





# Global architecture for the nutrition training of health professionals: a scoping review and blueprint for next steps

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**To cite:** Lepre B, Trigueiro H, Johnsen JT, *et al*. Global architecture for the nutrition training of health professionals: a scoping review and blueprint for next steps. *BMJ Nutrition, Prevention & Health* 2022;**5**:e000354. doi:10.1136/bmjnph-2021-000354

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Received 16 August 2021

Accepted 17 January 2022

Published Online First

16 February 2022



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## ABSTRACT

**Background** This paper provides an overview of capacity-building efforts in the context of nutrition education for medical and healthcare professionals.

**Methods** Content analysis of eighteen reports related to nutrition education and capacity building, and interviews with key personnel from the WHO and NNEdPro Global Centre for Nutrition and Health were synthesised.

Recommendations to improve nutrition education and subsequent nutrition capacity of healthcare professionals were identified based on policy guidance and interviews.

**Findings** Most included documents noted the importance of nutrition education and capacity building for medical and healthcare professionals. Healthcare professionals and the ‘health sector’ were positioned as central to achieving improved public health, and the promotion of nutrition knowledge and awareness in the general population.

**Conclusion** Increased focus on nutrition education and capacity of the health workforce are key to improvements in population health and well-being. The WHO is well placed to support global nutrition education.

**Recommendations** Key recommendations from the literature review and interviews include improved global data collection mechanisms, a pledge from governments to prioritise nutrition education and capacity building, along with implementation of standardised nutrition curricula for all healthcare sectors. This would include the development and expansion of on-line resources.

## INTRODUCTION

Good health is required for prolonged economic and social development.<sup>1</sup> Nutrition plays a major role in promoting both good health and overall quality of life.<sup>1</sup> Globally each year, 11 million deaths are attributable to dietary factors, placing poor diet ahead of any other risk factor for death.<sup>2</sup> Worldwide, 690 million people do not have enough to eat, while 1.9 billion adults are overweight and of these 650 million are obese.<sup>3,4</sup> This coexistence of undernutrition along with overweight and obesity and non-communicable disease is referred to as the double burden of malnutrition.<sup>1</sup> The United Nation (UN)

## What this paper adds

- ⇒ This paper provides a critical synthesis of capacity-building efforts in the context of nutrition education for medical and health care professionals to highlight gaps and opportunities for improvement in the wake of the UN Decade of Action on Nutrition (2016–2025).
- ⇒ Ongoing data collection on the nutrition education and training of medical and healthcare professionals is likely to facilitate improvements in nutrition capacity building, with subsequent benefits to population health.
- ⇒ Key recommendations include: 1) the establishment of a national curricula for nutrition education across all healthcare sectors, including the development and expansion of online resources, 2) Organisational and government pledges for the adoption of nutrition education in community and healthcare and 3) Improved global data collection mechanisms and validated indicators to assess and measure capacity and progress.

Decade of Action on Nutrition (2016–2025) (Nutrition Decade) is a commitment of Member States to undertake sustained implementation of policies and interventions to address the double burden of malnutrition.<sup>5,6</sup> The response of member states to the Nutrition Decade has the potential to influence public health outcomes internationally. The Second International Conference on Nutrition (ICN2) Framework for Action and the 2030 Agenda for Sustainable Development provide an architectural blueprint for action.<sup>7,8</sup>

Multiple international efforts are occurring that aim to improve health outcomes through more favourable diet quality, as well as policy-driven actions at a population-level.<sup>9</sup> As the specialised agency of UN concerned with world public health, the WHO has made universal health coverage (UHC) a major

component of health reform and the overall goal of the General Programme of Work 13, thus a priority objective of the agency.<sup>10</sup> The priority encompasses the need for equitable access to high-quality health services and the delivery of evidence-based, people-centred care by competent healthcare professionals.<sup>11</sup> These organisations have a role to play in nutrition education and capacity of the health workforce.

Health professionals are well placed to initiate and support nutrition care as part of routine practice, and this is recognised as an essential part of usual care by institutions such as the American Dietetic Association, the American Medical Association, the National Academy of Sciences and the Society of Teachers of Family Medicine.<sup>12–16</sup> In order to provide nutrition care, healthcare professionals need to develop requisite nutrition knowledge in addition to capacity and adequate confidence. However, medical doctors have insufficient exposure to nutrition in their medical education regardless of geographical region, setting or year of training.<sup>17–18</sup> Similar scenarios are reported in other healthcare professions.<sup>19</sup> For example, nurses require nutrition knowledge to improve patient outcomes but report lacking sufficient education and training at an undergraduate level, and limited opportunities for continuing education to support high-quality care.<sup>20–22</sup> Clearly, there is an opportunity to enhance nutrition education provided to all medical and healthcare professionals.

Coherent and sustained efforts to enhance the nutrition capacity of the health workforce through improved nutrition education may lead to sustained benefits for population health and will, therefore, likely be effective in reducing the double burden of malnutrition.<sup>23</sup> In order to improve the nutrition capacity of the health workforce, there is a need to establish consensus on global nutrition standards as a benchmark for universities.<sup>17</sup> First, there is a need to synthesise existing global guidance on nutrition

education to inform a global approach to medical and health professional nutrition education. This critical content analysis paper aims to appraise capacity-building efforts in the nutrition education of medical and healthcare professionals to identify current provision supported by the WHO and related standard setting organisations as well as highlighting gaps and opportunities for improvement in the wake of the UN Decade of Action on Nutrition (2016–2025).

## METHODS

It was initially identified that this review would take a pragmatic approach to search and identify literature. Therefore, this literature review encompasses both traditional search methods as well as extensive consultation with experts to iteratively identify relevant documents. A review of the literature and interviews with key personnel from the WHO Department of Nutrition and Food Safety (NFS) took place over a year from December 2018 to December 2019. For the purposes of this study, we have defined key concepts below based on published definitions and author experience (table 1).

### Literature review

First, all policy outputs from the WHO NFS related to nutrition education and capacity were compiled for screening and review. Additionally, consultation with the WHO NFS Office of the Director was used to identify other relevant documents for inclusion. A total of 353 documents were screened for inclusion by the primary investigator (SR). Documents published up to 2018 by a global multilateral organisation such as the WHO related to education for the health workforce were included. Inclusion and exclusion criteria are provided in table 2. In total, eighteen policy guidance documents were selected for inclusion (box 1).

**Table 1** Definitions of key concepts used within this paper

Concept	Definition
Nutrition capacity	Capacity at the human, institutional, organisational and infrastructural levels to implement nutrition programmes and strengthen nutrition governance. <sup>60</sup>
Dietitian-nutritionist	A professional who applies the science of food and nutrition to promote health, prevent and treat disease to optimise the health of individuals, groups, communities and populations. <sup>61</sup> We recognise that these terms may have different definitions across countries.
Food system	The food system includes all interrelated activities involving the production, processing, transport and consumption of food. <sup>62</sup>
Food industry	The food industry encompasses a series of industrial activities directed at the processing, conversion, preparation, preservation, and packaging of foodstuffs. <sup>63</sup>
Nutrition care	Any practice that aims to improve the dietary intake of a patient to improve health outcomes. <sup>64</sup>
Nutrition science	Nutrition science deals with all aspects of the interaction between food and nutrients, life, health and disease, and the processes by which an organism ingests, absorbs, transports, uses and excretes food substances. <sup>65</sup>
Clinical nutrition	The discipline that deals with the prevention, diagnosis and management of nutritional and metabolic changes related to acute and chronic diseases and conditions caused by a lack or excess of energy and nutrients across the life course. <sup>65</sup>

**Table 2** Inclusion and exclusion criteria for eligible documents

Inclusion criteria	Exclusion criteria
Published up to 2018	Published after 2018
Published by a global multilateral organisation	Region specific guidance
Related to education in regard to scope of synthesis or recommendations	Not related to education
Relevant to the global health workforce (as defined in broad terms)	Not related to the health workforce

Three reviewers independently analysed all full-text documents. A content analysis approach was used to identify capacity-building efforts in the context of nutrition education for the health workforce.

### Interviews

Semistructured face-to-face interviews were conducted with key personnel from the WHO NFS to provide insight to recommendations to improve nutrition education and

capacity of the health workforce. A qualitative descriptive approach was taken as it enables rich description of recommendations to improve nutrition education and capacity of the health workforce. A mix of purposive and convenience sampling was used to recruit participants for interviews. The WHO NFS were included given their role in global nutrition education and capacity building. Furthermore, many WHO interns were currently undertaking a form of medical education, and therefore, this was seen as an additional capacity-building opportunity.

An invitation to participate in an interview was sent to all members of the WHO NFS. All who expressed interest were invited to participate in an interview. Written notes were taken during the interviews based on responses to three key questions: (1) Where do you see a role for medical/healthcare nutrition education within the Nutrition Decade efforts and the work of NFS/WHO?; (2) What do you perceive as the main barriers to policy formulation and implementation around medical/healthcare capacity building in this area? and (3) Can you identify any current or emerging opportunities to embed medical/healthcare nutrition education into primary and/or secondary prevention initiatives?

### Survey

NNEdPro networks were engaged to consider regional implications in countries other than the UK, including the Australia/New Zealand network. An email about the study was sent to members of the NNEdPro Virtual Core, an international, multidisciplinary group of 42 professionals. All who expressed interest were invited to participate in a survey, using the same three questions as for interviews. Participants were asked to provide written responses to the questions via email.

### Data analysis

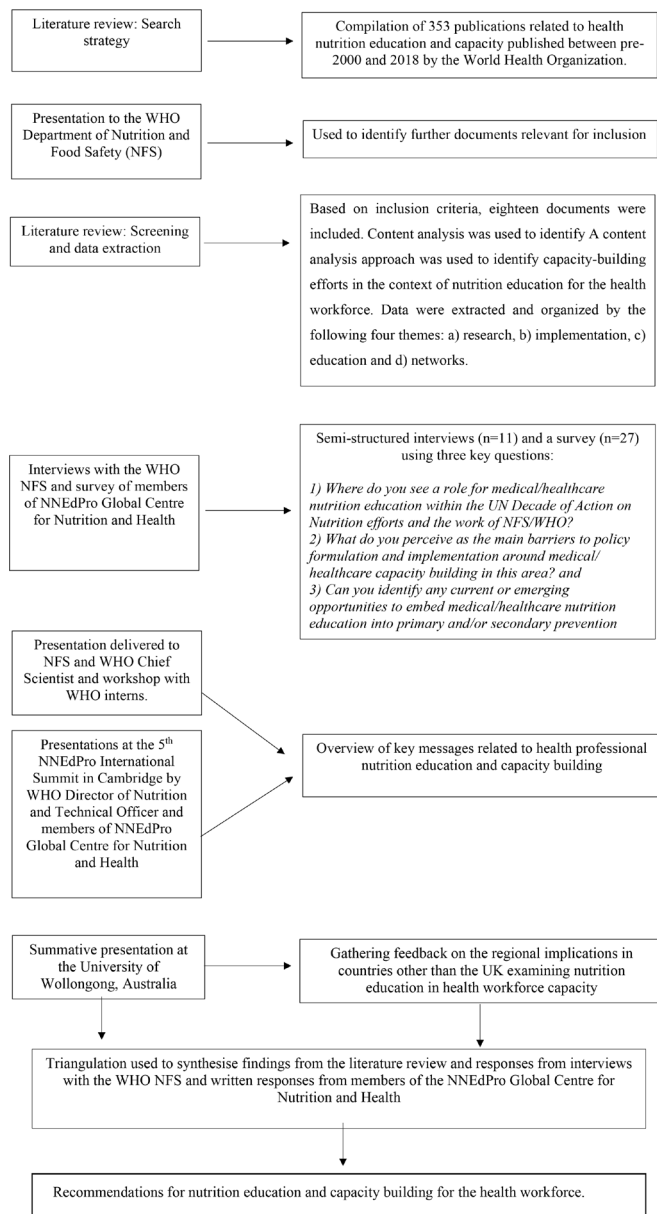
Interview and survey data consisted of a combination of hand-written notes from responses to questions and email responses. Two researchers were involved in transcribing and validating the responses to check the accuracy. Interview and survey responses were analysed using a comparative content analysis approach by the primary investigator (SR), whereby individual responses from participants were analysed for common themes, which were then collapsed into conjoined statements related to recommendations to improve nutrition education and capacity of the health workforce.

Findings from the review of 18 included publications and data from interviews with 11 individuals from the WHO NFS and written responses from 29 members of the NNEdPro Global Centre for Nutrition and Health (n=40) were synthesised using triangulation. Data were organised into key themes to highlight gaps and opportunities for improved nutrition education and capacity for health professionals. Themes from key outputs, namely presentations, related to global nutrition capacity are also summarised and inform the recommendations and next steps. A schematic of methods is provided in [figure 1](#).

### Box 1 Key policy guidance included in the review

1. Strengthening nutrition action: a resource guide for countries based on the policy recommendations of the Second International Conference on Nutrition.<sup>24</sup>
2. Driving commitment for nutrition within the UN Decade of Action on Nutrition.<sup>6</sup>
3. e-Library of Evidence for Nutrition Actions.<sup>25</sup>
4. Global nutrition policy review 2016–2017: Country progress in creating and enabling policy environments for promoting healthy diets and nutrition.<sup>26</sup>
5. Global nutrition monitoring framework: Operational guidance for tracking progress in meeting targets for 2025.<sup>27</sup>
6. 2018 Global Nutrition Report.<sup>28</sup>
7. Global targets tracking Tool.<sup>29</sup>
8. Implementation guidance: Protecting, promoting and supporting breastfeeding in facilities providing maternity and new born services: the revised baby-friendly hospital initiative.<sup>9</sup>
9. Taking Action on Childhood Obesity.<sup>30</sup>
10. Knowledge Action Portal: Nutrition Knowledge Hub.<sup>31</sup>
11. UNICEF-WHO-World Bank Group Joint Child Malnutrition Estimates: Key findings of the 2018 edition.<sup>32</sup>
12. Weekly iron and folic acid supplementation as an anaemia-prevention strategy in women and adolescent girls. Lessons learnt from implementation of programmes among non-pregnant women of reproductive age.<sup>33</sup>
13. Thirteenth general programme of work 2019–2023.<sup>10</sup>
14. Healthy Diet—Fact Sheet.<sup>34</sup>
15. Advancing equity, equality and non-discrimination in food systems: Pathways to reform.<sup>35</sup>
16. The Food and Agriculture Organization of the United Nations Website.<sup>36</sup>
17. United Nations System Standing Committee on Nutrition (UNSCN) Website.<sup>37</sup>
18. Global Governance for Nutrition and the role of UNSCN.<sup>38</sup>





**Figure 1** Schematic of methods used.

**RESULTS**

Overall, four key themes were identified based on the literature review, interviews and workshops: (1) The importance of medical and healthcare professional nutrition education and capacity, (2) Barriers to the application of nutrition in practice, (3) Barriers to policy formulation and implementation related to medical and healthcare nutrition capacity building and (4) Recommendations to improve medical and healthcare professional nutrition education and capacity which included (A) Nutrition education and resources, (B) Nutrition research, (C) Nutrition champions, (D) Government and policy and (E) Governance of nutrition. Findings are stratified by method (ie, policy analysis and interviews and workshops).

**Literature review**

A literature review of policy guidance identified two key themes as follows: (1) The importance of medical and

healthcare professional nutrition education and capacity and (2) Recommendations to improve nutrition education and capacity. Recommendations from the literature review are grouped into the following subthemes: (A) Nutrition champions, (B) Government and policy, (C) Nutrition education and resources, and (D) Governance of nutrition.

**The importance of medical/healthcare nutrition education and capacity**

Sixteen of 18 (89%) documents made some mention of the importance of nutrition education in capacity building for the healthcare workforce.<sup>6 9 10 24–38</sup>

Healthcare professionals and the healthcare system were identified as central to the promotion of nutrition in the general population and subsequent improved public health. Almost all countries in the review (153/159; 96%) reported nutrition-focussed professionals as part of their workforce (nutritionists or dietitians as regulated health professionals).<sup>26</sup> However, the density of trained nutrition professionals, which refers to a policy environment and capacity indicator related to the number of trained nutrition professionals per 100 000 population, varied greatly by country, which may reflect the capacity of a country to design and implement nutrition policy and interventions.<sup>27</sup> Among the 126 countries that reported the number of nutrition professionals, only 23 (18.3%) had the recommended density of 10 nutrition professionals per 100 000 population or higher.<sup>26</sup>

The healthcare system was identified as the primary delivery channel for nutrition interventions. The education sector was reported to be involved in the implementation of national nutrition policies in 69 out of 110 countries (63%), and in the implementation of nutrition programmes in 83 out of 127 countries (65%). Policy actions to promote healthy diets were more strongly related to education than to regulatory measures. Nutrition education and counselling on healthy diet were included in national policies by more countries than any other action (75%).<sup>26</sup>

**Recommendations to improve nutrition education and capacity**

This policy analysis synthesises a number of proposed strategies to improve nutrition capacity including nutrition advocacy, pledges from governments, supportive policy including coherence between trade and nutrition policies, nutrition education and research and monitoring, surveillance and evaluation systems related to nutrition and health. A summary of recommendations synthesised from the literature review is provided in [table 3](#).

**Nutrition champions**

The Food and Agriculture Organization of the United Nations (FAO) recommends the provision of tools, guidance and support for the scaling up of nutrition education and consumer nutrition awareness at a national and local level.<sup>39</sup> One of these suggested tools is nutrition champions, who are able to advocate for nutrition

**Table 3** Key recommendations and examples for improvement in nutrition education and capacity building (from literature review)

Recommendation	Example
(A) Nutrition champions—advocates for nutrition education	Advocacy for increased investment in nutrition
(B) Government and policy—key role in interinstitutional cooperation on nutrition education and capacity building	Allocation of financial resources for physical infrastructure and facilities
(C) Nutrition education and research—provides evidence base and training of personnel to improve nutrition behaviour and subsequent nutritional status	Design a rigorous evidence-based medical curriculum
(D) Governance of nutrition—review and measure ongoing progress	Monitoring progress of nations using objective and validated indicators such as nutrition professionals density

education, based on recognition that a champion cannot work alone and requires capacity and resources.<sup>9</sup> The Work Programme of the Nutrition Decade suggest nutrition advocates can empower others to make healthy lifestyle choices through public nutrition information.<sup>5</sup> For example, at the local level, United Nations System Standing Committee on Nutrition (UNSCN) guidance suggests women may have a role as nutrition champions by passing on nutrition knowledge and skills to their community. Not only does this have the potential to improve the nutrition capacity of the wider community, but it is also a platform to advance equity, equality and non-discrimination in food systems. This may be particularly relevant in rural and remote areas.<sup>35</sup>

#### Government and policy

Other recommendations for improvements to existing nutrition education and capacity of the medical and healthcare workforce included pledges from local governments to prioritise nutrition education to healthcare professionals. These pledges were identified as one way to support drafting, piloting and delivery of nutrition education to healthcare professionals at scale and provide UHC by 2030, as part of the SDGs.<sup>40</sup>

#### Nutrition education and research

The FAO and the WHO recommend continued research on and release of nutrition evidence, data and guidelines related to food composition, nutrition assessment, food-based indicators and human nutrition requirements across the lifespan.<sup>25</sup> The WHO e-library of Evidence for Nutrition Actions (eLENA) recommend expansion and dissemination of open access nutrition resources and evidence and adequate training of relevant WHO staff in nutrition policy, in order to assist countries to successfully implement and scale up nutrition interventions.<sup>25</sup> There was recognition within policy guidance of the need to establish a curriculum for nutrition education across all healthcare sectors, including the development and expansion of online resources to assist in nutrition capacity building.

Many of the publications reiterate the need to upscale community-based programmes which facilitate community participation in nutrition education and capacity

building. Recommendations for the delivery of nutrition education for the wider community included the use of smart technologies to deliver simple and targeted nutrition advice to the general population. There are opportunities to strengthen and champion resources to make this a key aspect of future policy. Accessible, evidence-based public nutrition education is key to empowering individuals and communities to make healthy dietary choices.

Other recommendations on nutrition education and capacity include nutrition education for teachers, as a platform for the incorporation of nutrition education in school curricula, and community-based nutrition interventions delivered by healthcare workers, particularly in rural and remote areas. For example, eLENA lists a range of nutrition interventions such as breastfeeding education for increased breastfeeding duration. Evidence suggests that educational interventions which target nutrition behaviour such as formal breastfeeding education during pregnancy may increase the duration of breastfeeding, which has many health benefits for both the mother and child.<sup>9 25</sup>

#### Nutrition monitoring, surveillance and evaluation systems related to nutrition and health

A number of documents detail the importance of systems to review and measure on-going progress related to established nutrition education and capacity goals. The majority of countries in this policy analysis reported tertiary-educated nutrition professionals as part of the health workforce. The validated Nutrition Professionals Density measure is recommended as an international indicator for monitoring nutrition capacity.<sup>27</sup> The Global Nutrition Monitoring Framework recommends the validity of the indicator is continually reassessed as national and global nutrition and health data is accrued.<sup>27</sup> Many publications in this analysis state the importance of nutrition education for the wider community. Therefore, it is recommended that there are also indicators in place to monitor the effect of nutrition education on population health status, dietary choices and the food industry, which ultimately has an impact on the former.

## Interviews and workshops

The three key themes identified from interviews, the survey and workshops were as follows: (1) Barriers to the application of nutrition in practice, (2) Barriers to policy formulation and implementation related to medical and healthcare nutrition capacity building and (3) Recommendations to improve medical and healthcare professional nutrition education and capacity. Recommendations from interviews are grouped into (A) Nutrition education and (B) Nutrition research. All illustrative quotes below are from WHO NFS team members.

### Barriers to the application of nutrition in practice

Despite strong agreement among key WHO NFS personnel that nutrition is an important component of healthcare, participants identified a number of barriers to the application of nutrition care in practice, which could be addressed by policy. Interview participants reported a lack of healthcare professionals with adequate nutrition skills and knowledge as a barrier to nutrition care in practice.

Lack of nutrition professionals (e.g., nutritionists, dietitians) at each level of health care

A lack of specific knowledge and skills were highlighted as barriers by participants including a lack of focus on motivational interviewing techniques in health professions nutrition education. Similarly, participants felt current nutrition education was limited by a lack of training on practical nutrition recommendations, such as recommendations for infant feeding.

Medical professionals are so heavily focused on clinical aspect of healthcare that nutrition almost even does not exist in their thought. For instance, most doctors, even paediatricians in many countries are not trained in infant and young child feeding (breast-feeding or complementary feeding).

WHO personnel identified other barriers to the provision of nutrition care, such as limited time with patients and the difficulty of eliciting positive behavioural change, particularly in the context of the current model of care.

Health workers have limited time with each client.

### Barriers to policy formulation and implementation related to medical and healthcare nutrition capacity building

Participants identified barriers to policy formulation and implementation related to medical and healthcare capacity building. One of the identified barriers was time, namely, that long-term efforts are required to develop and implement policy related to nutrition education and capacity building and that this may have an influence on action. Participants reported difficulty in collaboration between organisations to sustain efforts as another barrier to policy formulation and implementation in this context.

**Table 4** Key recommendations and examples for improvement in nutrition education and capacity building (from interviews, the survey and workshops)

Recommendation	Example
Nutrition education—to teach healthcare professionals the role of nutrition and its role in health and disease, and to empower introduction of evidence-based interventions	Training in nutrition counselling and understanding of referral pathways
Nutrition research—to broaden the evidence base of nutrition-based interventions and related policies	To identify and research problems with nutrition care

There are multiple actors (including INGOs [international non-governmental organization], NGOs [non-governmental organization]) providing training on the same topics that are not only less effective but also confusing to the Field Health Workers. Lack of co-ordination is a serious problem.

Furthermore, participants reported that while nutrition professional density is an important indicator and associated with all six global nutrition targets, the definition of a nutrition professional remains unclear.

But the question is how a country defines “nutrition professionals” and collect the data and report—are those comparable across countries?

### Recommendations for improvements to nutrition education and capacity

A summary of key recommendations from interviews, the survey and workshops is provided in [table 4](#). Illustrative quotes from NNEdPro personnel are also included from this point onwards.

#### Nutrition education

Education was seen as a steppingstone to a wider impact and needs to be connected to capacity building and change management to have a more sustained impact. Interview participants identified healthcare professionals at the forefront of public interaction and as a trusted point of contact between the public and the healthcare system.

Introducing nutrition curricula in academic setting (medical/nursing and several relevant courses at university level can be a starting point) is important to make a pool of trained nutrition professionals.

Furthermore, survey participants (from NNEdPro) felt that nutrition education for healthcare professionals may improve understanding of the established link between diet and the progression and onset of non-communicable disease. Participants identified this as key to enhancing the detection, treatment and prevention of non-communicable disease, and the double burden of



malnutrition. However, some participants identified that to meet the complex global health challenges we face today, healthcare professionals need education as support to meet nutrition goals outlined in the Nutrition Decade.

...looking at WHO documents on health workforce, the fact that a nutrition-trained and nutrition-knowledgeable health workforce is indispensable for global health improvement is still not 'evident'...

NNEdPro participants also provided recommendations for core nutrition competencies, such as the basic principles of a healthy diet, as defined by the WHO and as recommended by national food-based dietary guidelines, in addition to motivational interview techniques, to assist in behavioural change. Onward referral was also identified as an important nutrition competency, particularly for doctors, who NNEdPro members acknowledged as well placed to initiate and support nutrition care.

None or very few of them [doctors] (nurses too) are trained in nutrition counselling. But these are the techniques that need training to acquire required skills to practice in day-to-day care—both curative and preventive.

Furthermore, participants identified a person-centred approach as key to nutrition care in line with FAO recommendations identified in the document analysis above. Participants suggested the integration of nutrition competencies related to effective referral and follow-up with patients as an important aspect of person-centred care.

Client focused and appropriate to the context, including based on nutritional assessment of the client as appropriate

Lastly, participants suggested nutrition education include leadership competencies in order to equip medical and healthcare professionals with the knowledge, skills and confidence to advocate for nutrition in a number of capacities. This may include discussions with their patients, at the local level to advocate for and support peer engagement through education, research and practice and at the local and national level to influence policy and strategy in the delivery of public health priorities. Participants also identified a need for healthcare professionals to act as nutrition champions at the national level, to influence government policy, engage with stakeholders and establish international consensus. This may suggest that healthcare professionals have an un-filled role in nutrition advocacy, an important recommendation supported by policy guidance in this analysis.

**Leadership:** Health workers need to liaise with community leaders, and to advocate to them to make their communities nutrition friendly

Participants saw programmes of continuing education in nutrition as a short-term solution, rather than an ongoing method of capacity development. 'On-the-job' sessions were identified as a more suitable education-based

recommendation for capacity building, as it requires the application of nutrition knowledge and skills in practice.

Efforts have been made to provide in-service training by multiple stakeholders including Ministry of Health

### *Nutrition research*

Participants felt that while nutrition education is an important tool in building the nutrition capacity of the medical and healthcare workforce, it must be grounded in theory and research. Participants expressed the need for nutrition research capacity, as necessary to further identify and clarify problems with nutrition care, delivery and education so that solutions can be addressed, encouraging grassroots efforts.

WHO has maintained a rigorous approach to evidence-based nutrition in all of its training policies. Research is regularly undertaken by WHO collaborating centres.

### **Key themes and examples from facilitated discussions on next steps related to nutrition capacity building**

Five key themes were identified from intermediate outputs, namely, presentations related to global nutrition capacity: (1) Nutrition capacities—A competent and motivated health workforce is key to progress towards ending the double burden of malnutrition, (2) Diet quality and food systems—Food systems transformation is key to improvements in nutrition outcomes, (3) Indicators to monitor progress—The density of nutrition professionals is relevant to the nutrition capacity and progress within countries, (4) Scalable nutrition education interventions for sustainable change and (5) The role of voluntary nutrition networks. These themes are discussed in detail below and form part of the recommendations of this review.

### **Nutrition capacities: a competent and motivated health workforce is key to progress towards ending the double burden of malnutrition**

At the NNEdPro fifth International Summit on Medical and Public Health Nutrition Education and Research, Dr Francesco Branca, Director of the WHO NFS, reiterated the need for health practitioners to advocate for healthy diets in a collective effort to reduce malnutrition in all its forms.<sup>41</sup> Ms Lina Mahy, Technical Officer in the WHO NFS, exposed low existing coverage of nutrition actions through the health system. Nutrition capacity, including a well trained and motivated health workforce is one of the six pillars of an effective health system and is essential to address all forms of malnutrition.<sup>42 43</sup> There remains an urgent need to scale and improve the nutrition capacity of the health workforce, including medical doctors and nurses, who are well placed to provide dietary advice, by leveraging existing nutrition professionals, such as dietitians and public health nutritionists.

ICN2 yielded the Rome Declaration on Nutrition, encompassing 10 political commitments for effective

and co-ordinated action to achieve improved nutrition capacity and a framework of recommendations to operationalise political commitments.<sup>7</sup> Ms Mahy presented key ICN2 recommendations to ‘improve nutrition by strengthening human and institutional capacities to address all forms of malnutrition...’.<sup>41</sup> The Rome Declaration highlights the need for improved nutrition capacity of not only the health workforce, but of other community members well-placed to provide nutrition education, such as teachers and social workers.<sup>7</sup>

#### Diet quality and food systems: food systems transformation is key to improvements in nutrition outcomes

Diets are shaped by the food environment and food environments are shaped by food systems.<sup>35 39</sup> Consumer nutrition behaviour has a flow-on effect on health outcomes and the subsequent social, economic and environmental impacts of such outcomes. Ms Mahy outlined the need for political, programme and institutional action at the food supply, food environment and consumer behaviour stages of the food system model.<sup>41</sup>

#### Indicators to monitor progress: the density of nutrition professionals is relevant to the nutrition capacity and progress within countries

Nutrition data and indicators are central to effective nutrition surveillance, policy making and accountability. Ms Mahy presented the twenty primary outcomes, intermediate, process and policy environment and capacity indicators encompassed in the WHO Global Nutrition Monitoring Framework —Operational Guidance for Tracking Progress in Meeting Targets for 2025.<sup>27 41</sup> Nutrition professionals are well placed to provide dietary advice including evidence-based health and nutrition information. Therefore, the density of nutrition professionals was highlighted as an important indicator to measure the political economy and nutrition capacity and importantly, progress within a country. Recommendations to improve capacity development for nutrition include increasing the number of health professionals competent in nutrition.

Few countries provide nutrition education as part of higher education. Time dedicated to nutrition in tertiary curricula is lacking and therefore the quality of nutrition education may be compromised.<sup>44</sup> High-quality nutrition education, such as integrated nutrition training for front-line health workers, is essential to improve capacity for nutrition and address all forms of malnutrition.<sup>24</sup>

#### Scalable nutrition education interventions for sustainable change

Dr Luke Buckner, NNEdPro UK-India Scientific Lead and Nutrition Implementation Coalition Co-Convener, provided a global perspective on data-driven insights from outputs related to TIGR2ESS, Cambridge Global Food Security, Mobile Teaching Kitchens (MTK) and India.<sup>41</sup> Landscaping activities undertaken in Kolkata, India in 2015 revealed a double burden of malnutrition, characterised by undernutrition, wasting and stunting, as well as pockets of the community living with metabolic

syndrome. These findings led to the establishment of the MTK project, which aims to provide a scalable nutrition intervention to improve the nutrition knowledge and capacity of the population through demonstration by trained nutrition educators for development of a sustainable model.<sup>45</sup> The MTK initiative is based on a ‘See one, do one and teach one’ model, which underscores the transfer of nutrition knowledge between community members, to empower healthy and affordable dietary choices. Increased investment in some of the most marginalised in society can have an upward social and health impact. Overall improvements in clinical status and self-perceived nutrition knowledge were seen as a result of the MTK educational intervention—a promising result.<sup>45</sup>

SR highlighted the need for a strengthened architecture of nutrition education for health professionals, in line with the Nutrition Decade.<sup>41</sup> A recent synthesis of UK medical education identified a need for enhanced medical nutrition training, particularly the application of nutrition to a clinical context.<sup>44</sup> Given continued deficits in healthcare professional nutrition competency, there is a need for engaging, scalable training-based solutions to increase capacity, such as the MTK initiative and the Nutrition Education Policy in Healthcare Practice (NEPHELP) project developed by NNEdPro.<sup>45 46</sup> See online supplemental file 1 for an infographic summarising findings from Time for Nutrition in Medical Education.<sup>44</sup>

#### The role of voluntary nutrition networks

Given the recommendations previously mentioned, efforts to improve health through action on nutrition require integrative strategies that evaluate the impact of diets on communities and individuals. The potential of policy strategies to improve healthy food environments and human diet is recognised, but since every environment is different, a range of approaches is adequate for distinctive realities. Regional or national groups that study and focus on nutrition related problematics should be centres of dissemination of evidence, offers and opportunities, allowing policies and action to focus on specific problem-solving and needs.

Working on the best interest of regional networks in nutrition means planning a wide-ranging web that connects different agents in nutrition that transfer knowledge regarding needs, ideas and locally tailored strategies. The integration of holistic practices in local networks and systems concerning nutrition allows the development of action and should start with transdisciplinary evidence-based research. After the development and implementation of action, it is crucial to evaluate outcomes to understand limitations, feasibility and benefits as well as measure the impact of these approaches in the multiple regional and national contexts. As an example, NNEdPro convenes regional networks across six continents which provide a primary pathway through which to implement the recommendations below in different regions, each with customised and adequate aims and purposes.<sup>47</sup>



## DISCUSSION

The six Action Areas of the Work Programme of the Nutrition Decade are interlinked and call for sustainable, resilient food systems for healthy diets, aligned health systems to support the universal delivery of essential nutrition actions, increased investment in nutrition and strengthened governance for nutrition.<sup>5</sup> This review reiterates the importance of medical and healthcare professional nutrition capacity and synthesises key recommendations to improve nutrition education and capacity based on policy guidance from the WHO, FAO and UNSCN, interviews with participants from the WHO NFS and NNEdPro Global Centre for Nutrition and Health and key outputs (ie, presentations) related to global nutrition capacity. The need for nutrition capacity building at the individual, organisational and systemic levels is clear and key recommendations are discussed below.

The third action area of the Work Programme of the Nutrition Decade, social protection and nutrition education, directly relates to nutrition education, based on ICN2 recommendations.<sup>5 24</sup> Furthermore, in the Sixth Report on the World Nutrition Situation, the UNSCN concludes that for all populations, [nutrition] education and social marketing are crucial components of national, municipal and community efforts for sustained improvements in food and nutrition security...'.<sup>48</sup> Knowledge and education are key to lifestyle and behavioural change and health professionals are well-placed to provide dietary advice to support healthy choices.<sup>5</sup> Despite this, only 23 of 126 countries (18%) which reported nutrition-focussed professionals as part of their workforce had the recommended density (10 nutrition professionals per 100 000 population).<sup>26</sup> This is of concern given the indicator is based on recognition that a sufficient workforce with adequate nutrition capacity will lead to better outcomes for country-specific nutrition and health outcomes.<sup>26</sup>

Furthermore, nutrition professionals play a central role in training other health professionals to plan and deliver nutrition interventions. The nutrition competency of the health workforce has been previously established as insufficient and variable,<sup>49 50</sup> despite international efforts to improve nutrition education for health professionals, such as the Nutrition Academic Award, developed by the National Heart, Lung and Blood Institute.<sup>51</sup> One recommendation was the establishment of an interdisciplinary competency-based nutrition curriculum for health professionals. The use of a competency-based approach in improving nutrition education for the medical profession has been previously established<sup>52</sup> and has been shown to increase a clinician's ability to integrate nutrition into patient care.<sup>50</sup> The cross-cutting nature of nutrition has the potential to upskill across multiple aspects of broad health promotion, including both skills and capacity building, and therefore, to have continued and wide-ranging impact. Nutrition competencies identified as core to all health professionals in this paper included the principles of a healthy diet, motivational interviewing, onward referral and leadership. Other cross-cutting

nutrition competencies identified in the literature include awareness of how sociocultural determinants of health may affect nutrition behaviour and health status, and the ability to work effectively in a multidisciplinary team to provide nutrition care.<sup>53</sup> Standardised nutrition education might address variability in nutrition education for health professionals and provides incentive for the integration of nutrition competencies into curricula. The integration of innovative, skills-based curriculum initiatives is required to support the development of nutrition competence. For example, culinary skills training and interprofessional education have been shown to promote team-based care and lead to significant changes in health professionals nutrition knowledge, personal health habits and confidence to provide nutrition advice.<sup>54 55</sup> The need to establish global consensus on nutrition competencies for medical and healthcare professionals has been echoed in the literature for decades and further progress is required.<sup>17 50</sup>

Nutrition capacity development must be supported by the expansion and dissemination of open access nutrition resources and evidence for the medical and health workforce. Modern technology (ie, technology-based education and resources) can reduce the unavoidable costs of quality education. For example, the eNutrition Academy was created in 2014 by a consortium of international organisations and offers free e-learning nutrition modules for healthcare professionals.<sup>56</sup> Similarly, the WHO eLENA, an online library of guidelines for nutrition interventions, aims to assist countries in successfully implementing and scaling up nutrition interventions by providing resources which guide evidence-based policy development and programme design.<sup>25</sup> The World Food Programme host an open access learning platform called *nut<sup>x</sup>*, which includes self-paced e-learning courses, interactive tests and exercises.<sup>57</sup> The continued expansion and dissemination of evidence-based nutrition resources and knowledge hubs is recommended to drive improvements in the nutrition capacity of the medical and health workforce and country-level efforts to develop supportive policy and implement and scale nutrition interventions.

The above efforts related to nutrition education and capacity must continue to be grounded in quality research supported by government and policy. Innovative nutrition research provides a fundamental evidence base for nutrition education, guidelines and policy development. The 2020–2030 Strategic Plan for National Institutes of Health (NIH) Nutrition Research confirms the role of nutrition research in efforts to improve population health and is organised around the vision of precision nutrition.<sup>58</sup> There is also current funding provided for research efforts related to the microbiome, digital approaches to dietary assessment and the evolution of artificial intelligence. These efforts underpin the need for the health workforce to be competent in nutrition given the potential downstream impact of nutrition research on healthcare practice. Political entities must commit to a supportive environment for the delivery and

implementation of nutrition policy and programmes, such as pledges from local governments to prioritise nutrition education for healthcare professionals. Nomination of a central coordinator for nutrition education initiatives will reduce difficulty in collaboration between organisations to implement and sustain efforts as identified as a barrier in this study. This must be matched with increased investment in nutrition, such as funding for provision of physical infrastructure and innovative nutrition education curriculum initiatives for healthcare professional nutrition capacity building.

Finally, improved global data collections mechanisms and validated indicators are essential to assess and measure capacity and progress. FAO states the importance of developing 'countries' capacities to evaluate and monitor nutrition situations, analyse options, and implement agricultural policies and programmes that impact positively on nutrition.<sup>36</sup> The Global Nutrition Monitoring Framework recommends trained nutrition professional density as a core policy environment and capacity indicator, which can be used to assess country-level capacity to design and implement nutrition policy and programmes, as mentioned earlier. Validation of the indicator has shown it can predict important maternal, infant and young child nutrition outcomes.<sup>26</sup> Nutrition professional density was one of four indicators deferred for reporting by the WHO until 2018, as Member States were unclear how to report these indicators. This review recommends further clarification on the definition of 'nutrition professional' due to differences in professional education and accreditation internationally. Countries are encouraged to implement registration and accreditation systems for nutrition professional education to ensure quality training and professional competence.

### Strengths and limitations

This paper provides a critical synthesis of capacity-building efforts with regards to nutrition education for medical and healthcare professionals and provides recommendations to enhance efforts, however, needs to be considered in the context of its limitations. The role of nutrition professionals, namely nutritionist-dietitians, may vary internationally and particularly between low-income to middle-income countries and high-income countries. This may have implications for the generalisability of the recommendations provided, particularly with regard to nutrition education needs.

### CONCLUSION

Nutrition data collection, policy, education and implementation of change is likely to improve the nutrition behaviour of the wider community, which will in turn have population health and economic benefits. None of these benefits are possible without the described actions to build the nutrition capacity of the medical and health workforce.

Global nutrition surveillance and monitoring systems must be in place to evaluate the impact of changes in policy and education. This is a call to action for Government to pledge to prioritise nutrition education and capacity building, as a platform for improved health and well-being. Eliminating malnutrition in all its forms is key to progress towards the Sustainable Development Goals.

### RECOMMENDATIONS

1. Establishment of a national curriculum for nutrition education across all healthcare sectors, including the development and expansion of on-line resources.
2. Individual and government pledge for adopting nutrition education in community and healthcare as a priority, including establishment of frameworks for best practice.
3. Improved global data collections mechanisms and validated indicators to assess and measure capacity and progress, such as the nutrition professionals density Indicator.

### FUTURE VISION

Following a call to action for improved nutrition education for health professionals, NNEdPro developed NEPHELP, which aims to develop a training programme for junior doctors, primary care physicians and allied healthcare professionals in nutrition-related problems, nutrition interventions and scope of practice including appropriate onward referral to a specialist, such as a registered dietitian or nutritionist. More broadly, NEPHELP is a bespoke, interdisciplinary, sustainable nutrition education intervention to improve the capacity of the health workforce.<sup>46</sup>

In a joint initiative to support nutrition education and capacity, NNEdPro and LGC developed the International Knowledge Application Network Hub in Nutrition 2025 (iKANN).<sup>59</sup> iKANN is an open access online portal of published evidence in nutrition, encompassing evidence syntheses, raw data and meta data, evidence-based guidelines and e-learning to support workforce nutrition capacity development. The platform was launched on 26 September 2020 at the sixth International Summit on Medical and Public Health Nutrition Education & Research and can be found at [www.ikann.global](http://www.ikann.global).<sup>59</sup> iKANN has been established with over 10 regional network hubs positioned worldwide for scalability. A key function of iKANN is to support high quality, scalable nutrition education and training, to improve knowledge application globally.

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**Acknowledgements** We would like to thank the WHO Department of Nutrition and Food Safety, especially, Francesco Branca (Director), Felicetta Catanzaro, Kaia Engesveen, Fabienne Maertens, Lina Mahy, Thahira Mustafa, Kuntal Saha, Simona Seravesi & Juan Pablo Pena-Rosas. We would like to acknowledge the support of WHO Chief Scientist, Soumya Swaminathan for including feedback in the pre-final presentation of this work. We also acknowledge additional WHO colleagues including Diana Estevez for helpful comments and Christine Yvonne Tretter from the

WHO Global Internship Programme for organising a linked development workshop. We would like to acknowledge key contributions from the following members of the NNEdPro Global Centre for Nutrition and Health: Suzana Almoosawi, Matheus Abrantes, Preya Amin, Eleanor Beck, Iain Broadley, Luke Buckner, Dominic Crocombe, Timothy M Eden, Emily Fallon, Rajna Golubic, Duleni Herath, Ally Jaffee, Celia Laur, Dionysia Angeliki Lyra, Elaine MacAninch, Kathy Martyn, Sucheta Mitra and Claudia Mitrofan. We would like to acknowledge UK research and innovation (Medical Research Council) and the NNEdPro Global Centre for funding support. We would also like to acknowledge the University of Wollongong, Australia for contribution of doctoral student input.

**Contributors** All authors contributed to revision of the manuscript and approval of the final manuscript. The corresponding authors attest that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted. Patients and/or the public were not involved in this study.

**Funding** The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

**Competing interests** None declared.

**Patient consent for publication** Not applicable.

**Ethics approval** This study does not involve human participants.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** No data are available. Not applicable.

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#### REFERENCES

- World Health Organization. *Ambition and action in nutrition 2016-2025*, 2017: 64.
- GBD 2017 Diet Collaborators. Health effects of dietary risks in 195 countries, 1990-2017: a systematic analysis for the global burden of disease study 2017. *Lancet* 2019;393:1958-72.
- FAO I, UNICEF, WFP and WHO. *The state of food security and nutrition in the world 2020. transforming food systems for affordable healthy diets*. Rome: FAO, 2020.
- WHO. Obesity and overweight: World Health organization, 2020. Available: <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight> [Accessed 6 May 2021].
- World Health Organization. *Work programme of the United nations decade of action on nutrition (2016-2025)*. Geneva: World Health Organization, 2017.
- World Health Organization. *Driving commitment for nutrition within the UN decade of action on nutrition: policy brief*. Geneva: World Health Organization, 2018.
- ICN2. *Conference outcome document: Framework for Action - from commitments to action*. Rome: Food and Agriculture Organization of the United Nations, 2014.
- United Nations. *Transforming our world: the 2030 agenda for sustainable development*. United Nations, 2015.
- World Health Organization & UNICEF. *Implementation guidance: protecting, promoting and supporting breastfeeding in facilities providing maternity and newborn services: the revised Baby-friendly Hospital initiative*. Geneva: World Health Organization & UNICEF, 2018.
- World Health Organization. *Thirteenth General Programme of Work 2019-2023 - Promote Health, Keep the World Safe, Serve the Vulnerable*. Geneva: World Health Organization, 2019.
- World Health Organization. *Strengthening a competent health workforce for the provision of coordinated/integrated health services*. Geneva: World Health Organization, 2015.
- Weinsier RL, Boker JR, Brooks CM, et al. Priorities for nutrition content in a medical school curriculum: a national consensus of medical educators. *Am J Clin Nutr* 1989;50:707-12.
- National Research Council (US) Committee on Nutrition in Medical Education. *Nutrition education in U.S. medical schools*. Washington (DC): National Academies Press (US), 1985.
- Nutrition TGo. *Physician's Curriculum in Clinical Nutrition: Primary Care*. In: *Society of teachers of family medicine*. 3rd Edn, 2007.
- Kushner RF, Thorp FK, Edwards J, et al. Implementing nutrition into the medical curriculum: a user's guide. *Am J Clin Nutr* 1990;52:401-3.
- White J, Young E, Lasswell A. Position of the American Dietetic Association: nutrition--an essential of medical education. *J Am Diet Assoc* 1994;94:555-7.
- Crowley J, Ball L, Hiddink GJ. Nutrition in medical education: a systematic review. *Lancet Planet Health* 2019;3:e379-89.
- Lepre B, Mansfield KJ, Ray S, et al. Reference to nutrition in medical accreditation and curriculum guidance: a comparative analysis. *BMJ Nutr Prev Health* 2021;4:e000234.
- Mitchell H, Lucas C, Charlton K, et al. Models of nutrition-focused continuing education programs for nurses: a systematic review of the evidence. *Aust J Prim Health* 2018;24:101-8.
- Park KA, Cho WI, Song KJ, et al. Assessment of nurses' nutritional knowledge regarding therapeutic diet regimens. *Nurse Educ Today* 2011;31:192-7.
- Xu X, Parker D, Ferguson C, et al. Where is the nurse in nutritional care? *Contemp Nurse* 2017;53:267-70.
- Trueland J. Nutritional care is as crucial as nursing care to patient outcomes: why enticing people to eat well in hospital is a huge part of making sure they get better and go home in good health. *Nurs Stand* 2014;34:56-8.
- Aspry KE, Van Horn L, Carson JAS, et al. Medical nutrition education, training, and competencies to advance Guideline-Based diet counseling by physicians: a science Advisory from the American heart association. *Circulation* 2018;137:e821-41.
- World Health Organization & Food and Agriculture Organization of the United Nations. *Strengthening nutrition action: a resource guide for countries based on the policy recommendations of the second International Conference on nutrition (ICN2)*, 2018.
- World Health Organization. e-Library of evidence for nutrition actions (eLENA) Geneva: World Health organization. Available: <https://www.who.int/elena/en/> [Accessed 25 Mar 2020].
- World Health Organization. *Global nutrition policy review 2016-2017: country progress in creating enabling policy environments for promoting healthy diets and nutrition*. Geneva: World Health Organization, 2018.
- World Health Organization. *Global nutrition monitoring framework: operational guidance for tracking progress in meeting targets for 2025*. Geneva: World Health Organization, 2017.
- Development Initiatives. *2018 global nutrition report: shining a light on spur action on nutrition*. Bristol, UK: Development Initiatives, 2018.
- Global targets tracking tool Geneva: World Health organization, 2020. Available: <https://extranet.who.int/nhdtargets/en/Menu2020>
- World Health Organization. *Taking action on childhood obesity report*. Geneva: World Health Organization, 2018.
- Knowledge action portal: nutrition knowledge hub: World Health organization, 2020. Available: <https://www.knowledge-action-portal.com/content/nutrition-knowledge-hub> [Accessed 23 Oct 2020].
- United Nations Children's Fund (UNICEF) tWHO, and the International Bank for Reconstruction and Development/The World Bank. *Levels and trends in child malnutrition: key findings of the 2018 edition of the joint child malnutrition estimates*. Geneva: World Health Organization, 2018.
- World Health Organization. *Weekly iron and folic acid supplementation as an anaemia-prevention strategy in women and adolescent girls: lessons learnt from implementation of programmes among non-pregnant women of reproductive age*. Geneva: World Health Organization, 2018.
- World Health Organization. *Fact sheet No. 394: healthy diet*. Geneva: World Health Organization, 2018.
- United Nations Standing Committee on Nutrition (UNSCN). *UNSCN news 43: advancing equity, equality and non-discrimination in food systems: pathways to reform*. Rome: United Nations Standing Committee on Nutrition (UNSCN), 2018.
- Nutrition: food and agriculture organization of the United nations (FAO), 2020. Available: <http://www.fao.org/nutrition/en/2020>
- United nations system standing Committee on nutrition (UNSCN). home, 2020. Available: <https://www.unscn.org/> [Accessed 25 Mar 2020].
- United Nations System Standing Committee on Nutrition. *Global governance for nutrition and the role of UNSCN*, 2017.
- Nutrition and food systems. *A report by the high level panel of experts on food security and nutrition of the Committee on world*



- food security. Rome: High Level Panel of Experts on Food Security and Nutrition (HLPE), 2017.
- 40 World Health Organization. *Mobilising ambitious and impactful commitments for mainstreaming nutrition in health systems: nutrition in universal health coverage - global nutrition summit*. Geneva: World Health Organization, 2020.
  - 41 Laur C, Johnsen JT, Bradfield J, *et al*. Closing the gap: data-based decisions in food, nutrition and health systems: proceedings of the fifth International Summit on medical and public health nutrition education and research. *BMJ Nutr Prev Health* 2020;3:397–402.
  - 42 World Health Organization. *Monitoring the building blocks of health systems: a Handbook of indicators and their measurement strategies*. Geneva: World Health Organization, 2010.
  - 43 World Health Organization. *Everybody's business - strengthening health systems to improve health outcomes: WHO's framework for action*. Geneva: World Health Organization, 2007.
  - 44 Macaninch E, Buckner L, Amin P, *et al*. Time for nutrition in medical education. *BMJ Nutr Prev Health* 2020;3:40–48.
  - 45 Buckner L, Bhat S, Bhar S, *et al*. P200 the evaluation of mobile teaching Kitchens as a nutrition education tool to improve health outcomes in underserved communities. *J Nutr Educ Behav* 2019;51:S122–3.
  - 46 Home: NNEdPro global centre for nutrition and health, 2020. Available: <https://www.nnedpro.org.uk/> [Accessed 7 Oct 2020].
  - 47 Regional networks Cambridge: NNEdPro global centre for nutrition and health, 2020. Available: <https://www.nnedpro.org.uk/regional-networks> [Accessed 23 Oct 2020].
  - 48 United Nations Standing Committee on Nutrition (UNSCN). *6Th report on the world nutrition situation. progress in nutrition*, 2010.
  - 49 Deslisle H, Shrimpton R, Blaney S. Capacity-building for a strong public health nutrition workforce in low-resource countries. *Bull World Health Organ* 2017;95:313–88.
  - 50 Kris-Etherton PM, Akabas SR, Douglas P, *et al*. Nutrition competencies in health professionals' education and training: a new paradigm. *Adv Nutr* 2015;6:83–7.
  - 51 Van Horn L. The nutrition academic Award: brief history, overview, and legacy. *Am J Clin Nutr* 2006;83:936S–40.
  - 52 United nations decade of action on nutrition 2016-2025: United nations, 2020. Available: <https://www.un.org/nutrition/about> [Accessed 8 May 2020].
  - 53 Lepre B, Mansfield KJ, Ray S, *et al*. Nutrition competencies for medicine: an integrative review and critical synthesis. *BMJ Open* 2021;11:e043066.
  - 54 Mogre V, Scherpbier AJJA, Stevens F, *et al*. Realist synthesis of educational interventions to improve nutrition care competencies and delivery by doctors and other healthcare professionals. *BMJ Open* 2016;6:e010084.
  - 55 Caines L, Asiedu Y, Dugdale T, *et al*. An interprofessional approach to teaching nutrition counseling to medical students. *MedEdPORTAL* 2018;14:10742.
  - 56 The eNutrition Academy: the eNutrition Academy, 2020. Available: <https://the-enutrition-academy.teachable.com/> [Accessed 11 Nov 2020].
  - 57 nutx Rome, Italy: world food programme, 2018. Available: <https://cdn.wfp.org/nutrition/nutx/> [Accessed 11 Nov 2020].
  - 58 National Institutes of Health (NIH). *2020-2030 strategic plan for NIH nutrition research: a report of the NIH nutrition research Task force*, 2020.
  - 59 The International knowledge application network hub in nutrition 2025 (iKANN) Cambridge, UK: NNEdPro global centre for nutrition and health, 2020. Available: <https://www.ikann.global/> [Accessed 23 Oct 2020].
  - 60 United Nations Children's Fund (UNICEF). *Nutrition capacity assessment in Indonesia*. Jakarta: United Nations Children's Fund (UNICEF), 2018.
  - 61 Definition of Dietitian-Nutritionist. *ICDA By-Law: international Confederation of dietetic associations*, 2016.
  - 62 What is the food system? : Oxford Martin Programme on the Future of Food, 2021. Available: <https://www.futureoffood.ox.ac.uk/what-food-system> [Accessed 26 Oct 2021].
  - 63 Malagie M, Jensen G, Graham J. Food Industry Processes. In: *Encyclopedia of occupational health and safety*. 3rd edition. International Labour Office, 1989.
  - 64 Ball LE, Hughes RM, Leveritt MD. Nutrition in general practice: role and workforce preparation expectations of medical educators. *Aust J Prim Health* 2010;16:304–10.
  - 65 Cederholm T, Barazzoni R, Austin P, *et al*. ESPEN guidelines on definitions and terminology of clinical nutrition. *Clin Nutr* 2017;36:49–64.