

BMJ Open

Setting Priorities for Research in Medical Nutrition Education: A Global Approach

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2016-013241
Article Type:	Research
Date Submitted by the Author:	28-Jun-2016
Complete List of Authors:	Ball, Lauren; Griffith University, Menzies Health Institute Queensland Barnes, Katelyn; Griffith University, Menzies Health Institute Queensland Laur, Celia; Need for Nutrition Education Programme group Crowley, Jennifer Ray, Sumantra; MRC Human Nutrition Research,
Primary Subject Heading:	Medical education and training
Secondary Subject Heading:	Nutrition and metabolism
Keywords:	NUTRITION & DIETETICS, MEDICAL EDUCATION & TRAINING, STATISTICS & RESEARCH METHODS, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

SCHOLARONE™
Manuscripts

Title Page

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Title: Setting Priorities for Research in Medical Nutrition Education: A Global

Approach

Journal: BMJ Open

Running Head: Research Priorities in Medical Nutrition Education

Authors: Lauren Ball^{1,2}, Katelyn Barnes¹, Celia Laur^{2,3}, Jennifer Crowley^{2,4},
Sumantra Ray²

¹Centre for Health Practice Innovation, Menzies Health Institute Queensland, Griffith
University, Gold Coast, Australia

²The Need for Nutrition Education/Innovation Programme, The University of
Cambridge, C/O MRC Elsie Widdowson Laboratory, 120 Fulbourn Rd, Cambridge,
CB1 9NL

³Faculty of Applied Health Sciences, School of Public Health and Health Systems,
University of Waterloo, 200 University Avenue West, Waterloo, Ontario, Canada.

⁴Faculty of Medical and Health Sciences, University of Auckland, New Zealand

Corresponding Author: Dr L Ball, Menzies Health Institute Queensland, Griffith

University QLD 4222 Australia, l.ball@griffith.edu.au

Keywords: nutrition education, medical training, research planning

ABSTRACT

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Objectives: To identify the research priorities for medical nutrition education worldwide.

Design: 5-step stakeholder engagement process based on methodological guidelines for identifying research priorities in health.

Participants: 277 individuals were identified as representatives for 30 different stakeholder organisations across 86 countries. The stakeholder organisations represented the views of medical educators, medical students, doctors, patients, and researchers in medical education.

Interventions: Each stakeholder representative was asked to provide up to three research questions for medical nutrition education deemed as a priority.

Main outcome measures: Research questions were critically appraised for answerability, sustainability, effectiveness, potential for translation and potential to impact on disease burden. A blinded scoring system was used to rank the appraised questions, with higher scores indicating higher priority (range of scores possible 36-108).

Results Thirty-seven submissions were received, of which 25 were unique research questions. Submitted questions received a range of scores from 62-106 points. The highest scoring questions focused on (i) the confidence of medical students and doctors in providing nutrition care to patients, (ii) the essential nutrition skills doctors should acquire, (iii) the effectiveness of doctors at influencing dietary behaviours and (iv) medical students' attitudes towards the importance of nutrition.

Conclusions: These research questions can be used to ensure future projects in medical nutrition education directly align with the needs and preferences of research stakeholders. Funders should consider these priorities in their commissioning of research.

ARTICLE SUMMARY (Strengths and Limitations)

- 53
- 54 • A research priority setting project was conducted using a 5-step stakeholder
- 55 engagement process.
- 56 • The project utilised a management team to provide informed, objective input
- 57 throughout the stakeholder engagement process.
- 58 • The research scope, context and criteria for prioritising research questions was
- 59 drafted and confirmed by the management team through iterative written and
- 60 verbal discussions.
- 61 • Categories of potential stakeholders were identified by the management team
- 62 to include medical students, medical educators, medical practitioners, nutrition
- 63 organisations and patient representative bodies.
- 64 • Research questions were provided by stakeholders and initially reviewed for
- 65 alignment with scope before being scored and ranked using the criteria
- 66 developed by the management team.

67 Introduction

68 Good nutrition is essential for human wellbeing, yet nutrition-related health
69 conditions such as malnutrition, obesity and chronic disease affect nearly all countries
70 worldwide.¹ As a result, poor dietary behaviours contribute significantly to the global
71 burden of disease. Many countries are making progress in improving the nutrition
72 outcomes of individuals and population groups,¹ which provides opportunity for
73 supporting similar improvements in other countries. Health care systems aim to utilise
74 strategies to support patients to have healthy dietary behaviours,² and this highlights
75 an emerging priority for optimising health outcomes.³

76
77 The World Health Organization has previously recommended that medical
78 professionals should be supported to take an active role in promoting healthy dietary
79 behaviours.² Authoritative medical bodies have also confirmed that it is within the
80 responsibility of doctors to address nutrition-related issues concerning patients and
81 the public.⁴ To best support doctors in the development of nutrition knowledge and
82 skills, nutrition education should be integrated into undergraduate and postgraduate
83 medical training.² Advancements in nutrition curriculum guidelines have occurred
84 internationally,⁵ and stem from widespread reports of insufficient nutrition education
85 during medical training.⁶⁻⁸

86
87 There is considerable variability in the quantity and quality of nutrition education
88 provided to medical students and graduates worldwide.⁵ Notable differences include
89 the specificity of nutrition content areas, recommended teaching approaches and
90 extent of mandatory enforcement.^{5,9} As such, nutrition topics that have been decided
91 as important for inclusion in medical education are not always sufficiently taught and
92 may not result in a change of medical practice. Furthermore, many studies in medical

1
2
3 93 nutrition education use self-reported changes in practices as a proxy indicator of
4
5 94 effectiveness at enhancing nutrition care provided to patients,⁹⁻¹¹ and do not
6
7 95 investigate whether interventions translate into improved dietary behaviours or health
8
9
10 96 outcomes of patients. Clearly, future research should be carefully planned to
11
12 97 overcome these challenges and to advance understanding that supports other countries
13
14 98 to make similar improvements.

15
16
17 99

18
19 100 Research priority setting is a key component of research planning, particularly when
20
21 101 research options far exceed available resources.¹² The objective of research priority
22
23 102 setting is to use a fair, transparent and systematic approach to identify the most
24
25 103 important research projects to conduct.¹² Research prioritisation is a valuable strategy
26
27 104 used to ensure that future research projects are directly aligned with the needs and
28
29 105 preferences of research end-users, such as stakeholders. This prioritisation process is
30
31 106 important because it increases the likelihood that research projects elicit a meaningful
32
33 107 impact and can be implemented in a sustainable, feasible and acceptable manner.
34
35
36 108 Research priorities have been developed for specific aspects of nutrition research,
37
38 109 such as micronutrient intake for child health,¹³ and artificial feeding in hospitals.¹⁴
39
40 110 This process has not yet been applied to other contexts, such as such as medical
41
42 111 nutrition education.

43
44
45 112

46
47 113 The aim of this study was to identify global research priorities for medical nutrition
48
49 114 education. The findings are essential for strengthening future research, and will
50
51 115 demonstrate a thorough understanding of priority research questions. The study will
52
53 116 guide future research projects to be aligned with the needs and preferences of research
54
55 117 end-users.
56
57
58
59
60

1
2
3 118 **Methods**

4
5 119 *Overview*

6
7 120 A 5-step stakeholder engagement process was undertaken to identify priorities for
8
9 121 research in medical nutrition education worldwide. The stakeholder engagement
10
11 122 process was informed by guidelines for setting research priorities.^{12, 15} An overview of
12
13 123 the stakeholder engagement process is shown in Figure 1. The study was approved by
14
15 124 the relevant institutional Human Research Ethics Committee (reference number
16
17 125 2015/900).

18
19
20
21 126

22
23 127 INSERT FIGURE ONE ABOUT HERE

24
25 128

26
27 129 *Step 1: Select Management Team*

28
29 130 The project utilised a management team to provide informed, objective input
30
31 131 throughout the stakeholder engagement process. The management team was formed
32
33 132 through professional contacts of the researchers and comprised five researchers. Team
34
35 133 members were from the UK, Canada, Australia and New Zealand. All members of the
36
37 134 management team had extensive experience in medical nutrition education and
38
39 135 research, including obtaining research funding support, developing research
40
41 136 proposals, conducting studies, disseminating findings and translating evidence into
42
43 137 changes in practice.

44
45
46
47 138

48
49 139 *Step 2: Confirm scope and context*

50
51 140 The research scope and context was drafted and confirmed by the management team
52
53 141 through iterative written and verbal discussions. This process confirmed the
54
55 142 population of interest, health conditions of interest, goals for translation and relevant
56
57
58
59
60

1
2
3 143 stakeholders. An explanation of the research scope and context was developed to
4
5 144 distribute to stakeholders, and reads as follows:
6

7
8 145 *“The research we are focusing on examines the best way to support medical*
9
10 146 *students to become competent at incorporating nutrition care into their future*
11
12 147 *routine practices as doctors. Medical nutrition education facilitates students to*
13
14 148 *have adequate nutrition knowledge, skills and attitudes to feel confident at*
15
16 149 *providing nutrition care, as well as advocating for nutrition for improved public*
17
18 150 *health. For the purpose of this project, medical nutrition education*
19
20 151 *encompasses undergraduate, postgraduate and continuing medical education*
21
22 152 *experiences for doctors in all countries; and does not include nutrition*
23
24 153 *education for other health professionals. Outcomes could be measured by self-*
25
26 154 *perceived or actual nutrition knowledge; demonstrated nutrition skills, attitudes*
27
28 155 *towards nutrition, frequency of nutrition care, effectiveness of nutrition care on*
29
30 156 *patients' health outcomes, and advocacy activities related to nutrition.”*
31
32 157

33 158 *Step 3: Engage with Stakeholders*

34 159 Categories of potential stakeholders were identified by the management team to
35
36 160 include medical students, medical educators, medical practitioners, nutrition
37
38 161 organisations and patient representative bodies. A list of stakeholder contact details
39
40 162 was developed using publicly available information from English websites.
41
42 163 Preference was given to national and international bodies in order to capture informed
43
44 164 opinions from the broadest possible audience. Figure 2 outlines the global reach of
45
46 165 national stakeholder bodies involved in the stakeholder engagement process. Table 1
47
48 166 shows the global representation of the major stakeholder groups invited to participate.
49
50 167 In addition to national bodies, international bodies for medical students, medical
51
52 168 educators and medical practitioners were invited to provide input. Each stakeholder
53
54 169 organisation was contacted via email to explain the aim and ethical approval of the
55
56 170 project. In addition, the email outlined the scope and context of the research and
57
58 171 asked representatives to provide up to three research questions deemed as a priority.
59
60

1
2
3 172 Two reminder emails were sent to each stakeholder organisation over a period of two
4
5 173 months.
6

7 174

8
9 175 INSERT FIGURE TWO ABOUT HERE

10 176 INSERT TABLE ONE ABOUT HERE

11
12
13 177

14
15
16 178 *Step 4: Confirm Criteria for Appraising and Prioritising Research*

17
18 179 The criteria for prioritising research questions were drafted and confirmed by the
19
20
21 180 management team through blinded ranking. Fifteen possible criteria and their
22
23 181 explanations were proposed and ranked in order of relevance and importance for the
24
25 182 scope and context of research.¹² The four highest ranked criteria (i) answerability, (ii)
26
27 183 sustainability, (iii) effectiveness and (iv) potential for translation and impact on
28
29 184 disease burden were used to score each research option proposed by the stakeholders.
30
31 185 Between two and four assessment questions were drafted and confirmed by the
32
33 186 management team to adequately assess each criterion. Box 1 outlines the criteria and
34
35 187 assessment questions applied when appraising each research question.
36
37

38 188

39
40 189 INSERT BOX ONE ABOUT HERE

41
42
43 190

44
45 191 *Step 5: Score of Research Options*

46
47 192 The research questions provided by stakeholders were initially reviewed for
48
49 193 alignment with scope and ability to be scored using the five criteria. Minor edits were
50
51 194 made to the wording of research questions to enable structured scoring by the
52
53 195 management team. The submitted research questions were independently scored by
54
55 196 each member of the management team using the assessment questions for each
56
57 197 criteria, with answers: “Yes” (3 points), “Unsure” (2 points) or “No” (1 point). The
58
59
60

1
2
3 198 total number of points awarded to each research question was summed in order to
4
5 199 provide an overall score for each criterion, ranging from 36-108 given the assessment
6
7 200 criteria and size of the management team. Finally, the appraised questions were
8
9 201 ranked from highest to lowest score to provide a list of prioritised research questions.
10
11 202

12 13 14 203 **Results**

15
16 204 Thirty-seven research questions from 19 stakeholder organisations were obtained
17
18 205 from the stakeholder engagement process over the two month data collection period.
19
20 206 Twelve questions were collapsed with others due to considerable overlap, resulting in
21
22 207 25 unique research questions for appraisal. Table 1 outlines each of the research
23
24 208 questions as well as the score achieved for each criterion. The questions achieved a
25
26 209 mean±SD total score of 86±16 points (range 62-106 points).
27
28 210

29
30
31 211 INSERT TABLE TWO ABOUT HERE
32
33 212

34
35
36 213 The appraisal process allowed a total ranking for each question, with clear separation
37
38 214 between scores. The highest scoring question overall related to the confidence of
39
40 215 medical students and doctors in providing nutrition care to patients. Other high
41
42 216 scoring questions focused on the essential nutrition skills for doctors, the
43
44 217 effectiveness of doctors at influencing dietary behaviours and medical students'
45
46 218 attitudes towards the importance of nutrition.
47
48 219

49
50
51 220 The ranking of questions differed for each criterion. For example, Table 2 indicates
52
53 221 that the seventh highest scoring question overall (translation of nutrition education
54
55 222 into improved nutrition care), achieved the highest score in terms of sustainability, the
56
57
58
59
60

1
2
3 223 12th highest for answerability, third highest for effectiveness and highest for the
4
5 224 potential for translation.
6

7 225

8
9
10 226 **Discussion**

11 227 Medical nutrition education is an important component for the translation and
12
13 228 sustainability of multi-faceted interventions within health care. As such, the
14
15 229 incorporation of medical nutrition education into current interventions should be
16
17 230 considered collaborative rather competitive. This study aimed to identify the global
18
19 231 research priorities for medical nutrition education. The process for developing these
20
21 232 priorities was consultative and consensus-based. The stakeholder engagement process
22
23 233 resulted in a wide variety of research questions being critically appraised and
24
25 234 prioritised. This suggests that the aim of developing a fair, transparent and systematic
26
27 235 approach to identifying the most important research priorities was satisfied.¹² This
28
29 236 work can inform future research projects that align with the needs and preferences of
30
31 237 research end-users in medical nutrition education. Funding bodies and health service
32
33 238 providers are encouraged to use these research priorities in decision-making about
34
35 239 future projects.
36
37
38
39

40 240

41
42 241 The highest scoring questions focused on the confidence of medical students and
43
44 242 doctors in providing nutrition care to patients; the essential nutrition skills doctors
45
46 243 should acquire; the effectiveness of doctors at influencing dietary behaviours and
47
48 244 medical students' attitudes towards the importance of nutrition. Interestingly, most of
49
50 245 these topics have been previously researched to variable extents.^{8, 16-31} This indicates
51
52 246 that previous research activities are generally aligning with the needs and preferences
53
54 247 of stakeholders. The extent to which current research projects align with the
55
56 248 prioritised research questions when planning projects should be reviewed, with
57
58
59
60

1
2
3 249 particular emphasis on incorporating indicators of effectiveness and translation into
4
5 250 practice. Furthermore, the priorities identified in this study align with grand/global
6
7 251 challenges schemes underway in several countries including Canada, the UK and
8
9
10 252 USA in terms of improving global health through prevention and management of
11
12 253 infectious and non-communicable diseases.

13
14 254

15
16 255 The ranking of research questions differed for each criterion. This suggests that a
17
18 256 different list of priority research questions may have been produced using different
19
20 257 criteria. An iterative approach was used in the present study to determine the most
21
22 258 appropriate criteria for appraising the research questions. These criteria could be used
23
24 259 to strengthen potential research questions by enhancing answerability, or altering
25
26 260 study designs to increase the potential for translation to practice. To overcome this
27
28 261 limitation, providing stakeholder organisations with instructions on the optimal
29
30 262 development of research questions may help align future submissions to the criteria.

31
32
33
34 263

35
36 264 The attributes of the submitted research questions require consideration prior to future
37
38 265 research. For example, the submitted research questions differed in scope and focus,
39
40 266 and achieved variable scores for each appraisal criterion. The stakeholder organisations
41
42 267 typically represented the views of clinicians, with less direct representation of
43
44 268 patients. Furthermore, the research questions that were more specifically worded
45
46 269 appeared to achieve higher scores than generally worded questions. This suggests that
47
48 270 the appraisal by the management team may have been more favourable when the
49
50 271 questions were easily understood and clearly described, rather than whether or not the
51
52 272 question was an important priority. Specific questions may also score higher in the
53
54 273 feasibility criteria compared to general questions because the translation to study
55
56 274 design may be clear. These limitations suggest that future research planning should

1
2
3 275 use the prioritised research questions as a source of guidance, whilst also considering
4
5 276 other relevant factors such as translating general questions into study designs,
6
7 277 acknowledging existing projects, patients' preferences, international priorities in
8
9
10 278 nutrition and whether the intervention translates into improved dietary behaviours or
11
12 279 health outcomes of patients.

13
14 280

15
16 281 In conclusion, this study has identified the global research priorities for medical
17
18 282 nutrition education. The process used provides a consultative, transparent, and
19
20 283 consensus-based model that could be applied elsewhere. The stakeholder engagement
21
22 284 process resulted in a wide variety of research questions being critically appraised and
23
24 285 prioritised. As a result, future research projects that align with the prioritised research
25
26 286 questions are likely to meet the needs and preferences of research stakeholders in
27
28 287 medical nutrition education.
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 288 **Funding:** This research received no specific grant from any funding agency in the
4
5 289 public, commercial or not-for-profit sectors.
6
7 290

8
9
10 291 **Competing Interests:** The authors declare no competing interests.
11
12 292

13
14 293 **Author's contribution:** LB and KB took a lead role in the concept and design of the
15
16 294 study. LB, KB, CL and SR advised on data collection and analysis. JC assisted with
17
18 295 the writing of the manuscript. All authors contributed to the manuscript development
19
20 296 and approved the final version prior to submission.
21
22 297

23
24 298 **Data Sharing:** There is no additional data available.
25
26 299

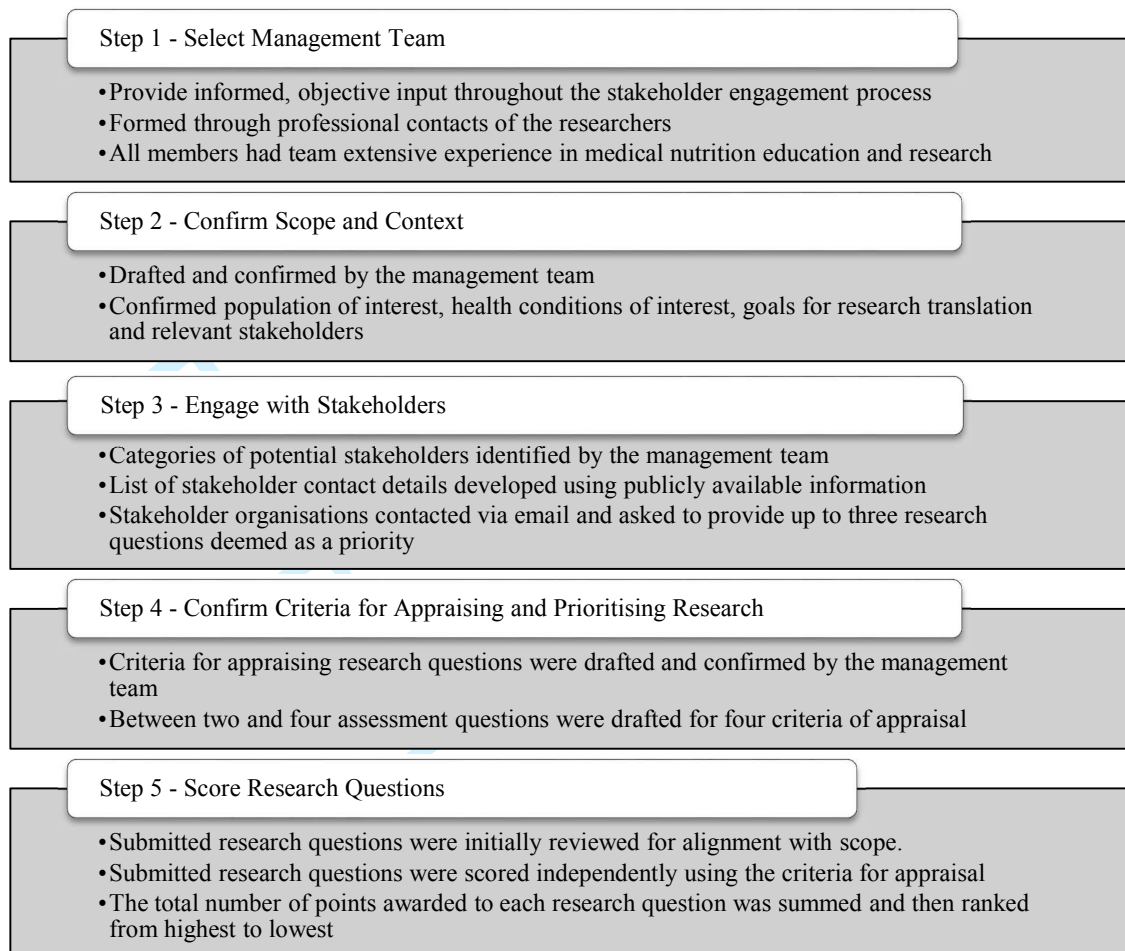
30 300 **References**

- 31
32 301 1. International Food Policy Research Institute. Global Nutrition Report 2014:
33
34 302 Actions and Accountability to Accelerate the World's Progress on Nutrition.
35
36 303 Washington, DC, 2014.
37
38 304 2. World Health Organization. WHO Technical Report Series: Diet, nutrition, and
39
40 305 the prevention of chronic diseases. Geneva, 2003.
41
42 306 3. Halcomb EJ, Davidson PM, Yallop J, *et al*. Strategic directions for developing
43
44 307 the Australian general practice nurse role in cardiovascular disease
45
46 308 management. *Contemp Nurse*. 2007;26(1):125-35.
47
48 309 4. Royal College of Physicians. Nutrition and Patients: A Doctor's Responsibility.
49
50 310 Report of a Working Party of the Royal College of Physicians. London, 2002.
51
52 311 5. Crowley J, Ball L, Laur C, *et al*. Nutrition guidelines for undergraduate medical
53
54 312 curricula: a six country comparison. *Adv Med Ed & Prac* 2015;6:127-33.
55
56
57
58
59
60

- 1
2
3 313 6. Adams K, Kohlmeier M, Zeisel S. Nutrition Education in U.S. Medical Schools:
4
5 314 Latest Update of a National Survey. *Acad Med.* 2010;85(9):1537-42.
6
7 315 7. Gray DS, Harvison S, Wilson JL. Evaluation of a nutrition education-program
8
9 316 for family-practice residents. *J Med Ed.* 1988;63(7):569-71.
10
11 317 8. Crowley J Ball L, Han D, *et al.* New Zealand medical students have positive
12
13 318 attitudes and moderate confidence in providing nutrition care: A cross-sectional
14
15 319 survey. *J Biomed Ed* 2015, Online Article ID 259653.
16
17
18 320 9. Ray S, Udumyan R, Rajput-Ray M, *et al.* Evaluation of a novel nutrition
19
20 321 education intervention for medical students from across England. *BMJ Open.*
21
22 322 2012;2:e000417.
23
24
25 323 10. Ball L, Crowley J, Laur C, *et al.* Nutrition in medical education: reflections
26
27 324 from an initiative at the University of Cambridge. *J Mult Health Care,*
28
29 325 2014;7:209-15.
30
31
32 326 11. Douglas P, Ball L, McGuffin L *et al.* Hydration: Knowledge, attitudes and
33
34 327 practices of UK dietitians. *J Biomed Ed,* 2015, Online Article ID 172020.
35
36
37 328 12. Rudan I, Gibson JL, Ameratunga S, *et al.* Setting priorities in global child
38
39 329 health research investments: guidelines for implementation of CHNRI method.
40
41 330 *Croat Med J.* 2008;49(6):720-33.
42
43 331 13. Brown KH, Hess SY, Boy E, *et al.* Setting priorities for zinc-related health
44
45 332 research to reduce children's disease burden worldwide: an application of the
46
47 333 Child Health and Nutrition Research Initiative's research priority-setting
48
49 334 method. *Public Health Nutr.* 2009;12(3):389-96.
50
51
52 335 14. Weenen TC, Jentink A, Pronker ES, *et al.* Patient needs and research priorities
53
54 336 in the enteral nutrition market: a quantitative prioritization analysis. *Clin Nutr.*
55
56 337 2014;33(5):793-801.
57
58
59
60

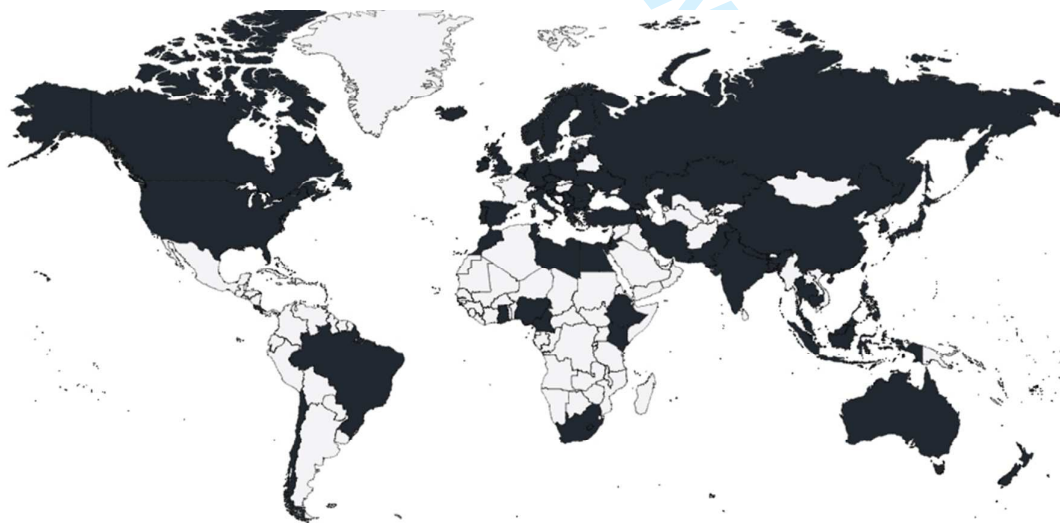
- 1
2
3 338 15. Yoshida S. Approaches, tools and methods used for setting priorities in health
4
5 339 research in the 21(st) century. *J Glob Health*. 2016;6(1):010507.
6
7 340 16. Crowley J, Ball L, McGill A, *et al*. New Zealand General Practitioners' views
8
9 341 on providing nutrition care: a focus group study. *J Prim Health Care*, 2015, 7(3)
10
11 342 244–250.
12
13 343 17. Crowley J, Ball L, Han D, *et al*. Doctors' attitudes and confidence towards
14
15 344 providing nutrition care in practice: Comparison of New Zealand medical
16
17 345 students, GP registrars and GPs. *J Prim Health Care*, 2015, 7(3):244-250.
18
19 346 18. Crowley J, Ball L, Leveritt MD, *et al*. Impact of an undergraduate course on
20
21 347 medical students' self-perceived nutrition intake and self-efficacy to improve
22
23 348 their health behaviours and counselling practices. *J Prim Health Care*,
24
25 349 2014;6(2):101-7.
26
27 350 19. Ray S, Rajput-Ray M, Ball L, *et al*. Confidence and attitudes of doctors and
28
29 351 dietitians towards nutrition care and nutrition advocacy for hospital patients in
30
31 352 Kolkata, India. *J Biomed Ed* 2015, Online Article ID 416021.
32
33 353 20. Moore H, Greenwood D, Gill T, *et al*. A cluster randomised trial to evaluate a
34
35 354 nutrition training programme. *Br J Gen Pract*. 2003;53(489):271-7.
36
37 355 21. Gramlich LM, Olstad DL, Nasser R, *et al*. Medical students' perceptions of
38
39 356 nutrition education in Canadian universities. *App Phys Nutr & Metab*.
40
41 357 2010;35(3):336-43.
42
43 358 22. Singh S, Somers V, Clark M, *et al*. Physician diagnosis of overweight status
44
45 359 predicts attempted and successful weight loss in patients with cardiovascular
46
47 360 disease and central obesity. *Am Heart J*. 2010;160(5):934-42.
48
49 361 23. Kushner R. Barriers to providing nutrition counseling by physicians - a survey
50
51 362 of primary-care practitioners. *Prev Med*. 1995;24(6):546-52.
52
53
54
55
56
57
58
59
60

- 1
2
3 363 24. Conroy M, Delichatsios K, Hafler J, *et al.* Impact of a preventive medicine and
4 nutrition curriculum for medical students. *Am J Prev Med.* 2004;27(1):77-80.
5 364
6
7 365 25. Weinsier R, Boker J, Morgan S, *et al.* Cross-sectional study of nutrition
8 knowledge and attitudes of medical-students at 3 points in their medical-training
9 366
10 367 at 11 southeastern medical-schools. *Am J Clin Nut.* 1988;48(1):1-6.
11
12 368 26. Weinsier RL, Boker JR, Brooks CM, *et al.* Priorities for nutrition content in a
13 medical-school curriculum - a national consensus of medical educators. *Am J*
14 369
15 370 *Clin Nut.* 1989;50(4):707-12.
16
17 371 27. Ball, Hughes R, Leveritt M. Nutrition in General Practice: Role and workforce
18 372 preparation expectations of medical educators. *Aust J Prim Health.*
19 373 2010;16(4):304-10.
20
21 374 28. Ball L, Desbrow B, Yelland M, *et al.* Direct Observation of the Nutrition Care
22 375 Practices of Australian General Practitioners. *Aust J Prim Health.*
23 376 2013;6(2):143-7.
24
25 377 29. Ball L, Johnson C, Desbrow B, *et al.* General practitioners can offer effective
26 378 nutrition care to patients with lifestyle related chronic disease: a systematic
27 379 review. *J Prim Health Care.* 2013;5(1):59-69.
28
29 380 30. Ball L, Leveritt M, Cass S, *et al.* Effect of nutrition care provided by primary
30 381 health professionals on adults' dietary behaviours: a systematic review. *Fam*
31 382 *Prac.* 2015;32(6):605-17.
32
33 383 31. Spencer E, Frank E, Elon L, *et al.* Predictors of nutrition counseling behaviors
34 384 and attitudes in US medical students. *Am J Clin Nut.* 2006;84(3):655-62.
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60



386
387
388

Figure 1: Overview of the stakeholder engagement process.



389
390
391
392

Figure 2: Reach of stakeholder input across the world. Shaded areas highlight countries with opportunity to participate in the stakeholder consultation process.

393 Table 1: List of countries invited to participate, in order of stakeholder group.

Stakeholder group	Global, Region or Country invited to participate
Medical educators	Global (worldwide), USA, Canada, Asia, Vietnam, Oceania, Europe, United Kingdom
Medical Practitioners	Global (worldwide), Africa, Nigeria, Ethiopia, Egypt, Tanzania, South Africa, Kenya, Sudan, Uganda, Mozambique, Malawi, Zambia, Zimbabwe, Rwanda, Namibia, Lesotho, The Bahamas, Curacao, USA, Canada, Brazil, Trinidad & Tobago, China, India, Pakistan, Bangladesh, Japan, Vietnam, Thailand, Myanmar, South Korea, Malaysia, Nepal, Taiwan, Sri Lanka, Hong Kong, Singapore, Russia, Phillipines, Australia, New Zealand, Spain, Ukraine, Poland, Romania, Czech Republic, Hungary, Bulgaria, Serbia, Slovakia, Croatia, Armenia, Albania, Lithuania, Macedonia, Slovenia, Latvia, Estonia, UK, Italy, Netherlands, Portugal, Sweden, Austria, Denmark, Finland, Norway, Ireland, Iceland, Liechtenstien, Kazakhstan, Turkey, Uzbekistan, Azerbaijan, Jordan, Kuwait, Georgia, Cyprus, Malta, Israel, Fiji, Samoa
Medical Students	Global (worldwide), Canada, Africa, Egypt, Kenya Ghana, Tunisia, The Americas, Brazil, Chile, Asia/Pacific, China, India, Pakistan, Bangladesh, Japan, Thailand, Myanmar, South Korea, Malaysia, Nepal, North Korea, Taiwan, Cambodia, Hong Kong, Singapore, Mongolia, Indonesia, Phillipines, Australia, New Zealand Europe, Ukraine, Poland, Romania, Bulgaria, Serbia, Croatia, Lithuania, Macedonia, Slovenia, Latvia, Italy, Belgium, Portugal, Austria, East Medditeranean, Turkey, Greece, Georgia, Malta, Iran, Iraq,
Patient advocacy	USA, Canada, Australia, Europe, UK.

394

395

1
2
3 396 Box 1: Assessment questions used to appraise each research question.

4 397 Criterion 1: ANSWERABILITY

5 398 1.1 Is the research question clear, including well defined study outcomes?

6 399 1.2 Can a study be feasibly designed to answer the research question?

7 400 1.3 Do you think that a study needed to answer the research question would feasibly
8 401 obtain ethical approval?

9 402 1.4 Taking into account the level of difficulty to answer the questions (e.g. required
10 403 design, safety, infrastructure, need to modify health professional behaviours), do
11 404 you believe the research question can be answered in the current local, national, or
12 405 global context?
13 406

14 407 Criterion 2: SUSTAINABILITY

15 408 2.1 Taking into account the resources required to answer the research question, do
16 409 you think the benefits from the research would be long lasting (ie. >5years)?

17 410 2.2 Do you think that the research question would be relevant and well justified for
18 411 governmental, industry or nationally competitive funding?
19 412

20 413 Criterion 3: EFFECTIVENESS

21 414 3.1 Do you believe the research could provide rationale to inform a future
22 415 intervention, OR, do you believe there is enough rationale to support the
23 416 development of an intervention to answer the research question?

24 417 3.2 Do you believe an intervention that answers the research question will have
25 418 equitable outcomes for all population groups?

26 419 3.3 Do you believe an intervention that answers the research question could be cost
27 420 effective?
28 421

29 422 Criterion 4: POTENTIAL FOR TRANSLATION AND IMPACT ON DISEASE
30 423 BURDEN

31 424 4.1 If the research question was answered, would the new knowledge be able to be
32 425 used by other stakeholders in the current context of medical education?

33 426 4.2 If the research question was answered, could the new knowledge facilitate
34 427 improvements in nutrition care provided by doctors within a local, national or
35 428 international context?

36 429 4.3 If the research question was answered, could the new knowledge support local,
37 430 national or international improvements in health care service delivery?

38 431 4.4 If the research question was answered, is there potential to improve the nutrition
39 432 care provided to patients by an amount that would cause a reduction in the burden
40 433 of over- or under-nutrition at a population level?

41 434 *All questions were answered in the format "Yes" (3 points), "Unsure" (2 points) or*
42 435 *"No" (1 point).*
43 436

44 437

45 438

439 Table 2: Summary of Scores for Appraised Research Questions from highest to lowest ranked priority (n=25).

Submitted Research Questions	Criterion Scores				Total Score (out of 108)
	Answerability (out of 36)	Sustainability (out of 18)	Effectiveness (out of 27)	Potential for Translation and Impact on Disease Burden (out of 27)	
How confident are medical students and doctors in providing nutrition care to patients?	36	17	27	26	106
What are the essential nutrition medical skills for physicians and physician-to-be to obtain?	36	16	27	26	105
How effective are doctors at influencing nutritional health of patients?	36	17	26	26	105
What level of importance is placed on nutrition care by medical students?	36	15	26	26	103
What is the cost benefit of educating medical students and doctors in nutrition?	36	15	24	26	101
Is CME/CPD education on nutrition available, and if yes, what proportion of doctors participate in this education?	31	18	26	26	101
To what extent does medical nutrition education translate into improved nutrition care of doctors?	29	18	26	27	100
How do we best support doctors and medical students to appropriately manage malnutrition?	35	12	23	25	97
What nutrition related competencies are being developed in medical students in different countries?	29	18	24	26	95
How can simple nutrition questionnaires be best used to support doctors and medical students to provide nutrition care?	32	16	22	25	95
What level of knowledge does the average medical graduate have of nutrition prescription?	32	16	21	26	95
What are the key nutrition messages that doctors should provide patients discharged from a rehabilitation centre?	34	13	22	24	93

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32

How well do medical students and doctors recognise the role of other health professionals in nutrition?	32	16	20	24	92
What is the most effective way to develop nutrition related competencies in medical students/physicians in different countries?	29	17	19	26	91
Does medical nutrition education currently cover dietary supplementation?	34	8	18	22	82
What is the prevalence of different nutrition related conditions of patients in different countries?	30	12	20	18	80
What are the most important laboratory tests to assess malnutrition in paediatrics?	25	10	18	17	70
How does nutrition effect dyslipidaemia and diabetes?	24	11	17	18	70
How does nutrition effect brain degeneration?	24	8	16	20	69
How does nutrition influence the outcomes of patients with psychiatric disorders?	23	8	17	19	68
What is the ideal role of supplements in managing over and under nutrition?	23	8	15	21	67
What is the effect of dietary supplementation in healthy patients?	22	12	18	17	67
What are the most common food allergies of patients in different countries?	27	9	15	16	67
What is the best way for doctors to manage hypervitaminosis?	21	8	16	18	63
How does nutrition influence the outcomes of patients with rheumatic diseases?	18	8	18	18	62
Mean (SD)	29 (5.5)	13 (3.8)	21 (4.0)	23 (3.9)	86 (15.7)

33
34
35
36
37
38
39
40
41
42
43
44
4546
47
48
49

BMJ Open

Setting Priorities for Research in Medical Nutrition Education: An International Approach

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2016-013241.R1
Article Type:	Research
Date Submitted by the Author:	02-Sep-2016
Complete List of Authors:	Ball, Lauren; Griffith University, Menzies Health Institute Queensland Barnes, Katelyn; Griffith University, Menzies Health Institute Queensland Laur, Celia; Need for Nutrition Education Programme group Crowley, Jennifer Ray, Sumantra; MRC Human Nutrition Research,
Primary Subject Heading:	Medical education and training
Secondary Subject Heading:	Nutrition and metabolism
Keywords:	NUTRITION & DIETETICS, MEDICAL EDUCATION & TRAINING, STATISTICS & RESEARCH METHODS, Quality in health care < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

SCHOLARONE™
Manuscripts

Title Page

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Title: Setting Priorities for Research in Medical Nutrition Education: An International Approach

Journal: BMJ Open

Running Head: Research Priorities in Medical Nutrition Education

Authors: Lauren Ball^{1,2}, Katelyn Barnes¹, Celia Laur^{2,3}, Jennifer Crowley^{2,4}, Sumantra Ray²

¹Centre for Health Practice Innovation, Menzies Health Institute Queensland, Griffith University, Gold Coast, Australia

²The Need for Nutrition Education/Innovation Programme, The University of Cambridge, C/O MRC Elsie Widdowson Laboratory, 120 Fulbourn Rd, Cambridge, CB1 9NL

³Faculty of Applied Health Sciences, School of Public Health and Health Systems, University of Waterloo, 200 University Avenue West, Waterloo, Ontario, Canada.

⁴Faculty of Medical and Health Sciences, University of Auckland, New Zealand

Corresponding Author: Dr L Ball, Menzies Health Institute Queensland, Griffith University QLD 4222 Australia, l.ball@griffith.edu.au

Keywords: nutrition education, medical training, research planning

1
2
3 26 **Funding:** This research received no specific grant from any funding agency in the
4
5 27 public, commercial or not-for-profit sectors.
6
7
8

9
10 29 **Competing Interests:** The authors declare no competing interests.
11
12 30

13
14 31 **Author's contribution:** LB and KB took a lead role in the concept and design of the
15
16 32 study. LB, KB, CL and SR advised on data collection and analysis. JC assisted with
17
18 33 the writing of the manuscript. All authors contributed to the manuscript development
19
20 34 and approved the final version prior to submission.
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

ABSTRACT

Objectives: To identify the research priorities for medical nutrition education worldwide.

Design: A 5-step stakeholder engagement process based on methodological guidelines for identifying research priorities in health.

Participants: 277 individuals were identified as representatives for 30 different stakeholder organisations across 86 countries. The stakeholder organisations represented the views of medical educators, medical students, doctors, patients, and researchers in medical education.

Interventions: Each stakeholder representative was asked to provide up to three research questions that should be deemed as a priority for medical nutrition education.

Main outcome measures: Research questions were critically appraised for answerability, sustainability, effectiveness, potential for translation and potential to impact on disease burden. A blinded scoring system was used to rank the appraised questions, with higher scores indicating higher priority (range of scores possible 36-108).

Results Thirty-seven submissions were received, of which 25 were unique research questions. Submitted questions received a range of scores from 62-106 points. The highest scoring questions focused on (i) increasing the confidence of medical students and doctors in providing nutrition care to patients, (ii) clarifying the essential nutrition skills doctors should acquire, (iii) understanding the effectiveness of doctors at influencing dietary behaviours and (iv) improving medical students' attitudes towards the importance of nutrition.

Conclusions: These research questions can be used to ensure future projects in medical nutrition education directly align with the needs and preferences of research

1
2
3 60 stakeholders. Funders should consider these priorities in their commissioning of
4
5 61 research.
6

7
8 **ARTICLE SUMMARY (Strengths and Limitations)**
9

- 10 63 • The research priority setting project was conducted using a well established
11
12 64 protocol previously used by international organisations and funding bodies.
13
14 65 • Participating stakeholder organisations were limited to English speaking
15
16 66 groups, which may have excluded some organisations from providing input.
17
18 67 • The stakeholder organisations typically represented the views of clinicians,
19
20 68 with less direct representation of patients.
21
22
23 69 • The project utilised a management team to provide informed, objective input
24
25 70 throughout the stakeholder engagement process, thereby enhancing the quality
26
27 71 of the project.
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

74 Introduction

75 Good nutrition is essential for human wellbeing, yet nutrition-related health
76 conditions such as malnutrition, obesity and chronic disease affect nearly all countries
77 worldwide.¹ As a result, poor dietary behaviours contribute significantly to the global
78 burden of disease. Many countries are making progress in improving the nutrition
79 outcomes of individuals and population groups,¹ which provides opportunity for
80 supporting similar improvements in other countries. Health care systems aim to utilise
81 strategies to support patients to have healthy dietary behaviours,² and this highlights
82 an emerging priority for optimising health outcomes.³

83
84 The World Health Organization has previously recommended that medical
85 professionals should be supported to take an active role in promoting healthy dietary
86 behaviours.² Authoritative medical bodies have also confirmed that it is within the
87 responsibility of doctors to address nutrition-related issues concerning patients and
88 the public.⁴ Within this context, nutrition care refers to any practice undertaken by a
89 doctor to facilitate improved dietary behaviours and subsequent health outcomes of
90 patients.⁵ To best support doctors in providing nutrition care, optimal nutrition
91 knowledge and skills, including when to consult a nutrition professional such as a
92 Registered Dietitian or Registered Nutritionist should be developed throughout
93 undergraduate and postgraduate medical training.² Advancements in nutrition
94 curriculum guidelines have occurred internationally,⁶ and stem from widespread
95 reports of insufficient nutrition education during medical training.⁷⁻⁹

96
97 There is considerable variability in the quantity and quality of nutrition education
98 provided to medical students and graduates worldwide.⁶ Notable differences include
99 the way nutrition is incorporated into the medical curricula, the specificity of nutrition

1
2
3 100 content areas, recommended teaching approaches and extent of mandatory
4
5 101 enforcement.^{6, 10} As such, nutrition topics that have been decided as important for
6
7 102 inclusion in medical curricula are not always sufficiently taught and may not result in
8
9 103 a change of medical practice. Furthermore, many studies in medical nutrition
10
11 104 education use self-reported changes in practices as a proxy indicator of effectiveness
12
13 105 at enhancing nutrition care provided to patients.¹⁰⁻¹² These studies do not investigate
14
15 106 whether interventions translate into improved dietary behaviours or health outcomes
16
17 107 of patients. Clearly, future research should be carefully planned to overcome these
18
19 108 challenges and to advance understanding that supports other countries to make similar
20
21 109 improvements.
22
23
24
25

26
27 110
28 111 Research priority setting is a key component of research planning, particularly when
29
30 112 research options far exceed available resources.¹³ The objective of research priority
31
32 113 setting is to use a fair, transparent and systematic approach to identify the most
33
34 114 important research projects to conduct.¹³ Research prioritisation is a valuable strategy
35
36 115 used to ensure that future research projects are directly aligned with the needs and
37
38 116 preferences of research end-users, such as stakeholders. This prioritisation process is
39
40 117 important because it increases the likelihood that research projects elicit a meaningful
41
42 118 impact and can be implemented in a sustainable, feasible and acceptable manner.
43
44 119 Guidelines for setting research priorities exist and are deemed superior to other
45
46 120 methodologies such as Delphi due to its ability to assure confidentiality of
47
48 121 stakeholders.^{13, 14} Research priorities have been developed for specific aspects of
49
50 122 nutrition research, such as micronutrient intake for child health,¹⁵ and artificial
51
52 123 feeding in hospitals.¹⁶ This process has not yet been applied to other contexts, such as
53
54 124 such as medical nutrition education.
55
56
57
58
59
60

1
2
3 126 The aim of this study was to identify international research priorities for medical
4
5 127 nutrition education. The findings are essential for strengthening future research, and
6
7 128 will demonstrate a thorough understanding of priority research questions. The study
8
9
10 129 will guide future research projects to be aligned with the needs and preferences of
11
12 130 research end-users.
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 131 **Methods**

4
5 132 *Overview*

6
7 133 A 5-step stakeholder engagement process was undertaken to identify priorities for
8
9
10 134 research in medical nutrition education worldwide. The stakeholder engagement
11
12 135 process was informed by guidelines for setting research priorities.^{13, 14} An overview of
13
14 136 the stakeholder engagement process is shown in Figure 1. The study was approved by
15
16 137 the relevant institutional Human Research Ethics Committee (reference number
17
18 138 2015/900).

19
20
21 139

22
23 140 INSERT FIGURE ONE ABOUT HERE

24
25 141

26
27 142 *Step 1: Select Management Team*

28
29 143 The project utilised a management team developed in accordance with published
30
31 144 guidelines.^{13, 14} The rationale of using a management team was to provide informed,
32
33 145 objective input throughout the stakeholder engagement process. The management
34
35 146 team was comprised five researchers with expertise in medicine, nutrition, education
36
37 147 and evaluation. Team members were from the UK, Canada, Australia and New
38
39 148 Zealand. All members of the management team had extensive experience in medical
40
41 149 nutrition education and research, including obtaining research funding support,
42
43 150 developing research proposals, conducting studies, disseminating findings and
44
45 151 translating evidence into changes in practice.

46
47
48
49 152

50
51 153 *Step 2: Confirm scope and context*

52
53 154 The research scope and context was drafted and confirmed by the management team
54
55 155 through iterative written and verbal discussions. This process confirmed the
56
57 156 population of interest, health conditions of interest, goals for translation and relevant
58
59
60

1
2
3 157 stakeholders. An explanation of the research scope and context was developed to
4
5 158 distribute to stakeholders, and reads as follows:
6

7 159 *“The research we are focusing on examines the best way to support medical*
8
9 160 *students to become competent at incorporating nutrition care into their future*
10
11 161 *routine practices as doctors. Medical nutrition education facilitates students to*
12
13 162 *have adequate nutrition knowledge, skills and attitudes to feel confident at*
14
15 163 *providing nutrition care, as well as advocating for nutrition for improved public*
16
17 164 *health. For the purpose of this project, medical nutrition education*
18
19 165 *encompasses undergraduate, postgraduate and continuing medical education*
20
21 166 *experiences for doctors in all countries; and does not include nutrition*
22
23 167 *education for other health professionals. Outcomes could be measured by self-*
24
25 168 *perceived or actual nutrition knowledge; demonstrated nutrition skills, attitudes*
26
27 169 *towards nutrition, frequency of nutrition care, effectiveness of nutrition care on*
28
29 170 *patients' health outcomes, and advocacy activities related to nutrition.”*
30
31 171

32 172 *Step 3: Engage with Stakeholders*

33 173 Categories of potential stakeholders were identified by the management team based
34
35 174 on their involvement with the activities described in the scope and context statement.
36
37 175 Key words such as “medical”, “nutrition”, “education”, “doctors”, “patients, and
38
39 176 “public health” were used to identify the following potential stakeholder groups:
40
41 177 medical students, medical educators, medical practitioners, nutrition organisations and
42
43 178 patient representative bodies. A list of stakeholder contact details was developed
44
45 179 using publicly available information from English websites. Preference was given to
46
47 180 national and international bodies in order to capture informed opinions from the
48
49 181 broadest possible audience. Figure 2 outlines the global reach of national stakeholder
50
51 182 bodies involved in the stakeholder engagement process. Table 1 shows the
52
53 183 international representation of the major stakeholder groups invited to participate. In
54
55 184 addition to national bodies, international bodies for medical students, medical
56
57 185 educators and medical practitioners were invited to provide input. Each stakeholder
58
59
60

1
2
3 186 organisation was contacted via email with an information sheet that outlined the aim
4
5 187 and ethical approval of the project. In addition, the email outlined the scope and
6
7 188 context of the research and provided a link to an anonymous online survey where
8
9
10 189 representatives could provide up to three research questions deemed as a priority.
11
12 190 Stakeholders providing questions via the online survey system inferred consent. Two
13
14 191 reminder emails were sent to each stakeholder organisation over a period of two
15
16 192 months.
17

18
19 193

20
21 194 INSERT FIGURE TWO ABOUT HERE

22
23 195 INSERT TABLE ONE ABOUT HERE

24
25 196

26
27 197 *Step 4: Confirm Criteria for Appraising and Prioritising Research*

28
29 198 The criteria for prioritising research questions were drafted and confirmed by the
30
31 199 management team through blinded ranking. Fifteen possible criteria and their
32
33 200 explanations were proposed based on published guidelines¹³ and ranked in order of
34
35 201 relevance and importance for the scope and context of research. The four highest
36
37 202 ranked criteria (i) answerability, (ii) sustainability, (iii) effectiveness and (iv) potential
38
39 203 for translation and impact on disease burden were used to score each research option
40
41 204 proposed by the stakeholders. Between two and four assessment questions were
42
43 205 drafted and confirmed by the management team to adequately assess each criterion.
44
45 206 Box 1 outlines the finalised criteria and assessment questions applied when appraising
46
47 207 each research question.
48

49
50 208

51
52 209 INSERT BOX ONE ABOUT HERE

53
54 210

55
56 211 *Step 5: Score of Research Options*
57
58
59
60

1
2
3 212 The research questions provided by stakeholders were initially reviewed for
4
5 213 alignment with scope and ability to be scored using the four criteria. Minor edits were
6
7 214 made to the wording of research questions to enable structured scoring by the
8
9
10 215 management team. The submitted research questions were independently scored by
11
12 216 each member of the management team using the assessment questions for each
13
14 217 criteria, with answers: “Yes” (3 points), “Unsure” (2 points) or “No” (1 point). The
15
16 218 total number of points awarded to each research question was summed in order to
17
18 219 provide an overall score for each criterion, ranging from 36-108 given the assessment
19
20
21 220 criteria and size of the management team. Finally, the appraised questions were
22
23 221 ranked from highest to lowest score to provide a list of prioritised research questions.
24
25
26

27 223 **Results**

28
29 224 Thirty-seven research questions from 19 stakeholder organisations were obtained
30
31
32 225 from the stakeholder engagement process over the two month data collection period.
33
34 226 Twelve questions were collapsed with others due to considerable overlap, resulting in
35
36 227 25 unique research questions for appraisal. Table 1 outlines each of the research
37
38 228 questions as well as the score achieved for each criterion. The questions achieved a
39
40
41 229 mean±SD total score of 86±16 points (range 62-106 points).
42
43
44

45 231 INSERT TABLE TWO ABOUT HERE
46
47
48

49 233 The appraisal process allowed a total ranking for each question, with clear separation
50
51
52 234 between scores. The highest scoring question overall related to increasing the
53
54 235 confidence of medical students and doctors in providing nutrition care to patients.
55
56 236 Other high scoring questions focused on the clarifying the essential nutrition skills for
57
58
59
60

1
2
3 237 doctors, understanding the effectiveness of doctors at influencing dietary behaviours
4
5 238 and improving medical students' attitudes towards the importance of nutrition.
6

7 239

8
9
10 240 The ranking of questions differed for each criterion. For example, Table 2 indicates
11
12 241 that the seventh highest scoring question overall (translation of nutrition education
13
14 242 into improved nutrition care), achieved the highest score in terms of sustainability, the
15
16 243 12th highest for answerability, third highest for effectiveness and highest for the
17
18 244 potential for translation.
19

20
21 245

22 246 **Discussion**

23
24
25 247 This study aimed to identify the international research priorities for medical nutrition
26
27 248 education. The process for developing these priorities was consultative and
28
29 249 consensus-based. The stakeholder engagement process resulted in a wide variety of
30
31 250 research questions being critically appraised and prioritised. This suggests that the
32
33 251 aim of developing a fair, transparent and systematic approach to identifying the most
34
35 252 important research priorities was satisfied.¹³ This work can inform future research
36
37 253 projects that align with the needs and preferences of research end-users in medical
38
39 254 nutrition education. Funding bodies and health service providers are encouraged to
40
41 255 use these research priorities in decision-making about future projects.
42
43
44

45 256

46
47 257 The highest scoring questions focused on increasing the confidence of medical
48
49 258 students and doctors in providing nutrition care to patients; clarifying the essential
50
51 259 nutrition skills doctors should acquire; understanding the effectiveness of doctors at
52
53 260 influencing dietary behaviours and improving medical students' attitudes towards the
54
55 261 importance of nutrition. Interestingly, most of these topics have been previously
56
57 262 researched to variable extents.^{5, 9, 17-30} This indicates that previous research activities
58
59
60

1
2
3 263 are generally aligning with the needs and preferences of stakeholders. Furthermore,
4
5 264 the priorities identified in this study align with grand/global challenges schemes
6
7 265 underway in several countries including Canada, the UK and USA in terms of
8
9
10 266 improving global health through prevention and management of infectious and non-
11
12 267 communicable diseases.

13
14 268
15
16 269 The ranking of research questions differed for each criterion. This variation suggests
17
18 270 that a different list of priority research questions may have been produced using
19
20 271 different criteria. An iterative approach was used in the present study to determine the
21
22 272 most appropriate criteria for appraising the research questions. These criteria could be
23
24 273 used to strengthen potential research questions by enhancing answerability, or altering
25
26 274 study designs to increase the potential for translation to practice. To overcome this
27
28 275 limitation, providing stakeholder organisations with instructions on the optimal
29
30 276 development of research questions may help align future submissions to the criteria.

31
32 277
33
34 278 The attributes of the submitted research questions require consideration prior to future
35
36 279 research. For example, the submitted research questions differed in scope and focus,
37
38 280 and achieved variable scores for each appraisal criterion. Furthermore, the research
39
40 281 questions that were more specifically worded appeared to achieve higher scores than
41
42 282 generally worded questions. This suggests that the appraisal by the management team
43
44 283 may have been more favourable when the questions were easily understood and
45
46 284 clearly described, rather than whether or not the question was an important priority.
47
48 285 Specific questions may also score higher in the feasibility criteria compared to general
49
50 286 questions because the translation to study design may be clear. These limitations
51
52 287 suggest that future research planning should use the prioritised research questions as a
53
54 288 source of guidance, whilst also considering other relevant factors such as translating
55
56
57
58
59
60

1
2
3 289 general questions into study designs, acknowledging existing projects, patients'
4
5 290 preferences, international priorities in nutrition and whether the intervention translates
6
7 291 into improved dietary behaviours or health outcomes of patients.
8
9

10 292

11 293 The present study had some notable limitations. For example, 37 submissions were
12
13 294 obtained from a possible 277 individuals who represented stakeholder organisations.

14
15 295 The anonymity of responses precluded any description of the responding stakeholder
16
17 296 organisations. Furthermore, it is unclear whether greater responses would have led to
18
19 297 a wider variety in questions appraised. However, given that 12 of the 37 submissions
20
21 298 (32%) overlapped significantly, it is evident that stakeholders had some consistent
22
23 299 questions deemed worthy of consideration.
24
25

26 300

27
28
29 301 In conclusion, this study has identified the international research priorities for medical
30
31 302 nutrition education. The process used provides a consultative, transparent, and
32
33 303 consensus-based model that could be applied elsewhere. The stakeholder engagement
34
35 304 process resulted in a wide variety of research questions being critically appraised and
36
37 305 prioritised. As a result, future research projects that align with the prioritised research
38
39 306 questions are likely to meet the needs and preferences of research stakeholders in
40
41 307 medical nutrition education.
42
43

44 308
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 309 **Funding:** This research received no specific grant from any funding agency in the
4
5 310 public, commercial or not-for-profit sectors.
6

7 311 **Competing Interests:** The authors declare no competing interests.
8

9 312 **Author's contribution:** LB and KB took a lead role in the concept and design of the
10
11 313 study. LB, KB, CL and SR advised on data collection and analysis. JC assisted with
12
13 314 the writing of the manuscript. All authors contributed to the manuscript development
14
15 315 and approved the final version prior to submission.
16
17

18 316 **Data Sharing Statement:** There is no further data that has not been published. Raw
19
20 317 data can be accessed by emailing l.ball@griffith.edu.au.
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

318 **References**

- 319 1. International Food Policy Research Institute. Global Nutrition Report 2014:
320 Actions and Accountability to Accelerate the World's Progress on Nutrition.
321 Washington, DC, 2014.
- 322 2. World Health Organization. WHO Technical Report Series: Diet, nutrition, and
323 the prevention of chronic diseases. Geneva, 2003.
- 324 3. Halcomb EJ, Davidson PM, Yallop J, *et al*. Strategic directions for developing
325 the Australian general practice nurse role in cardiovascular disease
326 management. *Contemp Nurse*. 2007;26(1):125-35.
- 327 4. Royal College of Physicians. Nutrition and Patients: A Doctor's Responsibility.
328 Report of a Working Party of the Royal College of Physicians. London, 2002.
- 329 5. Ball L, Leveritt M, Cass S, Chaboyer W. Effect of nutrition care provided by
330 primary health professionals on adults' dietary behaviours: A systematic review.
331 *Family Practice*. 2015;32(6):605-17.
- 332 6. Crowley J, Ball L, Laur C, *et al*. Nutrition guidelines for undergraduate medical
333 curricula: a six country comparison. *Adv Med Ed & Prac* 2015;6:127-33.
- 334 7. Adams K, Kohlmeier M, Zeisel S. Nutrition Education in U.S. Medical Schools:
335 Latest Update of a National Survey. *Acad Med*. 2010;85(9):1537-42.
- 336 8. Gray DS, Harvison S, Wilson JL. Evaluation of a nutrition education-program
337 for family-practice residents. *J Med Ed*. 1988;63(7):569-71.
- 338 9. Crowley J Ball L, Han D, *et al*. New Zealand medical students have positive
339 attitudes and moderate confidence in providing nutrition care: A cross-sectional
340 survey. *J Biomed Ed* 2015, Online Article ID 259653.
- 341 10. Ray S, Udumyan R, Rajput-Ray M, *et al*. Evaluation of a novel nutrition
342 education intervention for medical students from across England. *BMJ Open*.
343 2012;2:e000417.

- 1
2
3 344 11. Ball L, Crowley J, Laur C, *et al.* Nutrition in medical education: reflections
4
5 345 from an initiative at the University of Cambridge. *J Mult Health Care*,
6
7 346 2014;7:209-15.
8
9
10 347 12. Douglas P, Ball L, McGuffin L *et al.* Hydration: Knowledge, attitudes and
11
12 348 practices of UK dietitians. *J Biomed Ed*, 2015, Online Article ID 172020.
13
14 349 13. Rudan I, Gibson JL, Ameratunga S, *et al.* Setting priorities in global child
15
16 350 health research investments: guidelines for implementation of CHNRI method.
17
18 351 *Croat Med J*. 2008;49(6):720-33.
19
20
21 352 14. Yoshida S. Approaches, tools and methods used for setting priorities in health
22
23 353 research in the 21(st) century. *J Glob Health*. 2016;6(1):010507.
24
25 354 15. Brown KH, Hess SY, Boy E, *et al.* Setting priorities for zinc-related health
26
27 355 research to reduce children's disease burden worldwide: an application of the
28
29 356 Child Health and Nutrition Research Initiative's research priority-setting
30
31 357 method. *Public Health Nutr*. 2009;12(3):389-96.
32
33
34 358 16. Weenen TC, Jentink A, Pronker ES, *et al.* Patient needs and research priorities
35
36 359 in the enteral nutrition market: a quantitative prioritization analysis. *Clin Nutr*.
37
38 360 2014;33(5):793-801.
39
40
41 361 17. Crowley J, Ball L, McGill A, *et al.* New Zealand General Practitioners' views
42
43 362 on providing nutrition care: a focus group study. *J Prim Health Care*, 2015, 7(3)
44
45 363 244–250.
46
47 364 18. Crowley J, Ball L, Han D, *et al.* Doctors' attitudes and confidence towards
48
49 365 providing nutrition care in practice: Comparison of New Zealand medical
50
51 366 students, GP registrars and GPs. *J Prim Health Care*, 2015, 7(3):244-250.
52
53
54 367 19. Crowley J, Ball L, Leveritt MD, *et al.* Impact of an undergraduate course on
55
56 368 medical students' self-perceived nutrition intake and self-efficacy to improve
57
58
59
60

- 1
2
3 369 their health behaviours and counselling practices. *J Prim Health Care*,
4 370 2014;6(2):101-7.
5
6
7 371 20. Ray S, Rajput-Ray M, Ball L, *et al*. Confidence and attitudes of doctors and
8
9
10 372 dietitians towards nutrition care and nutrition advocacy for hospital patients in
11
12 373 Kolkata, India. *J Biomed Ed* 2015, Online Article ID 416021.
13
14 374 21. Moore H, Greenwood D, Gill T, *et al*. A cluster randomised trial to evaluate a
15
16 375 nutrition training programme. *Br J Gen Pract*. 2003;53(489):271-7.
17
18 376 22. Gramlich LM, Olstad DL, Nasser R, *et al*. Medical students' perceptions of
19
20 377 nutrition education in Canadian universities. *App Phys Nutr & Metab*.
21
22 378 2010;35(3):336-43.
23
24 379 23. Singh S, Somers V, Clark M, *et al*. Physician diagnosis of overweight status
25
26 380 predicts attempted and successful weight loss in patients with cardiovascular
27
28 381 disease and central obesity. *Am Heart J*. 2010;160(5):934-42.
29
30 382 24. Kushner R. Barriers to providing nutrition counseling by physicians - a survey
31
32 383 of primary-care practitioners. *Prev Med*. 1995;24(6):546-52.
33
34 384 25. Conroy M, Delichatsios K, Hafler J, *et al*. Impact of a preventive medicine and
35
36 385 nutrition curriculum for medical students. *Am J Prev Med*. 2004;27(1):77-80.
37
38 386 26. Weinsier R, Boker J, Morgan S, *et al*. Cross-sectional study of nutrition
39
40 387 knowledge and attitudes of medical-students at 3 points in their medical-training
41
42 388 at 11 southeastern medical-schools. *Am J Clin Nut*. 1988;48(1):1-6.
43
44 389 27. Weinsier RL, Boker JR, Brooks CM, *et al*. Priorities for nutrition content in a
45
46 390 medical-school curriculum - a national consensus of medical educators. *Am J*
47
48 391 *Clin Nut*. 1989;50(4):707-12.
49
50 392 28. Ball, Hughes R, Leveritt M. Nutrition in General Practice: Role and workforce
51
52 393 preparation expectations of medical educators. *Aust J Prim Health*.
53
54 394 2010;16(4):304-10.
55
56
57
58
59
60

- 1
2
3 395 29. Ball L, Desbrow B, Yelland M, *et al.* Direct Observation of the Nutrition Care
4
5 396 Practices of Australian General Practitioners. Aust J Prim Health.
6
7 397 2013;6(2):143-7.
8
9
10 398 30. Ball L, Johnson C, Desbrow B, *et al.* General practitioners can offer effective
11
12 399 nutrition care to patients with lifestyle related chronic disease: a systematic
13
14 400 review. J Prim Health Care. 2013;5(1):59-69.
15
16 401 30. Spencer E, Frank E, Elon L, *et al.* Predictors of nutrition counseling behaviors
17
18 402 and attitudes in US medical students. Am J Clin Nut. 2006;84(3):655-62.
19
20
21 403
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 404 Figure 1: Overview of the stakeholder engagement process.
4 405

5
6 406 PLEASE SEE ATTACHED JPG
7

8 407

9 408

10 409 Figure 2: Reach of stakeholder input across the world. Shaded areas highlight
11 410 countries with opportunity to participate in the stakeholder consultation process.
12 411

13 412 PLEASE SEE ATTACHED JPG
14

15 413

16 414

17 415

18 416 Table 1: List of countries invited to participate, in order of stakeholder group.

Stakeholder group	Global, Region or Country invited to participate
Medical educators	Global (worldwide), USA, Canada, Asia, Vietnam, Oceania, Europe, United Kingdom
Medical Practitioners	Global (worldwide), Africa, Nigeria, Ethiopia, Egypt, Tanzania, South Africa, Kenya, Sudan, Uganda, Mozambique, Malawi, Zambia, Zimbabwe, Rwanda, Namibia, Lesotho, The Bahamas, Curacao, USA, Canada, Brazil, Trinidad & Tobago, China, India, Pakistan, Bangladesh, Japan, Vietnam, Thailand, Myanmar, South Korea, Malaysia, Nepal, Taiwan, Sri Lanka, Hong Kong, Singapore, Russia, Philippines, Australia, New Zealand, Spain, Ukraine, Poland, Romania, Czech Republic, Hungary, Bulgaria, Serbia, Slovakia, Croatia, Armenia, Albania, Lithuania, Macedonia, Slovenia, Latvia, Estonia, UK, Italy, Netherlands, Portugal, Sweden, Austria, Denmark, Finland, Norway, Ireland, Iceland, Liechtenstein, Kazakhstan, Turkey, Uzbekistan, Azerbaijan, Jordan, Kuwait, Georgia, Cyprus, Malta, Israel, Fiji, Samoa
Medical Students	Global (worldwide), Canada, Africa, Egypt, Kenya, Ghana, Tunisia, The Americas, Brazil, Chile, Asia/Pacific, China, India, Pakistan, Bangladesh, Japan, Thailand, Myanmar, South Korea, Malaysia, Nepal, North Korea, Taiwan, Cambodia, Hong Kong, Singapore, Mongolia, Indonesia, Philippines, Australia, New Zealand, Europe, Ukraine, Poland, Romania, Bulgaria, Serbia, Croatia, Lithuania, Macedonia, Slovenia, Latvia, Italy, Belgium, Portugal, Austria, East Mediterranean, Turkey, Greece, Georgia, Malta, Iran, Iraq,
Nutrition Organisations	USA, UK
Patient Representatives	USA, Canada, Australia, Europe, UK.

19 417

20 418

21

22

23

24

25

26

1
2
3 419 Box 1: Assessment questions used to appraise each research question.

4 420 Criterion 1: ANSWERABILITY

5 421 1.1 Is the research question clear, including well defined study outcomes?

6 422 1.2 Can a study be feasibly designed to answer the research question?

7 423 1.3 Do you think that a study needed to answer the research question would feasibly
8 424 obtain ethical approval?

9 425 1.4 Taking into account the level of difficulty to answer the questions (e.g. required
10 426 design, safety, infrastructure, need to modify health professional behaviours), do
11 427 you believe the research question can be answered in the current local, national, or
12 428 global context?
13 429

14 430 Criterion 2: SUSTAINABILITY

15 431 2.1 Taking into account the resources required to answer the research question, do
16 432 you think the benefits from the research would be long lasting (ie. >5years)?

17 433 2.2 Do you think that the research question would be relevant and well justified for
18 434 governmental, industry or nationally competitive funding?
19 435

20 436 Criterion 3: EFFECTIVENESS

21 437 3.1 Do you believe the research could provide rationale to inform a future
22 438 intervention, OR, do you believe there is enough rationale to support the
23 439 development of an intervention to answer the research question?

24 440 3.2 Do you believe an intervention that answers the research question will have
25 441 equitable outcomes for all population groups?

26 442 3.3 Do you believe an intervention that answers the research question could be cost
27 443 effective?
28 444

29 445 Criterion 4: POTENTIAL FOR TRANSLATION AND IMPACT ON DISEASE
30 446 BURDEN

31 447 4.1 If the research question was answered, would the new knowledge be able to be
32 448 used by other stakeholders in the current context of medical education?

33 449 4.2 If the research question was answered, could the new knowledge facilitate
34 450 improvements in nutrition care provided by doctors within a local, national or
35 451 international context?

36 452 4.3 If the research question was answered, could the new knowledge support local,
37 453 national or international improvements in health care service delivery?

38 454 4.4 If the research question was answered, is there potential to improve the nutrition
39 455 care provided to patients by an amount that would cause a reduction in the burden
40 456 of over- or under-nutrition at a population level?

41 457 *All questions were answered in the format "Yes" (3 points), "Unsure" (2 points) or*
42 458 *"No" (1 point).*
43 459

44 460

45 461

462 Table 2: Summary of Scores for Appraised Research Questions from highest to lowest ranked priority (n=25).

Submitted Research Questions	Criterion Scores				Total Score (out of 108)
	Answerability (out of 36)	Sustainability (out of 18)	Effectiveness (out of 27)	Potential for Translation and Impact on Disease Burden (out of 27)	
How confident are medical students and doctors in providing nutrition care to patients?	36	17	27	26	106
What are the essential nutrition skills for physicians and physicians-to-be to obtain?	36	16	27	26	105
How effective are doctors at influencing nutritional health of patients?	36	17	26	26	105
What level of importance is placed on nutrition care by medical students?	36	15	26	26	103
What is the cost benefit of educating medical students and doctors in nutrition?	36	15	24	26	101
Is CME/CPD education on nutrition available, and if yes, what proportion of doctors participate in this education?	31	18	26	26	101
To what extent does medical nutrition education translate into improved nutrition care of doctors?	29	18	26	27	100
How do we best support doctors and medical students to appropriately manage malnutrition?	35	12	23	25	97
What nutrition related competencies are being developed in medical students in different countries?	29	18	24	26	95
How can simple nutrition questionnaires be best used to support doctors and medical students to provide nutrition care?	32	16	22	25	95
What level of knowledge does the average medical graduate have of nutrition prescription?	32	16	21	26	95
What are the key nutrition messages that doctors should provide patients discharged from a rehabilitation centre?	34	13	22	24	93

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32

How well do medical students and doctors recognise the role of other health professionals in nutrition?	32	16	20	24	92
What is the most effective way to develop nutrition related competencies in medical students/physicians in different countries?	29	17	19	26	91
Does medical nutrition education currently cover dietary supplementation?	34	8	18	22	82
What is the prevalence of different nutrition related conditions of patients in different countries?	30	12	20	18	80
What are the most important laboratory tests to assess malnutrition in paediatrics?	25	10	18	17	70
How does nutrition affect dyslipidaemia and diabetes?	24	11	17	18	70
How does nutrition affect brain degeneration?	24	8	16	20	69
How does nutrition influence the outcomes of patients with psychiatric disorders?	23	8	17	19	68
What is the ideal role of supplements in managing over and under nutrition?	23	8	15	21	67
What is the affect of dietary supplementation in healthy patients?	22	12	18	17	67
What are the most common food allergies of patients in different countries?	27	9	15	16	67
What is the best way for doctors to manage hypervitaminosis?	21	8	16	18	63
How does nutrition influence the outcomes of patients with rheumatic diseases?	18	8	18	18	62
Mean (SD)	29 (5.5)	13 (3.8)	21 (4.0)	23 (3.9)	86 (15.7)

33 463
34
35
36
37
38
39
40
41
42
43
44
4546
47
48
49

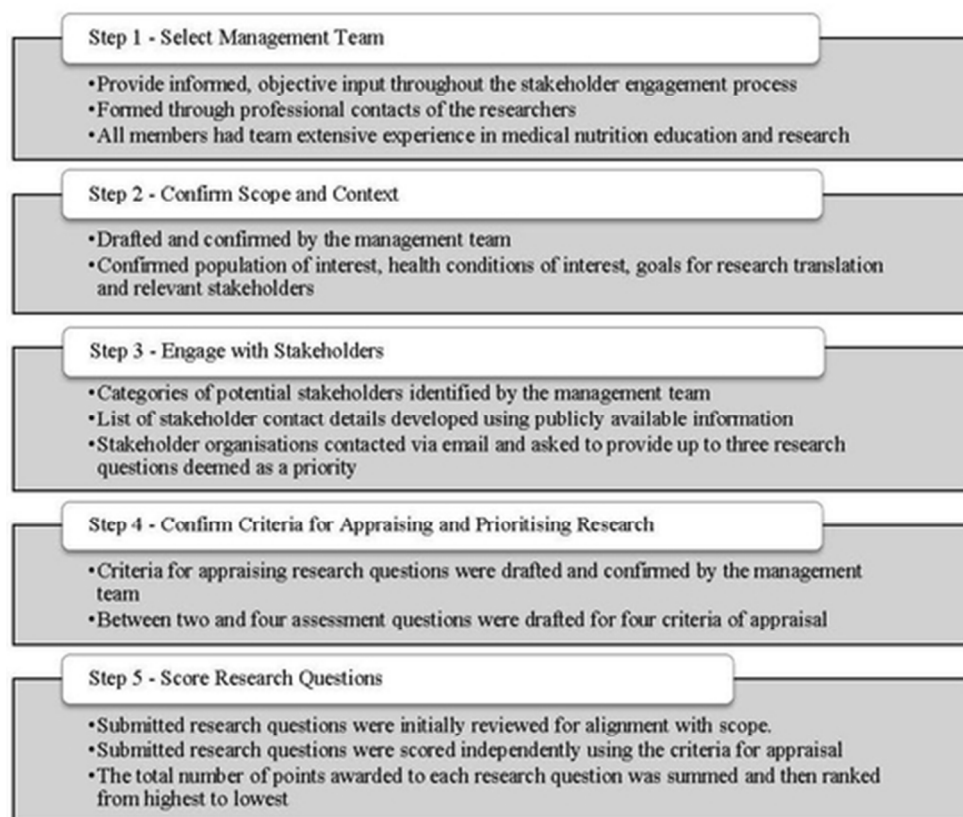


Figure 1: Overview of the stakeholder engagement process.

42x36mm (300 x 300 DPI)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60



Figure 2: Reach of stakeholder input across the world. Shaded areas highlight countries with opportunity to participate in the stakeholder consultation process.

24x10mm (300 x 300 DPI)

peer review only