**Title****: Pedi-R-MAPP: The development of a nutritional awareness tool for use in remote paediatric consultations using a modified Delphi consensus**

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**Background and aims**:

The Remote Malnutrition Application (R-MAPP) was developed during the COVID-19 pandemic to provide support for health care professionals (HCPs) working in the community to complete remote nutritional assessments, and provide practical guidance for nutritional care. The aim of this study was to modify the R-MAPP into a version suitable for children, Pediatric Remote Malnutrition Application (Pedi-R-MAPP), and provide a structured approach to completing a nutrition focused assessment as part of a technology enabled care service (TECS) consultation.

**Methods:**

A ten-step process was completed: 1) permission to modify adult R-MAPP, 2) literature search to inform the Pedi-R-MAPP content, 3) Pedi-R-MAPP draft, 4) international survey of HCP practice using TECS, 5) nutrition experts invited to participate in a modified Delphi process, 6) first stakeholder meeting to agree purpose/draft of the tool, 7) round-one online survey, 8) statements with consensus removed from survey, 9) round-two online survey for statements with no consensus and 10) second stakeholder meeting with finalisation of the Pedi-R-MAPP nutrition awareness tool.

**Results:**

The international survey completed by 463 HCPs, 55% paediatricians, 38% dietitians, 7% nurses/others. When HCPs were asked to look back over the last 12 months, dietitians (n=110) reported that 5.7±10.6 out of every 10 appointments were completed in person; compared to paediatricians (n= 182) who reported 7.5±7.0 out of every 10 appointments to be in person (p<0.0001), with the remainder completed as TECS consultations.

Overall, 74 articles were identified and used to develop the Pedi-R-MAPP which included colour-coded advice using a traffic light system; green, amber, red and purple. Eighteen participants agreed to participate in the Delphi consensus and completed both rounds of the modified Delphi survey. Agreement was reached at the first meeting on the purpose and draft sections of the proposed tool. In round-one of the online survey, 86% (n=89/104) of statements reached consensus, whereas in round-two 12.5% (n=13/104) of statements reached no consensus. At the second expert meeting, contested statements were discussed until agreement was reached and the Pedi-R-MAPP could be finalised.

**Conclusion:**

The Pedi-R-MAPP nutrition awareness tool was developed using a modified Delphi consensus. This tool aims to support the technological transformation fast-tracked by the COVID-19 pandemic by providing a structured approach to completing a remote nutrition focused assessment, as well as identifying the frequency of follow up along with those children who may require in-person assessment.

**Introduction**

Remote consultations fall under the umbrella term telemedicine, defined by the World Health Organisation (WHO) as *‘the delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies’* ([1](#_ENREF_1)). Remote health care technology is hugely complex and inclusive of a wide range of capabilities including the delivery of synchronous and asynchronous telehealth, use of mobile applications, telephone services, text messaging applications, transmission of data from wearable and implantable biosensors, and patient-generated health data deployed within an integrated electronic patient record ([2](#_ENREF_2)). Although the use of remote consultations is seen as a way to enhance face to face visits, barriers for use include i) technological complexity issues, ii) clinician and patient acceptance of using this means of consultation, and iii) health care professional (HCP) confidence and training in using technology ([2-4](#_ENREF_2)).

Prior to the pandemic, the WHO ([1](#_ENREF_1)) alongside the medical community and health services worldwide, had ambitions to improve access to health care for all sectors of society. Particularly individuals who are hard to reach due to geographical barriers and vulnerable groups, e.g. children, through the widespread implementation of technology enabled care services (TECS) ([5](#_ENREF_5), [6](#_ENREF_6)). Implementation of these types of services would usually be completed over time with robust process framework for use in place, with associated training and evaluative report of the efficacy of processes used with these consultations and associated health care outcomes ([2](#_ENREF_2)). However, because of the global health crisis, the implementation of these services has been fast-tracked, fundamentally changing the way HCPs deliver health care including those for children. Nutrition focused consultations for children usually include a review of i) anthropometry, ii) biochemistry and clinical status, iii) dietary intake and changes in nutritional status linked to nutritional intervention, iv) goal setting with the provision of verbal or written information to caregivers and v) follow-up ([7](#_ENREF_7), [8](#_ENREF_8)). Several surveys have been completed considering the use of TECs by HCPs, which have documented high levels of satisfaction ([3](#_ENREF_3)). Shriqui- Kaufman *et al* reported that 45% of dietitians had no formal training in alternative nutrition counselling via TECS and that the majority of TECS was delivered by telephone and half delivered through an online platform. Those with less experience were more likely to report lower satisfaction scores; suggesting that experience, knowledge acquisition and training were key drivers for confidence around the completion of a remote nutrition focused assessment ([3](#_ENREF_3), [9](#_ENREF_9)). Recommendations to improve confidence and support for dietitians using TECS include the development of “scripts” or tools to optimise the completion of a nutrition focused assessment ([3](#_ENREF_3), [10](#_ENREF_10)).

Decision making field guides available for use in paediatrics in community settings include the World Health Organization Integrated Management of Childhood Illness (WHO-IMCI) ([11](#_ENREF_11)), and iterations of the Academy of Nutrition and Dietetics Nutrition Care Process ([12](#_ENREF_12)). The WHO-IMCI guidelines were developed with the aim of reducing variation in practice and promoting the delivery of high-quality care within primacy care in a limited resource environment. The IMCI case management series use a stepwise approach to assessment including, i) assessing the child’s illness, ii) classifying the illness based on these signs, iii) identifying treatment, iv) treating the child, v) counselling the caretaker and vi) providing follow up care. Responses to each section of the process are RAG rated (i.e. red, amber, green) providing a visual interpretation to the assessor of the results with amber (some concern) and red (significant concern), along with actionable health care recommendations ([11](#_ENREF_11)). The IMCI approach has been used in various nutritional pathways including congenital heart disease (CHD) ([13](#_ENREF_13)), human immune deficiency virus (HIV) and acquired immune deficiency syndrome (AIDS) ([14](#_ENREF_14)), and updated to include considerations for the prevention of overweight/ obesity ([15](#_ENREF_15)). Across all sectors there is increasing concern about the subsequent long-term consequences of COVID-19 pandemic on nutritional status of vulnerable groups, particularly children with the well described increase in sedentary behaviour and obesogenic diets ([16](#_ENREF_16)). To our knowledge, a nutrition awareness tool using a RAG rating approach incorporating the double burden of nutrition to guide nutrition decision-making processes has not yet been incorporated into a readily available electronic format for children as part of a remote consultation in a community setting.

Krznarić *et al*. ([17](#_ENREF_17)) have developed the Remote Malnutrition Application (R-MAPP) for desktop to support HCPs’ working in the community to complete remote nutritional assessments and provided practical guidance for nutritional care for adults.

To better support HCPs working in paediatric primary health care to complete a nutrition focused assessment via TECS, the goal of this study was to adapt the R-MAPP into a version suitable for children and young people i.e., Pediatric Remote Malnutrition Application (Pedi-R-MAPP). The aim of this was to provide a format to systematically obtain nutrition information that guide HCPs in the development of i) personalised nutrition care plans when using TECS consultations and ii) providing guidance with regards to the need for in-person assessment and iii) frequency of follow up.

**Methods**

*Modified Delphi consensus*

This study uses standard Delphi consensus methodology first described by Dalkey *et al (*[*18*](#_ENREF_18)*)* and updated by Fitch *et al* ([19](#_ENREF_19))along with modified Delphi methods described by Woodcock *et al.* ([20](#_ENREF_20)). In brief, a Delphi consensus is a process using multiple steps including; a narrative review of the literature, development of the tool, selection of the expert panel, the rating process including documentation required for the first and second round of anonymous voting, initial and final meeting moderation and finally overcoming methodological issues relating to statements where consensus was not achieved. The aim of which is to convert individual opinions into group consensus, based on the premise that consensus of a group is more accurate than those of the individual. This ensures there is transparency regarding areas of consensus and non-consensus ([18](#_ENREF_18), [19](#_ENREF_19), [21](#_ENREF_21)). The modified Delphi method used in this study, to develop the Pedi-R-MAPP comprised of ten steps ([18-21](#_ENREF_18)) (Figure 1).

**Methods**

*Step 1, 2 and 3: Permission to adapt the R-MAPP tool, narrative literature review and development of draft nutrition awareness tool Pedi-R-MAPP*

In the first instance, the project study group sought permission from the authors of the R-MAPP ([17](#_ENREF_17)) to adapt this into a paediatric version. In brief, the R-MAPP provides a simple guide to be used as part of a nutrition-focused assessment during a video or voice call and is intended for use in a primary care setting to identify patients at risk of malnutrition and therefore ensure nutrition care is optimised.

The content of the Pedi-R-MAPP was evidence based. A narrative literature review was conducted by LVM and RM using a systematic approach to the development and completion of the literature search. The NICE Healthcare Databases Advanced Search website (<https://hdas.nice.org.uk/>) was used as a tool to complete multiple searches within nine databases available, including the Cumulative Index to Nursing and Allied Health Literature (CINAHL), PsycInfo, British Nursing Index, Pubmed, EMBASE, EMCARE, Health Management and Information Consortium, Allied and Complimentary Medicine and Medline. The search included peer reviewed literature relating to i) nutrition awareness of paediatric nutrition in a community setting, ii) food security and iii) growth monitoring as part of a remote consultation and iv) principles outlined in the WHO-IMCI guidelines (Supplementary File 1: Library search). Abstracts were reviewed for eligibility by LVM using Ryyan.ai software (https://www.rayyan.ai/), with full texts selected for further review. Issues regarding eligibility of articles to be include in the narrative review were resolved by a second reviewer (RM) where needed.

With the permission of the R-MAPP ([17](#_ENREF_17)) authors a small working group of investigators (LVM, JJ, RMB, ASD, NC) sought to adapt the R-MAPP tool providing a simple nutritional assessment tool based on a traffic light system of green (no concern), amber (some concern) red (significant concern) and purple (overnutrition) ([11](#_ENREF_11), [15](#_ENREF_15)) before it was presented at the first expert stakeholder meeting. In brief the proposed Pedi-R-MAPP tool comprised of eight sections; 1) General information about the child, 2) Presence of long term condition, 3) Assessment of recent changes in growth, 4) Assessment of nutritional intake, 5) Assessment of food insecurity, 6) Presence of changes in physical activity, 7) Presence of clinical concerns that suggest an urgent medical review is required, and 8) Development of nutrition care plan. Depending on the provided answers, a nutrition awareness plan is proposed based on the colour rating described above.

*Step 4: International survey of practice regarding paediatric remote nutrition consultations*

To understand how international practices of remote nutrition consultations may have changed since March 2020, an anonymous survey was developed which included sections on i) HCP demographics, ii) area of practice e.g., hospital, community and role in nutrition screening, iii) changes in practice related to growth monitoring and parental access to equipment and iv) future training and education. A URL link to the survey was distributed, using snowball sampling, through British Dietetic Association Paediatric Group, South African Dietetic Association, participants of the Delphi consensus and other individuals known to some authors (LVM, NC, LP), between May 10 and June 30, 2021. Completion of the survey was voluntary and electronic consent was obtained through the online survey (Supplementary File 2: Survey).

*Step 5 and 6: Expert invitation and an initial virtual expert group meeting to agree the content of the nutrition awareness tool to be used in the modified Delphi process*

An initial e-mail outlining the project and study design and inviting participants to take part in the study was sent to a group of recognised experts (n=18) in the field of nutrition awareness, child health and paediatric nutrition from different regions in the world.

*First virtual expert meeting*

The adult R-MAPP tool was modified following an evidence review, the results of which were presented at the first expert meeting held on March 5, 2021, with the purpose of i) discussing and reviewing the initial draft Pedi-R-MAPP nutrition awareness tool, ii) establishing agreement behind the nutritional principles incorporated from the available evidence, into the nutrition awareness tool and iii) outlining the process for gaining consensus (Table 1). In terms of the process for achieving consensus of the nutrition awareness tool content consensus was set *a priori* at 75% agreement within any one of the available actions (keep, remove or modify the question). Responses with “no opinion” were excluded from the percentage agreement calculations ([20](#_ENREF_20)).

*Step 7, 8 and 9: Delphi on-line questionnaire and iterative changes to the draft of the Pedi-R-MAPP tool*

Google Forms was used to create the anonymous structured questionnaire (Supplementary File 3: Delphi survey round one). The questionnaire was administered to the expert group via a URL link and open for a period of one week (March 17-20, 2021). Participants were asked to vote on each question/ statement within the Pedi-R-MAPP, in turn electing to; “keep”, “remove”, “modify the question” or state “no opinion”.

Categorical response options were used to ensure panel members were clear about the significance of their vote and to ensure the results were actionable with regards to what the final Pedi-R-MAPP tool should include. For each of the sections, a free text box was included for the expert panel to recommend modifications to a question/ statement or suggestions for the inclusion of additional questions/ statements ([20-22](#_ENREF_20)). For questions where consensus to “keep” or “remove” or “modify” was not achieved; written comments were examined, and suggested modifications were included to be voted on in the second survey. Questions that did not achieve consensus were included in the second survey.

*Round 2: Delphi on-line questionnaire*

As part of the second survey participants were informed, about three sets of question/ statements; 1) a set of questions/ statements to keep by consensus, 2) a set of questions to remove by consensus and 3) a set of questions/ statements where consensus to keep or remove was not achieved, which would be discussed during the second virtual expert meeting. Participants were asked to review the aggregated agreement percentages for each of the questions/ statements where consensus had not been achieved and to vote on whether to keep”, “remove”, “modify the question” or state they had “no opinion”. The second survey was open from the (23 March – 2April 2021).

*Step 10:* *Second expert meeting to gain agreement for remaining questions and* *finalise the content of the nutrition awareness tool*

Prior to the final meeting participants were sent a PDF version of the Pedi-R-MAPP including the percentage of responses and actions for all the questions, and a list of statements where consensus was not achieved. The purpose of this meeting was to i) review questions/ statements where there was no-consensus, ii) agree to “keep” or “remove” a question/ statement and ii) agree on the final content of the Pedi-R-MAPP tool ([18-21](#_ENREF_18)).

**Statistical analysis**

Mean and standard deviation (SD) was used to summarise the data. Categorical variables are expressed as frequencies and percentages. Non-parametric tests such as Mann Whitney and Chi square tests were used to examine differences between outcome variables reported in the international survey. Statistical analysis was performed by GraphPad 9 (San Diego, CA, USA). A *p* value of <0.05 was considered statistically significant.

**Results**

*Step 1, 2 and 3: Permission to adapt the R-MAPP tool, literature review and development of draft nutrition awareness tool Pedi-R-MAPP*

The authors of the R-MAPP ([17](#_ENREF_17)) tool provided permission to adapt the adult tool into a paediatric version. Seventy-four articles ([10](#_ENREF_10), [11](#_ENREF_11), [23-95](#_ENREF_23)) were identified through the literature review to help generate the questions/statements of this tool which informed the draft Pedi-R-MAPP tool (Figure 2). Using a focused literature search, the draft Pedi-R-MAPP nutrition awareness tool was based on existing evidence in addition to the nutrition focused approached described in the WHO-IMCI guidelines using a traffic light system of green (no concern), amber (some concern), red (significant concern) and purple (overnutrition) ([11](#_ENREF_11), [15](#_ENREF_15)).

*Step 4: International survey of practice regarding paediatric remote nutrition consultations*

In total, 463 HCPs completed the survey; 55% (n=253) were Paediatricians, General Practitioners & physicians practicing in other specialties 38% (n=176) dietitians, 4% Nurses (n=19) and 3% (n=15) other including health visitors. HCP respondents practiced in the following countries in order of recorded responses (n=416); Turkey (n=118), United Kingdom (n=85), Spain (n=62), Croatia (n=40), United States (n=25), South Africa (n=25), Israel (n=22), Russia (n=21), Philippines (n=5), India (n=4), Australia (n=4), Italy (n=4). Most respondents reviewed children aged 0 – 5 years. They were seen in a variety of settings, including inpatients (45%), hospital outpatients (55%), and in the community (38%). HCPs managed children with clinical conditions that i) increased nutrient losses (50%), ii) decreased nutritional intake (74%) and iii) increased nutritional requirements (64%). Most respondents (75%) asked parents to complete weight or height checks at home with digital bathroom scales or a tape measure as the most commonly available tools, during the COVID-19 pandemic. Respondents (74%) thought that a nutrition awareness tool designed for use as part of a remote consultation would be useful to their practice. Eighty-five percent responded that the COVID-19 pandemic had negatively impacted on children’s nutritional status, with increased risk of malnutrition including obesity (82%), eating disorders (66%) and undernutrition (48%). When HCPs were asked to look back over the last 12 months, dietitians (n=110) reported that 5.7±10.6 out of every 10 appointments were completed in person; compared to paediatricians (n= 182) who reported 7.5±7.0 out of every 10 appointments to be in person (p<0.0001) with the remainder completed as TECS consultations (Table 1).

*Step 5 and 6: Expert invitation and an initial virtual expert group meeting to agree the content of the nutrition awareness tool to be used in the modified Delphi process*

Eighteen participants agreed to participate in the modified Delphi process with all participants completing round 1 and 2 of the modified Delphi survey (Table 2).

*First expert meeting*

*i) the purpose of the nutrition awareness tool*; experts agreed that the purpose of this tool was to provide a format to systematically obtain nutrition information guiding HCPs as part of a remote consultation; especially for junior HCPs and those working independently and which children require an in-person review.

ii) *sections of the proposed tool*; participants discussed the questions/statements within the tool and recommendations for iterative changes were audio recorded. Following the first virtual expert panel meeting, a word document of the proposed Pedi-R-MAPP tool was circulated for further comments, and iterative changes were incorporated by some authors (NC, LVM) prior to the first survey. Descriptive statistics were used to summarise the responses.

*Step 7, 8 and 9: Delphi Online questionnaire and iterative changes to the draft Pedi-R-MAPP tool*

Following the completion of round 1, 86% (n=89/104) statements/ questions achieved consensus. Several participants recommended removing the disease classifications (n=11) and replacing them with 3 overarching statements. At the end of the second questionnaire 12.5% (n=13/104) of statements/ questions reached no consensus (Supplementary File 4: Table 2).

*Step 10: second virtual expert meeting to establish agreement for the following sections/questions to finalise the content of the nutrition awareness tool (Figure 3).*

The following sections required expert discussion at the meeting to finalise the content of the tool.

* *Section 1: General information about the child (n=1) agreement was achieved to keep the statement* “Good nutrition is key for healthy growth and development. However, many factors impact on optimal growth including; nutritional adequacy (macro- and micronutrients), acute or chronic diseases, access to food and feeding practices e.g. responsive feeding.”
* *Section 3: Assess recent changes in growth (n=6) agreement was achieved to retain the statement;* retain z scores and add downloadable resources about z score/centile equivalencies (n=3), along with BMI >2 z scores and remove length for age and weight more than 2 centiles above the height centiles (n=3).
* *Section 4: Assess what and how much a child eats or drinks (n=3)*; remove statements around drinking more or less than usual (n=2) and pictures of food groups (n=1).
* *Section 6: Have there been any changes in physical activity (n=1);* remove statement related to reduced activity due to pandemic restrictions.
* *Section 8: Developing a nutrition care plan (n=2);* include a statement to reflect the caregiver relating to (n=1) and risk factors for obesity including the quality of food (n=1).

At the end of the final meeting all participants agreed on the content of the finalised pathway presented (Figure 3), which will form the basis of the Pedi-R-MAPP tool.

**Discussion**

This study presents the results of a modified Delphi consensus which aimed to develop a nutrition awareness tool to support all HCPs working in community/primacy care practice. The tool provides a nutrition focused assessment of children and young people, as well as identifying those children requiring an in person medical assessment and suggesting frequency of review. To develop the Pedi-R-MAPP nutrition awareness tool, a modified Delphi consensus process was used and involved paediatric HCPs working across international academic and clinical settings. At the end of round 2 of the Delphi survey, consensus was achieved in all but five areas; four of which resulted in minor changes to the way in which statements were worded. The main area where consensus was not achieved until the final expert meeting related to assessing and classifying growth using centile equivalencies or z scores ([96](#_ENREF_96), [97](#_ENREF_97)). During the final meeting the group agreed to retain z scores and add downloadable resources about z score/centile equivalencies. This was also reflected in the results of the international survey where over half of the participants reported the benefit of additional training resources on the use of z scores to classify nutrition status as part of a nutrition assessment.

The delivery of TECs consultations in nutrition care can be challenging for HCPs ([3](#_ENREF_3), [10](#_ENREF_10), [98](#_ENREF_98)). The universal challenges reported include; i) dietitians/ parents unable to regularly complete anthropometric measurements, ii) reduced interpersonal communication, iii) technical difficulties and iv) challenges around the lack of peer support and clinical skills. Whilst this tool was developed in the wake of the COVID-19 pandemic, consultations using TECS have become embedded within clinical services involving children with a wide range of body habitus i.e. double burden of nutrition ([10](#_ENREF_10), [99](#_ENREF_99)). Brunton *et al* ([10](#_ENREF_10)) recommended the development of a nutrition awareness tools for use as part of remote consultations. The results from our international survey suggest the use of a nutrition awareness tool as part of TECS consultations would be useful, and tools such as Pedi-R-MAPP could be used to support a nutrition focused consultation through raising nutrition awareness as part of a TECS consultation.

The proposed Pedi-R-MAPP tool comprised of a number of colour coded sections providing HCPs with level of concerns using a systematic approach to a nutrition assessment considering; i) whether the child has a long term condition, ii) changes in growth, iii) reviewing what and how the child eats and drinks, iv) food insecurity, v) changes in physical activity and vi) clinical concerns that suggest an urgent medical review is required. From this the HCP can develop a nutrition care plan based on the colour rating green (no concern), amber (some concern), red (significant concern) and purple (overnutrition). Several risk factors for childhood undernutrition have been identified, including food insecurity, low dietary diversity/ quality, and interruption in school provided meals ([100](#_ENREF_100), [101](#_ENREF_101)). As one in three children worldwide are not growing at an expected rate, UNICEF proposes through the Innocenti Framework that key aspects of the food systems should be made a priority to facilitate better growth, particularly in low and medium income countries . Within the Pedi-R-MAPP tool, two validated questions were included to determine the likelihood of food insecurity with prompts within the nutrition care plan section to recommend the HCP to sign post the caregiver to seek support. Obesity risk factors associated with the pandemic include cessation in school teaching, reduced physical activity, increased screen time and a decline in mental health and well-being, which if prolonged, may contribute to the rise in non-communicable disease ([101](#_ENREF_101)). Other components of the Pedi-R-MAPP tool are dedicated to reflecting with caregivers on aspects around growth, nutrition adequacy, nutrition support, food insecurity, supporting physical activity and health and wellbeing. The risk of remote consultations may be that HCPs misdiagnose deteriorating nutritional and clinical status. In recognition of this, six questions were included, four of which focused on a change in clinical condition, one regarding concerns around child protection and one on mental health and well-being.

There are several limitations to this study including a lack of validation of the content and criterion validity of the nutrition awareness tool in a range of settings where remote consultations are being completed, as well as country specific requirements. Future work will seek to address these limitations by prospectively testing the usability, feasibility and precision of the application in clinical practice. The nutritional principles embedded within the tool represent the best evidence to date, along with the consensus views of leading participants. Although the Delphi process was robust, the expert group was of modest size and may not have represented the expert opinion of a wider audience. However, the results from the international survey would suggest commonality amongst nutritional issues and need for tools to assist in developing a nutritional diagnosis.

The COVID-19 pandemic has provided the opportunity to reduce barriers with regards to TECS and allow HCPs to re-examine traditional models of nutrition focussed assessments and nutrition care plans into TECS modalities. The ongoing challenge for HCPs is how to harness and embrace ‘digital disruption’ to ensure they understand and adopt the transformation within the digital landscape to remain relevant. As such, it is essential that nutrition services remain relevant by supporting digital healthcare, which is underpinned by the evidence base of literature ([4](#_ENREF_4)). The Pedi-R-MAPP tool seeks to support this technological transformation by providing a structured approach to nutrition awareness in children reviewed via virtual consultations; as well as identifying those children who would benefit from an in-person nutrition focussed assessment, in addition to the frequency of review and follow-up.

**Conclusions**

We report on the Pedi-R-MAPP tool, developed using a modified Delphi consensus. The tool seeks to provide a structured approach to completing a nutrition focused assessment, in addition to identifying the frequency of follow up with children who may require in-person assessment. Although further study and validation is needed, there is potential for this tool to be embedded within a child’s electronic patient health records. When used within a quality improvement framework it may help improve the early recognition of declining nutrition status thereby improving nutritional status of children.

**Table 1: International survey results characteristics of response presented at percentage and numbers**

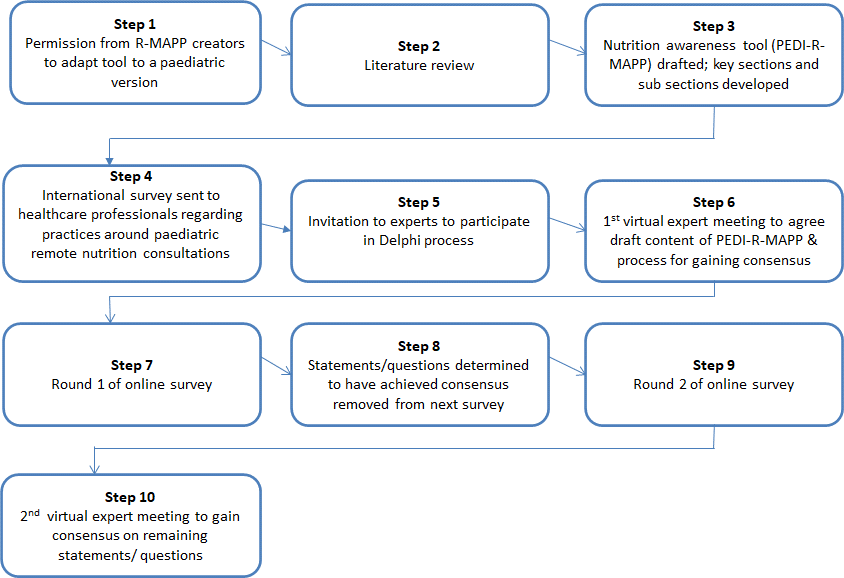
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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | n= | |  | | | | | |  | |
| Participant’s profession (n=430)   * Dietitian * Paediatrician | * 178 * 194 | |
| **Where are patients seen? (n=430)** | **Hospital In-patients** | | **Hospital Out-patients** | | **Community** | |  | |
| Dietitian | 59% | 105 | 54% | 95 | 36% | 63 |
| Paediatrician | 37% | 72 | 58% | 113 | 41% | 79 |
|  | p=0.004 | | p=0.5 | | p=0.5 | |  | |
| **Do children have any of the following? (n=430)** | **Increased nutrient losses** | | **Decreased nutritional intake** | | **Increased nutritional requirements** | | **None of these** | |
| Dietitian | 69% | 122 | 5% | 9 | 79% | 140 | 5% | 9 |
| Paediatrician | 38% | 74 | 10% | 20 | 51% | 99 | 10% | 20 |
|  | p<0.0001 | | p=0.6 | | p<0.0001 | | p=0.6 | |
| **When undertaking a remote consultation, do the parents you speak with have the following tools for measurement? (n=148)** | | | | | | | | | | |
| **Digital baby scales** | **All Parents** | | **All / Most Parents** | | **Some Parents** | | **Very Few / None of the Parents** | | **I do not ask / I do not know** | |
| Dietitian | 0% | 0 | 7% | 5 | 34% | 25 | 48% | 35 | 3% | 2 |
| Paediatrician | 0% | 0 | 15% | 8 | 40% | 21 | 38% | 20 | 6% | 3 |
| **Length mat** | **All Parents** | | **All / Most Parents** | | **Some Parents** | | **Very Few / None of the Parents** | | **I do not ask / I do not know** | |
| Dietitian | 0% | 0 | 8% | 6 | 7% | 5 | 71% | 52 | 5% | 4 |
| Paediatrician | 0% | 0 | 11% | 6 | 32% | 17 | 47% | 25 | 6% | 3 |
| **Which of the following negative outcomes on nutritional status have been amplified by the COVID-19 pandemic in your paediatric patients? (n=307)** | | | | | | | | | | |
|  | **Malnutrition** | | **Obesity** | | **Food Insecurity** | | **Eating Disorders** | | **Declining nutritional status** | |
| Dietitian | 63% | 77 | 76% | 93 | 63% | 77 | 66% | 80 | 54% | 66 |
| Paediatrician | 35% | 50 | 85% | 122 | 15% | 21 | 65% | 94 | 28% | 40 |
| **How useful would you find a paediatric nutritional awareness tool specifically designed for use in remote consultations? (n=299)** | | | | | | | | | | |
|  | **Extremely useful** | | **Very useful** | | **Somewhat useful** | | **Not so useful** | | **Not at all useful** | |
| Dietitian | 52% | 62 | 22% | 26 | 15% | 18 | 8% | 9 | 4% | 5 |
| Paediatrician | 24% | 34 | 36% | 50 | 25% | 35 | 9% | 13 | 5% | 7 |

**Table 2: Demographic characteristic of participants in the modified Delphi consensus**

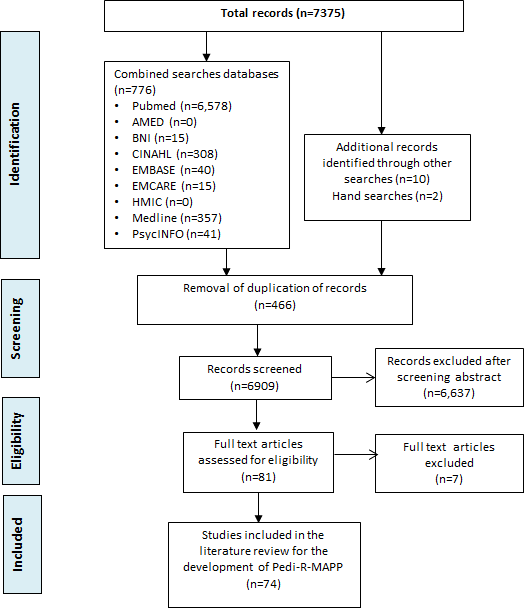
|  |  |  |
| --- | --- | --- |
|  | | **Participants (n=18)** |
| **Gender**  Male  Female | | 7 (39%)  11 (61%) |
| **Country of nutrition practice** | | |
| United Kingdom  The Netherlands  Croatia  Israel  South Africa  Canada  Turkey  Belgium | | 7 (39%)  1 (5.5%)  2 (11%)  3 (17%)  2 (11%)  1 (5.5%)  1 (5.5%)  1 (5.5%) |
| **Health care professional role** | | |
| Dietitian  Paediatrician  Psychology researcher | | 5 (27%)  12 (63%)  2 (10%) |
| **Survey round 1** | | |
| Survey completion | 18 (100%) | |
| **Survey round 2** | | |
| Survey completion | | 18 (100%) |

**Table 3: Draft Pedi-R-Mapp sections and number of statements per section**

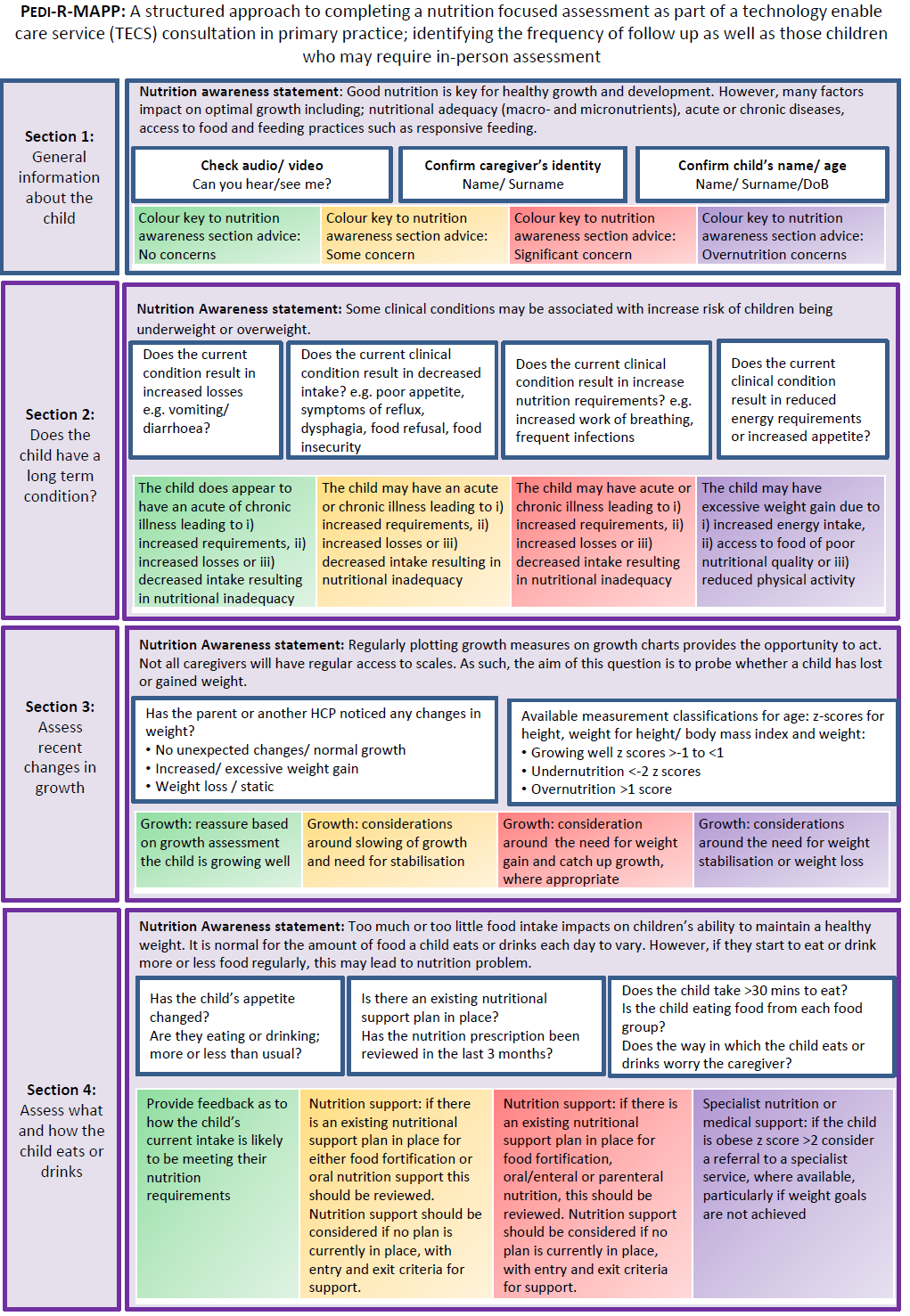
|  |  |  |
| --- | --- | --- |
| **Section number** | **Section Name** | **Number of statements per section (n=)** |
| 1 | General information on the child | 3 |
| 2 | Does the child have a long-term condition | 12 |
| 3 | Assess recent changes in growth | 17 |
| 4 | Assess what and how much a child eats and drinks | 9 |
| 5 | Is there enough food at home | 3 |
| 6 | Have there been changes in physical activity | 8 |
| 7 | Are there are any clinical concerns that suggest a medical review is require | 7 |
| 8 | Developing a nutrition care plan | 45 |

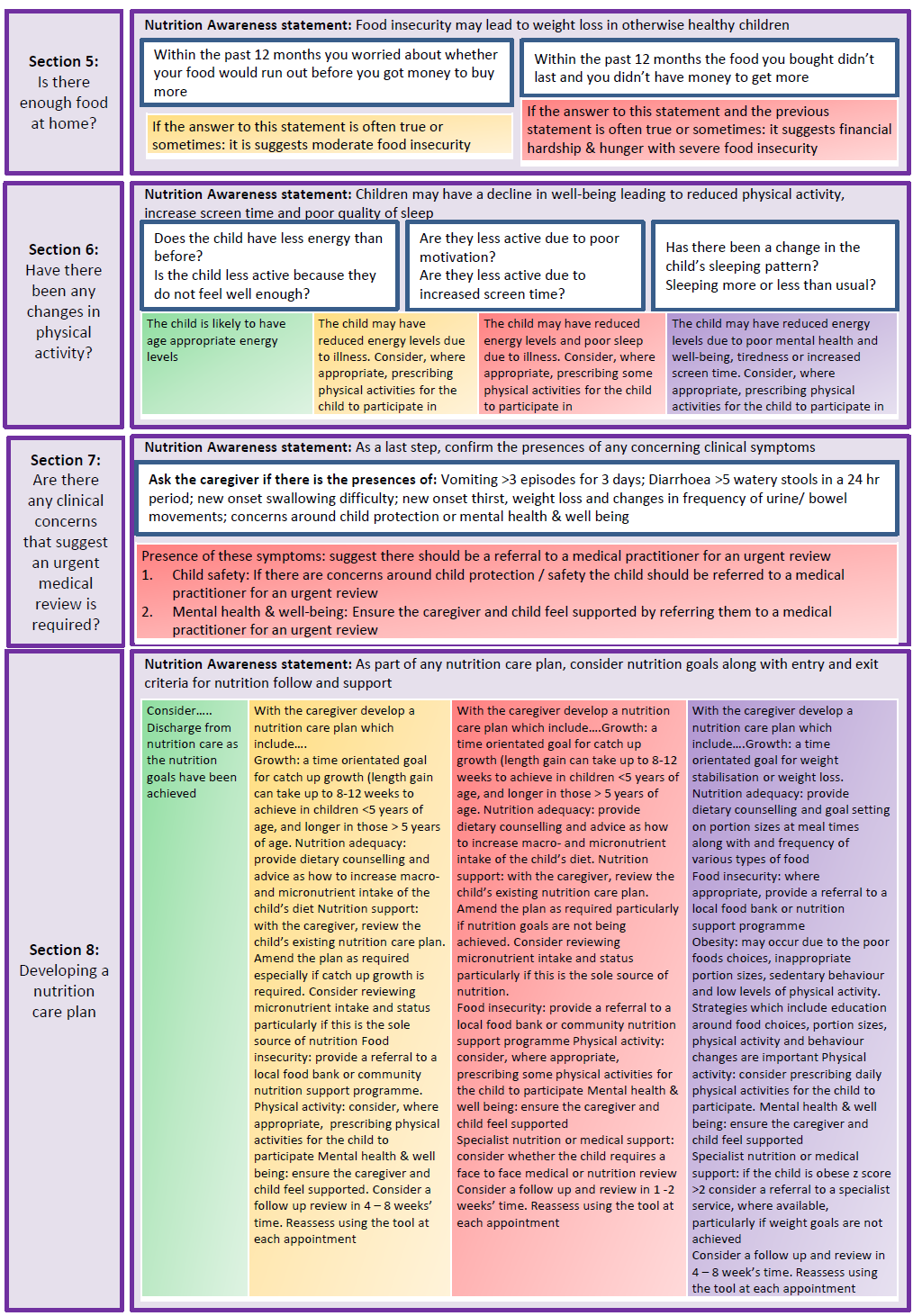


**Figure 1: Ten step process in the development of Pedi-R-MAPP nutrition awareness tool**



**Figure 2: Search results for literature review of evidence used to develop Pedi-R-Mapp**



**Figure 3: The development of Pedi-R-MAPP using a modified Delphi process**

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**Statement of authorship**

Authors made the following contribution to the manuscript: (1) ZK, DVB formulate the idea for the R-MAPP tool, (2) LVM formulated the idea for the adapted Pedi-R-MAPP tool, completed the literature search and initial design (2) LVM, RMB, ASD, JJA, NC further developed the tool for presentation at the expert meetings, (4) NC, ASD, JJA, RMB, JH, JK, TN, DM, RS, SA, AGM, ZK, LC, LMC, SC, KG, JM, LVM all completed the modified Delphi consensus (5) LVM drafted the manuscript (6) all authors critically reviewed and revised the manuscript for important intellectual content, (7) and all authors provided final approval of the version to be submitted.

**Conflict of interest**

Professor Darlington and Dr Marino report an unrestricted grant from Abbott Laboratories, during the conduct of the study. Dr Marino report honoraria from ABBOTT Laboratories and Danone - Nutricia outside the submitted work. Professors Vranešić Bender and Krznaric reports personal fees and non-financial support from Abbott Laboratories, personal fees and non-financial support from Fresenius Kabi, personal fees and non-financial support from G-M Pharma-Nutricia, personal fees and non-financial support from Oktal Pharma – Nestle Nutrition, personal fees and non-financial support from Belupo, outside the submitted work. Professor Gerasimidis reports consultancy work for Nestle, Nutricia, Baxter and Abbott Laboratories. Professor Kolacek reports grant pending from BioGaia; honoraria received from for educational presentations from Abbott Laboratories, Abbvie, Abela Pharma, GM Pharma, Nestle, Nutricia, Takeda. Dr Huysentruyt reports board membership for Danone. Dr Meyer reports consultancy for Danone, Abbott Laboratories and Nestle including the development of the CoMISS score, hydrolysed rice formula and research applications; honoraria for academic lectures for Abbott, Nestle, Danone-Nutricia and Mead Johnson; and payment for manuscript preparation for Danone-Nutricia. Professor Beattie, Sharmir, Joosten and Dr’s Cooke ML, Guz-Mark, Hulst, Nemet, Niseteo, Selimoglu and Ms Cooke LH and Cader report no conflict of interests.

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**Ethics**

Ethical approval was not required as an anonymous survey was completed along with anonymous voting in the modified Delphi survey rounds. Health care professionals attended the round table meetings voluntarily.

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