BMJ Nutrition, Prevention & Health

# Mapping nutrition within medical curricula in Australia and New Zealand: a cross-sectional content analysis

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**To cite:** King RE, Palermo C, Wilson AN. Mapping nutrition within medical curricula in Australia and New Zealand: a cross-sectional content analysis. *BMJ Nutrition, Prevention & Health* 2023;**6**:e000522. doi:10.1136/bmjnph-2022-000522

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/bmjnph-2022-000522).

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Received 14 July 2022
Accepted 19 September 2023
Published Online First
9 November 2023



## ABSTRACT

**Objective** To systematically map nutrition content in medical curricula across all 23 medical schools in Australia and New Zealand accredited by the Australian Medical Council (AMC).

**Methods** A cross-sectional content analysis was conducted. Learning outcomes for 20 AMC-accredited medical curricula were extracted from online repositories and directly from universities in February to April 2021. Nutrition relevant learning outcomes or equivalent learning objectives/graduate attributes were identified. Nutrition learning outcomes were analysed according to Bloom's revised taxonomy to determine whether outcomes met cognitive, psychomotor or affective domains and at what level.

**Results** Of the total 23 AMC-accredited medical curricula, 20 medical schools had learning outcomes able to be sourced for analysis. A total of 186 nutrition learning outcomes were identified within 11 medical curricula. One medical school curriculum comprised 129 of 186 (69.4%) nutrition learning outcomes. The majority of outcomes (181, 97.3%) were in the cognitive domain of Bloom's revised taxonomy, predominantly at level 3 'applying' (90, 49.7%). The psychomotor domain contained five nutrition learning outcomes (5, 2.7%), while the affective domain contained none. New Zealand medical curricula (153, 82.3%) contained 4.6-fold more nutrition learning outcomes than Australian curricula (33, 17.7%). When comparing clinical and preclinical years across curricula, the proportion of learning outcomes in the psychomotor domain was 3.7-fold higher in clinical years (4.08%) versus preclinical years (1.15%).

**Conclusion** There is wide variation across medical curricula regarding the number of nutrition learning outcomes. This may lead to varying competency of medical graduates to provide nutrition care in Australia and New Zealand.

### WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Globally, one in five deaths is attributable to dietary risk factors. Doctors are well positioned to address nutrition issues, yet nutrition in medical curricula remains widely insufficient. The Australian Medical Council's accreditation standards of Australian and New Zealand medical curricula contain no nutrition relevant Graduate Outcome Statements.

### WHAT THIS STUDY ADDS

⇒ Our cross-sectional content analysis found nutrition education varies widely across Australian and New Zealand medical curricula. Additionally, the complexity of nutrition espoused by these curricula was limited.

### HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This may result in an evidence-practice gap between nutritional knowledge and competency to provide effective nutrition care in Australian and New Zealand medical graduates.

## INTRODUCTION

Globally, one in five deaths is attributable to suboptimal diet.[1] Poor dietary intake has been identified as a major preventable risk factor for non-communicable diseases (NCDs), including cardiovascular disease, obesity and type 2 diabetes mellitus.[2] This refers to a pattern of dietary consumption that is low in vegetables, fruits, grains and high in fat, sugar and salt.[3] Inversely, optimal nutrition can play an integral role in the management or treatment of certain diseases, including but not limited to frailty, NCDs and inborn errors of metabolism such as phenylketonuria.[4] In Australia and New Zealand (NZ), NCDs are accountable for an estimated 89% of all deaths.[5] There is an urgent need for an adequately equipped workforce to address nutrition issues to alleviate this burden. Doctors are a key professional group well positioned to intervene through clinical assessment, prevention and treatment of NCDs.[6] Given the interrelation between diet and health status, including NCDs, there is an evident need for medical practitioners to possess adequate knowledge, skills and attitudes towards nutrition.[7]

The international evidence suggests that current medical education is inadequate to prepare doctors with sufficient knowledge and skills to address nutrition for individuals and communities.[8] This is not, however, a recent phenomenon. Inadequate nutrition training in medical schools and a resultant deficit in nutrition knowledge has been reported in the medical education literature for over five decades.[8] Medical education must be adaptive if it is to prepare medical graduates and future doctors to best meet the needs of the patients they treat.[9] The provision of effective practice to improve a patient's dietary behaviour and subsequent health is known as nutrition care.[10] A longstanding evidence-practice gap exists between nutrition knowledge—or lack thereof—espoused in medical curricula and the requisite competencies to provide effective nutrition care.[8]

In Australia and NZ, the Australian Medical Council (AMC) is responsible for the accreditation of medical schools in this region. Currently, the AMC has 23 schools accredited—21 are located in Australia, the remaining 2 are in NZ.[11] This accreditation process is underpinned by the Standards for Assessment and Accreditation of Primary Medical Programs by the AMC 2012 which outlines what primary medical education providers must include in their curricula to produce a competent medical graduate.[12] Throughout the AMC's standards, there are no graduate outcome statements related to nutrition, rather it is left up to the discretion of the individual medical school and academic staff interest for inclusion.[13 14] This may lead to inconsistencies in the nutrition competency of medical graduates, and the potential for nutrition curriculum to not be included at all.

What is not understood is how medical schools have built nutrition curriculum into medical education to better prepare their graduates for practice. This study aims to systematically map nutrition in medical curricula across all 23 medical schools accredited by the AMC in Australia and NZ. Our study sought to quantify and assess nutrition in Australian and NZ medical schools by mapping the nutrition content of these schools' curricula.

## METHODS

### Study design

We used a cross-sectional study design to systematically map nutrition education of the 23 AMC-accredited primary medical curricula in Australia and NZ. All curricula were mapped using each medical school's 2021 curriculum to provide a snapshot of nutrition education at a point in time. Our study used a previously established approach, Deakin University's Extended Nutrition Competency Framework,[15] based on the principle of constructive alignment, that is, for content to be delivered a learning outcome must be stated.[16]

### Data collection

In February 2021, we compiled a spreadsheet of all 23 AMC-accredited undergraduate and postgraduate medical degrees in Australia and NZ, detailing for each curriculum its respective: university affiliation, faculty, medical school title, location, website URL, contact phone number, type of medical degree, undergraduate or postgraduate entry, duration, and amount of preclinical and clinical years in the course. All course and subject learning outcomes, or equivalent learning objectives/graduate attributes available for all medical schools were extracted from online university handbooks for their 2021 curricula. Learning outcomes of individual tutorials, lectures, practicals or other clinical classes were excluded, as comparability between curricula at this level was less precise than at the course or subject level. Extracted curricula data were downloaded as a web archive of the handbook, or equivalent where it was published online in this format. If either set of learning outcomes were unavailable, the most appropriate staff member, such as the course director of that medical school, was contacted by electronic mail in March 2021 to obtain these. Ethics approval was not sought as data were publicly available.

### Identification of learning outcomes

Extracted data were reviewed to identify learning outcomes for content analysis. Suitable learning outcomes were deemed *nutrition relevant*, referred to herein as a nutrition learning outcome. To identify the relevant learning outcomes from the extracted data, a list of primary and secondary keywords relevant to nutrition in medical education was generated. These were derived from Deakin University's Extended Nutrition Competency Framework[15 17]; a proposed benchmark for Australian medical courses for the inclusion of nutrition knowledge and skill-based competencies developed by medical and nutrition professionals for medical graduates. The framework outlines four knowledge and five skill-based nutrition competencies specifically mapped to the AMC Graduate Outcomes Statements and the Medical Deans Australia and NZ competencies for primary medical courses.[15] The proposed competencies range from knowledge of basic nutrition science to the ability to work in a multidisciplinary team to deliver optimal nutrition care.[17] Each competency is aligned with at least one of the current AMC graduate outcome statements to allow for seamless integration. For each competency, the framework details: student learning outcomes (SLOs), subject matter examples to address SLOs, example SLOs for incorporation into existing medical curricula, and assessment strategy examples.[17] Keywords relevant to nutrition were extracted and detailed information for each competency analysed, in consultation with two coauthors with clinical backgrounds in dietetics, medicine and tertiary nutrition education. Any learning outcome containing a primary keyword such as 'metabolism', 'appetite'' or 'micronutrient' was classified as a relevant learning outcome. A list of secondary keywords was developed to ensure learning outcomes were not missed, such words included 'preventative', 'homeostasis' and 'biochemical'. Learning outcomes containing these keywords were reviewed to see if they met criteria within its context; where uncertainties and discrepancies existed, a consensus among authors was reached. Certain keywords were modified to ensure all possible suffixes were covered, for example, Diet* for Diet, Dietary, Dietetic, Dietitian.

## Analysis

The analysis was performed in Microsoft Excel (V.16.50), provided as online supplemental data. All 20 curricula were analysed quantitatively, generating descriptive statistics to determine course duration, course composition (preclinical and clinical years) and the total number of nutrition learning outcomes. A 'clinical' year of a curriculum was defined as a year of study within the degree primarily carried out in a clinical environment. Smaller amounts of clinical exposure in an otherwise predominantly online or campus-based year were defined as preclinical. We included two curricula for which only overarching course learning outcomes were available in our analysis. The location (Australia and NZ) and course entry (undergraduate and postgraduate) details were similarly recorded for each curriculum.

Each extracted learning outcome was reviewed and coded qualitatively according to Bloom's revised taxonomy; a widely known framework that can be used to classify the differing complexity of learning outcomes in a hierarchical order.[18 19] This involved initial classification of a given learning outcome into one of Bloom's three domains: cognitive (knowledge), psychomotor (action), and affective (emotive) according to the assessment verb stated in the outcome and the context in which it was described. Each domain comprises a set of unique levels that are ranked in a hierarchical order, with level one as the lowest, most simple level and the highest being the most complex.[18] This enabled a broad analysis of their frequency by overarching domain.

The nutrition learning outcomes were coded within the allocated domain, according to the hierarchical level the verb resembled most closely in the taxonomy, providing a more detailed set of frequency data. Descriptive analysis was conducted to enable comparisons of frequencies and proportions between medical schools across Bloom's domains and also within each domain by level. These frequencies were then stratified by four parameters related to characteristics of the medical curricula. Learning outcomes were analysed by course composition (preclinical or clinical years), location (Australian or NZ), course entry (undergraduate or postgraduate) and by year of medical course.

If a learning outcome had two or more verbs, the learning outcome was assessed for each additional verb and coded independently. One curriculum had a general health science undergraduate first year component; learning outcomes for this year were not analysed as several courses with different subjects could fulfil this. If a verb could be potentially coded into multiple levels of a given domain, it was coded into the lowest possible level to not overestimate its complexity. If the learning outcome had no verb present, which occurred in only 1 year level of a single curriculum, it was coded into the most basic cognitive level 'remembering'. The coding of learning outcomes into their respective domain and level was reviewed and approved by all coresearchers. For medical schools accredited by the AMC to deliver two medical courses, at undergraduate level and postgraduate entry level, these were analysed as a single curriculum and classified as two courses.

**Table 1** Descriptive statistics of medical courses (n=20) included in the analysis

| Characteristic | n=20<br>n (%) |
|---|---|
| Location | |
| Australia | 18 (90) |
| States and territories: | |
| 1. New South Wales (6) | |
| 2. Queensland (4) | |
| 3. Victoria (3) | |
| 4. Western Australia (2) | |
| 5. South Australia (2) | |
| 6. Australian Capital Territory (1) | |
| New Zealand | 2 (10) |
| Contains ≥1 nutrition learning outcome | |
| Yes | 11 (55) |
| No | 9 (45) |
| Entry* | |
| Undergraduate (BMedSt/MD, MBBS, BMedSc/MD, MBChB, BMed/MD, MD) | 10 (48) |
| Postgraduate (MChD, MD, BMedSc/MD) | 11 (52) |
| Course duration* | |
| 4 years | 11 (52) |
| 5 years | 5 (24) |
| 6 years | 5 (24) |

*includes statistics from one AMC accredited medical school that provides two medical courses at different entry levels, one is undergraduate and the other is postgraduate.

## RESULTS

Overall, 20 of the 23 AMC-accredited curricula had learning outcomes able to be sourced for analysis (table 1). Eighteen medical schools had both course and subject learning outcomes available. Two medical schools did not provide subject learning outcomes but had overarching course learning outcomes available. Eleven medical schools without publicly available or missing learning outcomes were contacted for their assistance in sourcing learning outcomes. Two medical schools declined to provide their outcomes citing limited access, and one medical school did not respond. Two curricula had incomplete data available, and one curriculum had not yet published learning outcomes for the latter half of its course—confirmed by a staff member at this institution.

Of the 20 curricula analysed, 18 were based in Australia and 2 in NZ. All NZ medical schools were included. The course duration of curricula studied ranged from 4 to 6


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years. The entry level of the curricula analysed comprised 10 undergraduate and 11 postgraduate courses, inclusive of 1 AMC-accredited medical school that delivers 2 medical courses at both entry undergraduate and postgraduate levels; this was analysed as a single curriculum.

### Nutrition learning outcomes

Of the 20 curricula analysed, 11 (55%) contained at least 1 or more nutrition learning outcomes, while 9 (45%) medical curricula contained none. When comparing nutrition learning outcomes by location, there were 33 from 18 Australian curricula, compared with 153 from 2 NZ curricula (table 2). NZ medical schools comprised 82.3% of the total 186 nutrition learning outcomes. Furthermore, 69.4% (129) of all nutrition learning outcomes were from 1 NZ curriculum.

Applying Bloom's revised taxonomy (table 3), 181 (97.3%) of the 186 nutrition learning outcomes were in the cognitive domain and five (2.7%) were in the psychomotor domain. No learning outcomes analysed were in the affective domain. The majority met level 3 'applying' in the cognitive domain (90, 49.7%). Four (2.2%) cognitive learning outcomes met level four or higher. The proportion of psychomotor learning outcomes that were in clinical years (4.08%) was 3.7-fold higher than preclinical years (1.15%).

When analysed by course entry, undergraduate curricula contained 176 nutrition learning outcomes compared with postgraduate curricula which had 10. Undergraduate curricula contained all five psychomotor learning outcomes, whereas postgraduate contained none. In the analysis by year of course, from year 2 to year 6, the proportion of nutrition learning outcomes at level 3 'applying' in the cognitive domain increases. Year 2 of the curricula contained the most (47) while year 1 contained the least (8).

## DISCUSSION

Through content analysis of curriculum learning outcomes of 20 of 23 medical schools across Australia and NZ, we identified a considerable variation regarding the number of nutrition learning outcomes across accredited medical curricula. The two NZ curricula comprised more nutrition learning outcomes (82.3%) than the entirety of Australian curricula analysed. Our study highlights that there remains a gap in nutrition learning for many doctors in training across Australia which has implications for their preparedness to improve nutritional health.

This study builds on previous work in a 2012 study which mapped nutrition across 18 Australian medical curricula, which found nutrition-related knowledge and skills 'varied considerably' between curricula.[13] Our analysis goes further to look at both Australian and NZ curricula and demonstrated the complexity of nutrition education espoused was limited. First, the majority of nutrition learning outcomes analysed were allotted to the cognitive domain of Bloom's revised taxonomy, where very few met level four or higher. As the taxonomy represents a hierarchy of complexity, this indicates the cognitive nutrition learning outcomes comprising the majority of nutrition learning outcomes may lack sufficient depth, potentially hindering medical students' development of effective nutrition care competency. Second, no medical curricula contained a nutrition learning outcome belonging to the affective domain. This is concerning, given emotive learning is critical for the development of professional values in health profession students.[20] Nutrition learning outcomes that could be integrated to correct this deficiency might include verbs that foster increased appreciation, value and attitudes towards the provision of nutrition care. A 2017 study on 928 Australian medical students found that, despite awareness of the importance of nutrition in clinical practice, just over half of participants felt nutritional counselling and assessment should be part of routine practice.[14] By aligning nutrition learning outcomes with Bloom's Affective domain, medical curricula could cultivate improved attitudes towards nutrition care.

Currently, there is no global consensus on nutrition competencies deemed sufficient for medical education.[21] A 2021 integrative review qualitatively synthesised internationally published medical nutrition competencies, including Deakin University's Extended Nutrition Competency Framework.[17 21] Five cross-cutting themes were found across published nutrition competencies: clinical practice, health promotion and disease prevention, communication, working as a team and professional practice.[21] These themes were integrated by Lepre *et al*[21] into a proposed conceptual nutrition competency framework for medicine, informed in part by Miller's pyramid, which stratifies the assessment of clinical competence into a hierarchy of four levels—knows, knows how, shows how, does.[22] The Objective Structured Clinical Examination (OSCE), common in medical school examinations, involves demonstration of clinical skill such as history taking and presenting differential diagnoses or possible interventions (shows), and as such sits more highly in Miller's pyramid, above interpretation of knowledge (knows how), and fact recall (know).[23] As an established medical school assessment, the OSCE has been highlighted as a prime example of how nutrition competencies could be incorporated vertically within existing medical education.[21] The vertical placement of nutrition which diffuses relevant themes throughout medical education poses an effective way to embed relevant nutrition content, without encroaching on limited curriculum space.[24]

A 2021 comparative analysis found preliminary evidence that clear nutrition content or guidance on nutrition education is missing from medical education accreditation internationally.[25] To rectify this, an institutional commitment to make nutrition education compulsory in medical training, and the formulation of nutrition competencies to benchmark nutrition knowledge and skills in medical graduates was proposed.[8] This international precedent provides further impetus for Australian and NZ medical

**Table 2** Analysis of nutrition learning outcomes according to Bloom's revised taxonomy by characteristics of medical curricula

| | | | Course composition* | | | | Location | | | | Course entry | | | | Year of course* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Preclinical | | Clinical | | Australia | | New Zealand | | Undergraduate | | Postgraduate | | Year 1 | | Year 2 | | Year 3 | | Year 4 | | Year 5 | | Year 6 | |
| | | | Freq† | % | Freq† | % | Freq† | % | Freq† | % | Freq† | % | Freq† | % | Freq† | % | Freq† | % | Freq† | % | Freq† | % | Freq† | % | Freq† | % |
| **Domain** | | Cognitive | 86 | 98.9 | 94 | 95.9 | 31 | 93.9 | 150 | 98.0 | 171 | 97.2 | 10 | 100.0 | 8 | 100.0 | 47 | 97.9 | 33 | 100.0 | 33 | 100.0 | 33 | 97.1 | 26 | 89.7 |
| | | Affective | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | | Psychomotor | 1 | 1.1 | 4 | 4.1 | 2 | 6.1 | 3 | 2.0 | 5 | 2.8 | 0 | 0.0 | 0 | 0.0 | 1 | 2.1 | 0 | 0.0 | 0.0 | 0.0 | 1 | 2.9 | 3 | 10.3 |
| | | **Total** | **87** | **100.0** | **98** | **100.0** | **33** | **100.0** | **153** | **100.0** | **176** | **100.0** | **10** | **100.0** | **8** | **100.0** | **48** | **100.0** | **33** | **100.0** | **33** | **100.0** | **34** | **100.0** | **29** | **100.0** |
| **Level** | **Cognitive** | 1 Remembering | 45 | 52.3 | 13 | 13.8 | 6 | 19.4 | 52 | 34.7 | 55 | 32.2 | 3 | 30.0 | 2 | 25.0 | 27 | 57.5 | 16 | 48.5 | 5 | 15.2 | 6 | 18.2 | 2 | 7.7 |
| | | 2 Understanding | 11 | 12.8 | 17 | 18.1 | 11 | 35.5 | 18 | 12.0 | 24 | 14.0 | 5 | 50.0 | 2 | 25.0 | 6 | 12.8 | 4 | 12.1 | 7 | 21.2 | 4 | 12.1 | 5 | 19.2 |
| | | 3 Applying | 27 | 31.4 | 63 | 67.0 | 11 | 35.5 | 79 | 52.7 | 88 | 51.5 | 2 | 20.0 | 3 | 37.5 | 13 | 27.7 | 12 | 36.4 | 21 | 63.6 | 22 | 66.7 | 19 | 73.1 |
| | | 4 Analysing | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | | 5 Evaluating | 3 | 3.5 | 1 | 1.1 | 3 | 9.7 | 1 | 0.7 | 4 | 2.3 | 0 | 0.0 | 1 | 12.5 | 1 | 2.1 | 1 | 3.0 | 0 | 0.0 | 1 | 3.0 | 0 | 0.0 |
| | | 6 Creating | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | | **Total** | **86** | **100.0** | **94** | **100.0** | **31** | **100.0** | **150** | **100.0** | **171** | **100.0** | **10** | **100.0** | **8** | **100.0** | **47** | **100.0** | **33** | **100.0** | **33** | **100.0** | **33** | **100.0** | **26** | **100.0** |
| | **Affective** | 1 Receiving | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | | 2 Responding | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | | 3 Valuing | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | | 4 Organisation | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | | 5 Characterisation | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | | **Total** | **0** | **0.0** | **0** | **0.0** | **0** | **0.0** | **0** | **0.0** | **0** | **0.0** | **0** | **0.0** | **0** | **0.0** | **0** | **0.0** | **0** | **0.0** | **0** | **0.0** | **0** | **0.0** | **0** | **0.0** |
| | **Psych-omotor** | 1 Perception | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | | 2 Set | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | | 3 Guided response | 1 | 100.0 | 3 | 75.0 | 1 | 50.0 | 3 | 100.0 | 4 | 80.0 | 0 | 0.0 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 3 | 100.0 |
| | | 4 Mechanism | 0 | 0.0 | 1 | 25.0 | 1 | 50.0 | 0 | 0.0 | 1 | 20.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1 | 100.0 | 0 | 0.0 |
| | | 5 Complete overt response | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | | 6 Adaptation | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | | 7 Organisation | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| | | **Total** | **1** | **100.0** | **4** | **100.0** | **2** | **0.0** | **3** | **100.0** | **5** | **100.0** | **0** | **0.0** | **0** | **0.0** | **1** | **100.0** | **0** | **0.0** | **0** | **0.0** | **1** | **100.0** | **3** | **100.0** |

Total frequency and percentages are shown in bold.
*Results include only nutritional learning outcomes identified in subject learning outcomes not course learning outcomes.
†Freq is abbreviated for frequency of nutrition learning outcomes.

**Table 3** Analysis of nutrition learning outcomes according to Bloom's revised taxonomy

| | | n=186<br>n (%) |
|---|---|---|
| Domain | Cognitive | 181 (97.3) |
| | Affective | 0 (0.0) |
| | Psychomotor | 5 (2.7) |
| | **Total** | **186** (**100.0**) |
| Level | Cognitive | |
| | 1 Remembering | 58 (32.0) |
| | 2 Understanding | 29 (16.0) |
| | 3 Applying | 90 (49.7) |
| | 4 Analysing | 0 (0.0) |
| | 5 Evaluating | 4 (2.2) |
| | 6 Creating | 0 (0.0) |
| | **Total** | **181** (**100.0**) |
| | Affective | |
| | 1 Receiving | 0 (0.0) |
| | 2 Responding | 0 (0.0) |
| | 3 Valuing | 0 (0.0) |
| | 4 Organisation | 0 (0.0) |
| | 5 Characterisation | 0 (0.0) |
| | **Total** | **0** (**0.0**) |
| | Psychomotor | |
| | 1 Perception | 0 (0.0) |
| | 2 Set | 0 (0.0) |
| | 3 Guided response | 4 (80.0) |
| | 4 Mechanism | 1 (20.0) |
| | 5 Complete overt response | 0 (0.0) |
| | 6 Adaptation | 0 (0.0) |
| | 7 Organisation | 0 (0.0) |
| | **Total** | **5** (**100.0**) |

Total frequency and percentages are shown in bold.

curricula to embed comprehensive nutrition content across Bloom's domains and all preclinical and clinical training years. The Deakin University Extended Nutrition Competency Framework poses a promising benchmark for AMC-accredited medical schools' curriculum alignment,[17] where currently an international consensus on nutrition competencies in medicine is lacking.[21] Crowley *et al*[8] recognise the paucity of nutrition in medicine as a right to health within the EAT-Lancet Commission framework—a 2019 report with global scientific targets on healthy diets from sustainable food systems.[2 26] This presents a dual opportunity, to establish complementary nutrition competencies and planetary health education that aligns with patients' right to preventative healthcare.[8] Integration of these competencies into accreditation standards may be required to encourage medical schools to change curricula.

International and national accreditation standards influence the content and quality of medical curricula,[27] without integration of nutrition into the AMC's Standards, nutrition is likely to remain unchanged. Given the AMC's current standards were published in 2012 and are currently undergoing review, there is an opportunity to improve standards related to nutrition.[12 28]

## Limitations

It is possible that inherent variations among curricula (course formatting, depth of information on expected learning outcomes) could have presented data that was underestimated in the analysis that is, missed nutrition learning outcomes. However, if nutrition learning outcomes are not explicitly stated in the curriculum with sufficient depth, it is difficult to ascertain whether these outcomes are formally taught and assessed in practice. As three eligible Australian curricula were not able to be included in this study, the results may be less generalisable than if all Australian curricula were able to be mapped. However, the course length, degree type and entry level of these medical schools were reflective of the other Australian curricula studied; hence, our results may actually be generalisable to this region. The interpretation of assessment verbs was a limitation, as Bloom's levels are not always discrete and entail some overlapping elements. Despite this, Bloom's taxonomy enabled a systematic mapping of nutrition content by quantifying the amount and complexity of learning outcomes studied. Additionally, discrepancies may exist between espoused nutrition learning outcomes and what is taught in practice; this could be a promising area of future research to reconcile variations that might exist.

## Conclusion

Our study of 20 AMC-accredited medical curricula in Australia and NZ demonstrates that there is wide variation regarding nutrition relevant learning outcomes. Despite the lack of nutrition integrated within current AMC Standards, some medical schools have recognised the importance of equipping their graduates with sufficient knowledge and skills for effective nutrition care in their future practice. This snapshot analysis provides timely evidence that curriculum standards should not only require medical curricula to embed substantial nutrition education content, but to incorporate it through more varied teaching and assessment to diversify and increase the complexity and skillset espoused. The inconsistencies observed across medical curricula may lead to varying competency of newly graduated doctors to provide nutrition care in Australia and NZ. There is opportunity to enhance the nutrition capability of medical graduates through reaccreditation and curriculum reform.

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**Acknowledgements** Research presented at The NNEdPro 7th International Summit on Nutrition and Health on 17th July 2021. Conference abstract published in BMJ Nutrition, Prevention and Health.

**Contributors** Study design led by all authors. Data collection, analysis and interpretation led by REK with input from all authors. Manuscript writing led by REK with input from all authors. All authors read and approved the final manuscript, with REK acting as guarantor.

**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.

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

**Data availability statement** All data relevant to the study are included in the article or uploaded as supplementary information.



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