one of the most frequent approaches used when trying to change behaviour (Michie, Johnston, Francis, Hardeman, & Eccles, 2008) ; (Zimbardo & Leippe, 1991) ; (Abraham & Michie, 2008; Abraham & Michie, 2008) . The literature proposed several methods for identifying the key beliefs to take forward for further investigation or for intervention development. However, there is a lack of evidence about which methods are best for identifying attitudinal beliefs that are most important and thus most likely to be key to behaviour change.

Several working assumptions about this question are evident in research about health-related behaviour, including the behaviour of healthy people (to maintain health), those with a diagnosis (to manage their condition) and health professionals (as they deliver health care). In social cognitive approaches, the cognitive accessibility of a concept (i.e., how readily it comes to mind) (Higgins, King, & Mavin, 1982) is proposed to indicate its importance for processing relevant information (e.g., combining concepts when forming attitudes) and to moderate the attitude-behaviour relation (Fazio, 1989; Fazio, Powell, & Williams, 1989). For example, some people who think about the consequences of increasing their physical activity may immediately (and frequently) think of losing weight; others may think about increasing their cardiovascular fitness; others may think about building muscle mass. Behaviour change scientists would be justified in assuming that an individual's most quickly and

frequently activated beliefs (i.e., those with greatest cognitive accessibility) are the most likely to drive that person's motivation and, thus, behaviour. This assumption has obvious and important implications for selecting the informational content of behaviour change interventions. The 'cognitive accessibility' assumption underlies theory-based elicitation studies: participants are interviewed to elicit their salient beliefs; some of these beliefs are then identified as 'modally-salient' (i.e. most frequently mentioned across a sample of interview participants). The modally salient beliefs are then included in questionnaires to identify the strongest predictors of intention, motivation or behaviour (Ajzen, 1991)(Sutton et al., 2003).

Modal salience is not the only approach to identifying belief importance. Two contrasting approaches to assessing the importance of attitudinal beliefs do not rely on the cognitive accessibility assumption. First, 'expectancy-value' approaches to designing questionnaires include two kinds of questionnaire items: (1) items to assess the 'expectancy' associated with each belief (i.e., strength of belief, or the individual's estimate of the probability of the consequence occurring); and (2) 'value' of that consequence to the individual (i.e., its subjective importance) (Fishbein & Ajzen, 1975) .

Second, a 'judgement analysis approach' has been applied to clinical reasoning (Cooksey, 1996). This approach contrasts subjective and objective importance by considering both questionnaire-based importance ratings (e.g., *How important is it to you to build muscle mass?* Scale: 1 [not at all important] to 7 [extremely important]) and the relative power of each belief to predict attitude or behaviour. For example, in a multiple linear regression to predict global attitude from a number of strength-of-belief ratings, the relative sizes of the standardised regression coefficients would reflect their relative importance in determining attitude (Evans St., Harries, Dennis, & Dean, 1995) . Evans et al. (1995) used this multiple regression approach to identify the "tacit policies" of General Medical Practitioners and compared them with their

stated policies (subjective ratings of the influence of each factor in a clinical scenario). The multiple regression method is used to identify the 'objectively important' beliefs (or 'tacit policies') that are appropriate targets in behaviour change interventions. A variation on this method is the Pearson's correlation coefficient which represents the linear relationship between a belief and global attitude, regardless of any other beliefs that might explain variation in the attitude score.

In summary, in the social cognition literature, there appear to be four methods for determining belief importance, each based on different assumptions: (1) the *elicitation* method (based on the cognitive accessibility assumption); (2) the *self-report* method (based on the assumption that individuals can accurately report the importance of their beliefs for influencing their attitudes or behaviour); (3) the *bivariate prediction* method (based on the assumption that prediction, while different from causation, is nonetheless an indicator of the beliefs that are most likely to have a causal influence on attitude and behaviour); and (4) the *multivariate prediction* method (based on the assumption that the relative importance of beliefs is best judged by considering them together in one analysis). These four approaches, and their underlying assumptions, are presented in Table 1.

TALBE 1 HERE

To identify the extent of usage of these four methods of assessing importance, we conducted a brief but systematic scoping search, in the PsycINFO database to May 2013, of the following terms when combined with terms relating to attitude and belief importance: ("elicit*" or "modal salien*"); ("rating" or "self-report"); "correlat*"; ("beta-weight" or "regression"). This search resulted in identification, respectively, of 625, 3758, 3476 and 1966 results. When these four searches were combined with "AND", no papers were identified. This confirmed that, first, the four methods have been

extensively reported in the literature and, second, no investigations have been reported that compare all these methods.

In the field of behaviour change, intervention design crucially relies on the validity of whichever of these four methods is used for identifying important beliefs. For example, intervention mapping approaches propose that a key step in intervention design is the use of empirical evidence (literature reviews, qualitative and quantitative studies) to identify the important determinants of the health problem to be addressed (Bartholomew, Parcel, & Kok, 1998) . In addition, recent reports of the development of behaviour change interventions to enhance the uptake of clinical guidelines have been based on evidence about the importance of beliefs, where evidence about importance is generated from the elicitation method (McKenzie et al., 2008)(French et al., 2012) or the prediction method (Foy et al., 2007).

As the elicitation method is frequently used to select the most important beliefs to include in questionnaires, questionnaires usually contain only a subset of beliefs elicited in interview studies. Hence, there is little research directly comparing these measures of importance. Steadman and Rutter (Steadman & Rutter, 2004) compared attitude scores based on salient (frequently elicited) beliefs with attitude scores based on a subset of those beliefs that were rated as 'important' but did not directly compare the importance indices. More direct evidence can be found in the social judgment analysis literature, which indicates that the relative importance of subjective (importance ratings) and objective beliefs (predictive power) does not always converge (Evans St., Harries, Dennis, & Dean, 1995; Hunter, McKee, Sanderson, & Black, 1994) . However, no study has compared the congruence between all four approaches. How, then, can we identify the best methods for selecting the beliefs that should drive the design of behaviour change interventions?

A recent international Delphi study of beliefs of healthcare professionals about a clinical procedure, Selective Decontamination of the Digestive tract (SDD), in

Intensive Care Units (ICUs) study (the SuDDICU study), provided the opportunity to test, for the first time, the congruence of four indices of importance. SDD involves the application of non-absorbable antibiotic paste to the mouth and stomach and a short course of intravenous antibiotics, for prevention of infection (Cuthbertson et al., 2010). The evidence base relating to SDD is strong, with 11 published meta-analyses of 36 randomised controlled trials (RCTs). These meta-analyses show that SDD reduces rates of ventilator-associated pneumonia and hospital acquired infections. It also reduces mortality in critically ill patients in more recent meta-analyses. However, uptake of SDD, internationally is low. The Delphi study investigating clinicians' views about SDD was part of a larger multi-phase, mixed-methods study (the SuDDICU study) reported elsewhere, that investigated the reasons for such low uptake in the United Kingdom, Canada, Australia and New Zealand (Cuthbertson et al., 2010; Francis et al., 2013).

Delphi approaches have been used in health research for over four decades (Dalkey, 1969; Fink, Kosecoff, Chassin, & Brook, 1984) to establish expert consensus (e.g., to decide appropriateness of clinical actions, where there was a lack of evidence), or to identify levels of agreement (or disagreement) within an expert group. Delphi studies use a structured, iterative process including anonymised feedback in a series of sequential questionnaires or 'rounds'. There are two advantages of using this technique, compared with face-to-face group discussion. First, it operationalises the principle that good decision making first involves the generation of multiple alternatives, leaving a critique of those alternatives to a later stage (D'Zurilla & Nezu, 1998). Second, it avoids the problems that may occur in face-to-face (or 'nominal') group discussions, e.g. 'groupthink' (in which individuals reach premature consensus through 'normative' influence (Janis, 1972) arising from the early or strong views of influential individuals such as senior colleagues) or 'group polarisation' (in which individuals express opposing views because of competition within the group) (Myers & Lamm, 1975) . It is designed to use 'informational' influence (Asch, 1955), in which

novel ideas may be introduced and considered by individuals in the group without being contaminated by the effects of group dynamics. The appropriate number of Delphi rounds will vary according to the complexity of the issues discussed and the diversity of the sample, but evidence suggests that three or four rounds are appropriate (Erffmeyer & Erffmeyer, 1986; Murphy et al., 1998) .

Reflecting the four methods for assessing the importance of beliefs, the SUDDICU Delphi study involved: (1) an interview round to elicit participants' beliefs about the consequences of delivering SDD; (2) two questionnaire rounds in which the same participants were asked to rate their strength of agreement with, and the importance of, each belief; (3) computation of bivariate correlations; and (4) building of a regression model to predict global attitude from strength-of-agreement scores for each belief. The aim of the current paper was to assess the congruence of the findings based on these four methods for assessing the importance of attitudinal beliefs.

Methods

Sample

Participants were clinicians working in intensive care in three geographical zones (UK, Canada and Australia/New Zealand). They included four groups of professionals identified as key stakeholders with respect to the delivery of SDD in ICUs: intensive care physicians, clinical microbiologists, hospital pharmacists and ICU clinical leads. In each geographical zone, clinicians in each of the four professional groups were purposively sampled to achieve diversity on a range of potentially relevant characteristics (teaching hospital versus general hospital, size of ICU, experience of using SDD or not, years of experience in ICU).

There is a range of opinions on the appropriate sample size for Delphi studies, but smaller sizes (10) have been deemed appropriate where participants have similar training (Akins, Tolson, & Cole, 2005). Thus, the target sample size was 10 participants per stakeholder group in each geographical zone (40 per zone and 120 in total). The analysed sample included all clinicians who provided complete data across all three Delphi rounds.

Of the 141 clinicians interviewed, 105 (74%) provided complete data (i.e., no missing items) across the three data collection rounds. There was good representation of all geographical zones (32, 35 and 38 in Australia / New Zealand, Canada and UK, respectively) and all clinician groups (34, 20, 24 and 27 for intensivists, microbiologists, pharmacists and ICU leads, respectively). Participants reported an average of 16.5 (SD = 7.8) years' experience working in the intensive care context. It was not possible (or appropriate) to recruit equal numbers of participants with and without experience of the target behaviour (delivering SDD) as it is not used in Australia / New Zealand or Canada. Of the 38 participants in the UK, seven reported current or past experience of using this procedure.

Materials

A topic guide was designed (presented in Appendix), based on the Theoretical Domains Framework (TDF) of behaviour change (Michie S. Johnston M. Abraham C. Lawton R. Parker D. Walker A. "Psychological Theory" Group, 2005; Michie et al., 2005). The TDF was developed by experts in behaviour change and health services research using a consensus process. The framework integrates overlapping constructs from 33 theories to make theory more useful in applied research and is frequently used to investigate clinical behaviours (Francis, O'Connor, & Curran, 2012) . The topic guide included at least one prompt for eliciting beliefs from each of the 12 theoretical domains in the framework and a range of potential follow-up

prompts. The topic guide was piloted with three clinicians and minor adjustments were made to increase usability and clinical sensibility.

Based on the interview (Round 1) findings, a questionnaire was developed for Round 2. Items incorporated all elicited beliefs (i.e., not only the frequently mentioned beliefs but also minority beliefs, as long as they were mentioned in each geographical zone and were thus relevant to each healthcare context) and included the global attitude item, *I am opposed to SDD*. For each belief, participants were asked to report the strength of their agreement or disagreement (where 1 = strongly disagree and 9 = strongly agree) and their rating of the personal importance of this issue to their overall opinion about the delivery of SDD to critically ill patients (where 1 = not at all important and 9 = very important). Nine-point Likert items were used, as is recommended for Delphi studies involving expert samples(Fitch et al., 2000). For Round 3 an identical questionnaire was used, with the addition of feedback of the Round 2 results for each item, in the form of a frequency histogram of the sample's responses, together with an individually customised reminder of the participant's Round 2 response. Example screen shots from the Round 2 and Round 3 materials are presented in Figures 1 and 2.

FIGURE 1 HERE

FIGURE 2 HERE

Procedure

Clinicians were initially contacted by clinical members of the research team and invited to participate. Those who agreed to participate were contacted by a researcher in each zone (ED, AM, EW) to arrange a telephone interview. In Round 1, semi-structured one-to-one, audio-recorded telephone interviews of 30 to 40 minutes duration were conducted. Recordings were transcribed verbatim, checked for

accuracy and anonymised. One week after the completion of Round 1 interviews (four months after the first interview), the same participants were invited by email to complete Round 2. Ten weeks after the initial circulation of the Round 2 materials, participants were invited by email to complete Round 3. Computer programming of the Round 2 and 3 materials enabled direct downloading of data as participants submitted their responses, thereby eliminating the possibility of data entry error.

The study was given ethics approval in each jurisdiction: in the UK (NHS REC; Reference 10/S0801/69); in Canada (Research Ethics Board of Sunnybrook Health Sciences Centre, reference 306-2010) and in Australia/New Zealand (Nepean Blue Mountains Local Health Network Health Research Ethics Committee; No. 11/08).

Analysis

For Round 1, interview transcripts were classified into theoretical domains by one researcher in each zone. These classifications were checked and discussed by other members of the team in each nation and by the study's international working group. Content analysis was performed on data within each domain by other members of the team, using an inductive process, to identify specific beliefs. Beliefs with similar content (e.g., relating to cost-effectiveness) but opposite valence (i.e., implying being *for* or *against* SDD) were classified together as one belief. The analysis was conducted in parallel in the three geographical zones, and the international research team met by telephone conference once each month during the four-month duration of Round 1 to ensure similar methods were used.

The iterative approach of the Delphi approach enables the assessment of the extent to which participants change their opinions during the process of viewing group-level feedback. Round 2 and 3 responses were thus assessed for stability at the level of both individuals (change scores) and the whole sample (group means). Round 3 data in the Beliefs about Consequences domain (i.e., attitudinal beliefs) are reported in the current paper, as a greater number of specific beliefs were generated in this domain than in any other domain. Mean importance ratings were computed. Pearson's

bivariate correlations were computed between agreement scores for each attitudinal belief and global attitude scores (assessed using the item *I am opposed to SDD)*. A multiple linear regression was performed to predict global attitude scores from agreement scores for the individual beliefs.

The relative importance of beliefs was thus measured using four methods: (1) *elicitation* (frequency of coding in interview data); (2) *self-report* (importance ratings); (3) *bivariate prediction* (correlation) and (4) *multivariate prediction (*standardised regression coefficients in a multiple regression using agreement ratings to predict global attitude). These four indices were tabulated and the congruence between them was assessed using Spearman's correlation coefficients.

Results

Beliefs elicited in Round 1 interviews are presented in Table 2, together with coding frequencies for each geographical zone. Participants generated a total of 16 attitudinal beliefs. Of these, one was classified as a 'global' attitude item (*I am opposed to SDD)* and was used as the dependent variable. Fourteen beliefs were elicited across all three zones. Patterns of frequencies were similar across the zones (Table 2).

TABLE 2 HERE

Responses were highly stable, at the individual level, between Round 2 and Round 3. The Inter Quartile Range (IQR) of individual change scores for agreement ratings was zero (i.e. no change) for every item and the IQR of change scores for importance ratings was zero for all items except *SDD increases antibiotic resistance,* for which the IQR (change score) was 1. Group-level stability was evident from the small changes in mean scores for each item between Round 2 and Round 3; absolute mean differences ranged from 0 to 0.52. Hence, a further Delphi round was

deemed not required and the decision was made to stop at Round 3 and to use the Round 3 data for analysis.

Table 3 presents beliefs from highest to lowest frequency in interviews, together with the other three indices of importance. Mean importance ratings at Round 3 ranged from 4.93-8.00 (on the scale of 1 to 9). Correlations between individual belief scores and global attitude scores ranged from $\pm$0.09 to $\pm$0.54. Beta-weights (standardised regression coefficients) ranged from $\pm$0.01 to $\pm$0.30. The regression model accounted for 43.5% of the variance (adjusted R^2) in scores on the global attitude item, $F(14,90) = 6.72$, $p < 0.001$. The semi-partial correlations, presented in Table 2 to show the unique variance accounted for by each belief, were substantially lower than the beta-weights for two beliefs (*SDD increases antibiotic resistance* and *Overall, SDD benefits the patients to whom it is delivered*), indicating substantial shared variance with other predictors. However, the rank order of beliefs based on beta weights and semi-partial correlations was the same.

TABLE 3 HERE

Three of the four indices of importance identified *SDD increases antibiotic resistance* as the most important belief. This belief was elicited in 93/105 (89%) interviews; had a mean importance rating of 8.00 (on the scale of 1 to 9) and was significantly correlated with global attitude ($r = 0.54$, $p < 0.001$). In the multiple regression model it had the second highest beta weight ($\beta = 0.26$, $p < 0.001$). Similar congruence among importance indices was not demonstrated for the other beliefs; for example, identification of the next three most important beliefs (bolded in Table 3) differed according to the measure used as follows (listed in order):

- <u>From frequencies</u>: SDD is cost effective; SDD reduces ventilator associated pneumonia; SDD benefits the patients to whom it is delivered; There is no

mortality benefit associated with SDD (four beliefs listed here as the third and fourth beliefs had equal frequency);

- From importance ratings: SDD would increase *Clostridium difficile* infections; The risks of SDD outweigh the benefits; SDD reduces hospital acquired infections
- From correlations: The risks of SDD outweigh the benefits; SDD benefits the patients to whom it is delivered; SDD is cost effective;
- From beta-weights: SDD benefits the patients to whom it is delivered; SDD increases pharmacy workload; I am opposed to the IV component of SDD.

Spearman's correlations, for assessing the congruence (in ranking of beliefs) between the four indices, are presented in Table 4. Although the sample size was small (n = 14 items), correlations were high, and significant at the 0.05 level, for the relationship between importance ratings and frequencies, and between importance ratings and bivariate correlations *rho* = 0.54 and 0.66, respectively). Spearman's *rho* for the relationship between the beta weights and bivariate correlations was 0.42 ($p > 0.05$). Spearman's correlations between the other measures were in the range $-0.12 < rho < 0.39$, all non-significant.

TABLE 4 HERE

Discussion

This international study is the first to assess the congruence between the four most commonly used methods for identifying the importance of attitudinal beliefs. It showed that importance indices based on self-report (importance ratings) were correlated with those based on elicitation and bivariate prediction. The multivariate prediction method, using beta weights, was congruent with bivariate prediction (these two indices not being independent of each other) but not with the other two methods.

These findings in general support the theoretical assumptions that underlie three of these measures (namely, the cognitive accessibility assumption, the assumption that individuals can accurately report the importance of their beliefs; and the assumption that bivariate linear relationship is an indicator of importance). However, the statistical complexities underlying multivariate regression (specifically, when predictors are inter-correlated as in this case) appear to make this an inferior indicator of belief importance. Using multiple regression analysis (as proposed by the social judgement approach), therefore, may not be a robust method to use routinely for identifying important beliefs. It could be argued that a reason for using multiple regression is to get rid of shared variance between predictors. However, we would argue that shared variance, while an important consideration for prediction, should not rule out a variable as an appropriate, or potentially important, intervention target. It is perhaps not surprising that there was no reliable relationship between the frequency method and the Pearson's correlation method: we do not regard this as a fault of the interview method as such. Rather, it reflects the different objectives of each method. The frequency method does not seek to assess how strongly a belief is held, but assesses the prevalence of a belief across a sample.

Despite some evidence of congruence, these results suggest that methods for selecting a few of the most important beliefs (e.g., for designing interventions) may not produce reliable selections. It is usual practice to select the most frequently elicited beliefs either for further investigation in a predictive questionnaire study (Foy et al., 2007) or for intervention design (French et al., 2012). Although three methods for assessing importance identified the same 'most important' belief about SDD, the next three most important beliefs differed according to the method used. Hence, selecting a small number of important beliefs to target in an intervention would lead to interventions with different informational content depending on which measure of importance was used.

If researchers wish to select beliefs as the focus of interventions, we would recommend the use of multiple methods. This would, for example, require that a belief be assessed as important according to at least two indices before being taken forward for further consideration. As an example, from Table 3 above, using the three related indices, the following beliefs were identified in the top four for importance at least twice:

- *SDD increases antibiotic resistance*
- *The risks of SDD outweigh the benefits*
- *Overall, SDD benefits the patients to whom it is delivered*
- *Overall, SDD is cost effective*

In any intervention that aimed to alter clinicians' attitudes to SDD, it would thus be appropriate to target these specific beliefs. It is worthy of note that, while it could appear that the second and third beliefs in the above list are essentially the same, they were actually different for the clinicians in this sample, who distinguished between individual patients and patients collectively. Many reported that, although SDD could benefit the individual patient, they felt that there was an unacceptable risk of the development of antibiotic resistance among patient populations as a whole if SDD were delivered to some individuals.

This study had a number of strengths. First, in a diverse multinational, multi-professional panel of clinicians responsible for the care of patients in ICUs, there was a relatively high level of participant retention. The parallel use of the same methods for data collection and analysis across three continents and different health systems yielded similar patterns of data, suggesting that the findings are robust across different healthcare contexts. However, the specific topic investigated (the use of SDD in intensive care) may have particular features that could limit the generalisability of the specific findings (e.g., with respect to one belief consistently

emerging as most important). Nonetheless, the findings relating to methods for assessing the importance of attitudinal beliefs appear robust.

Since the introduction of evidence-based health care, clinical guidelines, frequently developed using Delphi methods to obtain expert consensus, have become a major approach to trying to influence healthcare practice. For example, the National Institute for Health and Clinical Excellence (NICE) in England, the Scottish Intercollegiate Guidelines network (SIGN), and Australia's National Health and Medical Research Council all produce evidence-based guidelines that aim to prioritise and direct changes in healthcare practice. Hence, the identification of important beliefs may influence the practice of evidence-based health care as well as being central to behavioural research. Assessment of the validity of importance ratings is thus necessary to judge the validity of this methodology to develop clinical guidelines as well as the likely success of behaviour change interventions.

Thus, the question of which methods are valid for identifying belief importance has significant implications. Further research could take this approach a step further by assessing the extent to which guidelines or interventions that are based on 'important' beliefs (identified using these different methods) are effective in changing practice recommendations, attitudes, intentions or behaviour.

Conclusion

To our knowledge this is the first study to test congruence of four methods for assessing the importance of beliefs in determining attitude: frequency of elicitation or modal salience; importance ratings; bivariate prediction and multivariate prediction. Importance ratings were strongly related to both frequency of elicitation and bivariate correlation. However, studies usually select a few 'most important' beliefs for further investigation or for intervention design. In this study, each of the four measures of

importance gave a different set of the four most important beliefs. Based on these findings, identification of important attitudinal beliefs for intervention design should not use a singular approach and should not rely on the multiple regression approach as the method of choice.

References

Abraham, C., & Michie, S. (2008). A taxonomy of behavior change techniques used in interventions. health psychology. *Health Psychology, 27*, 379-387. doi: 10.1037/0278-6133.27.3.379

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179-211.

Akins, R. B., Tolson, H., & Cole, B. R. (2005). Stability of response characteristics of a delphi panel: Application of bootstrap data expansion. *BMC Medical Research Methodology, 5*, 37. doi:10.1186/1471-2288-5-37

Asch, S. (1955). Opinions and social pressure. *Scientific American, 193*, 31-35.

Bartholomew, L. K., Parcel, G. S., & Kok, G. (1998). Intervention mapping: A process for developing theory- and evidence-based health education programs. *Health Education and Behavior, 25*, 545-563. doi:10.1177/109019819802500502

Cooksey, R. W. (1996). *Judgement analysis: Theory, methods and applications*. London: Academic Press.

Cuthbertson, B. H., Francis, J., Campbell, M. K., MacIntyre, L., Seppelt, I., &

Dalkey, N. C. (1969). *The delphi method: An experimental study of group opinion*. Santa Monica, California: RAND.

D'Zurilla, T. J., & Nezu, A. (1998). A study of the generation-of-alternatives process in social problem solving. *Cognitive Therapy and Research, 4*, 67-72. doi:10.1007/BF01173355

Erffmeyer, R. C., & Erffmeyer, E. S. (1986). The delphi technique: An empirical evaluation of the optimal number of rounds. *Group & Organization Management, 11*, 120-128. doi: 10.1177/105960118601100110

Evans St., J. B. T., Harries, C., Dennis, I., & Dean, J. (1995). General practitioners' tacit and stated policies in the prescription of lipid lowering agents. *British Journal of General Practice, 45*, 15-18. PMCID: PMC1239107

Fazio, R. H. (1989). On the power and functionality of attitudes: The role of attitude accessibility. *Attitude, structure and function*. Hillsdale, NJ: Erlbaum.

Fazio, R. H., Powell, M. C., & Williams, C. J. (1989). The role of attitude accessibility in the attitude-to-behaviour process. *J Consumer Research, 16*, 280-288. doi: 10.1086/209214

Fink, A., Kosecoff, J., Chassin, M., & Brook, R. H. (1984). Consensus methods: Characteristics and guidelines for use. *Am J Public Health, 74*. 979-983. doi: 10.2105/AJPH.74.9.979

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior : An introduction to theory and research.* Reading, Mass: Addison-Wesley.

Fitch, K., Bernstein, S. J., Aguilar, M. D., Burnand, B., LaCalle, J. R., Lázaro, P., . . . Kahan, J. P. (2000). *The RAND/UCLA appropriateness method user's manual* RAND Europe, RAND Health.

Foy, R., Francis, J. J., Johnston, M., Eccles, M., Lecouturier, J., Bamford, C., & Grimshaw, J. (2007). The development of a theory-based intervention to promote appropriate disclosure of a diagnosis of dementia. *BMC Health Services Research, 7*, 207. doi: 10.1186/1472-6963-7-207

Francis, J. J., O'Connor, D., & Curran, J. (2012). Theories of behaviour change synthesised into a set of theoretical groupings: Introducing a thematic series on the theoretical domains framework. *Implementation Science, 7,* 35. PMID: 22531601

French, S. D., Green, S. E., O'Connor, D. A., McKenzie, J. E., Francis, J. J., Michie, S., . . . Grimshaw, J. M. (2012). Developing theory-informed behaviour change interventions to implement evidence into practice: A systematic approach using the theoretical domains framework. *Implementation Science,7*, 38. doi:10.1186/1748-5908-7-38

Higgins, E. T., King, G. A., & Mavin, G. H. (1982). Individual construct accessibility and subjective impressions and recall. *Journal of Personality and Social Psychology, 43*, 35-47. doi: 10.1037/0022-3514.43.1.35

Hunter, D. J. W., McKee, C. M., Sanderson, C. F., & Black, N. A. (1994). Appropriate indications for prostatectomy in the UK – results of a consensus panel. *Journal of Epidemiology & Community Health, 4*, 58-64. PMCID: PMC1059896

Janis, I. (1972). *Victims of groupthink: A psychological study of foreign-policy decisions and fiascos.* Boston: Houghton-Mifflin.

McKenzie, J. E., French, S. D., O'Connor, D. A., Grimshaw, J. M., Mortimer, D., Michie, S., . . . Green, S. E. (2008). IMPLEmenting a clinical practice guideline for acute low back pain evidence-based manageMENT in general practice

(IMPLEMENT): Cluster randomised controlled trial study protocol. *Implementation Science., 3*, 11. doi:10.1186/1748-5908-3-11

Michie S. Johnston M. Abraham C. Lawton R. Parker D. Walker A. (2005). Making psychological theory useful for implementing evidence based practice: A consensus approach. *Quality & Safety in Health Care, 14*, 26-33. doi:10.1136/qshc.2004.011155

Michie, S., Johnston, M., Francis, J. J., Hardeman, W., & Eccles, M. P. (2008). From theory to intervention: Mapping theoretically derived behavioural determinants to behaviour change techniques. *Applied Psychology: An International Review, 57*, 660-680. DOI: 10.1111/j.1464-0597.2008.00341.x

Murphy, M. K., Black, N. A., Lamping, D. L., McKee, C. M., Sanderson, C. F., Askham, J., & Marteau, T. (1998). Consensus development methods, and their use in clinical guideline development. *Health Technology Assessment (Winchester, England), 2*, 1-88. DOI: 10.4135/9781848608344

Myers, D. G., & Lamm, H. (1975). The polarizing effect of group discussion. *American Scientist, 63*, 297-303. doi.org/10.1016/0022-1031(78)90049-5

Steadman, L., & Rutter, D. R. (2004). Belief importance and the theory of planned behaviour: Comparing modal and ranked modal beliefs in predicting attendance at breast screening. *British Journal of Health Psychology, 9*, 447-463. DOI: 10.1348/1359107042304579

Sutton, S., French, D. P., Hennings, S. J., Mitchell, J. O., Wareham, N. J., Griffin, S., . . . Kinmonth, A. L. (2003). Eliciting salient beliefs in research on the theory of planned behaviour: The effect of question wording. *Current Psychology, 22*, 234-251. doi: 10.1007/s12144-003-1019-1

Zimbardo, P. G., & Leippe, M. R. (1991). *The psychology of attitude change and social influence. McGraw-hill series in social psychology.* New York, NY: McGraw-Hill Book Company.

Table 1: Four methods for assessing belief importance

Method	Approach	Underlying assumption	Measure
Elicitation	Modal Salience	Cognitive accessibility – how readily an issue comes to mind reflects its importance for influencing attitudes and behaviour	Frequency of interviews in which the belief is mentioned
Self-report	Expectancy-value	Individuals can accurately rate the importance of their own beliefs for influencing attitudes and behaviour	Means of importance ratings for each belief, generated from participants' questionnaire responses
Bivariate prediction	Judgement analysis	Prediction is an indicator of the beliefs most likely to exert causal influence on attitudes and behaviour	Pearson's correlation coefficients between agreement ratings for each specific belief and measure of global attitude#
Multivariate prediction	Judgement analysis	Prediction is an indicator of the beliefs most likely to exert causal influence on attitudes and behaviour. The relative importance of beliefs is best judged by considering all beliefs together in one analysis	Beta-weights in a multiple linear regression to predict measure of global attitude#

Measure of global attitude:

Table 2. Frequencies of coding of 14 beliefs in 105 interview transcripts.

Item Wording	**Number of interviews where belief coded**		
	UK (n=38)	**ANZ (n=32)**	**CA (n=35)**
There is no mortality benefit associated with SDD	12	17	18
The risks of SDD outweigh the benefits	11	15	6
SDD reduces VAP	16	17	21
SDD reduces length of stay	6	8	7
Overall SDD benefits patients	23	13	11
SDD increases nursing workload	8	13	19
SDD increases pharmacy workload	1	1	6
SDD increases antibiotic resistance	32	32	29
SDD causes unpleasant side-effects for patients	7	7	4
SDD reduces Hospital Acquired Infections	22	15	8
I am opposed to the IV component of SDD	2	9	9
SDD would increase ICU *Clostridium difficile* infections	4	2	11
Overall, SDD is cost effective	21	30	13
Educating staff would be expensive	1	2	1

Note. The beliefs listed here present the *content* elicited in Round 1 interviews but in many cases there was variation in the *direction of the belief* (for or against SDD).
SDD = Selective Decontamination of the Digestive Tract; VAP = Ventilator Associated Pneumonia; IV = Intravenous; ICU = Intensive Care Unit, UK = United Kingdom; ANZ = Australia and New Zealand; CA = Canada

Table 3. Importance of attitudinal beliefs: four methods presented in rank order from most to least frequently coded in interviews (n = 105) together with semi-partial correlations to assist with interpreting beta-weights.

Belief	Frequency	Mean importance rating (1 - 9)	[a]Pearson's correlation	[b]Beta-weight	Semi-partial correlation
SDD increases antibiotic resistance	**93**	**8.00**	**0.54*** **	**0.26***	0.17
Overall, SDD is cost effective	**64**	6.52	**-0.43*** **	-0.09	-0.07
SDD reduces VAP	**54**	6.76	-0.14	0.07	0.06
Overall, SDD benefits the patients to whom it is delivered	**47[c]**	6.96	**-0.48*** **		-0.19
There is no mortality benefit associated with SDD	**47[c]**	6.91	0.33**	0.09	0.08
SDD reduces Hospital Acquired Infections	45	**7.10**	-0.31**	-0.04	-0.03
SDD increases nursing workload	40	5.54	0.09	-0.15	-0.12
The risks of SDD outweigh the benefits	32	**7.11**	**0.48*** **	0.14	0.10
SDD reduces length of stay	21	6.48	-0.13	0.02	0.02
I am opposed to the IV component of SDD	20	6.47	0.37***	**0.16**	0.13
SDD causes unpleasant side-effects for patients	18	5.93	0.20*	-0.07	-0.06
SDD would increase ICU *Clostridium difficile* infections	17	**7.24**	0.36***	0.01	0.01
SDD increases pharmacy workload	7	4.93	0.17	**0.22***	0.17
Educating staff would be expensive	4	4.98	0.21*	0.10	0.09

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

Note. In each column, the four most important beliefs are presented in bolded font. SDD = Selective Decontamination of the Digestive Tract; VAP = Ventilator Associated Pneumonia; IV = Intravenous; ICU = Intensive Care Unit

[a] Correlation between item and score on the global attitude item, *I am opposed to SDD.*

[b] From a multiple regression to predict score on the global attitude item, *I am opposed to SDD.*

[c] Equal 4th ranking

Table 4. Correlations on ranks of four indices of belief importance (p values in brackets).

	1	2	3	4
1. Frequency of elicitation	-			
2. Importance ratings	0.54 (0.047)	-		
3. Pearson correlations	0.39 (0.169)	0.66 (0.010)	-	
4. Beta weights	0.21 (0.474)	-0.12 (0.681)	0.42 (0.140)	-

Note. 1. Frequency of elicitation in interviews; 2. Participant-rated importance (on 9-point Likert scales); 3. Pearson correlation with global attitude score; 4. Beta weights in multiple regression to predict global attitude score.
The absolute values of Pearson and Beta estimates were used.

Figure 1. Example screen shot from the Round 2 materials (items to measure agreement and importance).

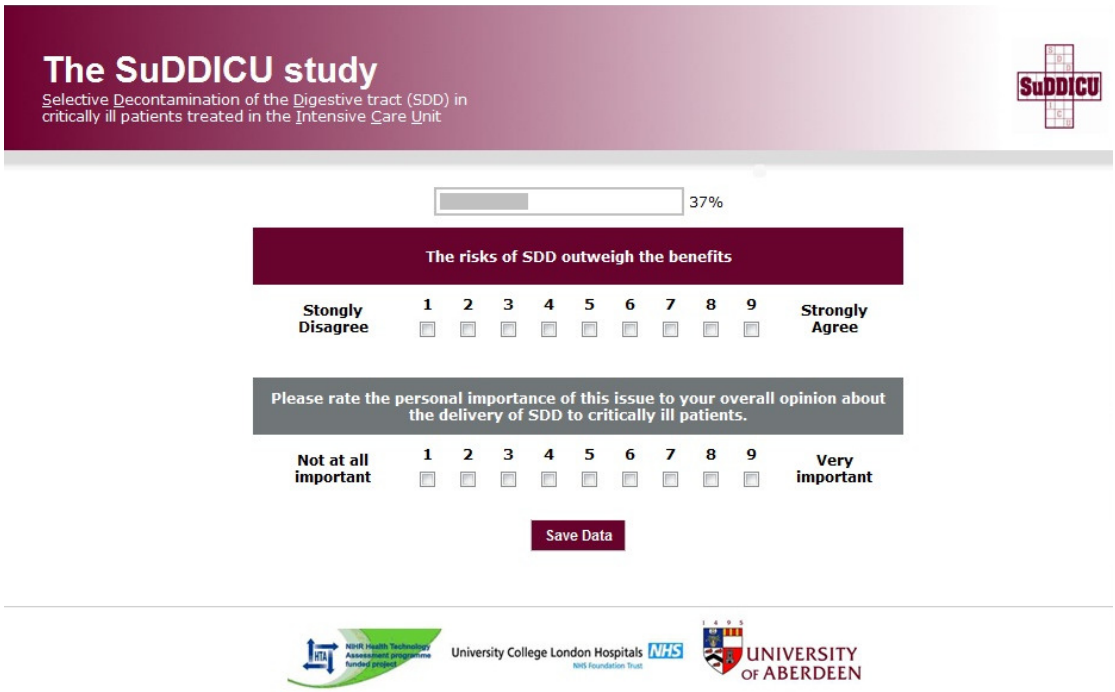
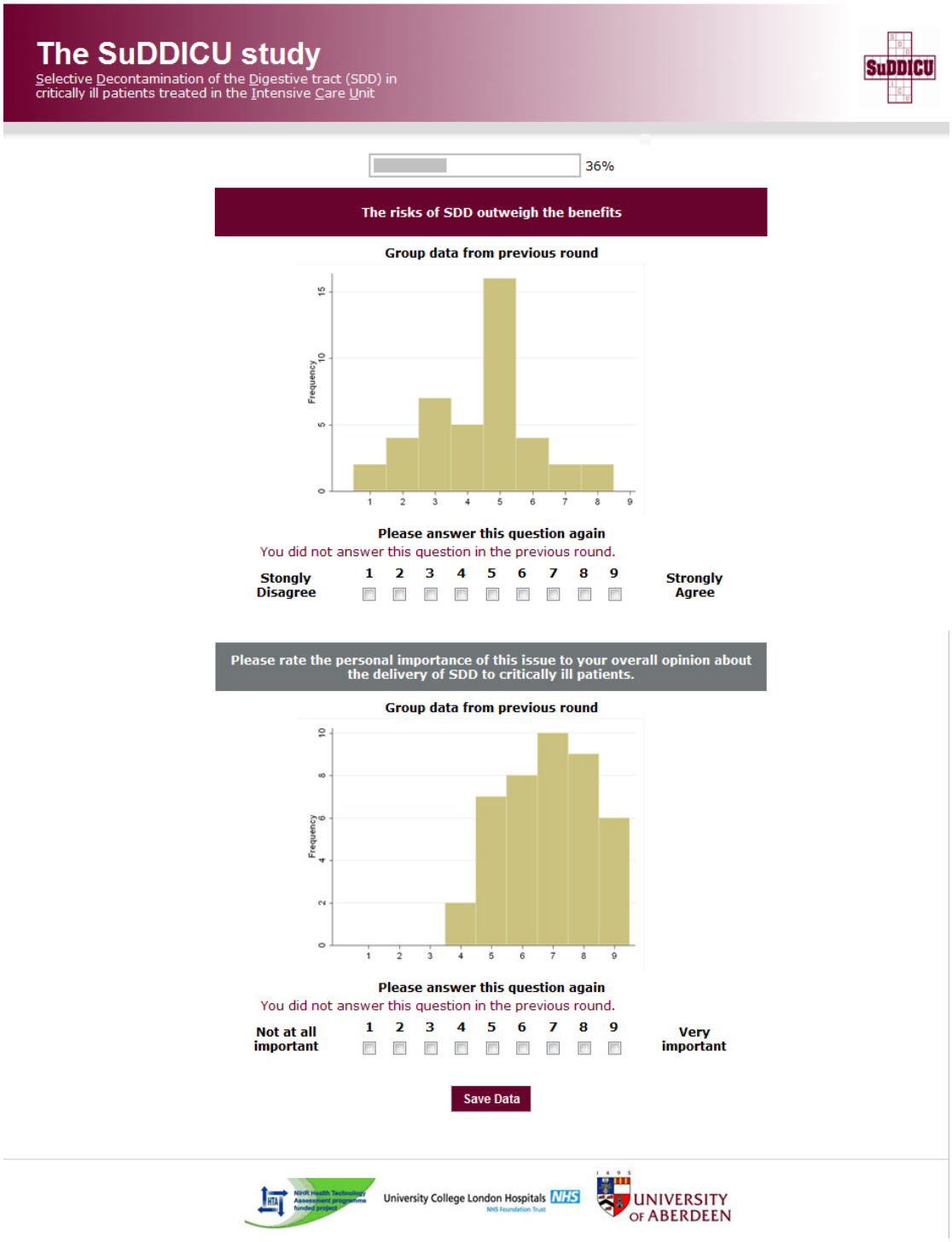


Figure 2. . Example screen shot from the Round 3 materials (anonymised group-level, and individual-level, feedback; items measure agreement and importance).



APPENDIX: Delphi study interview topic guide exploring delivery of SDD to patients in the Intensive Care Unit

Shaded cells present alternative questions for participants whose ICU delivers SDD.

Domain	Core Question	Possible Prompts
Knowledge	In your view, what are the components of SDD?	What are the possible variations in these components?
	What are the components of SDD as they are delivered in your unit? Do you know about the unit SDD protocol?	What does the protocol say?
Have I understood you correctly that SDD involves the application of antibiotic pastes to the mouth, throat and stomach and a short course of intravenous antibiotics for the purpose of prophylaxis? [If no: *There is variation in what people consider to be SDD. For the purpose of this interview, would it be possible to think about SDD as the application of antibiotics in three ways; orally, to the mouth and throat, gastric application to the stomach and a short course of IV antibiotics*]		
General	Is SDD delivered in your ICU?	What would you say is the main reason?
Motivation and goals	How important is the issue of SDD for you?	How does it fit with other priorities in the ICU? Is its priority for you related to your assessment of the evidence?
Professional role and identity	Do you sense whether there is general consensus in your profession about SDD?	What is the range of views?
		How does SDD fit with your own professional standards?
Emotion	Does anyone you work with have strong feelings about SDD?	(If Yes) Have you got a sense why they feel strongly about SDD?
Social influences	Would you say that your opinion on providing SDD has been influenced by your colleagues?	(If Yes) In what way? (If No) Why not?
Behavioural regulation	What else are you doing to prevent new infections in your unit? What would need to happen in order to adopt SDD in your Unit?	How would implementation of the protocol be monitored? If the decision was not to adopt SDD, what alternative procedures might you use instead?
	How is implementation of the SDD protocol monitored?	Are there procedures or ways of working that make it easier or more efficient to deliver SDD?
Beliefs about consequences	What would be *(are)* the benefits and downsides, of delivering SDD over and above what you are doing now? (I'm thinking of clinical outcomes but also financial costs, time, staff resources and so on.)	What about the bigger picture. What might be the short/medium-term benefits and downsides compared to longer term consequences? Are there consequences of using SDD in ICU that may affect other patients in the ICU or hospital?
Skills	Are there any specific skills needed for delivering SDD?	Do you think members of your profession have these skills? (Would training be needed to deliver SDD?)
Nature of the Behaviour	How difficult would SDD be in comparison to what you are doing already?	Do you think the complexity is an important barrier to adoption?

	Are the behaviours that make up SDD performed often enough to become routine?	Is SDD well embedded within the daily routines of the unit?
Environmental context and resources	What additional resources would *(does)* your Unit need in order to deliver SDD?	Any other resources?
		To what extent is the delivery of SDD influenced by physical or resource factors?
Beliefs about capabilities	How much influence do you personally have over whether or not your Unit adopts SDD?	Do you have responsibility for instigating changes?
	How difficult or easy is it for you to do the things that you are required to do as part of SDD delivery?	What problems have you encountered? What would help them?
Decision processes	How would you go about seeking agreement among your colleagues about whether or not to adopt SDD in your Unit?	How about individual clinical decisions - What would you consider when making the clinical decision whether or not to administer SDD to an individual? In which patient groups would you **not** administer SDD?
	What would you consider when making the clinical decision to administer SDD to an individual?	In which patient groups would you **not** administer SDD?
Further research	Do you think that further research would settle some of the issues surrounding SDD?	What type of research study do you think would be most informative for the future of SDD practice? Is further research ethical? Why? Or why not?
Secondary focus 1: Participation in an effectiveness trial	The purpose of this study is not to recruit you to a trial but if there was a study which randomised patients to a SDD group against a no-SDD control group would you be willing to recruit patients?	Why? Or why not?
Secondary focus 2: Participation in implementation trial	If there was a study whose aim was to increase adoption of SDD in ICUs nationwide would you be willing to participate?	Why? Or why not?
Other	Is there anything else that you want to say that you haven't mentioned yet?	What do you think is the current state of the evidence about SDD? Any other ethical matters?
Questions for describing sample	What ICU do you work in? How many beds are there in the ICU? How many years' experience do you have (within ICU/professional)?	