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Original Article

The development, testing, and preliminary feasibility of an adaptable pediatric oncology nutrition algorithm for low-middle income countries

Fleming CAK, Viani K[1], Murphy AJ[2], Mosby TT[3], Arora B[4], Schoeman J[5], Ladas EJ[6]

School of Medical Science, UNSW Medicine, University of NSW Australia, [1]Instituto de Tratamento do Câncer Infantil, Instituto da Criança do Hospital das Clínicas, Faculty of Medicine, University of Sao Paulo, Sao Paulo, Brazil, [2]Children's Nutrition Research Centre, Queensland Children's Medical Research Institute, The University of Queensland, Brisbane, Australia, [3]Clinical Nutrition Services, St Jude Children's Research Hospital, Memphis, Tennessee, USA, [4]Division of Pediatric Oncology, Tata Memorial Hospital, Mumbai, Maharashtra, India, [5]Steve Biko Academic Hospital and University of Pretoria Oncology Complex, Pretoria, South Africa, [6]Division of Pediatric Hematology/Oncology/Stem Cell Transplant, Columbia University, New York, United States

Correspondence to: Dr. Fleming CAK, E-mail: c.a.fleming@student.unsw.edu.au

Abstract

PURPOSE: Despite advances in the field of pediatric oncology, which have contributed to an overall increase in event-free survival, high rates of malnutrition in low-middle income countries (LMICs) is still a major concern. This paper aims to describe the multifaceted development process of a nutrition intervention algorithm for pediatric oncology in LMIC. **METHODS:** The development of evidence-based algorithm took place over seven developmental phases, utilizing an interdisciplinary process with the clinical review. Phase 1: Collaboration with the International Paediatric Oncology Nutrition Group. Phase 2: Review of peer-reviewed literature for evidence-based algorithm. Phase 3: Draft algorithm development. Phase 4: Draft algorithm presented at international meetings for stakeholder feedback. Phase 5: Consultation with LMIC dieticians to identify additional needs and feasibility of the algorithm in resource-poor settings. Phase 6: Review of the final draft algorithm by an expert panel. Phase 7: Pilot and Preliminary Feasibility. **RESULTS:** The nutrition algorithm was piloted in three LMIC countries (Brazil, South Africa and India). Overall the LMIC nutrition intervention algorithm was considered feasible for use with a "yes" response to the question "*was the algorithm useful to know what nutrition to give the child and when*" 90% of the time, rendering to the tool feasible. However, the testing process did identify several limitations that need to be considered in future versions. **CONCLUSIONS:** This comprehensive collaborative process with interdisciplinary health professionals has successfully developed a pediatric oncology nutrition intervention algorithm for LMIC. Further feasibility testing and a longitudinal study are required.

Key Words: Algorithm, low-middle income countries, nutrition, pediatric oncology

Introduction

Despite advances in the field of pediatric oncology, which have contributed to an overall increase in event-free survival, high rates of malnutrition in low-middle income countries (LMICs) is still a major concern. Recent studies from LMIC have shown the prevalence of malnutrition (over and under nutrition) to be as high as 50%[1] and to increase from 5.8% to 47% during treatment for childhood cancer.[2] Similarly for children with cancer living in developing countries, malnutrition is a major issue, with the prevalence of under-nutrition in LMIC believed to be between 8% and 43%.[3]

A growing body of evidence has demonstrated that malnutrition is associated with poorer treatment outcomes, long-term event-free survival and increased infection rates,[4-7] yet medical nutrition therapy still appears to be largely neglected globally as an aspect of standard care guidelines. This is particularly the case in LMIC where limited resources, time and personnel, impose additional constraints on nutrition intervention use.

To address malnutrition in pediatric oncology, it is imperative that medical nutrition therapy is included as a component of standard care for all patients. This must be in a manner that is applicable for both LMIC and high-income countries (HICs), through consideration of resources available and staff time in all clinical settings. The development of a universal battery of nutrition therapy resources for LMIC, including a screening tool, algorithm, and guidelines must be established. The aim of this paper is to describe the multifaceted development process of a nutrition intervention algorithm for pediatric oncology in LMIC, presented at the 1st International Society of Paediatric Oncology (SIOP)-Paediatric Oncology in Developing Countries workshop on Nutrition in Children with Cancer, Tata Memorial Hospital, Mumbai.

Methods

The development of an evidence-based nutrition intervention algorithm for pediatric oncology in LMIC's has taken place over seven developmental phases, each phase is outlined below and demonstrated in Figure 1.

Phase 1: Collaboration with the international community

All members of the International Paediatric Oncology Nutrition Group (IPONG) in 2012 (77 members from 26 countries) were contacted and requested to provide nutrition algorithms or guidelines currently used in their treatment center. Seven algorithms were provided by different participating centers from the following countries, Mexico, Guatemala, Brazil, Colombia, UK, US, and Australia. Other treatment centers indicated that they did not use an algorithm or guidelines for nutrition assessment and therapy. Where provided, algorithms were compared and inconsistencies were found between tools, with algorithms

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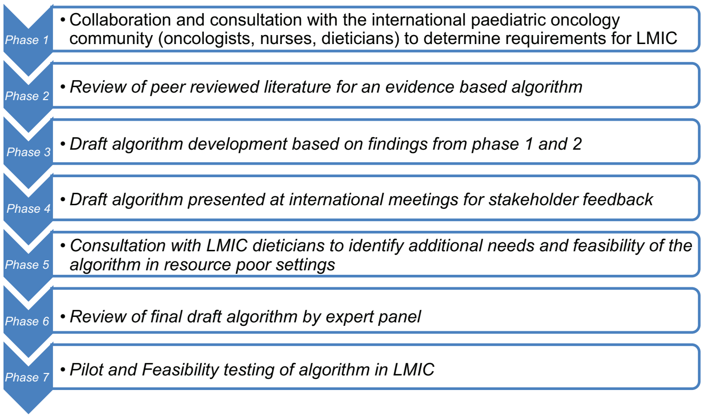

Figure 1: The seven developmental phases of a pediatric oncology nutrition algorithm for low-middle income countries

often hard to interpret and many failed to take into account limited resources available in LMIC's. In addition, during phase one, IPONG group members from both HIC and LMIC provided qualitative suggestions regarding which clinical nutrition therapy aspects would be required in a nutritional intervention algorithm.

Phase 2: Review of peer-reviewed literature for an evidence-based algorithm

A literature search was conducted across five electronic databases (PubMed, MEDLINE, EMBASE, CINAHL, and SCOPUS) from 1991 to 2012 to identify existing published and tested pediatric oncology nutrition intervention algorithms for both HIC and low income countries (LICs). Search findings across all four databases identified a total of 116 articles (PubMed $n = 20$, MEDLINE $n = 41$, EMBASE $n = 32$, CINAHL $n = 8$, and SCOPUS $n = 15$) which included information regarding nutritional care and intervention in childhood cancer, after undergoing a rigorous data extraction process, only four articles met specific study criteria for inclusion in the review. The papers identified were all published pediatric nutritional oncology algorithms and included, The Children's Oncology Group (COG), US,[8] St Jude's Hospital, US,[9] The Royal Collage of Nursing Trust, UK[10] and Asociacion de Hemato-Oncologia Pediatrica de Centro America (AHOPCA),[11] of which only one was specifically developed for LMIC.[11] This high rate of article exclusion indicates a paucity in the literature surrounding pediatric oncology nutrition intervention algorithms, particularly for LIC. All identified algorithms were highly complex, developed through expert opinion alone and not rigorously tested or adaptable. In addition, a review of empirical evidence regarding: Nutrition assessment in children with cancer, prevalence of malnutrition in childhood cancer patients, nutritional reference values for malnutrition and nutritional screening, current standards of nutritional care and intervention in pediatric oncology for both LMIC and HIC's was conducted.

Phase 3: Draft algorithm development

Taking into consideration, all findings from phases one and two, a draft algorithm for pediatric oncology nutrition intervention in LMIC was developed. The development process took into consideration all currently published peer reviewed evidence, expert clinical recommendations and elements from current pediatric nutrition algorithms that are clinically utilized (COG, St Jude, AHOPCA, Royal Collage of Nursing).

Phase 4: Draft algorithm presented at international meetings for stakeholder feedback

The draft algorithm was presented at the Australia New Zealand Children's Haematology Oncology Group (Gold Coast, Australia, 2012), SIOP (London, UK 2012), AHOPCA (El Salvador 2013) and monthly IPONG and SIOP meetings for feedback and discussion from pediatric oncologists, medical practitioners, dieticians, and nurses. Issues and concerns raised at each meeting were amended on the draft version and a new version of the algorithm formed.

Phase 5: Consultation with low-middle income countries dieticians to identify additional needs and feasibility of the algorithm in resource-poor settings

To ensure LMIC needs and requirements were specifically met for all levels of resources, a sub-group of dieticians, nursing staff, and medical practitioners from developing countries (Brazil, Mexico, South Africa, and India) were consulted. A particular concern of nursing staff from very LIC such as regions of Africa (Malawi) and Nicaragua was the inability to weigh patients due to lack of access to weighing devices and/or time for nursing staff to weight children for nutritional screening. This may often result in an inability to determine the nutritional risk of the patient. In addition, concern regarding the lack of available accesses to industrialized feeds for children in resource-poor treatment centers was discussed. To implement recommendations identified by the subgroup, and ensure the algorithm became adaptable to accommodate all resources levels, the addition of Mid Upper Arm Circumference (MUAC) as a weight free measurement occurred. Israels *et al*. 2013 recommend the use of MUAC for nutritional assessment in LIC when no weighing device is available. This nutritional measure is independent of tumor mass and does not require a child's weight, which can be a misleading measure of nutritional status, especially for children with a large abdominal tumor mass.[12]

To overcome the lack of access to industrialized feeds in LMIC treatment centers the addition of homemade oral supplements that are cost effective were included. Cultural specifications were taking into consideration and suggestions for different global regions included dry milk, soy milk powder, cassava flour, corn flour, cream, condensed milk, ice cream from South America, Incaparina (mixing of cornmeal and soybean meal with a mixture of key vitamins and minerals) from Central America and "Plumpy Nut" paste based on peanuts from Africa.

Phase 6: Review of the final draft algorithm by an expert panel

A review panel of registered dietitians, clinicians and nurses from both HIC and LMIC was established for final consultation of the algorithm. The review panel provided clinical guidance in regard to medical nutritional therapy discrepancies such specifications for Perinatal Nutrition use.

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Phase 7: Pilot and preliminary feasibility

Once finalized, to determine feasibility in LMIC the nutrition algorithm was piloted in three countries (Brazil, South Africa and India). A feasibility questionnaire was developed by investigators, based on a Likert-style format with additional written qualitative questions. Feasibility questions asked clinical staff about the suitability of the algorithm for use in patients, if the algorithm agreed with their clinical judgment, what deviations occurred away from the algorithm pathways (why) and finally was the algorithm useful to know what nutrition to provide the child. Data analysis occurred using the statistical software package SPSS (version 22, 2014; SPSS Inc., Chicago, IL, USA) to generate descriptive statistics. The feasibility of the algorithm was determined from the percentage of yes or no responses above or below 50% to the question, "was the algorithm useful to know what nutrition to give the child and when."

Results

The algorithm was tested with 86 patients, across three centers (Brazil $n = 22$, India $n = 27$, South Africa $n = 37$). The mean age of patients was 7 ± 5 years, ranging from 6 months to 18 years. The most commonly reported diagnose of participants was lymphoma, leukemia, sarcoma, and neuroblastoma [Table 1].

After utilizing either the Pediatric Oncology nutrition screening tool, MUAC or current nutritional screening methods for initial nutritional screening, 48% ($n = 41$) required the "low risk" nutrition intervention pathway identified on the algorithm, 22% ($n = 19$) required the medium risk pathway and 30% ($n = 26$) required the high-risk pathway. The most common form of nutrition intervention provided was oral supplements (either homemade of industrialized) (40%), followed by nasogastric (NG) tube feeding (35%), no nutrition intervention provided (14%) and nutrition education (12%). When assessing feasibility, the algorithm was considered suitable to use for the patient in 93% of the cases and agreed with the clinician or dietitians clinical judgment 63% of the time. Deviations from the outlined clinical pathways in the algorithm reported by participating dietitians occurred due to several reasons. The most common deviation being due to severe acute malnutrition (SAM 14%), followed by a high-risk child only able to access oral supplements (6%), the requirement for proactive NG feeding (4%) and if the patient was receiving palliative care (2%).

Table 1: Demographic characteristics of patients

	n (%)
Patients	
Total sample size	86
Country of residence	
Brazil	22 (25)
India	27 (31)
South Africa	37 (43)
Age of patients	
Child age at interview (mean, SD) years	
Mean (SD) years	7 (5)
Range	6 months to 18 years
Diagnosis	
Leukaemia	23 (26)
Sarcoma	11 (8)
Nephroblastoma	9 (10)
Neuroblastoma	7 (11)
Brain tumour	3 (3)
Lymphoma	3 (3)
Other	3 (3)

SD=Standard deviation

Overall the LMIC nutrition intervention algorithm was considered feasible for use in LMIC pediatric oncology treatment centers with "the algorithm useful to know what nutrition to give the child and when" 90% of the time, rendering to the tool feasible. However, the testing process did also identify several limitations that need to be considered in future versions, including more emphasis places on SAM requirements and palliative care.

Conclusions

This comprehensive process has demonstrated how a collaborative consultation process with both LMIC and HIC health professionals can be utilized to successfully develop a feasible pediatric oncology nutrition intervention algorithm for LMIC. It is the investigators' objectives that with the development of this crucial nutrition intervention guidance tool, clinicians in all oncology centers globally will be able to incorporate nutritional intervention and support into each child's standard of care and minimize malnutrition throughout their treatment trajectory. Moving forward a longitudinal study is required to rigorously measure the effect of such a tool on malnutrition and treatment outcomes of children in identified pediatric oncology treatment centers. This along with the development of a screening tool to precede the algorithm to determine the standard of nutritional risk the child falls into (high or low) and accompanying guidelines for a detailed explanation of algorithm content is required to complete this essential universal battery of nutrition therapy resources.

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Conflicts of interest

There are no conflicts of interest.

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