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Reducing pain in children with cancer: Methodology for the development of a clinical practice guideline

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Abstract

Although pain is one of the most prevalent and bothersome symptoms children with cancer experience, evidence-based guidance regarding assessment and management is lacking. With 44 international, multidisciplinary healthcare professionals and nine patient representatives, we aimed to develop a clinical practice guideline (following GRADE methodology), addressing assessment and pharmacological, psychological, and physical management of tumor-, treatment-, and

procedure-related pain in children with cancer. In this paper, we present our thorough methodology for this development, including the challenges we faced and how we approached these. This lays the foundation for our clinical practice guideline, for which there is a high clinical demand.

KEYWORDS
clinical practice guideline, evidence-based medicine, pain, pediatric oncology, supportive care

1 | INTRODUCTION

Pain in children with cancer has been well acknowledged and puts great burden on patients and their families.[1,2] For this reason, providing age-appropriate pain assessments and treatment strategies to reduce is a priority. Pain in children treated for cancer can have multiple origins, such as the tumor itself (e.g., pain associated with bone metastases), adverse effects of anticancer treatment (e.g., chemotherapy-induced neuropathic pain), or painful and distressing procedures that children with cancer undergo frequently (e.g., accessing a central venous access port).[3–5]

Even though reducing pain has been acknowledged as being of utmost importance, there is no uniform guideline that advises on assessment and management of pain in children with cancer. This is unfortunate, as high-quality evidence-based guidelines, also called clinical practice guidelines (CPGs), have been shown repeatedly to improve patient outcomes.[6,7] Clinical practice guidelines include a systematic review of evidence, thus providing clinicians with an overview of the current best available evidence.[8] Recommendations are then based upon the evidence and formulated by a representative multidisciplinary panel including professionals and patient representatives. Justifications and subgroup considerations are included to provide insight as to why specific treatments should or should not be provided and to which patients. In addition, by summarizing the available evidence research gaps are identified that help in composing and prioritizing a research agenda.

We know that children experience pain as one of the most bothersome symptoms of cancer and its treatment, and parents even designated pain as the most problematic are for their child undergoing cancer treatment.[9,10] With the current lack of evidence-based guidance in this area, and the existing large variations in daily practice, a CPG could be pivotal to improve pain outcomes and quality of life.[11]

We therefore initiated the development of a comprehensive CPG regarding pain in children with cancer. Our aim was to formulate recommendations for care for children with cancer regarding assessment and management of pain. In this article, we provide an overview of our methodology, and briefly present the identified evidence. Subsequent manuscripts will focus on the recommendations, reporting on (1) pain assessment, (2) management of procedure-related pain, and (3) management of tumor- and toxicity-related pain.

2 | METHODS

2.1 | Multidisciplinary guideline development panel

A full overview of the guideline development panel (GDP) can be found in Figure 1. The GDP was multidisciplinary and multinational, and consisted of 44 members, recruited through the International Pediatric Oncology Guidelines in Supportive Care Network (iPOG network) or solicited by other members.[12] All members provided a completed International Committee of Medical Journal Editors (ICMJE) form for disclosure of potential conflicts of interest.

The GDP consisted of a core group (CG) and six working groups (WGs), that focused on assessment and evaluation of pain (WG1), pharmacological management of tumor-related pain (WG2A), toxicity-related pain (WG2B), and procedure-related pain (WG2C), and psychological and physical management of tumor- and toxicity-related pain (WG3A) and procedure-related pain (WG3B).

Great value was placed on incorporating the perspective of the patient and the family. This was deemed important from a clinical viewpoint but also because we know from previous research how the involvement of patient representatives positively influenced CPG development.[13] Therefore, nine patient representatives (four cancer survivors and five parents) were solicited through childhood cancer patient/parent organizations and were involved in reviewing draft recommendations. Input was used to revise recommendations. The patient representatives attended a short training course covering the basics of evidence-based guideline development.

2.2 | Formulation of clinical questions

All WGs formulated clinical questions for topics deemed clinically relevant. Questions regarding pain assessment were developed in accordance with the COSMIN standards (COnsensus-based Standards for the selection of health status Measurement INstruments), defining the following: (1) target population, (2) domain, (3) determinant, and (4) relevant outcomes.[14] Questions regarding treatment strategies were developed according to the PICOS format, defining the following: (1) patient, (2) intervention, (3) comparison, (4) relevant outcomes, and (5) study design.

After finalization of the clinical questions, a simple nonweighted voting procedure using a 10-point scale was carried out to prioritize these questions for CPG development. For each WG, the clinical

questions with the highest median score were included (maximum 5 per WG, to keep the work manageable).

2.3 | Rating importance of outcomes

In accordance with the Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology, we wanted to decide on important outcomes before commencing the literature search, as this would facilitate the discussion for recommendations later on in the process.[15] For all individual clinical questions, WG and CG members voted on the importance of outcomes on a 9-point scale. Outcomes were categorized according to median score: 1–3: "critical for decision making," 4–6: "important, but not critical for decision making," and 7–9: "low importance for decision making."[15]

2.4 | Systematic literature search

Together with a medical librarian, we designed two comprehensive search strategies. The first focused on identifying studies evaluating measurement properties of pain and distress measurement instruments used in children with cancer (WG1). The second on identifying randomized controlled trials (RCTs) on interventions to reduce pain in children with cancer (covering all clinical questions of WG2 and WG3, as we expected separate clinical question searches would lead to a lot of overlapping citations and thus double work).

Searches were compiled by combining several search filters. If available, we used search filters of Cochrane Childhood Cancer (CCC).[16] We combined four search strategies with the "AND" Boolean operator, focusing on (1) children, (2) childhood cancer, (3) pain, and (4) measurement properties (WG1) or RCTs (WG2-3). See Supporting Information Material S1 for complete search strategies.

Several electronic databases were searched, from inception until March 13, 2018 (initial search March 23, 2017, top-up search March 13, 2018): PubMed/MEDLINE, CINAHL, PsycINFO, HaPI, EMBASE, AMED, and CENTRAL. We limited results to English language publications. For identification of additional studies that were not included in the search, we performed forward and backward citation chasing of included studies and consulted experts for missing eligible studies.

2.5 | Eligibility criteria

Studies had to meet certain criteria, which differed somewhat per clinical question (see Supporting Information Material S2). Overarching inclusion criteria were as follows.

Patient criteria. Studies that encompassed children and/or adolescents with cancer, defined as: (1) all participants < 25 years old or a median or mean ≤ 16 years old and (2) at least 75% of participants diagnosed with cancer. For the WGs focused on procedure-related pain, participants had to undergo a relevant minor procedure (e.g., blood sampling, access to central venous access port), a lumbar puncture procedure, or a relevant major procedure (e.g., bone marrow aspiration, bone biopsy).

Intervention /instrument criteria. Studies that investigated a relevant intervention (pertinent to the clinical question, e.g., gabapentin for
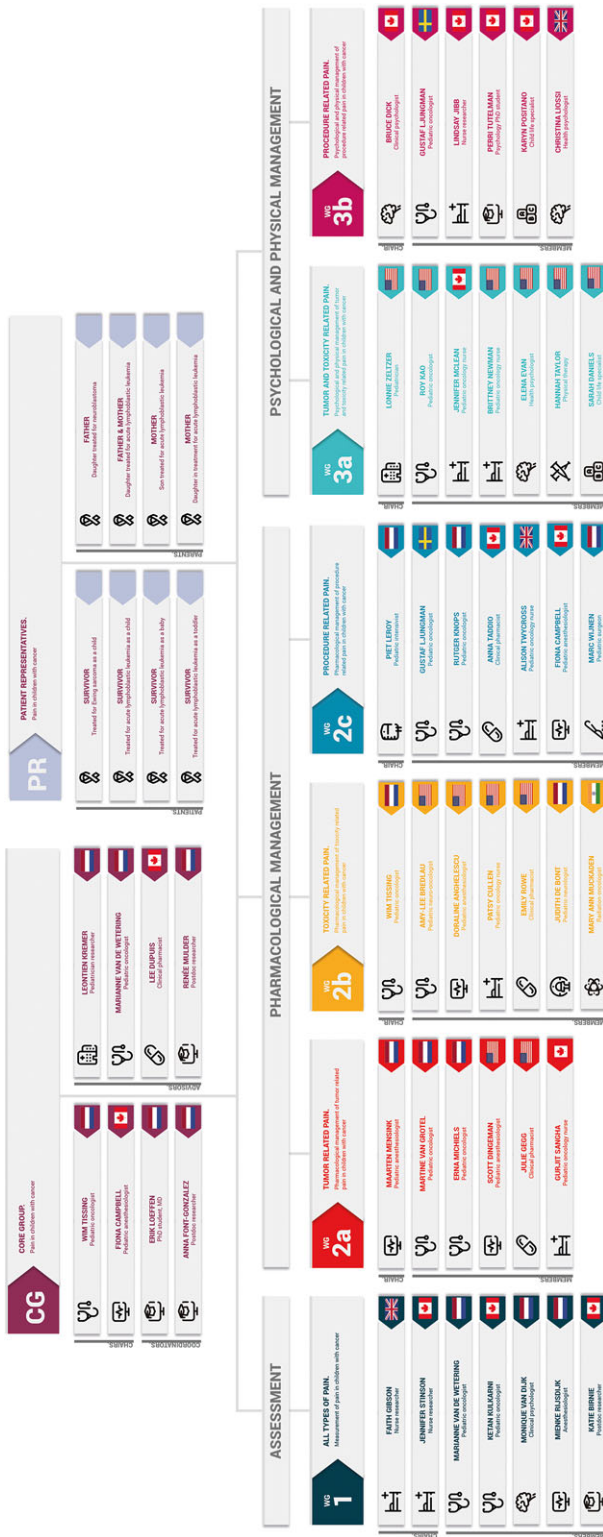

FIGURE 1 Overview of the guideline development panel

neuropathic pain, hypnosis for procedural pain) or a relevant measurement instrument (e.g., visual analog scale for self-rated pain).

Comparison criteria. Only relevant for intervention studies. Comparators were active (e.g., placebo, another medication) or passive (e.g., standard care).

Outcome criteria. Relevant outcomes for measurement properties studies were defined in accordance with COSMIN (e.g., reliability, validity).[14] For RCTs on interventions, several outcomes were included for all clinical questions (e.g., pain intensity, adverse effects) and several outcomes differed per clinical question (e.g., ability to eat, duration of procedure).

Study criteria. Only primary studies with at least 10 participants were included. In accordance with COSMIN, measurement properties studies had to state that their aim was to evaluate the clinimetric properties of an existing measurement instrument or to develop a new measurement instrument.[14] For intervention studies, only RCTs (including crossover RCTs) were included. Studies had to be published in a peer-reviewed journal, with a full-text available in English.

2.6 | Selection of studies

As we anticipated retrieving a large number of citations, we opted for a three-step fan-out approach (see Figure 2). We began with a selection based on titles only as this process was recently found to be potentially more effective than screening on titles and abstracts.[17]

Title selection. Two independent reviewers (EL, WT/FC) performed this selection, which served to exclude studies that were obviously irrelevant (e.g., older adult population). A conservative approach for inclusion was used: all citations classified as "include" by at least one reviewer were included for the next selection round (irrespective of the other reviewer's classification, no discussion was held). This approach was applied only during title selection. In all other phases, discrepancies among two reviewers were discussed in detail and resolved by consensus (or if necessary by a third reviewer). Reviewers identified the specific WG(s) which the citation was relevant for, after which the included citations were fanned out to the relevant WGs.

To pilot the title selection process, three reviewers (EL, WT, and RM) appraised the first 250 citations. If absolute agreement was below 85%, selection criteria were optimized and the pilot was repeated for the subsequent 250 citations.

Abstract selection. Two independent reviewers (EL, members of relevant WG) performed the WG-wise selection based on title and abstract. Reviewers also flagged citations that were relevant for another WG.

Full-text selection. In the final selection round, the same two independent reviewers performed the WG-wise selection of full texts in a similar manner as the abstract selection.

2.7 | Data extraction

For the data extraction, a purpose-built data extraction form including manual was developed (see Supporting Information Material S3 and S4); this was pilot tested on three studies by two reviewers (EL and WT). Subsequently, the form was completed independently by two reviewers (same as in full-text selection) for each included study. The form differed slightly per clinical question, but for all questions covered: (1) general study information (e.g., title, year); (2) study design characteristics (e.g., setting, duration); (3) participant characteristics (e.g., sample size, diagnosis); (4) intervention/instrument characteristics (e.g., intervention, participants per arm); (5) outcome characteristics (e.g., included outcomes, values); (6) bias assessment (see next paragraph); and (7) additional information (at the discretion of the reviewer).

2.8 | Quality appraisal

For measurement properties studies, the COSMIN checklist for assessing methodological quality of such studies was used.[14,18] This resulted in a score per included outcome for each study, that could either be "excellent," "good," "fair," or "poor."

For RCTs on interventions, risk of bias of the included studies was determined according to the criteria used in the Cochrane Risk of Bias tool, comprising selection bias, performance bias, detection bias, attrition bias, reporting bias, and other bias.[19] Per criteria risk of bias was judged as high, low, or unclear, as per the instructions in the Cochrane Handbook.[19]

After this, the quality of evidence for all outcomes was summarized using the GRADE system, where the primary focus is not on the individual studies, but on the body of evidence, i.e., all included studies per outcome combined.[20] The quality of evidence is classified as high, moderate, low, or very low. This classification is dependent on the design of the included studies (e.g., RCTs start as "high") and various specific factors, i.e., the quality is downgraded for study limitations, inconsistency, indirectness, imprecision or publication bias, or upgraded for dose response effect or large magnitude of effect.[21] The GRADE appraisal was performed independently by two reviewers.

2.9 | Data analysis

For intervention studies, the relative intervention effects for each outcome were calculated, using relative risks including 95% confidence intervals (CIs) for dichotomous outcomes, and standardized mean differences including 95% CIs for continuous outcomes. Meta-analyses were performed when multiple studies were included that had an equal study design and similar patient characteristics. Heterogeneity was assessed using forest plots and the I^2 statistic (cutoff for substantial heterogeneity $\geq 50\%$).[19] If there was no substantial heterogeneity, we estimated treatment effects using a fixed-effect model. If substantial heterogeneity was present, we explored possible causes and used a random-effect model to estimate treatment effects. Meta-analyses were performed in Review Manager version 5.3 (The Cochrane Collaboration, Copenhagen, Denmark). All other statistical analyses were performed in SPSS version 23.0 (IBM corp., Armonk, NY, USA). For all statistical tests, a P value of <0.05 was considered statistically significant.
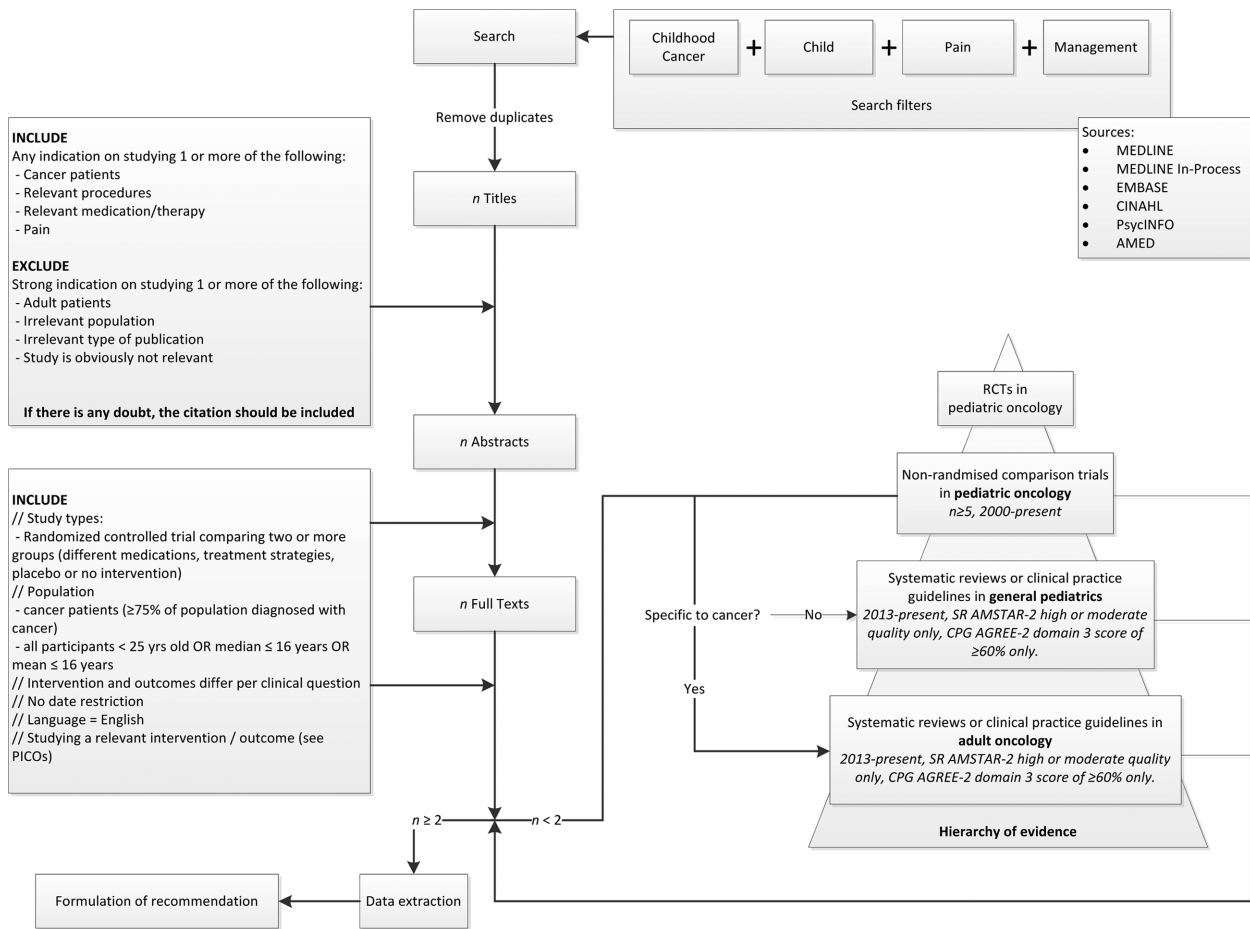
FIGURE 2 Flowchart of the study search and selection regarding clinical questions on the management of pain in children with cancer

2.10 | Synthesis of results

We prepared a narrative synthesis discussing our findings per clinical question. Tables with characteristics of included studies were prepared and contained information regarding study design, sample, intervention/instrument, where applicable comparison, and outcomes of the included studies.

For questions regarding measurement properties studies, we prepared a summary of findings tables per construct (e.g., self-reported pain intensity). To provide a comprehensive overview, we also developed a quality matrix including information on purpose, number of studies, age group, and COSMIN quality score.

For questions regarding intervention studies we prepared a summary of findings table per clinical question, with information for each included outcome on number of studies, number of participants, description of intervention, definition of outcome (unit), statistical method, effect size, and quality of evidence.

2.11 | Project group meeting in Amsterdam

All project members were invited to a two-day in-person consensus conference in Amsterdam (NL) in February 2018. Of 44 members, 36 attended (82%). The majority of the meeting proceedings consisted of discussing included studies, evidence summaries and formulating

recommendations in small WGs setting. In addition, total group meetings were held to discuss the draft recommendations and to devise the way forward. Decisions were made through group discussion and consensus. In all steps, except the formulation of final recommendations, a voting procedure was performed (majority voting system) in case of absence of unanimity. Final recommendations had to be supported unanimously by all WG members.

2.12 | Formulation of recommendations; evidence-to-decision table

For each clinical question, the WGs completed an evidence-to-decision (EtD) framework. Recently, GRADE published the EtD-framework, which is a systematic and transparent approach to formulating healthcare recommendations.[22] This framework consists of 11 questions in six domains and facilitates taking both the evidence and the represented expert knowledge into account. After an EtD framework was completed, we formulated an overall conclusion in which the benefits and harms are weighed. On the basis of these conclusions, recommendations for clinical care were formulated. These EtD frameworks and accompanying recommendations were also discussed in a separate meeting with the patient representatives, to explore their values and preferences and so validate and/or expand decision-making. If the latter led to alterations in the recommendations, these were discussed

again in the relevant WG. Final recommendations had also to be supported unanimously by the patient representatives panel.

2.13 | Additional evidence searches

For some of the included clinical questions on pain management, the literature review yielded very few or no eligible studies, leading to insufficient evidence upon which to base a recommendation. For these questions, the CG proposed a flowchart with steps to follow that the project group subsequently agreed with (see Figure 2).

For clinical questions regarding assessment of pain with insufficient evidence, we searched for systematic reviews (SRs), meta-analyses (MAs), and CPGs concerning pain measurement instruments in all child populations (indirect evidence). For all treatment questions with insufficient evidence we searched for lower quality evidence (i.e., nonrandomized comparison trials) in children with cancer, and for most questions we also searched for SRs, MAs, and CPGs in other child populations (e.g., for distraction techniques during procedures). For questions with a pathophysiology specific to cancer (e.g., chemotherapy-induced mucositis), we did not search for literature from other child populations, but only for adult oncology CPGs.

The systematic searches for these questions were more focused than the initial searches (see Supporting Information Material S1). For the non-RCTs, we included all primary studies with a comparison design (parallel, crossover, pre-post), a minimum of 10 participants, and published since 2000. For the SRs, MAs, and CPGs, we included only studies that complied with minimal quality criteria, and were published since 2013 (see Figure 2).

After the selection of studies and extraction of data, the retrieved information was added to the relevant evidence summary, which was subsequently used to complete the updated EtD framework. Formulation of recommendations then commenced in a similar manner as in the previous phase.

2.14 | Funding source

3 | RESULTS

3.1 | Clinical questions

The WGs formulated 89 clinical questions (see Supporting Information Material S2). After the voting rounds, 22 clinical questions were included (Table 1). Prioritized outcomes differed per clinical question; however, for the questions on pain management strategies, self-rated pain intensity was consistently prioritized as the most critical outcome.

3.2 | Systematic review

See Figure 3 for a PRISMA flow diagram of the selection process.[23] See Supporting Information Material S5 for a list of excluded studies that were read in full text. In the title selection process pilot, agreement was excellent (231 of 250 citations [92.4%] had identical scores by all three reviewers).

The literature search for clinical questions regarding assessment of pain yielded 2,857 citations. Of these, 79 articles were read in full text, of which 13 studies were included: two on self-rating of pain intensity using numbers, six on behavioral distress assessment, two on neuropathic pain, and three on multidimensional instruments.[24–36] Unfortunately for self-rating of pain intensity using numerical rating scales and for "simple" proxy ratings, no studies were eligible for inclusion.

For clinical questions on pain management strategies, the literature search yielded 11 159 citations, of which 194 articles were read in full text and eventually 55 RCTs were included. Regarding pharmacological management of tumor-related pain, no RCTs were eligible for inclusion. With regard to pharmacological management of treatment-related pain, seven RCTs were included: five on mucositis, one on neuropathic pain, and one on phantom limb pain.[37–42] Only one RCT was included regarding psychological and physical management of tumor- and treatment-related pain, concerning physical therapy.[43] Regarding pain during procedures, there were 33 RCTs included on pharmacological management: seven on minor procedures, eight on lumbar punctures, and 13 on major procedures.[44-76] For psychological and physical management of pain during procedures, 15 RCTs were included: six on hypnosis, five on active distraction, two on passive distraction, and two on combining treatment modalities.[69,71,77–89]

4 | DISCUSSION

The primary focus in children with cancer has initially, understandably, been on improving survival, supportive care has long been a relatively unexplored niche. However, with current survival rates and the high burden of cancer and its treatment on patients and their families, improving supportive care is increasingly acknowledged as an area that deserves attention.[90,91] To improve care, we initiated a project to develop childhood cancer supportive care CPGs, of which the development of a CPG regarding pain in children with cancer is one of the initial foci.[11] We executed this project in a very rigorous manner and described our methods in this article to promote transparency and to inspire and educate others on the verge of initiating a supportive care CPG project. Currently, we are developing recommendations, which will be published in a three-part series: (1) assessment of pain, (2) pharmacological, psychological, and physical management of tumor- and treatment-related pain, and (3) pharmacological, psychological, and physical management of procedure-related pain.

One of the strengths of this project is also an important challenge. Because we aspired to develop as comprehensive a CPG as possible, we included many clinical questions. When all these questions are answered, the emerging clinical and/or research recommendations will help healthcare professionals greatly in their daily work. However,

TABLE 1 Included clinical questions

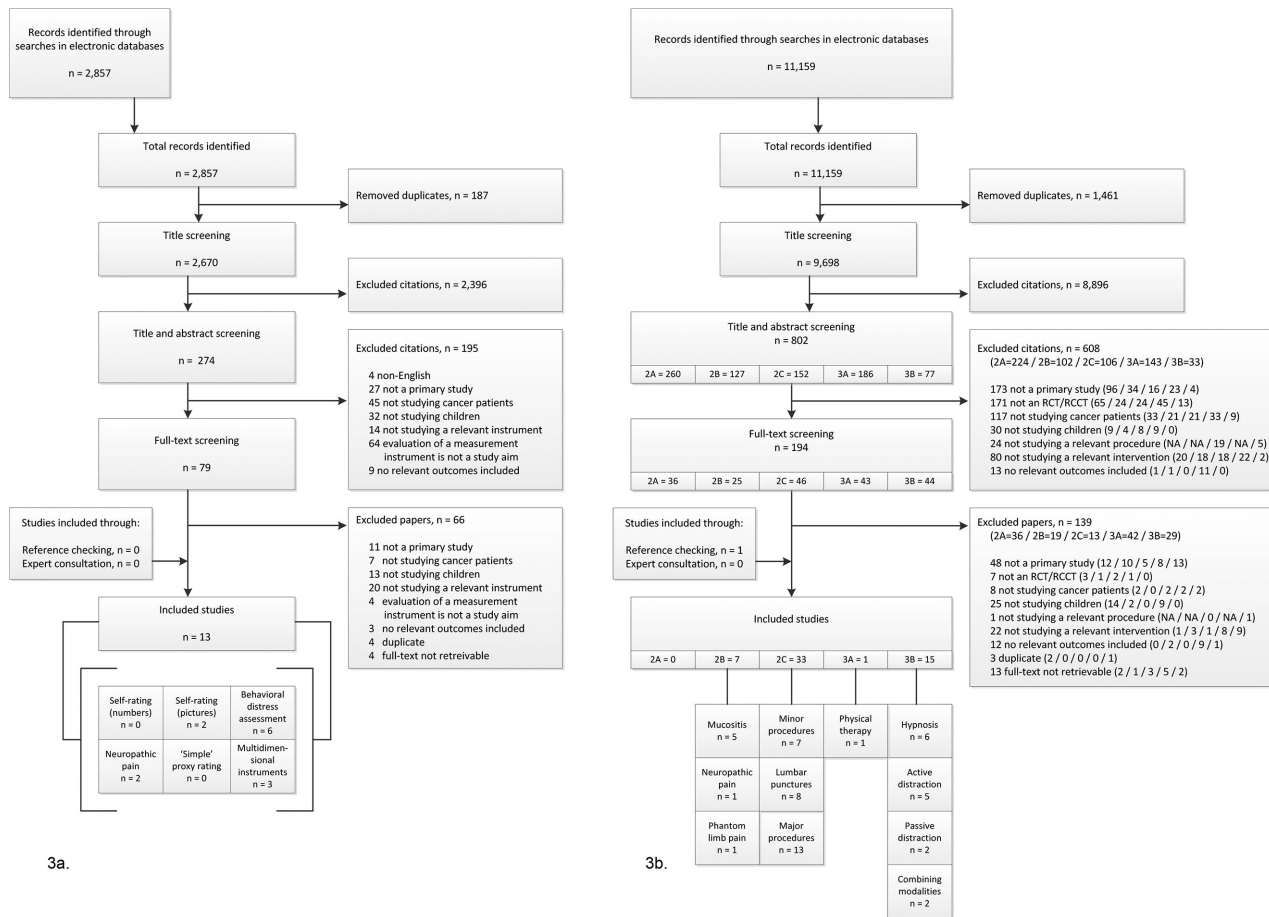|	Patient	Instrument		Critical outcomes (as prioritized)
	Children with cancer	Pain intensity: self-rating (numbers, pictures)		Reliability, validity, clinical utility, responsiveness, interpretability
	Children with cancer	"Simple" rating by proxy		Reliability, validity, clinical utility, interpretability
	Children with cancer	Behavioral distress assessment instruments		Reliability, validity, clinical utility, responsiveness, interpretability
	Children with cancer	Neuropathic pain		Reliability, validity, clinical utility, interpretability
	Children with cancer	Multidimensional instruments		Reliability, validity, clinical utility, interpretability
	Patient	**Intervention**	**Control**	**Critical outcomes (as prioritized)**
2A	Children with cancer	Pharmacological therapies to manage nociceptive pain	Any	Pain intensity (self-rated), distress (self-rated), quality of life (self-reported), adverse effects, distress ("simple" proxy rating), behavioral distress, changes in physical functioning, changes in general functioning
2A	Children with cancer	Pharmacological therapies to manage bone pain	Any	Pain intensity (self-rated), distress (self-rated), quality of life (self-reported), adverse effects, distress ("simple" proxy rating), behavioral distress, changes in physical functioning, changes in general functioning
2A	Children with cancer	Pharmacological therapies to manage tumor-related neuropathic pain	Any	Pain intensity (self-rated), distress (self-rated), quality of life (self-reported), adverse effects, distress ("simple" proxy rating), behavioral distress, changes in physical functioning, changes in general functioning, sleep
2A	Children with cancer	Opioid-sparing	Any	Pain intensity (self-rated), distress (self-rated), quality of life (self-reported), adverse effects, changes in physical functioning, changes in general functioning
2A	Children with cancer	Role of invasive procedures	Any	NA
2B	Children with cancer	Pharmacological therapies to manage chemotherapy-induced neuropathic pain	Any	Pain intensity (self-rated), distress (self-rated), quality of life (self-reported), adverse effects, distress ("simple" proxy rating), behavioral distress, changes in physical functioning, changes in general functioning, quality of life (reported by proxy), global judgement of satisfaction with treatment
2B	Children with cancer	Pharmacological therapies to manage pain from mucositis	Any	Pain intensity (self-rated), distress (self-rated), quality of life (self-reported), adverse effects, distress ("simple" proxy rating), behavioral distress,, quality of life (reported by proxy), duration of therapeutic effect, global judgement of satisfaction with treatment, oral intake, ability to eat
2B	Children with cancer	Pharmacological therapies to manage pain from constipation due to opioids	Any	Pain intensity (self-rated), adverse effects, distress (self-rated), distress ("simple" proxy rating), change in dose of opioids
2B	Children with cancer	Pharmacological therapies to manage phantom limb pain	Any	Pain intensity (self-rated), distress (self-rated), quality of life (self-reported), adverse effects, distress ("simple" proxy rating), behavioral distress, changes in physical functioning, changes in general functioning, quality of life (reported by proxy), duration of therapeutic effects, global judgement of satisfaction with treatment, need for "classic" (nociceptive) pain interventions
2B	Children with cancer	Pharmacological therapies to manage anti-gd2 antibody infusion-related pain	Any	Pain intensity (self-rated), distress (self-rated), adverse effects, distress ("simple" proxy rating), behavioral distress, quality of life (self-reported), changes in physical functioning, sleep

(Continues)

TABLE 1 (Continued)

	Patient	Instrument		Critical outcomes (as prioritized)
2C	Children with cancer undergoing a minor procedure	Pharmacological therapies to reduce procedure-related pain and distress	Any	Pain intensity (self-rated), distress (self-rated), behavioral distress, adverse effects
2C	Children with cancer undergoing a lumbar puncture	Pharmacological therapies to reduce procedure-related pain and distress	Any	Pain intensity (self-rated), distress (self-rated), adverse effects, distress ("simple" proxy rating), behavioral distress, procedure success
2C	Children with cancer undergoing a major procedure	Pharmacological therapies to reduce procedure-related pain and distress	Any	Pain intensity (self-rated), distress (self-rated), adverse effects, distress ("simple" proxy rating), behavioral distress
3A	Children with cancer	Physical therapy	Any	Pain intensity (self-rated), distress (self-rated), quality of life (self-reported), changes in general functioning, changes in physical functioning, adverse effects
3A	Children with cancer	Active distraction	Any	Pain intensity (self-rated), quality of life (self-reported), distress (self-rated), changes in general functioning, global judgement of satisfaction with treatment, adverse effects
3A	Children with cancer	Passive distraction	Any	Pain intensity (self-rated), quality of life (self-reported), distress (self-rated), changes in general functioning, global judgement of satisfaction with treatment, adverse effects
3A	Children with cancer	Meditation/mindfulness	Any	Pain intensity (self-rated), distress (self-rated), quality of life (self-reported), global judgement of satisfaction with treatment, adverse effects
3A	Children with cancer	Guided imagery	Any	Pain intensity (self-rated), quality of life (self-reported), distress (self-rated), changes in general functioning, global judgement of satisfaction with treatment, adverse effects
3B	Children with cancer undergoing a painful procedure	Active distraction	Any	Pain intensity (self-rated), distress (self-rated), distress ("simple" proxy rating), behavioral distress, fear for future medical procedures, adverse effects
3B	Children with cancer undergoing a painful procedure	Combination of modalities	Any	Pain intensity (self-rated), distress (self-rated), distress ("simple" proxy rating), behavioral distress, global judgement of satisfaction with treatment, fear for future medical procedures, adverse effects
3B	Children with cancer undergoing a painful procedure	Hypnosis	Any	Pain intensity (self-rated), distress (self-rated), distress ("simple" proxy rating), behavioral distress, fear for future medical procedures, adverse effects
3B	Children with cancer undergoing a painful procedure	Passive distraction	Any	Pain intensity (self-rated), distress (self-rated), distress ("simple" proxy rating), behavioral distress, fear for future medical procedures, adverse effects
3B	Children with cancer undergoing a painful procedure	Parent coaching	Any	Pain intensity (self-rated), distress (self-rated), distress ("simple" proxy rating), behavioral distress, fear for future medical procedures, adverse effects

the obvious drawback of including multiple clinical questions is that it might lead to almost unmanageable amounts of work. We have, however, made efforts to reduce this without compromising quality, i.e., by combining search strategies.

The biggest challenge in the development of this CPG was handling situations in which there was either very little or very low quality evidence. As previously mentioned, research in supportive care in childhood cancer is a relatively new area of investigation, thus the evidence base is small. Nevertheless, we were still disappointed by the scarcity of high-quality studies conducted in this important field of cancer care. This left us with several suboptimal options: omitting the clinical question, basing a recommendation upon expert consensus, or searching for lower quality and/or more indirect evidence. In a recent paper from the GRADE guidelines series, the GRADE working group acknowledged that clinicians can be frustrated when a guideline does not actually provide guidance.[92] Guideline panels are therefore encouraged to make

Figure 3a

- Records identified through searches in electronic databases n = 2,857
- Total records identified n = 2,857
  - Removed duplicates, n = 187
- Title screening n = 2,670
  - Excluded citations, n = 2,396
- Title and abstract screening n = 274
  - Excluded citations, n = 195
    - 4 non-English
    - 27 not a primary study
    - 45 not studying cancer patients
    - 32 not studying children
    - 14 not studying a relevant instrument
    - 64 evaluation of a measurement instrument is not a study aim
    - 9 no relevant outcomes included
- Full-text screening n = 79
- Studies included through:
  - Reference checking, n = 0
  - Expert consultation, n = 0
  - Excluded papers, n = 66
    - 11 not a primary study
    - 7 not studying cancer patients
    - 13 not studying children
    - 20 not studying a relevant instrument
    - 4 evaluation of a measurement instrument is not a study aim
    - 3 no relevant outcomes included
    - 4 duplicate
    - 4 full-text not retrievable
- Included studies n = 13

Self-rating (numbers) n = 0	Self-rating (pictures) n = 2	Behavioral distress assessment n = 6
Neuropathic pain n = 2	'Simple' proxy rating n = 0	Multidimensional instruments n = 3

3a.

Figure 3b

- Records identified through searches in electronic databases n = 11,159
- Total records identified n = 11,159
  - Removed duplicates, n = 1,461
- Title screening n = 9,698
  - Excluded citations, n = 8,896
- Title and abstract screening n = 802

2A = 260	2B = 127	2C = 152	3A = 186	3B = 77

  - Excluded citations, n = 608 (2A=224 / 2B=102 / 2C=106 / 3A=143 / 3B=33)
    - 173 not a primary study (96 / 34 / 16 / 23 / 4)
    - 171 not an RCT/RCCT (65 / 24 / 24 / 45 / 13)
    - 117 not studying cancer patients (33 / 21 / 21 / 33 / 9)
    - 30 not studying children (9 / 4 / 8 / 9 / 0)
    - 24 not studying a relevant procedure (NA / NA / 19 / NA / 5)
    - 80 not studying a relevant intervention (20 / 18 / 18 / 22 / 2)
    - 13 no relevant outcomes included (1 / 1 / 0 / 11 / 0)
- Full-text screening n = 194

2A = 36	2B = 25	2C = 46	3A = 43	3B = 44

- Studies included through:
  - Reference checking, n = 1
  - Expert consultation, n = 0
  - Excluded papers, n = 139 (2A=36 / 2B=19 / 2C=13 / 3A=42 / 3B=29)
    - 48 not a primary study (12 / 10 / 5 / 8 / 13)
    - 7 not an RCT/RCCT (3 / 1 / 2 / 1 / 0)
    - 8 not studying cancer patients (2 / 0 / 2 / 2 / 2)
    - 25 not studying children (14 / 2 / 0 / 9 / 0)
    - 1 not studying a relevant procedure (NA / NA / 0 / NA / 1)
    - 22 not studying a relevant intervention (1 / 3 / 1 / 8 / 9)
    - 12 no relevant outcomes included (0 / 2 / 0 / 9 / 1)
    - 3 duplicate (2 / 0 / 0 / 0 / 1)
    - 13 full-text not retrievable (2 / 1 / 3 / 5 / 2)
- Included studies

2A = 0	2B = 7	2C = 33	3A = 1	3B = 15

Mucositis n = 5	Minor procedures n = 7	Physical therapy n = 1	Hypnosis n = 6
Neuropathic pain n = 1	Lumbar punctures n = 8		Active distraction n = 5
Phantom limb pain n = 1	Major procedures n = 13		Passive distraction n = 2
			Combining modalities n = 2

3b.

FIGURE 3 A, Flowchart of the citation screening and selection, working group 1. B, Flowchart of the citation screening and selection, working groups 2A, 2B, 2C, 3A, 3B

an effort to provide recommendations, even when evidence is scarce or of low quality. Our guideline panel fully endorsed this aim; nevertheless, the panel also did not want to base a recommendation solely on expert opinion. Therefore, we devised a method to identify additional evidence (be it either of lower quality or more indirect) upon which to base our recommendations.

In addition, we encouraged patient representatives to share their values and preferences as so to contribute to formulating the recommendations. Working together closely with patient representatives, and providing them with training in evidence-based guideline development, will facilitate a CPG in which the patient perspective is interweaved.

The lack of identified high-quality studies also emphasizes the importance of undertaking studies focusing on effective pain measurement and management, as pain has been acknowledged repeatedly as one of the most important adverse effects of childhood cancer and its therapy.[1] Large randomized studies are needed, and as patient numbers are relatively small we encourage these to be multicentered and international in scope. In our upcoming CPGs, detailed research recommendations will be included which can serve to inform the research agenda for the coming decade.

In conclusion, with the improving cure rates of childhood cancer, it is of the utmost importance to develop high-quality evidence-based guidelines for supportive care, to reduce variabilities in care

and improve patient outcomes. In this project, we took the first steps toward a comprehensive CPG regarding assessment and pharmacological, psychological, and physical management of tumor-, treatment-, and procedure-related pain in children with cancer.

AUTHOR CONTRIBUTIONS

EL, LK, MD, RM, AF, and WT contributed to the conception of the study. EL, LK, MD, RM, AF, LD, FC, and WT contributed to the design of the study. EL, LK, MD, RM, AF, LD, FC, WT and all members of the Pain in Children with Cancer Guideline Development Panel (PCCGDP) contributed to the search strategy, data extraction, quality appraisal,

and the interpretation of the data. EL, LK, MD, FC, and WT drafted the manuscript which was subsequently critically revised by RM, AF, LD, and all members of the (PCCGDP). All authors approved the final version.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.