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International guidelines for the imaging investigation of suspected child physical abuse (IGISPA): a protocol for a modified Delphi consensus study

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ABSTRACT

Introduction Radiological imaging is a central facet of the multidisciplinary evaluation of suspected child physical abuse. Current guidelines for the imaging of suspected child physical abuse are often unclear, incomplete and highly variable regarding recommendations on critical questions, thereby risking clinical heterogeneity, unstructured decision-making and missed diagnoses. We, therefore, aim to develop and report an evidence-based and consensus-derived international guideline for the radiological investigation of index and contact children in the context of suspected physical abuse and to ascertain areas of scientific uncertainty to inform future research priorities.

Methods and analysis The international guidelines for the imaging investigation of suspected child physical abuse (IGISPA) consensus group includes formal representation from 127 recognised experts across 14 subspecialties, six continents and 32 national and/or international organisations. Participants will be divided into five longitudinal subgroups (indications for imaging, skeletal imaging, visceral imaging, neuroimaging and postmortem imaging) with three cross-cutting themes (radiography, genetics and adaptations for low- and lower-middle-income countries). Each subgroup will develop preliminary consensus statements via integration of current evidence-based guidelines, systematic literature review and the clinical expertise of a multinational group of experts. Statements will then undergo anonymised voting in a modified e-Delphi process and iterative revision until consensus (≥80% agreement) is achieved. Final statements will undergo both internal and external peer review prior to endorsement.

Ethics and dissemination As an anonymous survey of consenting healthcare professionals, this study did not require ethical approval. Experts provided written informed consent to participate prior to commencement of the modified Delphi process. The IGISPA consensus statement and any subsequent guidance will be published open access in peer-reviewed medical journals.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ International guidelines for the imaging investigation of suspected child physical abuse is an international study to develop robust guidelines for the imaging investigation of suspected child physical abuse, involving over 120 multidisciplinary healthcare professionals nominated by more than 30 national and/or international societies.

⇒ Guideline development centres around the robust Delphi method, aiming to ensure that all recommendations are evidence-based and consensus-derived.

⇒ The main limitation of this study is its reliance on the longitudinal collection of data from healthcare professionals who choose to participate without remuneration or reward, and so a degree of lost retention across Delphi rounds is anticipated; we define a minimum required retention of 75% to ensure the robustness of our recommendations.

INTRODUCTION

Child physical abuse, defined as the maltreatment of a child (aged <18 years) by a non-accidental act on the part of a parent or caretaker that causes, or has the potential to cause, injury or physical damage, is a significant yet preventable cause of childhood morbidity and mortality (prevalence 4–16% per annum), occurring in all societies and socioeconomic groups.[1–8] While the majority of parents do not cause harm to their children, there are many children worldwide who regularly suffer physical, sexual and/or psychological violence and maltreatment at the hands of parents and caregivers, the effects of which cast a long shadow on the development of the child and impose a heavy personal and socioeconomic toll.[4 9–11]

Radiological imaging plays a central role in the multidisciplinary investigation of suspected child physical abuse, in combination with a thorough physical examination, clinical history and laboratory data.[12–14] No injury or imaging sign is pathognomonic for an abusive aetiology; rather, the presenting history and constellation of injuries sustained may increase the clinical index of suspicion and lead to a diagnosis.[15 16] However, even in children with abusive injuries identified on clinical examination, further severe abusive injuries, including abusive head trauma and abdominal trauma, may remain occult.[17–22] Occult injuries may also be identified in asymptomatic contact children (defined as siblings, cohabiting children and children under the care of a suspected perpetrator) of an index child presenting with suspected physical abuse.[23 24] For these reasons, imaging in suspected physical abuse is a scenario in which the clinician is faced with both a screening and diagnostic test, requiring not only a high sensitivity but also a high specificity, given the fact that both false-negative and false-positive diagnoses of child physical abuse are potentially damaging. The former risks exposing infants to an estimated 35–50% risk of recurrent abuse, while the latter potentially conceals an alternate, at times treatable, diagnosis (such as a coagulopathy or fracture predisposition syndrome) and risks removing a child from a safe home.[21 25–30] As such, the early and accurate diagnosis of suspected child physical abuse is vital.

A recent systematic review of guidelines for the imaging evaluation of suspected child physical abuse in high-income countries identified discrepancies, lack of clarity and incomplete recommendations on critical questions, including, but not limited to, the role of follow-up skeletal survey, spinal MRI and abdominal imaging.[31] Not only this, but no clinical practice guidelines were identified for 38% of high-income countries.[31] This clinical heterogeneity has the potential to cause variability in clinical practice and decision-making, ultimately risking missed diagnoses and the perpetuation of child physical abuse. For example, in a pan-European survey of 236 physicians involved in child protection, 36% responded that a 10-week-old infant with bleeding from the mouth and a high likelihood of abuse was not a child protection concern requiring imaging investigation, while, in a second French survey of 274 physicians, only 28% responded that brain MRI is indicated for a 9-month-old child with a fractured femur, numerous bruises and head trauma.[32 33]

The WHO has identified the need for clear and accessible evidence-based guidelines for the early detection of child physical abuse as pivotal to the prevention of child maltreatment.[9] This is, however, complicated by there being a only a few prospective and multicentre studies, with frequent methodological divergence in terms of physical abuse definition, diagnostic techniques, diagnostic certainty, sample size, patient demography and national health/legal systems.[34 35] In this light, the development of a single robust, evidence-based guideline for the radiological imaging of suspected physical abuse necessitates the balanced integration and critical appraisal not only of published, peer-reviewed data but also of consensus clinical expertise in practice areas for which there is insufficient, conflicting or low-quality data. With this goal in sight, recent work from our group has proposed a guideline for the radiological investigation of contact screening in the context of suspected child physical abuse.[36 37] We now aim to build on this work via our established multidisciplinary consensus group and, based on a review of the literature and the collective clinical experience of a multinational group of experts, outline a standardised international consensus guideline for the imaging evaluation of index and contact children in the context of suspected physical abuse.

Aims and objectives

1. To develop and report an evidence-based and consensus-derived set of best practices for the imaging evaluation of index and contact children in the context of suspected physical abuse.
2. To ascertain areas of scientific uncertainty as future research priorities.

METHODS AND ANALYSIS

This modified Delphi consensus process, methodologically summarised in figure 1, will be conducted in line with ACCORD (Accurate Consensus Reporting Document) criteria.[38]

Participants

A panel of 127 recognised experts was recruited to participate in this modified Delphi consensus process between 1 January 2022 and 31 January 2025, with formal representation across six continents from 32 national and/or international organisations, named in box 1.[39] 91 experts were formally nominated by a national and/or international organisation, while 36 further experts were recruited by the International Guidelines for the Imaging investigation of Suspected Child Physical Abuse (IGISPA) steering committee given their contributions to the field, namely previous contributions to and leadership of guideline development for the detection and diagnosis of child physical abuse. Members of the IGISPA consensus group are listed in online supplemental file 1 while the geographical distribution of participating experts is shown in figure 2. Participating board-certified (or equivalent) experts include 46 paediatric radiologists, 33 paediatricians, 20 paediatric neuroradiologists, 11 paediatric and/or forensic radiographers, 3 paediatric neurologists, 2 forensic paediatricians, 2 paediatric geneticists, 2 paediatric neurosurgeons, 2 paediatric ophthalmologists, 1 paediatric emergency medicine physician, 1 paediatric general surgeon, 1 neuroradiologist, 1 paediatric oncologist, 1 midwife and 1 paediatric immunologist. All participating individuals have a minimum postqualification experience of 5 years in the diagnosis and management

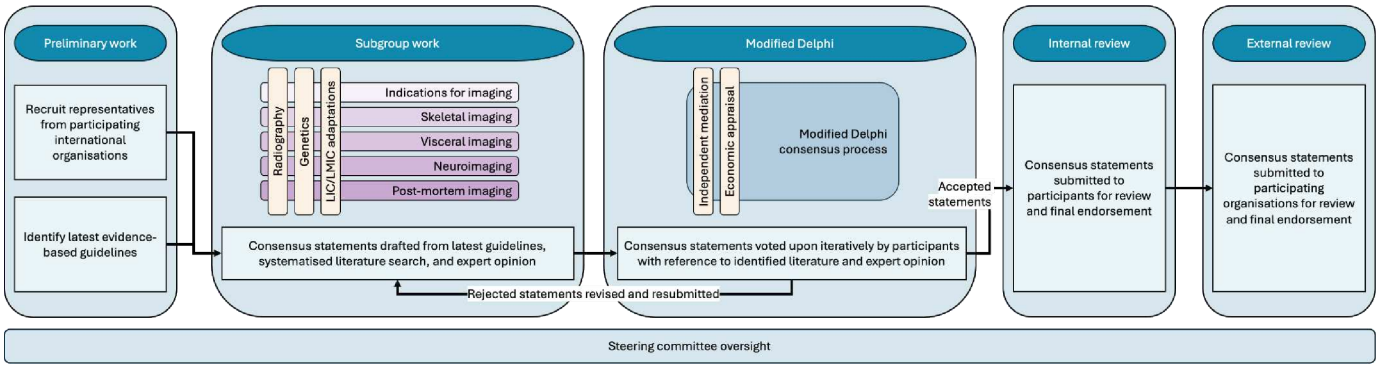

Figure 1 International guidelines for the imaging investigation of suspected child physical abuse (IGISPA) methodological summary. In a modified Delphi consensus process, a large consensus group of internationally recognised experts will first draft preliminary consensus statements in five longitudinally running subspecialty groups, prior to voting on all consensus statements in an online, interactive manner until consensus is achieved. The final consensus document will then undergo both internal and external review prior to final approval and endorsement. LIC/LMIC, low- and lower-middle-income countries.

of children with suspected physical abuse. The multidisciplinary nature of the IGISPA consensus group is vital, particularly since more complex cases of suspected child physical abuse typically involve complementary paediatric subspecialties.[21 30]

Box 1 National and/or international organisations formally represented within the international guidelines for the imaging investigation of suspected child physical abuse consensus group

African Society of Paediatric Imaging.
American Academy of Paediatrics.
American Society of Paediatric Neuroradiology.
Asian and Oceanic Society of Paediatric Radiology.
Austrian Society of Radiology.
Brazilian Society of Child Neurology.
British Society of Neuroradiology.
British Society of Paediatric Radiology.
Canadian Society of Paediatric Radiology.
European Academy of Paediatrics.
European Federation of Radiographer Societies.
European Society of Neuroradiology.
European Society of Paediatric Radiology.
French Paediatric Radiology Society.
German Society of Paediatric Radiology.
Hong Kong College of Radiologists.
Hong Kong Paediatric Society.
Indian Academy of Paediatrics.
Indian Society of Paediatric Radiology.
International Association of Forensic Radiographers.
International Society for the Prevention of Child Abuse and Neglect.
International Society of Forensic Radiology and Imaging.
Latin American Society of Paediatric Radiology.
Paediatric Society of New Zealand.
Ray E. Helfer Society.
Royal Australian and New Zealand College of Radiologists.
Royal College of Paediatrics and Child Health.
Royal College of Radiologists.
Society of Paediatric Neuroimaging.
Society of Paediatric Radiology.
Society of Radiographers.
South African Society of Paediatric Imaging.

Members of the IGISPA steering committee (n=22) are listed in online supplemental file 2. The IGISPA steering committee includes formal representation from all geographic areas, IGISPA subgroups (as later defined), core subspecialties and participating organisations with methodological oversight (Royal College of Radiologists, European Society of Paediatric Radiology, American Academy of Paediatrics (AAP), Royal College of Paediatrics and Child Health, and Ray E. Helfer Society). The defined scope of the steering committee is to provide strategic direction, methodological advice and ethical oversight. Delphi rounds will be mediated by two independent, non-voting authors to maintain the anonymity of participant opinions. Two systematic review methodologists, one medical physicist and one health economist with expertise in guideline development have also been recruited.

Preliminary consensus statement development

IGISPA subgroups

All voting participants (n=127) were self-allocated and divided into one, or at most two, of five longitudinally running subgroups, namely: (1) indications for imaging (n=37 experts); (2) skeletal imaging (n=36 experts); (3) visceral imaging (n=19 experts); (4) neuroimaging (n=38 experts) and (5) postmortem imaging (n=14 experts). Allocations were informed by both participant routine clinical practice and subspecialty expertise. The role of each subgroup is to draft preliminary consensus statements pertaining to these five core thematic areas for submission to the modified Delphi consensus process. Three cross-cutting themes, each of which runs across the longitudinal subgroups, have also been established in order to provide guidance pertaining to: (1) radiography (n=11 experts), to ensure that recommended imaging can be obtained in both a feasible, high-quality and safe manner; (2) genetics (n=2 experts) to ensure robust and thorough interrogation of the differential diagnoses of

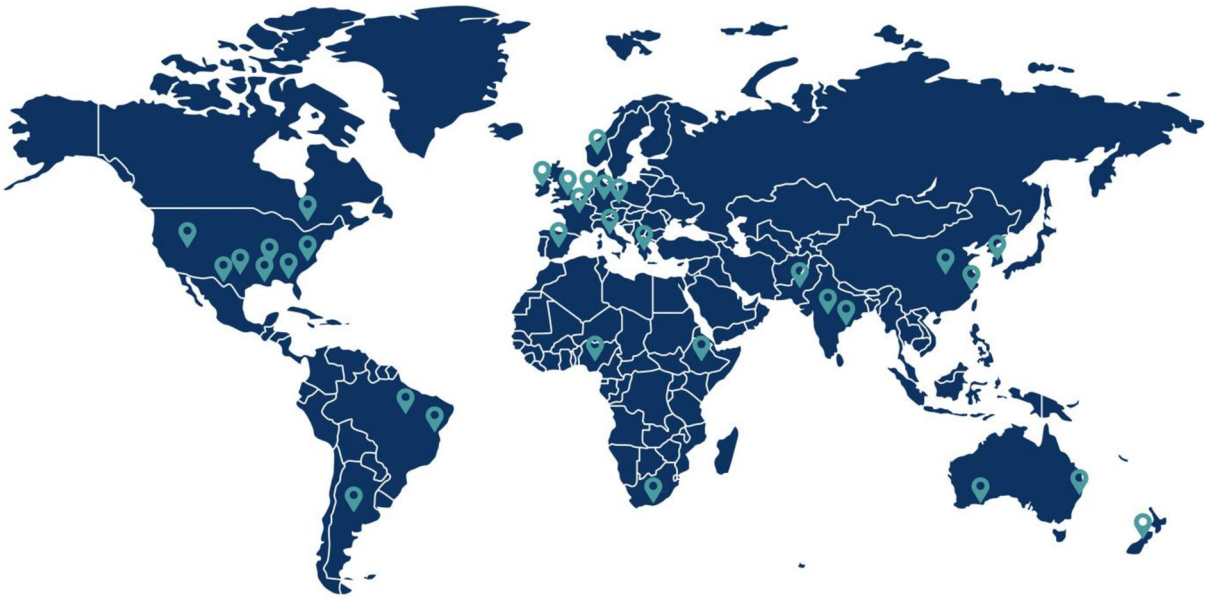

Figure 2 Geographical distribution of participating experts.

suspected child physical abuse and (3) guideline adaptations for low- and lower-middle-income countries (n=20 experts) to ensure applicability, utility and global implementation of consensus recommendations. National income was stratified by the World Bank's four-tier classification. Low- and lower-middle-income countries were selected for study in order to define a minimum set of best practices applicable to the most resource-limited settings.

Subgroup statement formulation

IGISPA subgroups will draft initial consensus statements via combinatorial integration of three evidence sources: the latest evidence-based guidelines, a systematised literature search and the expert opinion of a multinational group of experts (further detailed below). The quality of scientific evidence supporting each consensus statement will be evaluated using the Grading of Recommendations, Assessment, Development and Evaluation framework.[40 41] Recognising the potential for limited scientific evidence in some areas of child physical abuse clinical practice, initial consensus statement formulation will also consider the degree of clinical concordance for each statement across the proposing subgroup. An exemplar initial consensus statement integrating both scientific evidence and subgroup clinical expertise is provided in online supplemental file 3. Statements that rely heavily on either poor-quality or discordant evidence will be identified as future research priorities, which, at the discretion of subgroup leads, may be the focus of rapid, pooled research or scoping/systematic reviews via the IGISPA consensus group. This approach is designed to highlight discrepancies in current guidelines, inform the construction of consensus statements and document the evidence base for all recommendations. Final references will be listed based on originality and relevance to the scope of our recommendations. If required, and with the approval of the consensus committee chair, subgroup leads may enrol a maximum of four additional individuals with subspecialty expertise in order to gain greater clarity on initial consensus statements and scientific literature.

Evidence sources

Clinical guidelines must, as far as possible, be evidence-based, that is, derived from and reference high-quality scientific literature.[42] We, therefore, aim to derive consensus statements in both an evidence-based and clinically-informed manner for scenarios in which there is limited high-quality evidence, using three integrative data sources, as described below.

1. *Current evidence-based clinical guidelines:*
   We will retrieve the latest regional, national and/or international evidence-based guidelines for the evaluation of suspected child physical abuse published by academic organisations, medical societies or health agencies, as identified by a recent systematic review and as nominated by all participating individuals and organisations.[31] If several guidelines have been published by the same organisation, only the most recent will be considered. If guidelines have been published in multiple parts, we will consider them as a single guideline. If guidelines have been published in non-English languages, they will be translated and reviewed for accuracy by experts from the geographic area in question. Statements from identified guidelines will be divided into each subgroup theme by two independent mediating authors.
2. *Systematic literature review:*
   Ovid EMBASE, Ovid MEDLINE, CINAHL and Web of Science will be systematically searched, in a subgroup-specific manner, for articles reporting (1) imaging protocols for the investigation of suspected child physical abuse and (2) imaging findings in index and contact

children with suspected physical abuse. Keywords employed in the search will be standardised across subgroups by two independent systematic review methodologists and include variations on the Medical Subject Headings terms: 'child', 'child abuse', 'physical abuse' and 'diagnostic imaging'. No language or date restrictions will be imposed. Initial searches will be undertaken during the first quarter of 2024 and updated in the first quarter of 2025. Data extraction will be performed by each subgroup prior to synthesis. Systematic literature searches will be reported in line with Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 criteria.[43]

3. *Clinical expertise:*
Evidence-based medicine may be defined as '(the integration of) individual clinical expertise and the best external evidence'.[44] Each subgroup contains a critical mass of recognised subspecialty experts in the field of child abuse imaging, whose routine clinical experience is vast and whose research outputs have helped to define the field. This third data source aims to harness this multinational expertise and to derive safe clinical practice recommendations for areas which either lack scientific evidence or have conflicting scientific evidence.

Modified Delphi consensus process

Initial subgroup-formulated consensus statements will be collated (as shown in online supplemental file 3) and uploaded to the SmartDelphi e-Delphi platform (https://www.smartdelphi.com). Each voting participant will then be assigned a unique site log-in and study identifier, held only by the two independent mediators, to maintain anonymity while also enabling the auditing of participant responses and retention across Delphi rounds. Via SmartDelphi, participants will be able to discuss (via free text) and vote on consensus statements, in an anonymous and asynchronous manner, with reference to the scientific evidence base, and agree on new or modified recommendations for the imaging evaluation of index and contact children in the context of suspected child physical abuse. Asynchronous e-Delphi methods have been shown to provide similar results to conventional Delphi methods while reducing participant burden and attrition.[45] Voting will be captured using a 4-point Likert scale comprising the following terms: 'strongly agree', 'agree', 'disagree' and 'strongly disagree', with a separate fifth option, 'abstain'. 'Abstain' may be chosen if a particular statement lies outside an individual expert's clinical practice or knowledge base. Each Delphi round will remain open for a 1-month period, with four written electronic reminders sent to participants (one per week) to ensure participation and retention across Delphi rounds.

Results will be analysed between rounds by the two independent mediators and discussed at an anonymous, aggregate level by the IGISPA steering committee. Consensus has been defined a priori as ≥80% agreement between voting experts (≥101/127 individuals), in line with previous work from our group.[37] Unless otherwise stated, we will report recommendations meeting or exceeding this level of consensus (for both accepted and rejected statements). A further a priori decision-making algorithm has been instituted to permit interrogation of consensus statements with discordant clinical expertise or scientific evidence (figure 3), defining the role for desirable rather than essential investigations; rapid, pooled audit/research via the IGISPA consensus group and the safest clinical decision. Following the steering committee discussion, rejected consensus statements (agreement <80%) will be returned to the proposing subgroup for revision, considering discussions arising from the modified Delphi consensus process. Revised statements will undergo a second e-Delphi round, with this process occurring iteratively until consensus is achieved or, for statements failing to reach consensus, until a steering committee-defined point of cessation. Consensus statements failing to reach agreement at this point of cessation will be identified as future research priorities. Data collection is envisaged to be complete by late 2025, with full study results available in early 2026.

	Expert agreement ≥80%	Expert disagreement (<80% agreement)
Strong evidence base	Accept statement	Reject statement based on discordant clinical experience from a multinational group of experts caveated with the fact that there is likely conflicting evidence and consider: 1. Making this a desirable rather than essential investigation. 2. Conducting a rapid multicentre audit / service evaluation across the IGISPA consensus group, aiming to increase expert agreement. 3. The safest clinical decision.
Minimal evidence base or poor-quality evidence base	Accept statement based on concordant clinical experience from a multinational group of experts caveated with the fact that minimal or poor-quality evidence exists for the recommendation and consider: 1. Making this a desirable rather than essential investigation. 2. Conducting rapid, pooled research across the IGISPA consensus group to establish a high-quality evidence base. 3. The safest clinical decision.	Reject statement

Figure 3 Modified Delphi decision-making algorithm for consensus derived from both scientific evidence and the clinical expertise of a multinational group of experts. IGISPA, International Guidelines for the Imaging investigation of Suspected Child Physical Abuse.

Radiation dosimetry

The risks of radiation exposure to the developing child must be considered in the setting of child abuse imaging.[46 47] To this end, all IGISPA protocols that recommend imaging with ionising radiation will be dose-estimated by an independent medical physicist and compared with established regional guidelines for child abuse imaging, namely those of the Royal College of Radiologists/European Society of Paediatric Radiology (Europe) and the Society of Paediatric Radiology/AAP (USA).[7 48] In doing so, we aim to ensure that recommended protocols do not substantially exceed accepted levels of radiation exposure.

Guideline economic evaluation

The cost and economic feasibility of guideline implementation in the context of child abuse imaging have not been explored, particularly across different healthcare systems, which has led to criticism of previously reported consensus statements in the field.[47 48] We will, therefore, perform an economic evaluation of the final IGISPA recommendations to verify cost-effectiveness and to ensure the feasibility of guideline implementation across different geographies and resource settings. Standard economic evaluation methods will be followed.[49] More specifically, we will integrate evidence from the peer-reviewed literature within a decision model in order to estimate the differential costs and outcomes of alternative interventions. Outcomes will be measured in terms of early diagnoses of abuse and longitudinal forecasted health-related quality of life measures. Most analyses will be performed using the UK's National Health Service as a model system with a short-term time horizon, but longer-term impacts and other health systems will also be modelled. Costs and outcomes after the first year will be discounted using an approved discount rate. Sensitivity analyses will be performed to control for uncertainty in model parameters.

Guideline review, endorsement and dissemination

Final consensus statements will be integrated into a cohesive consensus document at the conclusion of the Delphi consensus process by the independent authors and reviewed by the IGISPA steering committee. Following steering committee approval, the consensus statement will then be reviewed internally by all participating authors prior to external review by all participating organisations, with the aim of formal guideline endorsement. The final, internally and externally approved, consensus statement will ultimately be submitted for peer-reviewed, open-access publication and presented at international scientific conferences. Results from individual Delphi rounds, in addition to comments and potential revisions arising from the external review process, will be published as supplementary material.

At the time of both internal and external review, recommendations will have undergone rigorous evaluation and achieved ≥80% agreement across a multinational group of experts, with comprehensive reference to both existing evidence-based guidelines and the peer-reviewed scientific literature. Proposed revisions to consensus statements instigated by either internal or external review must, therefore, be of sound scientific and clinical merit, as determined by a consensus vote of the steering committee (≥80%; ≥16/20 individuals), in order to proceed and, consequently, trigger another modified Delphi consensus round.

Guideline updates

Clinical guidelines necessitate revision in light of ever-changing scientific evidence and geopolitical circumstances. To this end, the IGISPA steering committee will meet every 2 years to evaluate the need for a revised international consensus guideline for the imaging evaluation of suspected child physical abuse. In the instance of rapidly available, high-impact new evidence in a specific IGISPA interest area, a single IGISPA subgroup may be tasked by the steering committee to develop updated guidance.

Patient and public involvement

None.

Ethics and dissemination

This study, being an anonymous survey of consenting healthcare professionals, did not require ethical approval. All participating experts provided written informed consent to participate prior to enrolment in the modified Delphi process. The IGISPA consensus statement and any subsequent guidance will be published open access in peer-reviewed medical journals.

DISCUSSION

Imaging plays a central role in the multidisciplinary evaluation of suspected physical abuse and the detection of occult injuries in children. IGISPA guidelines aim to, for the first time, provide a unified, internationally applicable set of best practices for the imaging evaluation of index and contact children in the context of suspected physical abuse.

As with all consensus studies, this study methodologically relies on the longitudinal collection of data from healthcare professionals who choose to participate without remuneration or reward, and so a degree of lost retention across Delphi rounds is anticipated. We define a minimum required retention of 75% to ensure the robustness of our recommendations.

Given both our aim to report an international consensus guideline and the fact that most individuals have been nominated to participate in IGISPA by a national and/or international organisation, it is vital that both geographic and organisational representation within IGISPA is conserved throughout the modified Delphi consensus process. To this end, if there is enrichment of lost representation from any single geography and/

or organisation, the steering committee may discretionarily request further, targeted enrolment to the consensus group. Further, despite our best efforts, it has not been possible to include experts from all geographic regions, and further refinement may be required on a region-specific basis.

Finally, while all consensus statements aim to be evidence-based, some may be developed on limited scientific evidence and require the support of the clinical expertise of our multinational expert group. These areas of scientific uncertainty will be defined as future research priorities, and future prospective audits of the IGISPA guideline will be required in order to further refine optimal imaging strategies for the diagnosis of child physical abuse.

Despite these limitations, the robust, transparent and systematic development of this international consensus guideline will represent a resilient platform from which clinicians may advocate for the optimal care of their patients within health service provision and international child protection systems. Identified research priorities will inform future primary studies and an international research agenda.

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