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TITLE: Protocol for a mixed-methods study to develop a Core Outcome Set for assessing interventions and care for parents after neonatal death in high income countries (iCHOOSE Neonatal study)

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ABSTRACT

Introduction: Neonatal death exerts long lasting impact on parents' mental health, finances and relationships, and the wider family. There is national and international momentum to evaluate interventions to support parents after the death of a baby. Core Outcome Sets provide a minimum set of outcomes, agreed by stakeholders to be important, that should be evaluated in all studies to support evidence syntheses and identification of the most effective interventions. We aim to develop a Core Outcome Set (COS) for assessing interventions and care after neonatal death in high income countries, to support future evidence syntheses and enable identification of effective interventions and care for parents.

Methods and analysis: We will develop the COS in 6 phases. A parent involvement group and stakeholder steering committee have been established and have informed each planned phase: 1) Systematic review of quantitative studies evaluating care and interventions provided after neonatal death, to describe interventions, outcomes, and outcome measurement tools used to assess intervention effectiveness; 2) Qualitative interviews with parents who have experienced neonatal death to identify outcomes important and relevant to them; 3) Think-Aloud interviews with stakeholders (bereaved parents, healthcare professionals and other stakeholders) to develop and refine an online survey; 4) Real-Time online international Delphi survey with bereaved parents, healthcare professionals and other stakeholders to shortlist outcomes for consideration in the COS; 5) Adapted nominal group online consensus meetings with parents, healthcare professionals and other stakeholders to agree final COS; 6) Identification of a preliminary set of measurement tools.

Ethics and dissemination: Ethical approval has been granted for all activities to be undertaken by the University of Bristol Health Sciences Faculty Research Ethics Committee (reference: 15121). We will disseminate the findings via peer-reviewed publications and relevant academic and professional conferences.

Registration: This COS has been registered on the COMET database.[1] The systematic review has been registered on the PROSPERO database (CRD42020151365).[2]

Strengths and limitations of this study

- We will systematically identify potentially relevant care outcomes from international randomised controlled trials and observational studies.
- We will identify additional relevant outcomes using qualitative interviews with parents with a range of pregnancy, neonatal and bereavement experiences.
- We will use a robust and inclusive consensus process involving bereaved parents, healthcare professionals and other stakeholders to identify the most important outcomes relevant to care after neonatal death for parents.
- The findings of this study will be limited to studies undertaken in high income contexts, and require further investigation about their applicability to upper-middle, lower-middle, and low income contexts.

INTRODUCTION

In 2021, there were 2004 neonatal deaths in the UK [3] and in 2022 2.3 million children died in the first 20 days of life worldwide.[4] Neonatal death has been defined in the UK and internationally as the death of a live born infant within the first 28 completed days of life,[5, 6] with some defining neonatal deaths as those occurring in babies born after 20 completed weeks' gestation.[5] Parents who experience the death of a baby at or soon after birth report grief and distress, negative impacts on family relationships, and economic burden.[7] Clinicians working in neonatal and obstetric settings and providing care to neonates that die experience negative impacts including stress, poor mental health, and a perceived lack of preparedness.[8, 9]

The UK National Bereavement Care Pathway[10] and international guidelines for perinatal death care[11, 12] [13] highlight the importance of good communication, continuity and consistency of care, and parent-led family involvement following neonatal death. Support and care interventions for parents recommended within guidelines include holding and making memories with their baby, investigations to identify the cause of death, psychological support and clinical and psychological care in a subsequent pregnancy.

There is national and international momentum to design and test interventions to improve perinatal bereavement care.[14, 15] A Cochrane review exploring the effectiveness of bereavement interventions after neonatal death has identified a dearth of studies in this area, with only three potentially relevant studies identified, all of which were excluded from the review due to poor quality evidence.[14] The authors highlight a need for trials to address the lack of evidence about the benefits and potential harms of support interventions for these parents.

There are challenges in conducting randomised controlled trials (RCTs) in this area, because of the limited incidence of neonatal death in the high income countries in which RCTs are frequently undertaken, and potential lack of equipoise. Therefore, it is vital that robust research findings, even if observational, can be combined in high-quality meta-analyses. However, systematic reviews in the perinatal death and neonatal care domain report challenges with synthesising the evidence, due to heterogeneity of interventions tested, of outcomes evaluated, and of outcome measurement tools used; a recent review of outcomes evaluated in relation to care after stillbirth identified 391 unique outcomes involving 24 measurement instruments,[16] and a review of outcomes in studies investigating neonatal care interventions identified 104 unique outcomes.[17] It is anticipated that it will be difficult to synthesise the

evidence for care interventions to support parents following neonatal death, given that this variation is likely to exist.

Core Outcome Sets (COS) address this heterogeneity and facilitate evidence syntheses by specifying a minimum set of 'core' outcomes to be reported in all studies within a given domain, identified through a consensus process between healthcare professionals, other stakeholders (e.g. researchers and charity representatives) and patients.[18, 19] The involvement of patients in selecting these outcomes is vital, to ensure that they are meaningful and relevant to their experiences.[20] COSs have been developed or are being undertaken for stillbirth prevention interventions,[21] stillbirth care,[22] neonatal palliative care,[23] and neonatal care.[17] A COS for assessing care interventions to support parents after neonatal death, informed by the views of professionals and bereaved parents, will improve the quality of future evidence syntheses.

AIM

We aim to develop a COS for assessing interventions and care after neonatal death in high income countries, with the involvement of parents, healthcare professionals and other stakeholders.

OBJECTIVES

We will:

i) Systematically identify interventions evaluated, outcomes measured and measurement tools used in studies evaluating interventions and care after neonatal death.

ii) Undertake qualitative interviews with bereaved parents to identify outcomes that are important and relevant to them.

iii) Develop and refine a survey for parents, professionals and other stakeholders to establish candidate outcomes for a COS using think-aloud interviews.

iv) Achieve consensus between parents, healthcare professionals and other stakeholders on a COS for assessing interventions and care after neonatal death using an online Delphi survey and consensus meetings.

v) Identify and map a preliminary set of outcome measurement tools from the systematic review to outcomes selected within the Delphi consensus.

METHOD

This protocol has been developed with reference to the COS-Standards for Development (COS-STAD)[24] and reported using the COS-Standards for reporting COS Protocols (COS-STAP; supplementary file 1).[25]

COS methodology

We will follow the method described in the COMET handbook[26] and draw upon methods described in published COS studies. This COS has been registered on the COMET database.[1]

Public and parent involvement

Parent and Public Involvement (PPI) is integral to this COS. A stakeholder engagement group has been convened comprising bereaved parents with experience of neonatal death (representing singleton and twin pregnancies) and professional stakeholders (clinicians, researchers, charity representatives and policy makers). A parent representative has contributed to the development of this protocol (LW). We will work with Sands (Stillbirth and Neonatal Death charity) and the Women's health Research Engagement Network in Bristol (WREN) to achieve engagement of under-represented parents from minoritised ethnicities, low income households, and younger parents. Parents, healthcare professionals and other stakeholderswill support project management as representatives on the study steering committee, inform the development of study materials relevant to the research phases described below, and support dissemination activities, including developing lay summaries of findings. It is expected that PPI will be limited to the UK in the initial stages of the project. However, it is anticipated that parents from high income countries outside of the UK will become involved in PPI activities once the research is advertised more widely through international networks.

Scope of the COS

The scope of this COS is described in table 1 below.

Programme of work

Six phases of work will be undertaken to develop the COS, presented in figure 1. Phases one and two commenced in 2023 and are not yet completed. The anticipated project completion and reporting date is the end of 2025.

Table 1: Scope of the COS

Context	For use in all research relating to care after neonatal death (e.g. randomised controlled trials, observational studies, systematic reviews). It could also be used to evaluate clinical practice guidelines, care pathways and training for healthcare professionals, and could be considered for use in clinical practice, for example in clinical follow-up consultations.

Health condition and population	The core outcome set will be applicable to families who have experienced a neonatal death in a singleton or multiple pregnancy. We have defined neonatal death as the death of a live-born baby after 20 weeks gestation and occurring up to and including 28 days after birth.[5] However, feedback from parents and professional stakeholders during PPI activities has indicated that an approximate timescale is appropriate to ensure that the experiences of parents whose baby died within a few days of this cut-off are accounted for within this research. We intend this COS to be relevant to care in high income countries (HIC). It could be of relevance to care in upper-middle (UMIC), lower-middle (LMIC) and low income (LIC) countries, however, further work will be needed to establish its appropriateness in these contexts.
Interventions	Any intervention providing support/care to parents and families following neonatal death. There will be no limit to the intervention type or setting. Interventions are expected to be medical and psychosocial, and may include, but not be limited to: offer of post-mortem; bereavement counselling and psychological support and medical care in a subsequent pregnancy. They will be interventions delivered to parents at any point after the death, from immediately after to many years post-bereavement.

Phase 1: Systematic review of outcomes and outcome measurement tools

Aim

To conduct a systematic review of RCTs and observational studies investigating the impact of interventions to provide support and care to parents and the wider family after neonatal death, to develop a long-list of outcomes assessed and the measurement tools used to assess them.

Method

A systematic review will be undertaken.

Protocol registration

The protocol for this review is registered on PROSPERO (registration no: CRD42020151365 [2]).

Study identification

We will identify randomised controlled trials (RCTs) and observational studies meeting the population, intervention, control and outcome (PICO) criteria[27] described below. These criteria will inform the

search strategy and will be used to select studies for inclusion in the review. We will search for studies meeting the following criteria:

Study design: We will include randomised controlled trials, non-randomised comparative studies with a control group, and non-comparative studies (e.g. observational, cross-sectional, case-control studies) reported in English. We will exclude evidence syntheses, case reports, abstracts, protocols and qualitative studies.

Population: We will include studies in which an intervention targets parents (mothers and fathers), siblings (including siblings from a multiple pregnancy) and grandparents where neonatal death has occurred following a singleton or multiple pregnancy. Neonatal death will be defined as death occurring in a live born infant, born after 20 completed weeks gestation, and dying within (and including) 28 days of life. We will include studies from all income contexts. We will exclude studies of families where there has been a stillbirth, miscarriage or termination of pregnancy, or loss of the pregnancy before 20 weeks gestation. We will exclude studies involving healthcare professionals as the intervention target.

Intervention: We will include studies evaluating an intervention/s which aims to provide support/care to families after neonatal death. This is expected to include but not be limited to interventions to understand the cause of death (e.g. postmortem, hospital review), support interventions such as bereavement care, counselling, social support, and interventions to provide healthcare and psychological support prior to and during a subsequent pregnancy. There will be no time limit on when interventions are deployed to families after the death, we will include those delivered within days, weeks, months or many years post-bereavement. We will exclude interventions delivered to the baby prior to death, and histopathological or mechanistic molecular studies where the aim is not to identify cause of death.

Control: We will include studies with any control group (differing care, historic or contemporaneous cohort) or studies with no comparison group.

Outcomes: We will include studies assessing any outcome with the aim of establishing the effectiveness or experience of support and care provided to parents and the wider family after neonatal death . These are expected to include but not be limited to: physical and mental health, satisfaction with care, economic outcomes, understanding of the cause of death, clinical outcomes in a subsequent pregnancy. We will exclude studies that do not report an outcome relating to care and support after neonatal death.

Search

A systematic search based on these PICO criteria has been developed with the support of a Medical Subject Librarian, using free text terms and identified Medical Subject Headings (MeSH) for application in six electronic databases (Medline, Embase, Amed, BNI, CINAHL, PsychINFO), Cochrane Reviews and two trial registries(Cochrane Register of Controlled Trials, ClinicalTrials.gov). See supplementary file 2 for search strategies.

The search is limited to the last 25 years from January 1999 to January 2024, to ensure that identified studies reflect recent and contemporaneous care practices. Study designs are limited to RCTs and observational studies, those published in the English language, and involving human subjects or clinical samples taken for the purposes of post-mortem. Protocols, pilot studies and conference abstracts will be excluded since they are unlikely to contain adequate data to extract.

Data screening and extraction

Citations will be downloaded into Covidence.[28] Titles and abstracts will be screened independently by two authors against the inclusion criteria, with a third reviewer resolving disagreements where necessary. Full texts of retained citations will be downloaded and screened in duplicate. A standardised, piloted data extraction form will be used to extract data on: publication details (author and date of publication); study setting; study population; details of intervention/care; study methodology; outcomes identified; outcome measurement tool/s; timing of outcome measurement; data reporting or referencing measure validity and reliability; patient and public involvement.

Risk of bias

In a variation to the registered protocol, we will not assess risk of bias, since this review does not aim to synthesise findings relating to intervention effectiveness.

Data Analysis

The systematic review will be reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[29] Study characteristics will be tabulated, summarised and presented as interventions evaluated, outcomes assessed and measurement tools.

Outcome inventory

A comprehensive outcome inventory will be developed from the extracted data. Outcomes will be listed verbatim, and true duplicate outcomes will be identified and agreed by two or more researchers, resulting

in a list of unique outcomes.[30] Duplicates are outcomes described using the exact same terms, or in such a way that they are obvious duplicates (e.g. agreement to post-mortem, uptake of post-mortem).

Outcomes will be organised into domains to support presentation and development of the Delphi survey (phase 3). Domains are '*broad concepts that group individual outcomes together'*.[30] For example, unique outcomes such as anxiety, depression, post-traumatic stress disorder could be grouped under a 'mental health' domain. We will use the domains developed within the stillbirth outcomes systematic review,[16] and will add or alter domains if outcomes do not group easily within them. Decisions about domain labels and allocation of outcomes to them will be agreed between at least two senior researchers (AD, DB, LM), with PPI and professional stakeholder input.

Measurement inventory

An inventory of the measures used to assess each unique outcome will be developed, to inform identification of potential tools that could be applied to measure outcomes in the agreed-upon COS. Data relating to their psychometric properties will be extracted where reported.

Phase 2: Qualitative interviews to identify outcomes that are important to bereaved parents

Aims

We aim to explore which outcomes are important to parents, to identify potentially novel outcomes not identified in the systematic review, and those outcomes that parents consider important to measure when evaluating the impact of interventions to improve care after neonatal death.

Method

We will undertake individual and paired (couple) semi-structured qualitative interviews with bereaved parents. The COnsolidated criteria for REporting Qualitative research (COREQ) checklist will be used to report the findings of the qualitative interviews.[31]Participants

We will include parents who have experienced the death of a live-born baby up to approximately 28 days postnatally. We will include parents who have experienced the death of a baby from any pregnancy (singleton or multiple) and who are able to give written, informed consent to take part.

We will exclude parents who meet one or more of the following criteria:

- Whose baby's death has happened beyond the neonatal period (>28 days postnatal).
- Where their baby's death is a possible sudden unexplained death in infancy (SUDI), since care offered to this parent group may differ from that following a neonatal death.
- Where their baby's death has occurred less than six months previously. This exclusion criterion has been agreed with our PPI group to limit distress to parents where it would involve taking part in an in-depth interview during the acute phase after bereavement.
- Who are unable to give informed consent.
- Who are unable to speak English to an adequate standard to be able to take part in a meaningful interview, since funds for interpretation are not available.

Sample Size and recruitment

The number of parents to be recruited is constrained by funding and timeline. We anticipate that a socio-demographically diverse sample of between 20 and 25 participants will result in a range of views and experiences, and may result in no new outcomes emerging (saturation).[32]

We will purposively sample participants for maximum variation relating to multiple/singleton pregnancy, cause of neonatal death (e.g. intrapartum event, congenital anomaly, pre-term birth), ethnicity, educational, socio-economic background, time since neonatal death, type of parent (mothers, fathers, non-birthing parents), and geographic variation within the UK. We will use the UK Standards for Public Involvement[33] to engage parents who are younger, from minority ethnicity groups and lower income households. All participants in this study will reside in the UK due to funding constraints, however phases 3-6 described below will include international participants from high income countries as defined by the World Bank criteria.[34] Since international participants cannot take part in the interviews, they will be given the opportunity to state additional outcomes that they believe have not been identified at the end of the Real-Time Delphi survey described in Phase 4 and these will be incorporated into discussions at the consensus meetings described in phase 5.

We will recruit participants by advertising on social media via national pregnancy and newborn charities (e.g. Sands, Bliss, Tommy's, Bereavement Care UK), online support groups, the PPI group, snowballing through personal contacts, and via community champions in the University of Bristol Women's health Research Engagement Network. Targeted social media advertising will be used for specific groups who are typically underserved in this research area (e.g. minority ethnicity parents, fathers, parents of twins,

same-sex parents). Plain-language participant information will be shared with participants via relevant organisations.

Parents will be invited to express interest via an online form or by emailing the research team. They will be given at least 24 hours to consider the information and ask questions prior to agreeing to participate. Written, informed consent will be taken using an online form and verbally reconfirmed at the start of the interview.

Data collection and analysis

A semi-structured topic guide has been developed with input from the PPI and professional stakeholder group to explore outcomes relating to parents' care experiences (see supplementary file 3 for topic guide).

Interviews will be conducted with couples, or with mothers and fathers/non-birthing parents separately as preferred by the participants. We will conduct the interviews via videoconferencing, telephone, or face-to-face in the participant's home as desired. Interviews will be audio recorded, anonymised and professionally transcribed verbatim. Transcripts will be checked for accuracy against the recording.

Analysis

Concurrent analyses will be undertaken by at least two members of the research team to allow adaptations to the topic guide during the interview period. Analyses will be carried out using an adapted framework approach, described below.[35]

1. *Familiarisation:* At least two researchers will read and re-read each transcript alongside the audio-recording to start identifying early themes.

2. *Identification of the thematic framework:* Transcripts will be coded independently in duplicate. Line by line coding will be carried out to identify outcomes using a deductive (using the outcomes list described in the COS for stillbirth care[16]) and inductive approach to identify unanticipated outcomes and domains.

3. *Indexing:* We will list and group together all potential outcome codes generated in step 2. We will determine whether the grouping and label for each outcome remains appropriate and is consistent with the COS for stillbirth care[16] (if determined a priori), or whether to assign a name to newly identified outcomes.

4. *Charting:* The study team will meet to agree the final coding framework. Two researchers will use it to code all transcripts in NVivo. Disagreements will be discussed and consensus reached with the PI.

5. *Mapping and interpretation:* We will map the coded outcomes and their groupings and compare them with the systematic review outcomes (phase 1) to determine those that are novel.

Phase 3: Outcome inventory, development and Think Aloud piloting of the Delphi survey

Aim

To establish an outcome long list and to pilot and refine a Delphi survey with stakeholder involvement.

Method

We will undertake survey development and Think Aloud interviews to refine an online Delphi Survey.

Outcome long-list and Delphi survey development

The outcomes derived from the phase 2 interviews will be added to the phase 1 systematic review outcomes. They will be organised under the phase 2 domain and outcome groupings by at least two researchers from differing professional backgrounds (e.g. a clinician, a methodologist), with new domains or outcomes agreed and defined where appropriate. Where there is disagreement, a third researcher will adjudicate.

We will draft the Delphi survey outcome items, participant information and consent materials, instructions for users and demographic questions, to ensure all aspects of participation in the Delphi can be trialled. The outcomes will be organised under headings using the agreed domains, and a plain language definition developed for each with support from the stakeholders (including parents) to facilitate comprehension.

Think Aloud survey pilot interviews

We will conduct Think Aloud pilot interviews[36] to improve the survey design. We will use the data from the interviews to refine the Delphi survey to support comprehension and acceptability for stakeholder representatives. Think Aloud interviews were used within the COS for stillbirth care[16] and resulted in important participant-driven survey changes, to increase useability and comprehension.[37] We will examine how parents, healthcare professionals and other stakeholders move through the survey, understand the questions, length of time taken to complete it, and how they respond to the survey items to identify potential barriers to engagement with, and completion of, the survey. It may also reduce items through merging of outcomes within outcome groupings.

Participants and recruitment

We will include parents who have experienced a neonatal death and healthcare professionals/ researchers with subject expertise. We will use maximum variation sampling to ensure representation of parents from a range of sociodemographic groups (mothers, fathers, parents of twins, non-birthing parents, ethnicity, socioeconomic status) and professional stakeholders from a range of disciplines. We will recruit parents, healthcare professionals and other stakeholders across high income countries to ensure that the survey is comprehensible and useable to a range of stakeholders from a range of contexts.

Parents will be able to take part if they:

- Have experienced a neonatal death (defined as death of a neonate up to approximately up to 28 days after birth), and more than six months previously (see inclusion criteria for phase 2 interviews for rationale),
- Are able to give informed consent to participate,
- Speak English to an adequate standard to take part in a meaningful interview,
- Reside in a high income country[34]
- Have adequate internet connectivity to take part in an online interview and screenshare for the Think Aloud task.

Healthcare Professionals and other stakeholders will be able to take part if they are:

- A clinician, charity representative or researcher in neonatal death care,
- Working in a high income country[34]
- Able to give informed consent to participate,
- Able to speak English to an adequate standard to take part in a Think Aloud interview,
- Have adequate internet connectivity to take part in an online interview and screenshare for the Think Aloud task.

Participants will be recruited via social media advertising, supported by charities and professional organisations. We will identify national and international charities and key stakeholders/ researchers identified from the systematic review (phase 1) to support recruitment both within and outside the UK. Participants will be asked to express interest in participating. If more participants come forward than are required, we will purposively sample participants to ensure representation of a broad range of sociodemographic and professional groups.

Sample size

We will interview approximately 12-15 parents, healthcare professionals and other stakeholders. This estimate is based on previously conducted Think Aloud studies.[38] [39] We aim to conduct interviews until no significant new changes to the survey are identified.

Data collection and analysis

Data collection will be iterative; two to four interviews will be conducted after which participants' feedback will be evaluated and incorporated into the Delphi survey. Therefore, the next group of two to four interviewees will use an updated version of the survey.

Participants will take part online using screen sharing, or in person if preferred. They will be asked to carry out the survey as if they were completing it. They will be asked to provide a running commentary on the introductory pages, demographic questions and outcome items as they complete them. The interviewer will use cognitive probes where necessary to ascertain comprehension and understand reasons for responses to the outcomes. Time taken to complete the survey will be recorded.

Transcribed interviews will be rapidly analysed by two independent researchers. We will organise potential changes under the groupings in table 2:

Table 2: Potential changes to Delphi Survey following Think Aloud task

1. Problems identified relating to introductory information, consent and instructions for completion
2. Problems relating to outcome items. These will be categorised as:
   - i) Participant comprehension (e.g. re-read the outcome, misread, reported problem with understanding, answer inconsistent with reasoning,
   - ii) Could not understand response scale,
   - ii) Queries about outcome definition,
   - iv) Queries about placement of outcome under domain/ grouping of outcome within outcome definition,
   - iii) Typographical or formatting errors in survey (e.g. spelling, grammar, incomplete sentence).
3. Overall positive or negative comments
4. Other suggested survey changes

Potential changes will be organised using a Table of Changes, adapted from the Person Based Approach,[40] which is a methodology typically used to develop and refine digital healthcare interventions. The Table of Changes described in this approach provides a transferable method to transparently identify, agree and document changes to the survey in each iteration. This will record suggested changes, ease with which they can be implemented, and importance of implementation. At least two researchers will agree on all changes implemented. A final version of the Delphi survey will be developed once no further significant changes are identified.

Phase 4: Real Time Delphi survey

Aims

To achieve consensus between parents, healthcare professionals and other stakeholders(researchers and charity representatives) about a core set of outcomes to be measured when evaluating care and care interventions for parents after neonatal death.

Method

The Delphi methodology enables all stakeholders to participate in a consensus process which assesses the extent of agreement and resolves disagreement. We will undertake a Real Time Delphi survey[41] using Calibrum's online Real-Time Delphi Survey software.[42] A Real-Time Delphi Survey is undertaken on a single occasion, however participants may revisit their responses as many times as they wish within the survey window. Participants can see other participants' responses to each question while they are completing the survey, in real time, with data aggregated for all respondents, and separated into participant groups (parents versus healthcare professionals/stakeholders). This enables respondents to converge on consensus about which outcomes are important, without the need for multiple survey rounds, thus reducing respondent burden, the potential for attrition between rounds and reducing the amount of time needed to set up and complete the survey for researchers. A previous study has suggested no benefit to using multiple survey rounds due to limited impact change in how individuals scored outcomes.[43] The Real-Time Delphi will be used to reduce the long-list of outcomes into a short-list for consideration in a consensus meeting (Phase 5).

Participants and recruitment

Survey participants will be all stakeholder groups including parents who have experienced a neonatal death, healthcare professionals, charity representatives and researchers Individuals who do not give

informed consent to participate, or are unable to read English to an adequate standard to understand the survey will be excluded. We aim to recruit participants internationally from high income countries as defined by the World Bank Criteria.[34]

Parent participants will be recruited through social media advertising via national and international parent support groups and charities (e.g. Sands, Star Legacy Foundation, Twins Trust, Bliss). Care professionals and researchers will be identified through professional contacts and networks (e.g. British Association of Perinatal Medicine, Royal College of Midwives, Royal College of Paediatrics and Child Health, American Academy of Pediatrics, Australian Paediatric Society). Advertising materials will include a direct link to the survey.

Panel size

There are no accepted guidelines for the optimal sample size to achieve a consensus in Delphi surveys. A previous review of COS studies for pregnancy and childbirth indicated that panel sizes range between 20 and 835.[44] It is important to achieve a representative sample of stakeholders. The assumptions are based on COMET guidelines and previous studies.[19, 26, 45, 46] We aim to recruit a minimum of 100 participants per stakeholder group (parents, professionals/researchers).

The Delphi survey

Before completing the Delphi survey, participants will be asked to consent, register, provide demographic details, and be asked to commit to completing the Delphi and review their responses on at least three separate occasions.

They will be asked to rate each outcome in relation to the extent to which it is important to measure in all research exploring care and care intervention outcomes. A 9-point Likert scale will be used to rate importance, with a score of 1-3 indicating 'limited importance', 4-6 indicating 'important' and 7-9 'critical' for inclusion in the COS. Participants will be able to indicate that they do not have a view about the outcome if they feel they have inadequate knowledge to rate it (score 0). This is to limit spurious answers and prevent non-response to questions.

Participants will be asked to view other participants' responses to each question, for all participants and disaggregated into participant groups (parents, healthcare professionals and other stakeholders). They will be asked to review their response and change it if they wish to. All participants will be asked to review their answers on up to three different occasions before the survey closes, since those completing it at the start of the recruitment period will have less data about others' responses to inform their rating.

Participants will be asked to identify any important additional outcomes that have not been addressed in the Delphi survey using free text responses. The survey will remain open for up to four months.

Analysis

Data will be downloaded and imported into a statistical software package. Data will be included from any participant who has completed the demographic questions and rated at least one outcome.

We will conduct descriptive analyses using counts and percentages, and means and standard deviations, to describe the study sample. The numerator for each outcome will be calculated as the number of respondents providing a response for the outcome, with those not rating it or indicating that they were unable to rate the outcome excluded for that item. We will explore attrition by identifying the number of responses for each outcome and identify the characteristics of those completing versus not completing all survey items.

We will calculate the percentage of participants as a whole and by group (parents, healthcare professionals and other stakeholders) rating each outcome as being of 'limited importance' (1-3), important but not 'critical' (4-6) and 'critically important' (7-9).

An a-priori consensus definition, replicating that of a Stillbirth Meta-COS [47] will be applied to identify which outcomes should be discussed in the consensus meetings (see table 3).

Table 3: Consensus criteria to determine which outcomes are discussed within consensus meeting

Classification and consideration in consensus meeting	**Definition**
Consensus in *Discuss in consensus meeting*	≥70% of participants from the parent and/or professional stakeholder groups rate the outcome as 'critical' to include (7-9) and ≤15% of participants in at least one group score the outcome 'limited importance' (score 1-3);
Consensus out *Present for confirmation as not included in the COS in consensus meeting*	≥50% of participants from either or both stakeholder groups score the outcome as being of 'limited importance' (score 1-3) and ≤15% of participants in at least one stakeholder group score the outcome as 'critical' (score 7-9);
No consensus (equivocal) *Discuss in consensus meeting*	Outcomes not meeting criteria above indicating lack of agreement between participants.

Phase 5: Consensus meetings to agree the final COS

Aims

To establish consensus between parents, healthcare professionals and other stakeholders on a set of core outcomes.

Method

We will hold at least two stakeholder consensus meetings to discuss the outcomes identified from the Delphi survey and prioritise outcomes for the COS. Virtual consensus meetings will be held to enable participation of international participants.

Participants and recruitment

Participants will be parents, healthcare professionals and other stakeholderswho have participated in the Delphi survey, and who have indicated interest in taking part in the consensus meeting at the end of the survey. The study team will invite them via email to the virtual consensus meeting/s. They will be eligible to take part if they are a bereaved parent or a professional and can take part in a virtual meeting.

Panel size

All parents, healthcare professionals and other stakeholders who indicate interest in taking part will be invited, however, it is expected that a smaller group of stakeholders will participate. We aim to achieve participation from a minimum of 8-10 parents, healthcare professionals and other stakeholders respectively.This number is commensurate with consensus group sizes seen in COS studies relevant to pregnancy and childbirth.[44] However, there was participation from over 30 stakeholders, with greater participation from parents compared with healthcare professionals/other stakeholders in our previously developed COS for care after stillbirth.

Consensus meetings

Demographic data and informed consent to participate will be sought using an online form prior to the meeting. Videoconferencing will be used to facilitate attendance, which will be audio recorded and transcribed.

Initial meeting: Parent participants will participate in an initial meeting prior to the main consensus meeting to present the potential outcomes, give them experience of a consensus meeting, and opportunity to discuss their views without the professionals present. These meetings will be sensitively conducted with the support of a bereavement midwife/nurse and a representative from Sands. During the meeting, the participants will identify a spokesperson/people who will ensure that the views of the parent group are voiced in the main consensus meeting. All parents will be invited to attend and participate in the main consensus meeting, however nomination of a spokesperson/people will ensure that parent views are voiced when discussed with healthcare professionals and other stakeholders.*Main consensus meeting:* Parents, healthcare professionals and other stakeholders will participate in the main consensus meeting. A modified nominal group technique will be used to prioritise the consensus outcomes.[48, 49] A member of the COS team will present the Delphi survey results for each group and indicate which have and have not met the criteria for consideration for the COS and those for which there was no consensus (see table 3). They will also present outcomes not included in the Delphi survey that were identified by survey respondents for discussion.

An independent chair will facilitate discussion of each outcome under consideration with support from a co-facilitator, and the parent spokesperson/people will be invited to give the parents' views. All participants will be encouraged to voice their opinions, through both verbal participation in the meeting or through the chat function, which will be monitored Following discussion of each outcome, all attendees

will participate in real-time anonymous voting to decide whether it should be included or excluded from the COS.

A-priori criteria for determining which outcomes are included in the COS will be agreed by the study steering group. It is anticipated that a more stringent criterion of ≥75% of attendees voting for the outcome to be included will result in it being incorporated into the COS, and where ≥75% of attendees vote that it should be excluded it will not. Where there is no consensus, further discussion of the item will take place and a second vote will be undertaken. If no consensus remains the outcome will not be incorporated into the COS.

Phase 6: Identifying preliminary outcome measurement instruments

Aims

To identify a preliminary set of tools to support measurement of the outcomes in the COS.

Method

To ensure that the COS can be implemented quickly, we will take a pragmatic approach. We will identify measurement tools for each outcome included in the COS from the systematic review described in phase 1. However, there may be no outcome measurement tool identified and the process through which to systematically select outcome measurement tools is lengthy and labour intensive.[50] Therefore, we will seek further funding to develop a final Core Measurement Set after the completion of the COS, which will be developed with reference to COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN)[50] guidelines for identifying outcome measurement instruments.

Ethics and Dissemination

Ethical approval for the studies described in the phases above has been granted by the University of Bristol Faculty of Health Sciences Research Ethics Committee (reference: 15121).

The dissemination strategy aims to ensure rapid uptake of the COS to improve research and care for parents following a neonatal death. We will work with professional and patient organisations and charities who support parents who have experienced stillbirth and neonatal death in the UK and internationally. This will include Sands, Child Bereavement UK, Bliss and Twins Trust as well as international organisations (e.g. International Study for the Study and Prevention of Perinatal and Infant Death (ISPID)) to develop and implement the dissemination strategy.

The protocol, systematic review, qualitative interviews, Delphi methodology, and consensus meeting will be published in discipline-specific journals and presented at relevant national and international conferences. We will use Core Outcome Set – STAndards for Reporting (COS-STAR)[51] tool to ensure transparency of methodology for future researchers.

An overview of the COS will be shared with the Core Outcomes in Women's Health (CROWN)[52] and Core Outcome Measures in Effectiveness Trials (COMET) initiatives.

DISCUSSION

This protocol describes the systematic development of a COS to assess interventions and care to support parents and families after neonatal death. Parents, healthcare professionals and other stakeholders will agree on the most important outcomes for inclusion. A COS will reduce heterogeneity of outcome reporting, to facilitate evidence syntheses. This will enable identification of interventions and care that are effective for bereaved parents. Future work should address prioritisation of interventions by stakeholders for evaluation, and to explore the applicability of this COS in upper-middle, lower-middle and low income contexts.

Authors' contributions: (CrediT AUTHOR STATEMENT)

AD: Joint funding acquisition; Writing- original draft; Writing- review and editing

CB, DO, DS, AM, LH, MR, AF, ML, LT, SM, JW: Joint funding acquisition; Writing- review and editing.

MP: Funder representative; Writing- review and editing.

CW, LM, LW: Writing- review and editing.

DB: Conceptualisation; Grant holder - funding acquisition; supervision; Writing- original draft; Writing- review and editing. Danya Bakhbakhi is the guarantor.

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data, or decision to submit results. A representative of the charity will sit on the study steering group and the charity will support recruitment of participants to the studies described above.

Competing interests statement

The authors have no competing interests to declare.

Data availability

No data are generated from this protocol.

Data resulting from the studies described above will be made available via the University of Bristol research repository to bona fide researchers, upon reasonable request and with appropriate ethical approvals and contractual agreements in place.

Figure Legends

Figure 1: Flow diagram of work phases to be undertaken

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