SUPPLEMENTARY FILE 1
Oxford consensus on primary cam morphology and femoroacetabular impingement syndrome. Part 1 and 2 methods

Contents

Dijkstra HP, *et al. Br J Sports Med* 2023; 57:342–358. doi: 10.1136/bjsports-2022-106092

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METHODS

We held a sequential, two-round online Delphi survey and two synchronous online mixed stakeholder group meetings (Interacting Group Process) to explore the level of agreement amongst a panel of experts, on primary cam morphology definitions, terminology, taxonomy, and imaging outcome measures for research, and work towards agreement on a set of research priorities on conditions affecting the young person's hip. The prioritised research statements were further ranked according to the Council on Health Research for Development's Essential National Health Research (ENHR) ranking method. The Delphi and ENHR exercises allowed panel members to participate anonymously to reduce the influence of dominant individuals. [1] Reporting followed the 31-item REporting guideline for PRIority SEtting of health (REPRISE) [2], and the Conducting and REporting DElphi Studies (CREDES) [3].

This comprehensive Methods document combines and extend the methods sections of the two Oxford Delphi consensus papers (Part 1 and 2).

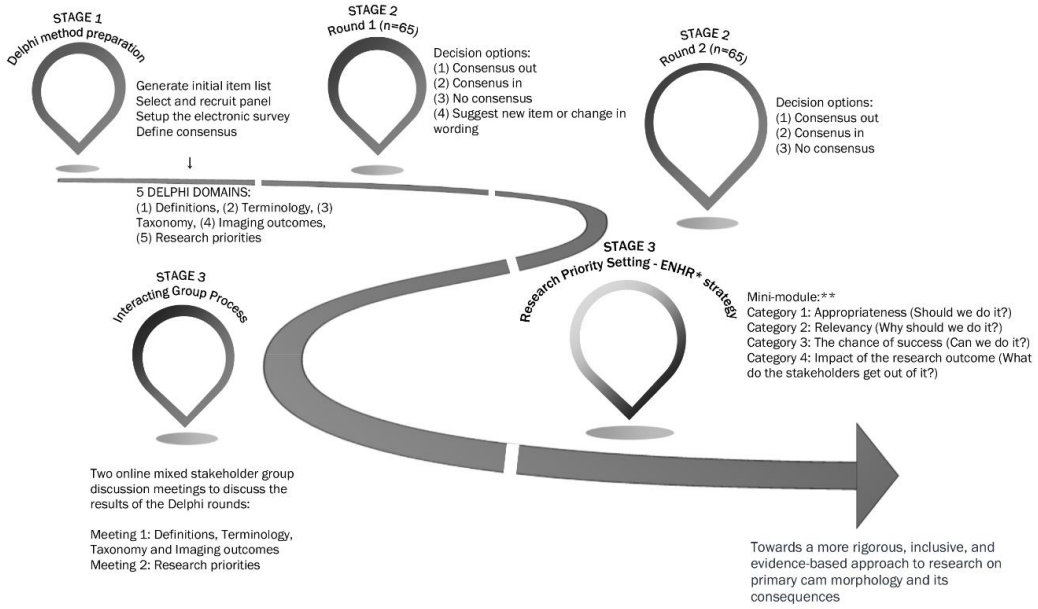

Figure SF1-1 Oxford Consensus Study flow chart. Stage 1: prepare for Delphi method; Stage 2: Delphi method online rounds; Stage 3: virtual discussion meetings and ENHR strategy for research priority setting. *Essential National Health Research; **Mini-module adapted from [4]

Methodology

The Delphi method, especially its qualitative elements, has roots in the philosophical traditions that emphasise the importance of opinions and perceptions of groups of people. [5] This is important, alongside other sources of empirical data, when exploring the nature of reality or informing decision making. [6] This study applied the Delphi method as a pragmatic tool for working towards consensus

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and for mapping the level of, and reasons for, any residual disagreement. Many studies applying the Delphi method suffice with statistical consensus or non-consensus. We went further.

By embracing the pragmatic qualities of the Delphi method, this study dealt with tension and dissent in a meaningful way. While some argued that the Delphi method "rises above the paradigmatic divide"—it includes elements of qualitative and quantitative approaches, and of constructivism and positivism—others, including Brady (2015), have argued its alignment with a pragmatic philosophy. [6] We agree with Brady (2015) and Skulmoski and Hartman (2007): The Delphi method is flexible, favouring diversity over statistical representativeness in sampling, relatively low-resource, and user-friendly. [6,7] It is therefore a good tool for community-based and community engaged research, working towards consensus and surfacing tension and dissent in a meaningful way.

> "…methods are the tools of the trade. Methodology is the philosophy that guides how and when you deploy those tools." [8]

Relevant to the primary cam morphology research field, community-engaged research empowers the potentially marginalised and minoritised voices of patients, children, parents, women, citizens of the global south, para-athletes and non-physicians. Community-engaged research, characterised by inclusion, collaboration, and participation, builds upon the principles of reciprocity, relationship building, and translational learning between communities and professional researchers. [9] It provides a less hierarchical and more ethical approach to conducting research, combining, in our study context, transformative and knowledge co-production lenses underpinned by pragmatism as the philosophical paradigm. [6]

Given the focus on (research) transformation and knowledge co-production, it is important to reflect on our positionality and identities (racial/ethnic, sex/gender). The steering committee members (HPD, SMA, CLA, JLK, ABM, AP, PB, AS, JO, KMK, SGJ, MK, TG), 5 women and 8 men, were English-speaking (as a first- or second language) white academics (11 with PhDs); 4 were physicians, 6 allied healthcare practitioners, and 3 health researchers. AP represented the Young Athlete's Hip Research Collaborative's Patient and Public Involvement Group. One resided in the Global South.

Not only did we combine multiple methodologies to accomplish this study's aim, but also multiple research methods, and reflexive quantitative and qualitative analyses. Combining multiple methodologies and methods is not new; qualitative scholars use the term "methodological bricolage"—"an eclectic critical, multi-perspectival, multi-theoretical and multi-methodological approach to enquiry". [10,11] Here we combined the online Delphi method, Interacting Group Process for mixed stakeholder group discussions [12], Essential National Health Research (ENHR) research strategy to rank the prioritised research statements, and revised Bloom's Taxonomy, a tool to

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create education that encourages critical thinking, to develop two education events aimed at early dissemination and implementation.

Study design – Delphi method and Research Priority Setting process

Delphi method: For this 3-stage Oxford Consensus Study (Figure SF1-1), we modified the classical Delphi method slightly by replacing an open qualitative first round with a pre-selected list of statements based on a review of existing literature and a synthesis of the knowledge of steering group members. [13–15] The Delphi method assesses consensus through an iterative multistage process of controlled online questionnaires, feedback, reflection, and discussion, documenting both agreements and the nature and extent of residual disagreement. [16–18] Multiple rounds allow panel members to work towards consensus as members are invited to amend their response in the light of the group average. [19,20] The Delphi method allows panel members to participate anonymously to reduce the influence of dominant individuals.[1] Reporting followed CREDES ('Conducting and REporting DElphi Studies') [3]. We report in a linked paper (Oxford Delphi consensus, Part 2) how the prioritised research statements were further ranked according to the Council on Health Research for Development's Essential National Health Research (ENHR) ranking method.[4]

The essence of the Delphi method, initially developed by the Rand Corporation for technological forecasting and named after the famous oracle at Delphi, is to generate discussion on a topic of interest amongst experts. [21,16] The Delphi method has four important methodological features: (1) a panel made up of various kinds of expert, (2) an anonymous process, (3) iterative rounds of enquiry, (4) subsequent rounds informed by a summary of the group response of the previous round. [3,13,22] While celebrating the Delphi method's strengths, it is important to acknowledge and deal with its challenges.

Although challenging, an *online* consensus development process is more likely to improve than jeopardise the process and outcome, especially during covid-19-related restrictions on travel and indoor face-to-face meetings. There are many empirical examples of successful online Delphi studies in health care involving geographically dispersed panel members. [23–25] The online consensus development process is reliable [26] while asynchronous online communication has well-established benefits in promoting reflection and knowledge construction. [27] Therefore, the quality of any Delphi study depends on the underlying design and rigour, and not the medium of the research process. [15] However, ensuring a high-quality Delphi study is easier said than done as no standard quality parameters exist to evaluate Delphi studies in healthcare. [28]

Many Delphi method quality criteria have been proposed. Nine criteria were used to assess the quality of 52 Delphi studies on coronavirus disease 2019 (covid-19). [28] In sum, this study assessed how Delphi studies (1) documented the process followed to identify the problem area; (2) selected panel members based on objective and predefined criteria; (3) maintained strict anonymity of panel

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members and their responses; (4) provided controlled feedback between rounds; (5) managed iterative rounds of discussions and feedback; (6) defined consensus criteria a priori; (7) analysed consensus in a transparent way; (8) identified criteria for stopping the Delphi rounds; (9) analysed stability of responses. Although comprehensive, this list is arguably not complete. For example, how Delphi researchers performed and reported qualitative analysis of panellists' responses, and treated dissent and ambiguity are equally important 'quality criteria'. [17,29,30]

Research Priority Setting – ENHR strategy: The problem of largely investigator-driven health research agendas, marginalising the voices of key stakeholders including patients, caregivers and the community, has fuelled a mismatch between the interests of patients and researchers, and a possible misdirected allocation of limited resources. [2,31,32] This spotlighted the need for transparent research priority setting with stakeholders. [2,33–40] Research priority setting—a range of "interpersonal" activities amongst stakeholders to identify, prioritise and achieve consensus on the key questions or research topics—can be small or broad. Small research priority setting projects, often the scope of a specific group or organization, focus on a health condition, while broader priority setting projects inform national or international health research strategies. [2,41–43] Ensuring transparency of the research priority setting process, and to "strengthen legitimacy and credibility for influencing the research agenda", we applied the 31-item REporting guideline for PRIority SEtting of health (REPRISE). [2] To add rigour and transparency, we plan to register this research priority setting project on the Ludwig Biltzmann Gesellschaft Open Innovation in Science Center's worldwide Priority Setting Database of research priority setting projects. This database inspires future priority setting projects serves as a research tool "for unanswered research questions and under-researched topics". [44] The *Early Hip and Knee Osteoarthritis Priority Setting Partnership* and *Too Fit To Fracture: a consensus on future research priorities in osteoporosis and exercise*, are examples of priority setting projects registered on this database. [45,46]

We adapted the ENHR "mini-module" [4], asking the Delphi Panel to apply a 0 to 3 Likert Scale score to category 1 criteria, and 1 to 3 Likert Scale for the remaining 6 criteria. A maximum 3 points per criterium resulted in an equal weighting of 6 points for each of the four categories (Figure SF1-2). We shared and discussed the ENHR ranking strategy results with Delphi panel members during optional online meetings.

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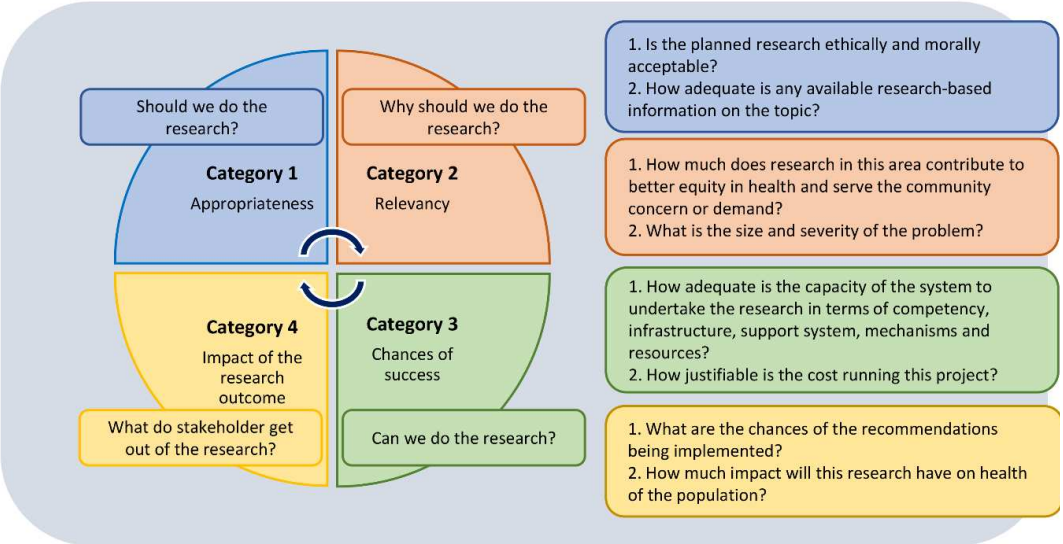

Figure SF1-2 Four categories (and 2 criteria for each) of the Essential National Health Research ranking strategy [4]

Stage 1: Planning

Steering committee: The study steering committee included members of the YAHiR Collaborative. Avoiding the "GOBSAT" (good old boys sat around a table) approach [47] the steering committee ensured a representative Delphi panel, and a robust Delphi method and ENHR ranking process. Interpreting 'diversity' as more than representation of certain demographic groups, the steering committee ensured a diverse and informed Delphi panel, representing six multi-profession stakeholder groups, including previously minoritised groups relevant to this research field (e.g., women, athletes, patients and the community, participants from the Global South). This study's online Delphi method, with a specific focus on anonymity and access to adequate topic-specific resources, supported a more equitable and inclusive process.

More equitable (as opposed to an in-person meeting) as traditionally underrepresented groups had similar opportunities to participate—levelling the playing field (they didn't need to travel and could share their opinion in a 'safe space'). Our efforts to promote a more inclusive Delphi study (referring to a positive and supportive experience) included online meetings to share and discuss study resources and topic-specific information, and giving patient and public involvement partners leading roles in all aspects of the study (including steering committee membership, active involvement in study design, leading roles in online discussions, and co-authorship of study reports, including peer reviewed papers). (We provided the Primary Cam Morphology Delphi Study Steering Committee Terms of Reference as a Supplementary File).

Delphi and ENHR ranking panel: The concept of 'expert' is contested. According to Christiansen-Ruffman and Stuart (1978), cited by Needham and de Loë (1990:136) expertise is restricted "to people with specialized training, such as architects, academics, medical doctors and scientists." [48] Cantril et al (1996:69) argued that an 'expert' is "any individual with relevant knowledge and experience of a particular topic". [49] However, the narrow definition of expertise is unfortunate and "excludes individuals who derive expertise, not from specialised training, but real or first-hand experience, or familiarity", and "more recognition must be given to a variety of experts who exist along a closeness continuum". [48]

The closeness continuum represents an inclusive expert population of individuals with subjective, mandated, and objective closeness to the topic of interest. Experts with subjective closeness have deep experiential knowledge or real-life experiences. Experts with mandated closeness are those with professional and/or legal (ethical) responsibility while experts with objective closeness are those who study the topic, exploring and inquiring without preconceived bias. [48,50]

We adapted and applied the "closeness continuum" to purposively recruit 73 experts for this study representing multiple stakeholder groups with relevant experience and expertise (Figure SF1-3 and Table SF1-1). Participants were not reimbursed.

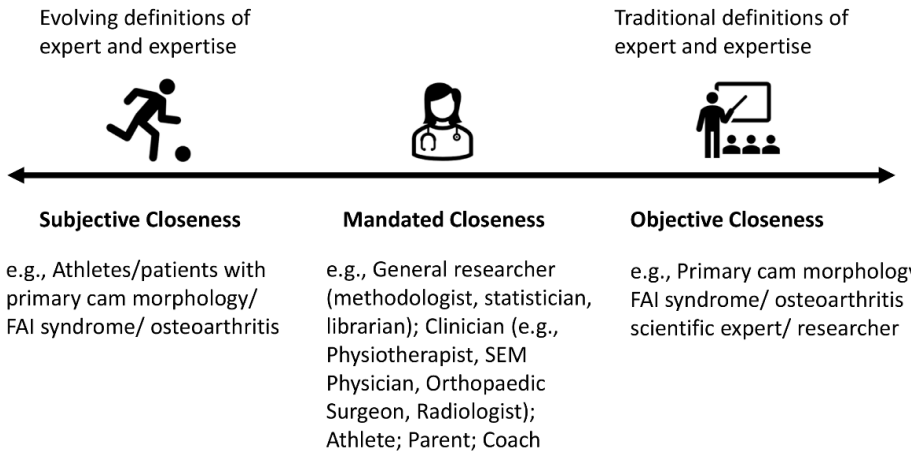

Figure SF1-3 Adapted closeness continuum of experts applied to the Oxford Consensus Study [48]

Table SF1-1 Delphi panel recruitment criteria

Identification of Delphi panel	Panel members were identified through (1) expert knowledge of the steering committee and colleagues; (2) International Olympic Committee's 11 research centres for the prevention of injury and protection of athlete health; (3) International Hip Pain Research Network Consensus Group; (4) a list of authors (lead/corresponding authors) with a track record of peer-review publications in sports medicine and science, preferably in the field of cam morphology/FAI syndrome over the past 15-20 years (2000 to 2021).

	We oversampled to compensate for possible attrition at a rate of 25% per round.
Researchers	Statisticians, methodologists, librarians, and sport scientists
Clinicians and clinician-researchers	Clinicians who treat patients with hip-related conditions and clinician-researchers with a peer reviewed publication record in the field (cam morphology and/or femoroacetabular impingement aetiology, prognosis, treatment), including orthopaedic surgeons, physicians (including sports medicine physicians, physical medicine and rehabilitation physician, rheumatologist, family medicine), radiologists, physical therapists
Patient and Public Involvement (PPI) representatives	➢ adult patients: a purposive sample of adults diagnosed with femoroacetabular impingement and cam morphology or hip osteoarthritis and cam morphology or hip arthroplasty and cam morphology or any other joint condition (e.g., inflammatory arthritis or osteoarthritis), or have a history of recreational or competitive high-load sports participation during adolescence or later ➢ parents of young adolescents regularly participating in competitive high-load sport, irrespective of a personal history of cam morphology or FAI syndrome ➢ sports coaches (defined as coaches of early adolescents regularly participating in high-load sports) or athletes (competitive, recreational, or retired), irrespective of a personal history of cam morphology or FAI syndrome ➢ individuals with experience in patient and public involvement, or unique perspectives on, health equity, health ethics, racial, ethnic, and minority groups in sports medicine (e.g., healthcare professionals involved in adolescent sports medicine screening (periodic health assessment) and patient / athlete education)
Journal editors, representatives of research funding bodies and policymakers	Journal editors (e.g., BJSM and JOSPT); Sports organisations/federations e.g. FIFA, IOC, IAAF

Sample size*:* We oversampled to compensate for possible attrition over rounds (at a rate of 25% per round). Consensus is normally achieved in an average of three rounds [51]; the steering committee, therefore, aimed to recruit a starting sample of 50 to 100 panel members. The study was fully anonymised and panel members did not know who the other panel members were during the Delphi survey rounds.

Patient and public involvement (PPI): We involved patient and public partners in the planning, delivery, and dissemination phases of the Delphi study through the YAHiR Collaborative's PPI group. The latter group was represented in the Delphi study steering committee. We supplied all members of the PPI group with a glossary, mentored them on definition use and content (during online individual and PPI Group meetings), and invited them to weigh in on each Delphi round. [52] They had access to the recordings of the *Oxford-Aspetar-La Trobe Young Athlete's Hip Webinar Series,* providing a good knowledge base including the current evidence, and issues, allowing an informed assessment. Members of the PPI Group lead and actively participated in the mixed stakeholder group discussions following the Delphi rounds (Stage 3 below).

Delphi software: We used DelphiManager®, "a web-based system designed to facilitate the building and management of Delphi surveys" for the Delphi rounds and Microsoft Forms for the ENHR research ranking exercise. [53]

Ethical considerations: Research participants provided informed online consent for the study as part of the DelphiManager® surveys. Participants did not meet face-to-face during the online Delphi rounds. The University of Oxford's Medical Sciences Interdivisional Research Ethics Committee (MS IDREC) provided ethics approval for the study - R73576/RE001.

Statement preparation: The Delphi study steering committee created an extensive list of statements and conceptual framework of all the potential definitions, terminology, taxonomy, and a set of research priorities on conditions affecting the young person's hip focussing on primary cam morphology and its natural history. We based the initial statement list on a concept analysis of primary cam morphology [54], the early results of a qualitative study to explore stakeholder perspectives on factors contributing to high-quality research on how primary cam morphology develops, and the Lisbon Agreement on Femoroacetabular Imaging. [55–57]. In addition, the list of possible research recommendations was informed by recent (since January 2016) consensus recommendations on research in the field. [55–62] Members of the Delphi study steering committee independently reviewed the statements, followed by an iterative, asynchronous online process to review, discuss, modify and approve the final statements. The steering committee provided additional descriptive information ("Help Text") where appropriate, and asked stakeholders, including members of the Patient and Public Involvement group, to provide feedback on the draft Delphi survey. Stakeholders examined the survey's face validity (e.g., comprehensibility and acceptability) and refined language, formatting, and layout.

Panel information pack: All panel members had access from the outset of the project and throughout the Delphi process, to the course material, including recorded presentations, of the first 9 Webinars of the *Oxford-Aspetar-La Trobe Young Athlete's Hip Webinar Series* (Appendix 2). (Webinar 1: *What is primary cam morphology? Taxonomy, terminology, and definitions,* and Webinar 2: *Imaging strategies for primary cam morphology and FAI syndrome*, were particularly relevant to this Delphi study). Panel members had full-text access to 5 recent consensus statements [58–62], and a summary of their research recommendations, to support scoring Domain 5 of the Delphi study on research priorities. We refer the reader to the relevant Supplementary Files (Oxford Delphi consensus study Part 1 and Part 2). Completion of the webinars and/or reading of the consensus statements was not required.

Consensus definition: The steering committee agreed on a consensus definition prior to the Delphi rounds (Table SF1-2).

Table SF1-2 Definition of consensus

Category	Definition	Action
Consensus in (high agreement)	Scored as very important (7 to 9) by ≥70% of panel members *and* not important (1 to 3) by <15% of panel members	Item retained for the next survey round/consensus meeting
Consensus out (low agreement)	Scored as not important (1 to 3) by ≥70% of panel members *and* very important (7 to 9) by <15% of panel members	Item discarded after round 2 (to be ratified at the face-to-face consensus meeting)
No consensus	Neither criteria above are met	Item retained for the next survey round/consensus meeting
Suggest rewording	Scored as important but must be reworded.	Provide the opportunity for panel members to suggest rewording. The study steering committee will consider retaining a reworded item for the next survey round.

Stage 2: Online Delphi Rounds

The consensus process involved a sequential, two-round Delphi survey and synchronous online consensus meetings to establish multi-stakeholder agreement and surface disagreement.

Round 1: Participants provided informed consent and registered for the Delphi study in one of 6 stakeholder groups. The statements were presented in a sensible and logical order in 5 questionnaire domains (definitions, terminology, taxonomy, imaging outcomes, and research priorities).

Panel members scored each statement using a 9-point Likert scale ranging from 1 ("not important/ disagree") to 9 ("critical/ agree"), based on the Grading of Recommendations Assessment, Development and Evaluation scale for scoring the importance of including the item in the final list of statements. [63] Round 1 survey included free text sections to allow participants to propose new or modified statements and provide general study feedback. The Delphi study steering committee reviewed the proposed new statements or statement modifications suggested by participants in round 1, discussed and considered all the agreed new or modified survey statements for a subsequent round(s), and resolved any uncertainties.

Round 2: Participants had access to the distribution of round 1 scores for each statement stratified by stakeholder group. Judgements after feedback, including aggregated group feedback, are less exposed to cognitive and personal biases, and panellists are more confident in their decisions. [64–66] Panel members saw their score and then re-scored each statement on a scale of 1 to 9 (or not if they chose to defend their outlying score) based on the average scores of the group. We documented changes in score from round to round, and panel members could provide reasons when their score boundaries changed between rounds 1 and 2, defending their outlying score(s).

The steering committee and Delphi panellists explored and discussed reasons for outlying scores, disagreement and dissent (including statements with overall consensus) during the online Interacting Group Process (stage 3 of the Delphi study). Multiple rounds can cause 'group-think' amongst

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participants via pressure to comply.[67] We did not wish to force agreement amongst participants and chose to limit the Delphi process to a maximum of 3 rounds. However, two Delphi rounds resulted in high consensus and surfaced important disagreements and areas of dissent to focus on in online discussions. A third voting round was therefore not required. Following Delphi round 2, we included all statements voted 'consensus in/ agree' and 'consensus out/disagree' in the final list of consensus statements.[68,69].

Stage 3: Online Interacting Group Process and Research Priority Setting using the ENHR ranking exercise

Interacting Group Process - online mixed stakeholder group discussion meetings: Delphi panellists discussed all discordant items as well as areas of tension and dissent, during two online mixed stakeholder group meetings, based on the Interacting Group Process. Interacting Group Processes stimulate participants to look at problems and solutions from different perspectives. [12,70] While Nominal Group Processes are better for generating ideas or solutions, interacting groups are better for sharing and evaluating information. [12] Acknowledging the importance of areas of dissensus or disagreement substantial time and effort were allocated to exploring these. To create a safe space for panellists to share their views, the steering committee facilitated discussions in small zoom breakout rooms (6-8 panellists representing different stakeholder groups); the discussions were not recorded. Group leads documented discussions in a field diary, and maintained speaker anonymity.

The first meeting discussed the results of the Delphi rounds, including ongoing areas of disagreement and dissent, and ratified the primary cam morphology definitions, terminology, taxonomy, and imaging outcome measures. The second meeting discussed the prioritised list YAHiR Collaborative research statements on conditions affecting the young person's hip, focussing on primary cam morphology and its consequences in athletes.

Research Priority Setting – ENHR strategy: An online Microsoft Forms survey process followed to further rank the prioritised statements according to the ENHR strategy for research priority setting as described earlier. [4]

Feedback: Following the ENHR ranking exercise, panellists were able to attend one of six optional, time-zone friendly online feedback-and-discuss-meetings. Although these were not recorded, the lead investigator took field notes that provided an additional context for analysis. Field notes aided in constructing thick, rich descriptions of the context and discussions of these (and other) encounters. [71]

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Data analysis

We entered and stored all data using the DelphiManager® electronic software tool and created Excel spreadsheets. [53] We calculated descriptive statistics for each statement and stakeholder group e.g., summary scores, ranges, percentage scoring for each statement "not important/ disagree" (score 1 to 3), "important but not critical/ neutral" (score 4 to 6) and "critical/ agree" (score 7 to 9). Specifically, we reported, per stakeholder group, the median and interquartile range (IQR) for each statement between each round. This central tendency and measure of distribution served to estimate the consistency of responses between successive rounds of the Delphi study. Stability of response is an indication of whether agreement (or continuous dissensus or disagreement) is present throughout and whether it develops between rounds. [72,73] The stability of group response between rounds 1 and 2 was calculated using the Intraclass Correlation Coefficient (ICC) type A, and an absolute agreement definition. [74,75] ICC estimates and their 95% confidence intervals were calculated using SPSS statistical package version 23 (SPSS Inc, Chicago, IL) based on 2-way mixed-effects model. [76] The lower bound 95% confidence interval of the ICC estimate was used as the basis to evaluate the level of reliability using the following general guideline: ICC values <0.5 (poor stability), ICC values 0.5 to 0.75 (moderate stability), 0.75 to 0.9 indicated (good stability) and ICC values >0.9 (excellent stability). [76]

Table SF1-2 represents the prior consensus definition for categorising the statements in all five Delphi domains. The Delphi study steering committee retained all statements between rounds 1 and 2 to enable participants to re-score every statement after considering feedback from round 1. This likely reduced participant burden in potential subsequent rounds and at the consensus discussion meetings. [1] Acknowledging that certain statements might be more relevant to some panel members than others, stakeholders were given the choice not to score a specific statement. We did, however, analyse the data of different stakeholder groups separately in each round. [68]

In addition to the quantitative consensus definition in table 2, the Delphi study steering committee reflected carefully on the findings, drawing on clinical wisdom and experience, encouraging, facilitating and documenting further deliberation during two synchronous online discussion meetings.

Dissent analysis: Although the main aim of the Delphi method is to structure a group communication process that might lead to consensus, we were also interested in panel dissent. To explore possible dissent, we applied *dissent analysis* including outlier analysis, bipolarity analysis, and stakeholder group analysis. [77,78]

- Outlier analysis: Outliers can have a substantial effect on variables (e.g., Interquartile range), and statistical consensus. The existence of outliers is therefore an important potential explanation for dissent. We identified low outliers (data points that fall more than 1.5 times the Interquartile range below the first quartile) and high outliers (data points that fall more

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than 1.5 times the Interquartile range above the third quartile). In addition, we visually inspected histograms of round 2 stakeholder group scoring for outliers. We re-analysed consensus after eliminating outliers for all statements with marginal non-consensus to test if these had an impact on the group's consensus.

- Bipolarity analysis: Opposing groups of experts with an important and insoluble cleft of opinion, might result in non-consensus. Bimodal data distribution is therefore a possible explanation for dissent. To test for bipolarity, we investigated potential bimodal distribution (two or more answer options had the same mode frequency) and visually inspected histograms for round 2 scores of each statement. [77]
- Stakeholder group analysis: Stakeholder group analysis, a classical dissent analysis, is important to identify opposing views. To compare the scores from round 2 between the six stakeholder groups, we performed Kruskal-Wallis tests. To account for multiple post hoc comparisons, we adjusted the statistical significance threshold p-value to 0.0033 according to Bonferroni method. We are conscious of the limitations of 'statistical significance' [79]; therefore, substantial stakeholder group differences ($p<0.0033$) prompted us to further scrutinise individual- and group opinions for the specific statement.

Qualitative analysis: The lead investigator (HPD) immersed himself in the details of participants' comments provided during Delphi rounds, Interacting Group Process, and ENHR ranking exercise.[80] After developing a framework based on recurrent and important themes, the free text comments were grouped into categories, iteratively discussed between the lead investigator and second author (SM). The lead authors (HPD and SM) then undertook thematic analysis to identify, group and agree on common threads within these categories, further refining themes and subthemes.[81,82] We provided summarised feedback of quantitative and qualitative open responses to panel members during Webinars 10 and 11 of the *Oxford-Aspetar-La Trobe Young Athlete's Hip Webinar Series.* The webinars preceded the online synchronous mixed stakeholder group discussions on 22 and 23 September 2021 (Stage 3).

Dissemination

Considerable time lags—up to an average of 17 years—exist in the health research (knowledge) translation process. [83–85] On the other hand, rapid knowledge translation and implementation into policy and practice, as evident in the early covid-19 pandemic days, served and savaged communities—scientific-, health and care-, and patient communities. [86–88] We created opportunities for the community of researchers, clinicians, athletes and athlete-patients, to responsibly disseminate and effectively implement the findings of this study, not only to amplify the ethical conduct of future research, but also to foster authentic co-production of new knowledge. [89] Dissemination of new knowledge, an active process of spreading or sharing evidence to a target population, is most effective "when it starts early, galvanizes support, uses champions and brokers,

considers contextual factors, is timely, relevant, and accessible, and knows the players and process." [90,91]

To fulfil objective 3 of the Oxford consensus, we applied the revised Bloom's taxonomy (Figure SF 1-4). [92], a tool to create education that encourages critical thinking, to develop two education events aimed at early dissemination and implementation: *Oxford-Aspetar-La Trobe Young Athlete's Hip Webinar Series* (Supplementary File 4), and *YAHiR Collaborative's Young Athlete's Hip Symposium and Research Meeting* (22-23 September 2022, Worcester College, Oxford).

Bloom and co-workers developed a taxonomy of learning domains, which was divided into cognitive (knowledge and mental skills), psychomotor (physical movement, coordination, and use of motor skills), and affective (how individuals deal with things emotionally – feelings, values, attitudes). While the original Taxonomy provided a hierarchy of six different levels of objectives in the cognitive domain, each entailing more intricate thinking than the previous one, the revised Bloom's taxonomy emphasised verbs— the basis of the cognitive process: "what is to be done with or to the subject matter content." (Figure 4) [92]

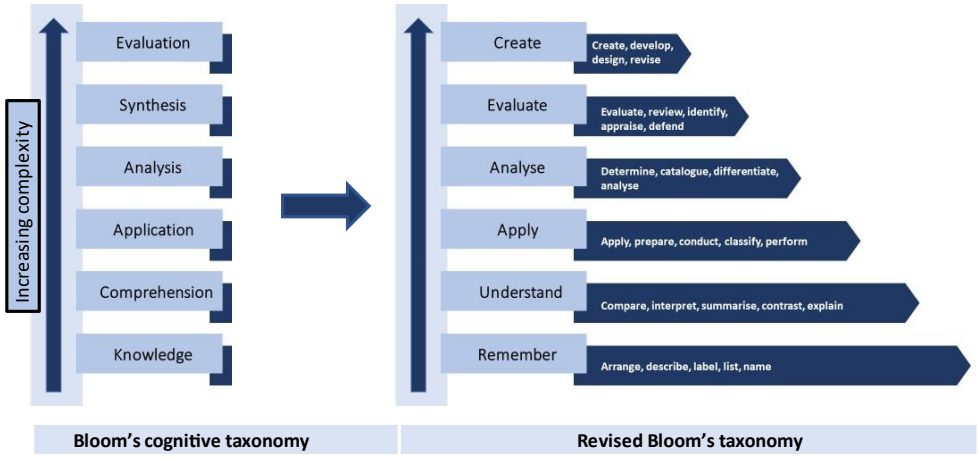

Figure SF1-4 Bloom's revised taxonomy of cognitive process action verbs

References

1 Williamson PR, Altman DG, Bagley H, *et al.* The COMET Handbook: version 1.0. *Trials* 2017;**18**:280. doi:10.1186/s13063-017-1978-4

2 Tong A, Synnot A, Crowe S, *et al.* Reporting guideline for priority setting of health research (REPRISE). *BMC Med Res Methodol* 2019;**19**:243. doi:10.1186/s12874-019-0889-3

3 Jünger S, Payne SA, Brine J, *et al.* Guidance on Conducting and REporting DElphi Studies (CREDES) in palliative care: Recommendations based on a methodological systematic review. *Palliat Med* 2017;**31**:684–706. doi:10.1177/0269216317690685

4 Okello D, Chongtrakul P, Datta M, *et al.* A manual for research priority setting using the ENHR strategy. The Council on Health Research for Development (COHRED). Document 2000.3. 2000;:52.

5 Turoff M. The design of a policy Delphi. *Technol Forecast Soc Change* 1970;**2**:149–71. doi:10.1016/0040-1625(70)90161-7

6 Brady SR. Utilizing and Adapting the Delphi Method for Use in Qualitative Research. *Int J Qual Methods* 2015;**14**:1609406915621381. doi:10.1177/1609406915621381

7 J. Skulmoski G, T. Hartman F, Krahn J. The Delphi Method for Graduate Research. *J Inf Technol Educ Res* 2007;**6**:001–21. doi:10.28945/199

8 Lingard L, Watling C. *Story, Not Study: 30 Brief Lessons to Inspire Health Researchers as Writers*. Cham: : Springer International Publishing 2021. doi:10.1007/978-3-030-71363-8

9 Israel BA, Checkoway B, Schulz A, *et al.* Health Education and Community Empowerment: Conceptualizing and Measuring Perceptions of Individual, Organizational, and Community Control. *Health Educ Q* 1994;**21**:149–70. doi:10.1177/109019819402100203

10 Rogers M. Contextualizing Theories and Practices of Bricolage Research. *Qual Rep* Published Online First: 20 January 2015. doi:10.46743/2160-3715/2012.1704

11 Pratt MG, Sonenshein S, Feldman MS. Moving Beyond Templates: A Bricolage Approach to Conducting Trustworthy Qualitative Research. *Organ Res Methods* 2020;:1094428120927466. doi:10.1177/1094428120927466

12 Van de Ven A, Delbeco AL. Nominal versus Interacting Group Processes for Committee Decision-Making Effectiveness. *Acad Manage J* 1971;**14**:203–12. doi:10.2307/255307

13 Hasson F, Keeney S. Enhancing rigour in the Delphi technique research. *Technol Forecast Soc Change* 2011;**78**:1695–704. doi:10.1016/j.techfore.2011.04.005

14 McKenna HP. The Delphi technique: a worthwhile research approach for nursing? *J Adv Nurs* 1994;**19**:1221–5. doi:10.1111/j.1365-2648.1994.tb01207.x

15 Greenhalgh T, Wong G, Westhorp G, *et al.* Protocol - realist and meta-narrative evidence synthesis: Evolving Standards (RAMESES). *BMC Med Res Methodol* 2011;**11**:115. doi:10.1186/1471-2288-11-115

16 Murphy MK, Black NA, Lamping DL, *et al.* Consensus development methods, and their use in clinical guideline development. *Health Technol Assess Winch Engl* 1998;**2**:i–iv, 1–88.

17 Hasson F, Keeney S, McKenna H. Research guidelines for the Delphi survey technique. *J Adv Nurs* 2000;**32**:1008–15. doi:10.1046/j.1365-2648.2000.t01-1-01567.x

18 Brown BB. Delphi Process: A Methodology Used for the Elicitation of Opinions of Experts. RAND Corporation 1968. https://www.rand.org/pubs/papers/P3925.html (accessed 13 Feb 2022).

19 Sinha IP, Smyth RL, Williamson PR. Using the Delphi Technique to Determine Which Outcomes to Measure in Clinical Trials: Recommendations for the Future Based on a Systematic Review of Existing Studies. *PLOS Med* 2011;**8**:e1000393. doi:10.1371/journal.pmed.1000393

20 Li S-A, Yousefi-Nooraie R, Guyatt G, *et al.* A few panel members dominated guideline development meeting discussions: Social network analysis. *J Clin Epidemiol* 2022;**141**:1–10. doi:10.1016/j.jclinepi.2021.09.023

21 Dalkey N, Helmer O. An Experimental Application of the Delphi Method to the Use of Experts. *Manag Sci Pre-1986* 1963;**9**:458.

22 Iqbal S, Pipon-Young L. The Delphi method. A step-by-step guide. *The Psychologist* 2009;**22**:598–601.

23 Wong G, Greenhalgh T, Westhorp G, *et al.* RAMESES publication standards: realist syntheses. *BMC Med* 2013;**11**:21. doi:10.1186/1741-7015-11-21

24 Elwyn G, O'Connor A, Stacey D, *et al.* Developing a quality criteria framework for patient decision aids: online international Delphi consensus process. *BMJ* 2006;**333**:417. doi:10.1136/bmj.38926.629329.AE

25 Turnbull AE, Dinglas VD, Friedman LA, *et al.* A survey of Delphi panelists after core outcome set development revealed positive feedback and methods to facilitate panel member participation. *J Clin Epidemiol* 2018;**102**:99–106. doi:10.1016/j.jclinepi.2018.06.007

26 Washington DL, Bernstein SJ, Kahan JP, *et al.* Reliability of clinical guideline development using mail-only versus in-person expert panels. *Med Care* 2003;**41**:1374–81. doi:10.1097/01.MLR.0000100583.76137.3E

27 Russell J, Elton L, Swinglehurst D, *et al.* Using the online environment in assessment for learning: a case-study of a web-based course in primary care. *Assess Eval High Educ* 2006;**31**:465–78. doi:10.1080/02602930600679209

28 Nasa P, Jain R, Juneja D. Delphi methodology in healthcare research: How to decide its appropriateness. *World J Methodol* 2021;**11**:116–29. doi:10.5662/wjm.v11.i4.116

29 Hsu C-C, Sandford BA. The Delphi Technique: Making Sense of Consensus. *Pract Assess Res Eval* 2007;**12**. doi:10.7275/PDZ9-TH90

30 Keeney S, Hasson F, McKenna H. Consulting the oracle: ten lessons from using the Delphi technique in nursing research. *J Adv Nurs* 2006;**53**:205–12. doi:10.1111/j.1365-2648.2006.03716.x

31 Macleod MR, Michie S, Roberts I, *et al.* Biomedical research: increasing value, reducing waste. *The Lancet* 2014;**383**:101–4. doi:10.1016/S0140-6736(13)62329-6

32 Pratt B. Towards inclusive priority-setting for global health research projects: recommendations for sharing power with communities. *Health Policy Plan* 2019;**34**:346–57. doi:10.1093/heapol/czz041

33 Ferri M, Davoli M, D'Amico R. Involving patients in setting the research agenda in drug addiction. *BMJ* 2013;**347**:f4513. doi:10.1136/bmj.f4513

34 Liberati A. Need to realign patient-oriented and commercial and academic research. *The Lancet* 2011;**378**:1777–8. doi:10.1016/S0140-6736(11)61772-8

35 Richards T, Montori VM, Godlee F, *et al.* Let the patient revolution begin. *BMJ* 2013;**346**:f2614. doi:10.1136/bmj.f2614

36 Bhaumik S, Rana S, Karimkhani C, *et al.* Ethics and equity in research priority-setting: stakeholder engagement and the needs of disadvantaged groups. *Indian J Med Ethics* 2015;**12**:110–3. doi:10.20529/IJME.2015.030

37 Manafò E, Petermann L, Vandall-Walker V, *et al.* Patient and public engagement in priority setting: A systematic rapid review of the literature. *PLoS ONE* 2018;**13**:e0193579. doi:10.1371/journal.pone.0193579

38 Pratt B. Constructing citizen engagement in health research priority-setting to attend to dynamics of power and difference. *Dev World Bioeth* 2019;**19**:45–60. doi:10.1111/dewb.12197

39 Grill C. Involving stakeholders in research priority setting: a scoping review. *Res Involv Engagem* 2021;**7**:75. doi:10.1186/s40900-021-00318-6

40 Synnot AJ, Tong A, Bragge P, *et al.* Selecting, refining and identifying priority Cochrane Reviews in health communication and participation in partnership with consumers and other stakeholders. *Health Res Policy Syst* 2019;**17**:45. doi:10.1186/s12961-019-0444-z

41 Nagraj, Sumanth Kumbargere. Research priority setting. Stud. 4 Best Evid. 2020.https://s4be.cochrane.org/blog/2020/04/17/research-priority-setting/ (accessed 24 Jan 2022).

42 Viergever RF, Olifson S, Ghaffar A, *et al.* A checklist for health research priority setting: nine common themes of good practice. *Health Res Policy Syst* 2010;**8**:36. doi:10.1186/1478-4505-8-36

43 Bryant J, Sanson-Fisher R, Walsh J, *et al.* Health research priority setting in selected high income countries: a narrative review of methods used and recommendations for future practice. *Cost Eff Resour Alloc CE* 2014;**12**:23. doi:10.1186/1478-7547-12-23

44 Priority Setting Database. Ludwig Boltzmann Ges. Open Innov. Sci. Cent. https://ois.lbg.ac.at/priority-setting-database/?lang=en (accessed 3 Apr 2022).

45 Early Hip and Knee Osteoarthritis | James Lind Alliance. https://www.jla.nihr.ac.uk/priority-setting-partnerships/early-hip-and-knee-osteoarthritis/ (accessed 3 Apr 2022).

46 Giangregorio LM, MacIntyre NJ, Heinonen A, *et al.* Too Fit To Fracture: a consensus on future research priorities in osteoporosis and exercise. *Osteoporos Int* 2014;**25**:1465–72. doi:10.1007/s00198-014-2652-2

47 Miller J, Petrie J. Development of practice guidelines. *The Lancet* 2000;**355**:82–3. doi:10.1016/S0140-6736(99)90326-4

48 Needham RD, de Loë RC. The Policy Delphi: Purpose, Structure, and Application. *Can Geogr Géographe Can* 1990;**34**:133–42. doi:10.1111/j.1541-0064.1990.tb01258.x

49 Cantrill JA, Sibbald B, Buetow S. The Delphi and nominal group techniques in health services research. *Int J Pharm Pract* 1996;**4**:67–74. doi:10.1111/j.2042-7174.1996.tb00844.x

50 Donohoe HM, Needham RD. Moving best practice forward: Delphi characteristics, advantages, potential problems, and solutions. *Int J Tour Res* 2009;**11**:415–37. doi:10.1002/jtr.709

51 Diamond IR, Grant RC, Feldman BM, *et al.* Defining consensus: A systematic review recommends methodologic criteria for reporting of Delphi studies. *J Clin Epidemiol* 2014;**67**:401–9. doi:10.1016/j.jclinepi.2013.12.002

52 Alper BS, Price A, van Zuuren EJ, *et al.* Consistency of Recommendations for Evaluation and Management of Hypertension. *JAMA Netw Open* 2019;**2**:e1915975. doi:10.1001/jamanetworkopen.2019.15975

53 COMET DelphiManager. http://www.comet-initiative.org/delphimanager/ (accessed 10 Jul 2018).

54 Dijkstra HP, Ardern CL, Serner A, *et al.* Primary cam morphology; bump, burden or bog-standard? A concept analysis. *Br J Sports Med* Published Online First: 18 July 2021. doi:10.1136/bjsports-2020-103308

55 Mascarenhas VV, Castro MO, Rego PA, *et al.* The Lisbon Agreement on Femoroacetabular Impingement Imaging—part 1: overview. *Eur Radiol* 2020;**30**:5281–97. doi:10.1007/s00330-020-06822-9

56 Mascarenhas VV, Castro MO, Afonso PD, *et al.* The Lisbon Agreement on femoroacetabular impingement imaging—part 2: general issues, parameters, and reporting. *Eur Radiol* Published Online First: 7 January 2021. doi:10.1007/s00330-020-07432-1

57 Castro MO, Mascarenhas VV, Afonso PD, *et al.* The Lisbon Agreement on Femoroacetabular Impingement Imaging—part 3: imaging techniques. *Eur Radiol* Published Online First: 7 January 2021. doi:10.1007/s00330-020-07501-5

58 Griffin DR, Dickenson EJ, O'Donnell J, *et al.* The Warwick Agreement on femoroacetabular impingement syndrome (FAI syndrome): an international consensus statement. *Br J Sports Med* 2016;**50**:1169–76. doi:10.1136/bjsports-2016-096743

59 Reiman MP, Agricola R, Kemp JL, *et al.* Consensus recommendations on the classification, definition and diagnostic criteria of hip-related pain in young and middle-aged active adults from the International Hip-related Pain Research Network, Zurich 2018. *Br J Sports Med* 2020;**54**:631–41. doi:10.1136/bjsports-2019-101453

60 Mosler AB, Kemp J, King M, *et al.* Standardised measurement of physical capacity in young and middle-aged active adults with hip-related pain: recommendations from the first International Hip-related Pain Research Network (IHiPRN) meeting, Zurich, 2018. *Br J Sports Med* Published Online First: 19 December 2019. doi:10.1136/bjsports-2019-101457

61 Kemp JL, Risberg MA, Mosler A, *et al.* Physiotherapist-led treatment for young to middle-aged active adults with hip-related pain: consensus recommendations from the International Hip-related Pain Research Network, Zurich 2018. *Br J Sports Med* 2019;:bjsports-2019-101458. doi:10.1136/bjsports-2019-101458

62 Impellizzeri FM, Jones DM, Griffin D, *et al.* Patient-reported outcome measures for hip-related pain: a review of the available evidence and a consensus statement from the International Hip-related Pain Research Network, Zurich 2018. *Br J Sports Med* Published Online First: 17 February 2020. doi:10.1136/bjsports-2019-101456

63 Guyatt GH, Oxman AD, Kunz R, *et al.* GRADE guidelines: 2. Framing the question and deciding on important outcomes. *J Clin Epidemiol* 2011;**64**:395–400. doi:10.1016/j.jclinepi.2010.09.012

64 Warth J, von der Gracht HA, Darkow I-L. A dissent-based approach for multi-stakeholder scenario development — The future of electric drive vehicles. *Technol Forecast Soc Change* 2013;**80**:566–83. doi:10.1016/j.techfore.2012.04.005

65 Heath C, Gonzalez R. Interaction with Others Increases Decision Confidence but Not Decision Quality: Evidence against Information Collection Views of Interactive Decision Making. *Organ Behav Hum Decis Process* 1995;**61**:305–26. doi:10.1006/obhd.1995.1024

66 Ecken P, Gnatzy T, von der Gracht HA. Desirability bias in foresight: Consequences for decision quality based on Delphi results. *Technol Forecast Soc Change* 2011;**78**:1654–70. doi:10.1016/j.techfore.2011.05.006

67 Woudenberg F. An evaluation of Delphi. *Technol Forecast Soc Change* 1991;**40**:131–50. doi:10.1016/0040-1625(91)90002-W

68 Avery K, Blazeby J, Wilson N, *et al.* Development of reporting guidance and core outcome sets for seamless, standardised evaluation of innovative surgical procedures and devices: a study protocol for content generation and a Delphi consensus process (COHESIVE study). *BMJ Open* 2019;**9**:e029574. doi:10.1136/bmjopen-2019-029574

69 Ma C, Panaccione R, Fedorak RN, *et al.* Development of a core outcome set for clinical trials in inflammatory bowel disease: study protocol for a systematic review of the literature and identification of a core outcome set using a Delphi survey. *BMJ Open* 2017;**7**:e016146. doi:10.1136/bmjopen-2017-016146

70 Delbecq AL, Van de Ven AH. A Group Process Model for Problem Identification and Program Planning. *J Appl Behav Sci* 1971;**7**:466–92. doi:10.1177/002188637100700404

71 Phillippi J, Lauderdale J. A Guide to Field Notes for Qualitative Research: Context and Conversation. *Qual Health Res* 2018;**28**:381–8. doi:10.1177/1049732317697102

72 Belton I, MacDonald A, Wright G, *et al.* Improving the practical application of the Delphi method in group-based judgment: A six-step prescription for a well-founded and defensible process. *Technol Forecast Soc Change* 2019;**147**:72–82. doi:10.1016/j.techfore.2019.07.002

73 von der Gracht HA. Consensus measurement in Delphi studies: Review and implications for future quality assurance. *Technol Forecast Soc Change* 2012;**79**:1525–36. doi:10.1016/j.techfore.2012.04.013

74 Shrout PE, Fleiss JL. Intraclass correlations: uses in assessing rater reliability. *Psychol Bull* 1979;**86**:420–8. doi:10.1037//0033-2909.86.2.420

75 Trevelyan EG, Robinson PN. Delphi methodology in health research: how to do it? *Eur J Integr Med* 2015;**7**:423–8. doi:10.1016/j.eujim.2015.07.002

76 Koo TK, Li MY. A Guideline of Selecting and Reporting Intraclass Correlation Coefficients for Reliability Research. *J Chiropr Med* 2016;**15**:155–63. doi:10.1016/j.jcm.2016.02.012

77 Beiderbeck D, Frevel N, von der Gracht HA, *et al.* Preparing, conducting, and analyzing Delphi surveys: Cross-disciplinary practices, new directions, and advancements. *MethodsX* 2021;**8**:101401. doi:10.1016/j.mex.2021.101401

78 Beiderbeck D, Frevel N, von der Gracht HA, *et al.* The impact of COVID-19 on the European football ecosystem – A Delphi-based scenario analysis. *Technol Forecast Soc Change* 2021;**165**:120577. doi:10.1016/j.techfore.2021.120577

79 Wasserstein RL, Schirm AL, Lazar NA. Moving to a World Beyond "p < 0.05". *Am Stat* 2019;**73**:1–19. doi:10.1080/00031305.2019.1583913

80 Ritchie J, Lewis J, editors. Analysis: Principles and Processes. In: *Qualitative research practice: a guide for social science students and researchers*. London: : SAGE 2014. 269–93.

81 Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol* 2006;**3**:77–101. doi:10.1191/1478088706qp063oa

82 Ziebland S, McPherson A. Making sense of qualitative data analysis: an introduction with illustrations from DIPEx (personal experiences of health and illness). *Med Educ* 2006;**40**:405–14. doi:10.1111/j.1365-2929.2006.02467.x

83 Balas EA, Boren SA. Managing Clinical Knowledge for Health Care Improvement. *Yearb Med Inform* 2000;:65–70.

84 Morris ZS, Wooding S, Grant J. The answer is 17 years, what is the question: understanding time lags in translational research. *J R Soc Med* 2011;**104**:510–20. doi:10.1258/jrsm.2011.110180

85 Hanney SR, Castle-Clarke S, Grant J, *et al.* How long does biomedical research take? Studying the time taken between biomedical and health research and its translation into products, policy, and practice. *Health Res Policy Syst* 2015;**13**:1. doi:10.1186/1478-4505-13-1

86 Else H. How a torrent of COVID science changed research publishing — in seven charts. *Nature* 2020;**588**:553–553. doi:10.1038/d41586-020-03564-y

87 Bramstedt KA. The carnage of substandard research during the COVID-19 pandemic: a call for quality. *J Med Ethics* 2020;**46**:803–7. doi:10.1136/medethics-2020-106494

88 Watson C. Rise of the preprint: how rapid data sharing during COVID-19 has changed science forever. *Nat Med* 2022;**28**:2–5. doi:10.1038/s41591-021-01654-6

89 Derman RJ, Jaeger FJ. Overcoming challenges to dissemination and implementation of research findings in under-resourced countries. *Reprod Health* 2018;**15**:86. doi:10.1186/s12978-018-0538-z

90 Owoeye OBA, Rauvola RS, Brownson RC. Dissemination and implementation research in sports and exercise medicine and sports physical therapy: translating evidence to practice and policy. *BMJ Open Sport Exerc Med* 2020;**6**:e000974. doi:10.1136/bmjsem-2020-000974

91 Ashcraft LE, Quinn DA, Brownson RC. Strategies for effective dissemination of research to United States policymakers: a systematic review. *Implement Sci* 2020;**15**:89. doi:10.1186/s13012-020-01046-3

92 Krathwohl DR. A Revision of Bloom's Taxonomy: An Overview. *Theory Pract* 2002;**41**:212–8. doi:10.1207/s15430421tip4104_2